A COMPARISON OF BIOFEEDBACK AND COGNITIVE THERAPY
IN THE CONTROL OF BLOOD PRESSURE UNDER
STRESS AND NO-STRESS CONDITIONS

DISSERTATION

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By
Roger E. Dafter, B.A.
Denton, Texas
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This study evaluated the efficacy of cognitive therapy and biofeedback training in lowering blood pressures of normotensives under no-stress and stress conditions. A cognitive therapy group was compared to biofeedback and habituation control groups with 32 normotensives. Subjects were taught to use the electronic sphygmomanometer that served as the device to measure blood pressure during pretreatment and posttreatment phases of the study. These measurement phases each consisted of three 19 minute periods. The first period consisted of no-stress, and then a stress period followed. Return-to-no-stress was the final period. Subjects in the cognitive therapy and biofeedback groups received five sessions of self-control training of 66 minutes each between the pre- and posttreatment phases. The cold pressor was the analogue stressor used to induce blood pressure elevations. Stress increased all groups' blood pressures during the stress condition from the no-stress condition. Cognitive therapy and biofeedback treatments were ineffective in lowering blood pressures under no-stress conditions.
However, pain was reduced in all groups. Non-cognitive subjects may have either habituated to the cold sensation or spontaneously formulated cognitive strategies for coping with stress. The results also showed that none of the groups reduce blood pressure concomittantly with pain perception. Future studies should control for habituation effects and the possible use of cognitive strategies by subjects in non-cognitive groups. Additionally, such research might utilize laboratory stressors where there is a clearer relationship between cognitive appraisal of stressful stimuli and blood pressure elevations.
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A COMPARISON OF BIOFEEDBACK AND COGNITIVE THERAPY IN THE CONTROL OF BLOOD PRESSURE UNDER STRESS AND NO-STRESS CONDITIONS

Recent breakthroughs in psychophysiological research have demonstrated that it is possible for humans to learn to regulate their blood pressure utilizing a number of self-control procedures (Schwartz, Shapiro, Redmond, Ferguson, Ragland, & Weiss, 1979). The learned control of cardiovascular responses has also been shown in lower animals (Hardy & Brady, 1974) and in both normotensive and hypertensive populations of humans (Shapiro, Mainardi, & Surwit, 1977; Schwartz, 1977). Self-control procedures for the control of blood pressure that have been successfully employed include relaxation, meditation, and biofeedback (Schwartz, et al., 1979). The importance of these self-control methods for the regulation of blood pressure has been in their potential application as a treatment for essential hypertension (Patel, 1977; Shapiro, Schwartz, Ferguson, Redmond, & Weiss, 1977). Blood pressure self-control procedures were developed with normotensive populations and then applied to hypertensive populations.

Hypertension has been considered a pathological condition of chronic elevated blood pressure. No absolute consensus has been established for dividing normotensive
from hypertensive levels of blood pressure, as blood pressure measurement exists along a continuum (Pickering, 1968). However, elevations of 160 millimeters of mercury (mm Hg) of systolic blood pressure and of 100 mm Hg of diastolic blood pressure have been generally considered to be the criterion for hypertensive disease. Systolic levels of 140-159 mm Hg and diastolic levels of 90-99 mm Hg has been regarded as borderline levels of hypertension.

Hypertensive disease may be divided into primary and secondary hypertension. Primary hypertension has been commonly called essential hypertension, and accounts for as many as 90% of the cases of hypertensive disease (Galton, 1973). The diagnostic criterion for essential hypertension has been that no casual etiological factors can be identified. Epidemiological studies have shown that the presence of several factors may increase the risk of its occurrence. These include a family history of hypertension (Levy, White, Stroud, & Hillman, 1945; Stamler, Stamler, & Pullman, 1967), obesity (Chiang, Perlman, & Epstein, 1967), elevated serum cholesterol (Stamler, 1967; Stamler et al., 1967), and emotional stimuli (Pickering, 1968; Wolf & Goodell, 1968). Some have suggested that essential hypertension may be exacerbated by psychosocial stress (Patel, 1977; Stoyva, 1976). In contrast, secondary hypertensive illnesses have been shown to be the result of
the physical dysfunctions of either the afferent or efferent control mechanisms of blood pressure and blood volume (Gnatt, 1967). Secondary hypertension has been diagnosed when these etiological factors have been detected. These secondary disorders include enovascular, malignant, neurogenic, and Goldblatt's hypertensive diseases.

The presence of hypertensive diseases has posed a severe public health hazard. Elevations of blood pressure have been correlated with increased incidents of illness and mortality. Between 10% and 15% of the adults in the United States has been estimated to have hypertension (Schwartz & Shapiro, 1973). Only about 50% of the hypertensive population has been detected. Twenty-three million new cases of hypertension have been found each year, and it has been a contributing factor to the death of 200,000 Americans annually (Deabler, Fidel, Dillenkoffer, & Elder, 1975). Current practices of classifying and recording deaths has resulted in hypertensive disease being included in mortality statistics in only about 25% of the cases in which hypertension was actually a contributing factor (Moriyama et al., 1971).

Hypertension has been an important factor in the onset of several fatal diseases (Galton, 1973). Hypertension has been ranked as the most significant risk factor in the development of artherosclerotic disease,
kidney failure, congestive heart failure, coronary heart disease, heart attack, and stroke. About 50% of the mortality rate of hypertension has been associated with cardiovascular dysfunction. At least 1,000,000 heart attacks have occurred annually in the United States, and another 2,000,000 persons have been victims of strokes. These two causes of death alone accounted for 775,337 deaths in the United States in 1967 (Galton, 1973). In persons with hypertensive disease the incidence of stroke has been three times that of normotensives (Kannel, Wolf, Verter, & McNamara, 1970), and congestive heart failure occurred six times more often in hypertensives (Kannel, Castelli, McNamara, McKee, & Feinleib, 1972). Levy, White, Stroud, and Hillman (1945) reported that in a study of 22,841 army officers, those that exhibited temporary elevations in blood pressure had disability retirement three to four times higher than those without these elevations. The mortality rate of this group was also three times higher than normotensives. Similar findings have been reported by Thompson (1950) who evaluated a group of employees in the Metropolitan Life Insurance Company.

The treatment of essential and secondary hypertension has differed in some respects. Since incidents of secondary hypertension have had clearly defined etiologies of either an anatomical or physiological nature, direct
surgical or pharmacological interventions for these disorders have been established. In contrast a substantial amount of research has failed to determine the specific causes of essential hypertension. At present no consensus has existed concerning its treatment. Since 1950 essential hypertension has typically been treated pharmacologically. Recent studies have shown the effectiveness of drugs in reducing the morbidity and mortality in persons with moderate elevations of blood pressure (Veterans Administration, 1970, 1976). These same studies indicated that a proportion of the treated essential hypertension population has not responded to treatment. Other drawbacks in the use of antihypertensive medication have also existed. The effectiveness of these drugs in controlling borderline hypertensives has not been firmly established. In addition, the use of this medication produced side effects in some individuals. These included elevations of blood sugar, drowsiness, lethargy, depression, increased secretion of gastric acid, hypotension, dizziness, reduced cardiac reserve, and impotence (Herting & Hunter, 1967; Veterans Administration, 1972). These side effects and the expense of medication has made many hypertensives reluctant to undergo drug treatments.

**Self-Control Methods: Stress and Blood Pressure Regulation**

Psychophysiological methods have been considered
potential alternatives to the control of blood pressure with drugs. Psychophysiological methods have been thought to exert control over blood pressure by initiating changes in the functioning of the autonomic nervous system (Green, Green, & Norris, 1980). Clinical, epidemiological, animal, and stress analogue research all have demonstrated that exposure to stressful stimuli from noxious environments results in blood pressure elevations (Patel, 1977). Other evidence indicates that arousal of the sympathetic branch of the autonomic system mediates these blood pressure elevations (Benson, 1977; Cannon, 1914; Green et al., 1980; Patel, 1977). Lacey and Lacey (1958, 1962) have provided evidence that people tend to react to stressful situations idiosyncratically through specific individual patterns of physiologic arousal. Hypertensives have been demonstrated to react to stress with higher elevations in blood pressure than normotensives (Brod, Fench, Hejl, & Jirka, 1959; Innes, Miller, & Valentine, 1959; Shapiro, 1961). Together this evidence suggests that hypertension may result from blood pressure elevations mediated by sympathetic arousal elicited by stress stimuli. Self-control methods have been thought to modulate this autonomic stress response (Benson, 1977; Green et al., 1980; Patel, 1977). The research demonstrating that exposure to stressful stimuli leads to blood pressure increases will be reviewed and a brief
account of the autonomic control of blood pressure under stress and no-stress conditions will be presented. The manner in which self-control procedures have been hypothesized to exert influence over this system to effect blood pressure changes will also be considered.

Clinical investigations have demonstrated that elevated blood pressure often occurs in patients as a result of being exposed to stressful stimuli arising from either aversive environmental conditions or situations that require unusual behavioral responses. Miasnikov (1962) observed high blood pressure in a substantial number of persons during the siege of Leningrad. He suggested that many of these people developed chronic hypertension. Graham (1945) similarly showed that at least 30% of a battalion of soldiers had elevations of systolic blood pressure over 180 mm Hg after exposure to two years of desert fighting. After an explosion of a nitrate plant 57% of the casualties were observed to have diastolic blood pressure increases at levels over 95 mm Hg (Ruskin, Beard, & Scaffer, 1948). Cobb and Rose (1973) found a higher mean pressure prevalence and increased annual incidence of hypertension in air traffic controllers, when compared to a group of second-class airmen. In a study with unemployed workers, Kasl and Cobb (1970) found that blood pressure rose in blue collar workers who had been suspended from their jobs after plant shutdowns.
These instances have shown how diverse psychosocial and physical stressors may result in blood pressure increases.

Epidemiological studies have demonstrated that elevated blood pressure may result from a population's failure to adapt to environmental changes (Scotch & Geiger, 1963). Henry and Cassel (1969) related variation in blood pressure groups as a function of their exposure to particular kinds of social and psychological environments. They utilized data from 18 epidemiological studies to show that where cultures remain stable through time, the population does not demonstrate a rise in blood pressure with age. In contrast, in cultures where the onset of industrialization, urbanization, and migration produces a flux in the usual social, cultural, and economic values, the individual is required to make continuous behavioral adjustments of a stressful nature. In these individuals, the stress was evidenced in rises in blood pressure as they aged. Cruz-Coke (1960, 1964) provided further evidence about blood pressure differences between populations with stable social environments, as compared to populations where social conditions were in a flux. He showed that when people live in isolated regions on a long-term basis, their blood pressures are consistently lower, as compared to people from the same region who migrate to highly urbanized centers. Maddocks (1961, 1967) compiled evidence that
demonstrated similar blood pressure differences between populations in stable environments versus those in rapidly changing environments.

Research with animals also has illustrated how conditions of crowding and competition may result in both transient and chronic elevations of blood pressure. Henry, Meehan, and Stephens (1967) exposed mice to a number of high-stress situations, including mixing males from different colonies, crowding them in small boxes, subjecting them to the continuous threat of a predator, and inducing territorial threats with an interconnecting box system among several established colonies. Within 6 to 12 months, all of these conditions facilitated chronic rises in blood pressure.

Blood pressure elevations have appeared to be related to coping efforts to avoid stress, active problem-solving, and several common social situations. Light and Orbrist (1980) demonstrated that cardiovascular responses to stress (including blood pressure rises) were greater for a group of human subjects that could avoid electric shock by active coping efforts when compared to a yoked group of subjects. The yoked subjects received shock identical to the coping group, based upon the coping group's performance. Forsyth (1968, 1969) conducted research that illustrated that rhesus monkeys exposed to longer and more complex avoidance
schedules showed significantly more marked and persistent blood pressure rises than those animals subjected to less complex schedules. Humans engaged in complex cognitive problem-solving tasks have also been demonstrated to produce elevations in blood pressure (Brod et al., 1959). Other studies with humans have provided evidence that blood pressure increases occur during driving, heated arguments, or anxiety and while speaking in public or being under time pressure (Hinmen, Engel, & Bickford, 1962; Sokolow, Werdegar, Perloff, Cowan, & Brennstuhl, 1970). Patel (1977) hypothesized, on the basis of similar research presented here, that the urban dweller's exposure to multiple noxious environmental stimuli, crowded conditions, and complex psychosocial situations requiring problem-solving and active coping skills may partly explain high incidences of hypertension of those living in urban areas.

Another line of research that has related stress to rises in blood pressure has used analogue stressors to induce blood pressure changes in normotensives and hypertensives under controlled laboratory conditions. In a study that measured the effects of a number of analogue stressors with hypertensives, Shapiro (1961) showed that knowledge of getting an injection, performance of a reaction-time task to avoid shock, and the immersion of limbs in ice-cold water all caused reliable increases in
blood pressures. Some studies have provided important evidence that hypertensives have higher blood pressure elevations than normotensives when exposed to stressful stimuli such as the threat of shock, immersion of limbs in cold water, and frustration promoted by an irritating lab technician (Patel, 1977). These studies have suggested that hypertensives may be specifically prone to react to stress by cardiovascular responses in a manner consistent with Lacey and Lacey's (1958, 1962) evidence demonstrating idiographic physiological stress reactance.

In conclusion, exposure to a wide variety of stressful stimuli has been demonstrated to result in blood pressure increases. These blood pressure elevations are hypothesized to be one component of a fight-flight stress reaction mediated by the emergency arousal of the sympathetic branch of the autonomic nervous system (Benson, 1977; Cannon, 1974; Green et al., 1980; Patel, 1977). A brief account of the manner in which the autonomic nervous system regulates blood pressure under normal and emergency conditions will be presented. This will provide background for understanding the manner in which self-control techniques have been hypothesized to impact on blood pressure regulatory mechanisms.

Evidence has indicated that the autonomic nervous system initiates changes in blood pressure through many
different interacting pressure control mechanisms (Guyton, 1976). These various mechanisms have been divided into those that affect short-, intermediate-, and long term blood pressure changes. Short-term mechanisms have been shown to be initiated instantaneously when blood pressure deviates from normal levels. Short-term regulation systems have included either neutral components, such as the baro-recepter reflexes, the atrial arterial reflexes, and the pulmonary arterial reflexes or hormonal mechanisms, such as the release of norepinephrine, epinephrine, renin, angiotension, and vasopressin from diverse glandular sites (Guyton, 1976). Effects of these systems have generally lasted for several minutes though sometimes these effects have been somewhat longer. Intermediate regulation systems have included the capillary fluid shift mechanism and the vascular stress-relaxation mechanism. These have been initiated within several minutes of deviations from normal blood pressure and have lasted up to several hours in their effects. The long-term arterial-pressure control mechanisms have been represented by the renal-body fluid-pressure control system and by the aldosterone control system. These systems have been demonstrated to act slowly, requiring several hours before they effect blood pressure.

The limbic system, especially the hypothalamus, has been demonstrated to play a major role in integrating
these diverse autonomic mechanisms to achieve the normal maintenance of blood pressure (Green et al., 1980). The hypothalamus has been shown to achieve these effects by controlling a large portion of the autonomic neural circuitry and the pituitary gland that initiates normal and renal mechanisms of blood pressure regulation (Carlson, 1977). The hypothalamus also has been thought to integrate fight-flight responses elicited by stressful stimuli through the same control systems (Green et al., 1980). This stress response has been related to a general arousal of the sympathetic autonomic nervous system that includes increases in catecholamine production and the rate of respiration, as well as desynchronization of the electroencephalograph (EEG) waves (Abrahams, Hilton, & Zybrozyna, 1960; Benson, 1977; Cannon, 1914; Gellhorn, 1970; Patel, 1977). Cardiovascular changes in this stress response have consisted of rises in blood pressure, increases in heart rate, and vasoconstriction in the skin, splanchnic, and renal vessels, (Abrahams et al., 1960; Brod et al., 1959; Folkow & Rubinstein, 1966).

Both central- and peripheral-nervous-system processes have been hypothesized to initiate fight-flight responses (von Eiff, 1970). In this model of stress responding, stimuli are received by the brain through sensory inputs. This information is analyzed in the cortex which interprets
stressful events and relates them to past conditioning, experiences of early life, attitudes, cognitions, and other features particular to an individual's cortical information processing (Patel, 1977). If the cortical interpretation of stimuli is one of threat, then the fight-flight physiologic reaction is initiated through the interconnected neural pathways of the cerebral cortex, hypothalamus, pituitary gland, and reticular activating system. Research has shown that by stimulating these neural areas either directly through electrical and mechanical means or indirectly through environmental stress, a fight-flight reaction has resulted with its arousal and cardiovascular components (Folkow & Rubinstein, 1966). When these neural areas were stimulated for prolonged periods of time, rats developed chronic elevated blood pressures (Folkow & Rubinstein, 1966). This evidence has suggested that excessive and prolonged hypothalamic stimulation may be an important etiological factor in the development of essential hypertension. Self-control techniques have been hypothesized to mitigate against autonomic arousal that has resulted from stress reactions. Self-control procedures have also been thought to influence both normal and hypertensive blood pressure levels by impacting upon the control centers of the autonomic nervous system.
Biofeedback and Relaxation Self-Control Methods

Psychophysiological techniques for the control of blood pressure have included biofeedback and relaxation techniques. Changes in blood pressure that have resulted from these self-control procedures have been attributed to autonomic processes mediated by the hypothalamus. Biofeedback has been based upon the monitoring of changes that occur through involuntary and autonomic physiological processes. When these monitored changes have been displayed as visual or auditory feedback, then voluntary changes in these physiological parameters have been initiated (Green et al., 1980).

Green, Green, and Norris (1980) have stated that the neocortex normally influences physiological processes without conscious awareness. These influences have been thought to be mediated by the diverse corticohypothalamic pathways previously mentioned. When feedback has provided a record of cortically mediated physiological changes to conscious centers, it became possible to learn what covert responses normally correlated with changes in physiological parameters. An individual could therefore initiate those covert responses that have been learned to be associated with the desired physiological changes. As a result, voluntary control of physiological parameters, such as blood pressure, have been able to come under the partial control of cortical centers.
Two forms of biofeedback have been most commonly used to alter blood pressure. These have included blood pressure feedback and electromyography (EMG) feedback of muscle tension. Since EMG biofeedback has been conceived of as a relaxation procedure, the research findings that have concerned its effects on blood pressure will be reviewed with the relaxation studies. Studies have shown that a number of variables are important in facilitating self-control of blood pressure with pressure feedback. Shapiro, Tursky, Gershon, and Stern (1969) were the first to report the effect of blood pressure feedback in facilitating self-control of blood pressure. They developed an automated systolic blood pressure monitoring system that gave continuous feedback at each successive heart beat. Feedback consisted of an 11 milli-second flashing light and sound contingent upon changes in blood pressure. Twenty normotensive males with an average age of 27 years were given twenty-five 65 second trials of feedback. Ten subjects were reinforced for lowering blood pressure, while the other ten were provided feedback for increases in blood pressure. After five trials subjects in the down condition significantly lowered their blood pressure an average of 4 mm Hg of systolic pressure. Subjects in the up condition also lowered their blood pressure, but this trend was not significant.
Several studies have demonstrated that normotensive (Fey & Lindholm, 1975, 1978; Schwartz, 1972; Schwartz, Shapiro, & Tursky, 1971; Shapiro, Tursky, & Schwartz, 1970a, 1970b) and hypertensives (Krist & Engel, 1975) can alter their blood pressure receiving feedback for either raising or lowering blood pressure. The majority of these studies have shown that more substantial changes have occurred in decreasing blood pressure than in raising blood pressure (Fey & Lindholm, 1975, 1978; Schwartz, 1972; Schwartz et al., 1971; Shapiro et al., 1970a, 1970b). The subject's poorer ability in raising blood pressures might not have been so much the result of the failure of feedback if it is considered that the response of raising blood pressure has been more incompatible with the physical activity of resting imposed by experimental conditions than that of lowering blood pressure (Fey & Lindholm, 1975).

Additional studies with normotensives have used feedback to lower blood pressure and omitted feedback to raise blood pressure (Brener & Kleinman, 1970; Blanchard, Haynes, Kallman, & Harkey, 1976; Elder, Leftwich, & Wilkerson, 1974; Shannon, Goldman, & Lee, 1978). Brener and Kleinman (1970) used systolic feedback from the finger employing an occluding cuff, since they found that the standard procedure where the blood pressure cuffs have been placed on the arm became uncomfortable during long periods of feedback.
They achieved significant mean reductions of 8 mm Hg systolic blood pressure in each of two 30 minute treatment sessions. Two other studies have only employed lower blood pressure conditions with systolic feedback provided through recording with conventional cuffs (Blanchard et al., 1976; Shannon et al., 1978). These studies used an average of three training sessions lasting an average of 45 minutes each. Mean blood pressure reductions equalled 5.2 mm Hg. Elder, Leftwich, and Wilkerson (1974) were the only study that provided normotensives with diastolic feedback. They found significant diastolic blood pressure changes of 6 mm Hg that represented an 8.8% reduction. Systolic pressure was also reduced 6 mm Hg but this change was not statistically significant.

Most studies with hypertensives have only attempted to lower blood pressure. These studies have demonstrated significant blood pressure reductions (Benson, Shapiro, Tursky, & Schwartz, 1971; Blanchard, Miller, Able, Haynes, & Wicher, 1979; Blanchard, Young, & Haynes, 1975; Elder & Eustis, 1975; Elder, Ruiz, Deabler, & Dillenkoffer, 1973; Goldman, Kleinman, Snow, Bidus, & Koral, 1974, 1975; Kristt & Engel, 1975; Surwit & Shapiro, 1976; Surwit, Shapiro, & Good, 1978). Systolic blood pressure reductions of up to 34 mm Hg have been reported (Benson, Shapiro, Tursky, & Schwartz, 1971) while diastolic reductions have equalled
15 mm Hg (Goldman et al., 1975). Studies with hypertensives have generally utilized more feedback sessions than those with normotensives. Some of these studies have included home practice procedures in order to facilitate the generalization of the blood pressure reductions to the home environment (Bradley & Hughes, 1979; Kleinman, Goldman, Snow, & Koral, 1977; Krist & Engel, 1975). Blood pressure feedback has been shown to be more effective with massed as opposed to distributed practice in hypertensives (Elder & Eustis, 1975). Blood pressure reductions achieved with biofeedback techniques have been maintained for periods of three months to one year (Blanchard et al., 1979; Surwit et al., 1978).

A number of studies have compared biofeedback training to no-treatment and placebo treatment conditions. Blood pressure biofeedback has been shown to be more effective than no-treatment control groups (Blanchard et al., 1976; Brener & Kleinman, 1970; Elder et al., 1973; Fey & Lindholm, 1978; Fidel, 1975; Goldman et al., 1975; Richter-Heinrich, Knust, Muller, Schmidt, & Sprung, 1975; Shannon et al., 1978) and more effective than attention placebo groups using either false or random feedback (Fey & Lindholm, 1978; Shapiro et al., 1970a; Surwit, Hager, & Feldman, 1977). In contrast, Frankel, Patel, Horovitz, Freewald, and Gaarder (1978) found that no-treatment control and
attention-placebo groups were not different from a blood pressure feedback group. However, they compared blood pressure feedback groups with the other groups in a setting that required generalization from training conditions without providing practice in the new setting. They did not statistically analyze blood pressure reductions during the training sessions which may explain why their findings differ from the other controlled studies.

Many methods of relaxation have been used to lower blood pressure. All of these techniques have been generally conceptualized as resulting in diminished autonomic arousal thereby contributing to lower blood pressures. Benson (1975) hypothesized that relaxation techniques all share four common features that include: a quiet environment; a mental device such as a word, phrase or systematic procedure that is repeated in a specific fashion over and over again; the adoption of a passive attitude; and a comfortable body position. When these four conditions are instituted daily as part of a relaxation routine, Benson (1975) has suggested that they elicit an innate relaxation response that is opposite the fight-flight response in its physiological effects. The relaxation response has been observed to result in lowered oxygen consumption, respiratory rate, heart rate, blood pressure, muscle tension, and blood lactate levels (Benson, 1975). In addition, alpha
waves have been demonstrated to increase. In contrast the stress response has consisted of physiological effects associated with heightened autonomic arousal. The hypothalamus has been hypothesized to integrate the physiological components of both the relaxation and fight-flight responses (Benson, 1977; Green et al., 1980).

Jacobson (1939) was the first to report using a relaxation procedure to lower blood pressure. His relaxation procedure consisted of alternately tensing and relaxing various muscle groups systematically throughout the entire body. A "rest" group of 17 normotensive subjects with no training in relaxation were compared to a group of subjects trained in his progressive muscle relaxation technique over a 75 minute period. EMG muscle tensions were recorded for both groups. The "rest" group showed blood pressure reductions of 3 mm Hg in both systolic and diastolic pressures. The relaxation group had 10 normotensive subjects that reduced both systolic and diastolic blood pressures an average of 8 mm Hg. In addition, this group included four hypertensive subjects that obtained reductions of 13 mm Hg systolic pressure, and 11.3 mm Hg diastolic pressure. A recent reanalysis of this data by Jacob, Kraemer, and Agras (1977) has found significant correlations between decreases in blood pressure and reduced muscle tension as measured by the EMG.
Many recent research studies have demonstrated that blood pressure can be significantly reduced utilizing progressive muscle relaxation methods (Byasse, 1975; Deabler et al., 1973; Frankel et al., 1978; Graham, Beiman, Ciminero, 1977; Orlando, 1975; Shoemaker & Tasto, 1975; Taylor, Farquhar, Nelson, & Agras, 1977; Walsh, Dale, & Anderson, 1977).

Several different types of relaxation procedures have been used to decrease blood pressure in both normotensives and hypertensives including various forms of meditation techniques such as yoga breathing and transcendental meditation (Benson, Rosner, Marzetta, & Klemchuck, 1974a, 1974b; Blackwell, Bloomfield, Cartside, Robinson, Haneson, Magenheim, Nidich, & Zigler, 1976; Datey, Deshnukh, Dahn, Vinekar, 1969; Patel, 1973, 1975, 1977; Patel & North, 1975; Pollack, Weber, Case, & Laragh, 1977; Stone & DeLeo, 1976; Surwit et al., 1978), autogenic procedures (Byasse, 1975; Fray, 1975; Orlando, 1975; Payson, 1977; metronome conditioned relaxation (Brady, Luborsky, & Kron, 1974) and EMG biofeedback with hypertensives (Fray, 1975; Orlando, 1975; Patel & North, 1975; Payson, 1977; Surwit et al., 1978) and normotensives (Blanchard et al., 1976; Mount, Walters, Rowland, Barnes, Payton, 1978). Successful reductions of blood pressure with relaxation procedures have resulted in systolic reduction up to 26 mm Hg (Patel & North, 1975) while diastolic reduction of up to 19 mm Hg have been
demonstrated (Deabler et al., 1973). In addition, relaxation groups have been shown to be significantly superior to no-treatment control groups (Blanchard et al., 1976; Deabler et al., 1973; Fidel, 1975; Patel, 1975; Patel & North, 1975; Shoemaker & Tasto, 1975; Stone & DeLeo, 1976; Taylor et al., 1977), and attention-placebo groups (Taylor et al., 1977). Frankel, Patel, Horowitz, Friedwald, and Gaarder (1977) found that relaxation did not differ from either a control group or from an attention-placebo group. However, as mentioned previously these results might be explained by the fact that test conditions required generalization of the learned response when such training had not been provided.

Some investigators have tested whether one self-control method for altering blood pressure has been superior to another. Fidel (1975) compared systolic biofeedback to a self-controlled relaxation procedure. No differences were found between the two groups. The biofeedback reported mean systolic blood pressure decreases of 10.4 mm Hg and the relaxation group means equalled 10.8 mm Hg. Blanchard, Miller, Abel, Haynes, and Wicker (1979) supported these results with similar findings that the efforts of biofeedback and relaxation on blood pressure were comparable. Walsh, Dale, and Anderson (1977) showed that progressive muscle relaxation on blood pressure were comparable.
They showed that progressive muscle relaxation was equivalent to systolic biofeedback in reducing systolic blood pressure, but the biofeedback group was superior to progressive muscle relaxation in reducing diastolic pressures. In another study, EMG biofeedback relaxation technique was demonstrated to be superior to a progressive muscle relaxation group and a systolic biofeedback group (Surwit et al., 1978). However, when blood pressure reductions utilizing either blood pressure feedback or relaxation training are averaged across studies, the degree of self-control achieved with these two techniques appears to be similar. An average of the values of significant blood pressure reductions for several studies that have utilized blood pressure biofeedback have shown mean systolic reductions of 10 mm Hg and diastolic reductions of 9.2 mm Hg (Elder & Eustis, 1975; Goldman et al., 1975; Kleinman et al., 1977; Krist & Engel, 1975). The average blood pressure reduction across several relaxation studies with significant results revealed mean systolic reductions of 12.6 mm Hg and diastolic reductions of 8.2 mm Hg (Benson et al., 1974a, 1974b; Blackwell et al., 1976; Patel, 1973, 1975; Patel & North, 1975; Pollack et al., 1977; Taylor et al., 1977). Research has presently demonstrated that blood pressure biofeedback and relaxation techniques have been equally effective as self-control techniques for blood pressure regulation.
Cognitive Therapy Approaches to Blood Pressure Control

Cognitive-behavioral techniques have represented another class of self-control treatments used to alleviate symptoms of psychophysiological disorders resulting from autonomic arousal. These techniques have successfully reduced symptoms of tension headache, migraine headache, duodenal ulcer, and irritable colon syndrome. Cognitive-behavioral therapy methods have been specifically concerned with thinking processes hypothesized to impact upon a person's emotions and behavior (Rimm & Masters, 1979). Cognitive-behavioral theorists have promoted the viewpoint that irrational beliefs (Ellis, 1957, 1962, 1971, 1974, 1975) illogical thought processes (Beck, 1976), and deficiencies in self-instructions for the coping and mastery of life situations (Meichenbaum, 1977) all result in psychopathological emotional and behavioral responding. Theorists have also related maladaptive cognitive processes to physiological arousal contributing to the development of psychophysiological disorders (Beck, 1976; Lazarus, 1977; Meichenbaum, 1977). Cognitive treatments have been oriented towards modifying irrational beliefs or maladaptive thought processes to alleviate pathological states of emotion and behavior. In addition, self-instructional techniques have taught clients to formulate instructional scripts that had facilitated coping or mastery performance
in stressful situations. Several theorists have speculated that altering maladaptive cognitive processes would likely effect a reduction of the impact of stress in facilitating heightened autonomic arousal (Beck, 1976; Lazarus, 1977; Meichenbaum, 1977) so that psychophysiological symptoms might be reduced.

In speculating about the relationship between cognitive and physiological functioning, Beck (1976) noted that persons prone to psychophysiological disorders would be more likely to perceive events as stressful when compared to those who lack these disorders. He suggested that people with psychophysiological disorders have acquired self-stressing cognitive processes. For example, people have developed psychophysiological disorders when no unusual, external stressors exist. Beck (1976) hypothesized that the stress in these cases has been self-generated cognitively and consisted of psychological phenomena as the time demands people have placed upon themselves, their repetitive fears, and their self-reproaches. In these instances the content of people's cognitions would have been a set of perfectionistic rules that would be impossible to fulfill. These people would never be able to meet their own time-demands or fulfill their standards of success. Consequently, they would be constantly generating stress for themselves. Anger, anxiety, and frustration would be
possible emotional consequences of these cognitive styles. These emotional states have all been correlated with high blood pressure (Baer, Collins, Bourianoss, & Kretchel, in press; Sokolow et al., 1970).

Meichenbaum (1977) has conceptualized cognitions as magnifying states of arousal that already exist as the result of stress. He has shown how anxiety triggered from stressful situations such as public speaking would be exacerbated by maladaptive self-statements. He contrasted the cognitive responses of two hypothetical public speakers that had equal initial levels of anxiety related to their speaking. Both speakers were depicted as reacting to people leaving the room during the speeches. One speaker construed the people leaving as resulting from their dissatisfaction with the speech. He had no objective data to prove or disprove this notion, but his self-depreciating cognitive appraisal of the situation was said to magnify his existing anxiety. The second speaker formed the belief that the people left the room because of appointments they were required to attend. This speaker's thoughts were shown not to intensify his initial anxiety. As anxiety has been related to elevations in blood pressure (Hinmen et al., 1962; Sokolow et al., 1970), an increase of anxiety by maladaptive cognitions would also tend to elevate blood pressure. By replacing anxiety magnifying cognitions with
coping cognitions, blood pressure elevations from anxiety would be minimized.

Miller and Dworkin (1977) have developed a theory and provided evidence about the pathogenesis of hypertension that suggested a cognitive treatment of hypertension. They hypothesized that blood pressure elevations mediated by the baroreceptor have been learned by hypertensives to attenuate aversive stimuli. They have based their hypothesis on evidence showing that baroreceptor stimulation has had considerable inhibitory effects on the arousal of the reticular formation and cortex (Bonvallet, Dell, & Hiebel, 1953, 1954; Bartorelli, Bizzi, Libretti, & Zanchetti, 1960; Koch, 1932). These inhibitory processes on cortical functioning would act to attenuate the translation of stressful stimuli into aversive experiences. This coeffect of high blood pressure accompanying baroreceptor stimulation would thus be reinforced, since the impact of aversive stimuli would also be minimized by this stimulation. Thus an escape/avoidance learning condition would be established. In addition to its possible function in the development of hypertension, this attenuating mechanism would also have survival value. In emergency situations in which high blood pressures would occur as when a mother saves a child from fire, the baroreceptor effect would attenuate cortical sensitivity minimizing pain perception (Miller & Dworkin, 1977).
Miller and Dworkin (1977) hypothesized that three conditions must exist for a person to develop hypertension via a baroreceptor stress attenuating process. First, the person must possess a high cortical reactivity to stressful situations resulting in frequent aversive experiences. This sensitivity would result from either genetic factors or from learned maladaptive behavioral or cognitive responses that magnify stressful stimuli. Second, the person must have a tendency for an unusually strong inhibition of the reticular system to result from a given increase in blood pressure (mediated by the baroreceptor). This inhibition would lessen the impact of stressful stimulation. Finally, the person would have to possess an above average ability to learn to alter blood pressure via a baroreceptor response. In this way, learned blood pressure elevations from baroreceptor stimulation would be quickly learned as the result of reinforcement consisting of the attenuation of stress. Miller and Dworkin (1977) stated that therapeutic measures to correct this state of affairs would consist of training individuals to develop alternative stress attenuating responses such as assertive behaviors or cognitive coping skills. These new skills minimizing stress would eliminate the need of baroreceptor stimulation. The lessened baroreceptor stimulation would also result in lower blood pressure.
Several lines of evidence have provided support for this theory. Dworkin, Filewich, Miller, and Craigmyle (1979) demonstrated that when blood pressure was raised by an infusion of phenylephrine, rats showed less running to terminate and avoid noxious stimulation during saline infusion. In addition, they found that this effect was blocked in rats with denervated baroreceptors. These results support the hypothesis that an acute rise of blood pressure reduced reactivity to stressful stimuli. Since the effect was blocked by baroreceptor denervation, it was suggested that attenuation of stressful stimuli was mediated by a baroreceptor reduction of cerebral arousal. Sapira, Scheib, Moriarty, and Shapiro (1971) have shown that compared to normotensives, hypertensives failed to perceive aversive psychosocial cues while watching stressful films. Kleinman, Goldman, Snow, and Koral (1977) found that hypertensives have cognitive deficits as measured by the Category Test. Self-control training with systolic biofeedback techniques that successfully reduces blood pressure also eliminated these cognitive deficits. Similar findings by this group of researchers have also been reported (Goldman et al., 1975, 1976). These results have been consistent with Miller and Dworkin's hypotheses and have suggested that the attenuation of cortical processes by baroreceptor stimulation leading to elevated blood
pressures may result in cognitive deficits that would be predicted by their theory.

No published studies were found that specifically employed cognitive techniques for the control of blood pressure. However, recent findings (in preparation for publication) by Hughes and Cunningham (1980) demonstrated that cognitive techniques can be used to significantly reduce blood pressure in hypertensives. Hughes and Cunningham (1980) compared a multielement therapy that combined systolic biofeedback, relaxation training, and cognitive therapy to a group that received only cognitive therapy alone. The study was divided into three phases including three weeks of baseline, treatment, and follow-up. The subjects were withdrawn from medication during baseline. Blood pressure measures were recorded in the home, clinic, and medical settings. Cognitive treatment consisted of 12 sessions of 60 minutes each. Subjects were instructed to incorporate techniques for altering stress inducing cognitions in a manner similar to Ellis (1975) and Meichenbaum (1977). Subjects also practiced cognitive procedures at home two to three times daily. Significant reductions were obtained for both the multielement and cognitive treatments across all settings. The multielement group reduced systolic blood pressure 6.6 mm Hg, 6.1 mm Hg, and 7.9 mm Hg in the home, clinic, and medical settings,
while the cognitive groups reduced blood pressures 5.2 mm Hg, 12.8 mm Hg, and 9.7 mm Hg in each of the respective settings. Diastolic pressures in the multielement group were reduced 6.0 mm Hg, 5.1 mm Hg, and 7.4 mm Hg in respective home, clinic, and medical settings. The cognitive group reduced diastolic blood pressures 7.8 mm Hg, 9.8 mm Hg, and 7.1 mm Hg in the three settings. The effectiveness of the multielement and cognitive treatments did not differ significantly except in the clinic setting where the cognitive treatment produced greater systolic and diastolic blood pressure reductions. These results have demonstrated that cognitive therapy can effect blood pressure reductions in hypertensives.

Analogue research with stressors also has suggested that cardiovascular responses can be modified by altering the level of a subject's subjective distress. These studies used the cold pressor as a stressor. This procedure consisted of having subjects immerse a limb in ice cold water for approximately 60 seconds. Reliable increases in cardiac output, and blood pressure have been shown in both normotensives and hypertensives (Lovallo, 1975; Victor, Mainardi, & Shapiro, 1978). The magnitude of the cardiovascular changes has been correlated with the subjects rating of discomfort (Hilgard, 1969; Wolf & Hardy, 1942). Hilgard, Cooper, Lenox, Morgan, and Voevarasky (1967)
showed that an analgesically treated group undergoing the cold pressor test had significantly lower reports of pain and heart rate increases than a control group that received no analgesic. Victor, Mainardi, and Shapiro (1978) exposed a group of subjects trained to lower their heart rate with biofeedback to cold pressor immersion. The biofeedback group had significantly less heart rate accelerations than a no-treatment control group. The magnitude of heart rate accelerations was correlated with the degree of discomfort reported. These studies have suggested that it may be possible to mitigate against increases in blood pressure mediated by stress by reducing the aversive qualities of the stress. Cognitive techniques would be likely to reduce subjective discomfort to stress since they have been shown to minimize discomfort associated with the perception of pain (Bowen & Turk, 1979; Chaves & Barker, 1974; Craig, Best, & Best, 1978; Follick, 1979; Follick, Zitter, & Kulic, 1979; Levendusky & Pandratz, 1975; Spanes, Horton, & Chaves, 1975; Stenn, Mothersill, & Brooke, 1979; Worthington, 1978).

Several studies have employed self-control treatments to lower blood pressure that have included cognitive components. These cognitive components by decreasing levels of stress may have accounted for some portion of the blood pressure reductions observed in these studies.
Beiman, Graham, and Ciminero (1978) employed cognitive elements in their relaxation treatment for two hypertensives. During baseline and treatment sessions, the experimenters assessed situations that the subjects reported to be stressful. The subjects' perceptions and cognitions related to physiological arousal in situations were found to be related to three general themes. These included themes of hostility, competition, and a sense of time urgency. Both subjects practiced relaxation therapy twice daily during the first training phase. After relaxation skills were successfully acquired, subjects practiced differential relaxation in response to tension related cognitive, behavioral, or situational cues and at fixed times during their daily regime. Home environment blood pressure was reduced to normotensive levels for these two subjects. One subject maintained these effects at a six month follow-up, while the other subject maintained the effects at a two month follow-up. Patel and North (1975) also trained subjects to monitor stressful events and implement relaxation in response to stress cues. However, they did not systematically assess cognitions as in the Beiman, Graham, and Ciminero (1978) study. Both these studies utilized procedures similar to that of cognitive treatment that may have accounted for some of the blood pressure reductions observed.
Taylor, Farquhar, Nelson, and Agras (1977) utilized strategies similar to cognitive treatments as part of a placebo control procedure used as a comparison to relaxation treatment. This placebo treatment included conceptualization training about stress, monitoring of stressful events, and formulation of alternative responses to stressful events. The placebo subjects received instruction about the role of stress reactions as an etiological factor in hypertension. They were asked to fill out self-monitoring forms for stressful events during the first treatment session. In subsequent sessions the experimenter encouraged the subjects to explore alternative reactions to the stressful events. It is possible that subjects devised cognitive strategies in constructing alternative responses to stressful situations, even though the experimenters did not specify the details of the procedure. Placebo subjects decreased an average of 9.21 mm Hg systolic and 3.6 mm Hg diastolic blood pressure. This improvement was slightly greater than the medication only group and and significantly less than the relaxation group. However, other variables that the placebo group lacked such as the systematic home practice of skills and continuous self-monitoring of stress by subjects in the relaxation group may have contributed to these differences.
Cognitive procedures have been successful in reducing symptoms in several psychophysiological disorders that have a stress related etiology. This evidence has suggested that cognitive therapy has a potential as a method of self-control for hypertensive elevations of blood pressure that have also been thought to be related to stress. Self-control techniques that have focused on modifying cognitive responses to stress eliciting situations have been successfully employed in the treatment of tension headaches (Holroyd, Andrasik, & Westbrook, 1977; Holroyd & Andrasik, 1978). Stress training began with presenting the rationale that tension headaches result from disturbing emotional and behavioral responses that are a direct function of maladaptive cognitions. Subjects were next instructed to self-monitor cues that triggered tension and anxiety. In addition self-statements that were concomitant to these states of anxiety were recorded. Clients were finally instructed to reappraise these self-statements that occurred with arousal, and develop alternative adaptive self-statements. Clients initiated rehearsal of these alternative self-statements in situations with stress cues. Holyrod, Andrasik, and Westbrook (1977) compared a coping-skills group to another group receiving frontal EMG feedback training. The results demonstrated more consistent improvement in the cognitive group. All subjects reported
headache reduction in the cognitive group, while only 6 out of 8 improved in the biofeedback group. A 15 week follow-up of both groups indicated continued improvement in those subjects that received "stress coping" training. In contrast subjects in the EMG biofeedback group either reported comparable headache activity or symptom increases from posttreatment levels.

Holyrod and Andrasik (1978) reported results of a second study in which they attempted to delineate the effective therapeutic ingredients of their stress-coping program. Four groups were utilized. The first group was a cognitive self-control group in which cognitive restructuring operations were implemented. This involved identifying environmental stressors and learning cognitive coping strategies to deal with them. Another group spent equal time learning cognitive self-control strategies and relaxation training. A headache discussion group reviewed the historical antecedents to their headaches, monitored their reactions to stress, but received no training in coping skills to reduce headache activity. The final group was a symptom-monitoring control group that was told that treatment time was unavailable but they were paid ten dollars to monitor their headache activity for the duration of the study. All three treatment groups showed significant reductions in headache activity while the self-monitoring
group showed no such changes. Holyrod and Andrasik (1978) postulated that subjects in the headache discussion group may have formed spontaneous cognitive strategies to cope with the relevant environmental stresses that they had identified. It should also be noted that reductions in frontal EMG levels were not demonstrated in any of the groups that reduced headaches.

In combining RET training with autogenic training, Huber and Huber (1979) treated six subjects with migraine headaches. The subjects had undergone pharmacological and relaxation treatments that were ineffective in controlling headaches before this treatment combination was implemented. After establishing a 24 week baseline, subjects received 21 weeks of training consisting of classic autogenic training and restructuring of irrational beliefs. RET was composed of disputing irrational thoughts and developing alternative thoughts with rational contents. The rational thoughts were substituted for irrational thoughts in the home environment. Headache duration was reduced 66% after three months, and 42% after thirteen months following treatment.

Mitchell and White (1977) also utilized cognitive strategies to treat persons with migraine headaches. Their behavioral self-management program involved teaching people to develop their own individualized self-control strategies.
by modifying their environment with alternative covert or overt reactions. Cognitive skill acquisition included training in covariant control of negative self-evaluations and self-criticism. This involved conditioning thoughts and fantasies incompatible with negative self-statements to develop self-control of covert behavior (thoughts). Additional self-change techniques included thought stopping, overt assertive training, and rational thinking. The subjects that received this comprehensive training in behavioral self-management with cognitive elements evidenced significantly fewer migraine headaches at the end of treatment.

The reduction of headache symptoms with cognitive interventions suggests that cognitive therapies have a potential to effect physiological changes. In a similar manner studies have applied cognitive techniques to the treatment of gastrointestinal disorders. Aleo and Nicassin (1977) found that relaxation and cognitive skills training could reduce duodenal ulcer pain. The cognitive skills training components consisted of identifying environmental stressors, and the restructuring of maladaptive cognitive responses to stressful situations. The alternative cognitions were thought to minimize autonomic arousal associated with GI hypermotility. Pain reduction occurred concomittantly with either complete elimination of duodenal
ulcer or a reduction of ulcers as determined by upper gastrointestinal x-ray. Thus direct physiological changes were correlated with the cognitive treatment.

Irritable colon syndrome has also been treated by cognitive methods. Harrell and Beiman (1978) utilized 7 weeks of cognitive restructuring followed by relaxation and social skills training with a 21-year-old male. Interviews and self-monitoring were used to discover irrational thoughts that might be functionally related to anxiety in major life areas. Once these maladaptive themes were identified RET cognitive restructuring of irrational beliefs was instituted. The client incorporated these alternative cognitions during stressful situations, and whenever he self-monitored irrational thought processes. The reported episodes of stomach distress were reduced from an average of 15 per week to 5 per week after 28 weeks of treatment. A one-year follow-up showed an incidence of the symptoms of approximately one per week.

The present study assessed the potential effectiveness of cognitive therapy for the self-control of blood pressure. A group that received cognitive treatment was compared to systolic feedback and no-treatment control groups. The systolic feedback method was chosen as a comparison treatment, since it has been frequently and successfully employed as a self-control technique to effect blood
pressure reactions. The effectiveness of these self-control methods in effecting blood pressure changes under no-stress and stress conditions was evaluated. Blood pressure was measured under both no-stress and stress conditions during pretreatment and posttreatment phases of the study. Blood pressure reductions occurring from pre- to posttreatment phases would reflect the effects of the treatment in lowering blood pressure under the no-stress and stress conditions. The analogue stressor used to induce blood pressure increases in subjects was the cold pressor. The cold pressor reliably increases blood pressure increases in both normotensive and hypertensive subjects and could therefore be uniformly applied to effect pressure increases under both pre- and posttreatment experimental phases (Lacey & Lacey, 1962; Lovallo, 1978). Consequently, the effectiveness of each treatment in mitigating against stress induced blood pressure elevations was compared.

Cognitive and biofeedback groups received instructions for the self-direction of their own treatments. These groups utilized blood pressure monitoring and feedback apparatus that have been readily employed in outpatient clinical settings. All subjects measured their own blood pressure, and initiated their respective self-control treatments in a manner similar to those employable in an outpatient clinical setting. Blood pressure reductions
achieved with either of the two self-control methods would demonstrate that these techniques have potential use as self-directed therapies that would be amenable to an outpatient setting.

Method

Subjects

The subjects were volunteers solicited from undergraduate psychology classes at North Texas State University. They were told that they would receive credit toward their final grades in return for participation in this study. Ninety-three subjects volunteered and filled out a confidential questionnaire (Appendix A) designed to screen out subjects who were hypertensive, who had a previous history of cardiac disease, and who were taking medication that influences blood pressure. Nine subjects were eliminated due to the presence of hypertension or cardiovascular disease. Forty-five subjects declined participation due to scheduling conflicts.

Thirty-nine normotensive subjects remained and were randomly assigned to three groups, including a cognitive therapy group (CT), a systolic biofeedback group (BF), and a habituation control group (HC). Each group consisted of six males, and seven females. Two of these subjects, one male and one female, were eliminated from the study because they evidenced hypertensive levels of blood pressure during
the no-stress condition of the pretest. In addition, five subjects, three females, and two males, did not complete the study. As a result of these seven drop outs, BF and HC consisted of five males and five females each, whereas CT was composed of seven females and five males. These subject's age ranged from 18 to 28 years, with the average age of the females being 21.5 years and of the males being 21.4 years. The arm circumference of all subjects did not exceed twice that of the width of the standard blood pressure measurement apparatus utilized in this study. Informed consent was obtained from each subject during the pretraining sessions held for each group (Appendix B).

**Instruments**

The blood pressure monitoring apparatus used by the subjects throughout the study was an electronic sphygmomanometer, the Astropulse 10, designed for self administration and manufactured by Marshall Electronics of Skokie, Illinois. Blood pressure measurements were recorded from the dial of each unit and when the sensor detected the onset and termination of Korotkoff's sounds (K-sounds), a tone and a blinking light occurred or discontinued. The cold pressor apparatus consisted of an insulated ice chest that held a liquid volume of 21 litres and was separated into two compartments by a plastic screen. In one compartment 5.9 litres of ice were added and separated from the second
compartment where the subjects immersed their feet. Fifteen litres of water was also added to the apparatus. The "ice compartment" of the cold pressor was further insulated with a cover. An Atwood "Mimi King 300" bilge pump was placed in the "ice compartment" side of the cold pressor and circulated water at the rate of 1263 litres per hour. The water circulated 30 minutes prior to the cold pressor immersions so that temperatures were maintained at ranges of 0° to 2° C. The subjects performed the pretest treatment and posttest phases of the study in therapy rooms equipped with one-way mirrors. Room temperatures were maintained within a range of 17° to 20° C. Subjects were seated next to tables that were 85 cm high, so that when they recorded their blood pressures their arms were extended on the table at the level of their hearts. All instructions to the subjects for the pretest, training, and posttest session were recorded and played to subjects on a Sears Solid State Model 799 cassette-tape recorder.

Procedure

All subjects attended a 2 hour pretraining meeting. During the first hour, subjects were taught to record their own blood pressures with the blood pressure cuff. Training was identical to that described by Bradley and Hughes (1979). During this session, the experimenter modeled the blood pressure recording procedure to be used, while
cassette recorded instructions for measuring blood pressure were played to each group of subjects (Appendix C). A written summary of the instructions for blood pressure recording were then provided to each subject (Appendix D). This was reviewed by the experimenter with the subjects. Each subject then practiced these procedures. The experimenter observed a minimum of 10 self-monitoring trials for each subject and made independent recordings of the obtained blood pressure readings. Subjects were considered competent in these procedures when the mean of five consecutive readings did not differ more than 2 mm Hg from those recorded by the experimenter. The subjects continued to practice this procedure, and at least an additional four co-readings by the experimenter and subjects were recorded.

The second hour consisted of a pretraining baseline in which subjects recorded their blood pressures, and levels of experienced pain (only for cold pressor) during 57 minutes of self-directed relaxation. Subjects spent 15 minutes in the test room prior to both the pre- and posttest to habituate to room temperatures. Each subject was exposed to 19 minutes of no-stress (NS) and then 19 minutes of stress (S) conditions. A 19 minute return-to-no-stress (RNS) period followed the stress condition. Instructions were given for self-directed relaxation during the pretest condition (see Appendix E).
Under each of these conditions blood pressure was self-recorded for a total of eighteen times during minutes 1, 2, 9, 10, 17, 18, 20, 21, 28, 29, 36, 37, 39, 40, 47, 48, 55, and 56 of the pretest session. Stress consisted of the cold pressor procedure wherein each subject immersed their dominant foot for 60 seconds into ice water. The experimenter observed all subjects undergo all cold pressor procedures through a one-way mirror. Three immersions were given at minutes 20, 28, and 36. Thus blood pressure was recorded during and immediately after immersions (minutes 20, 21, 28, 29, 36, 37) which occurred every seven minutes. The subjects also reported the intensity of the pain they experienced after taking the two stress blood pressure readings at minutes 21, 29, and 37. The subjects recorded their pain on a graphic representation scale recommended by Scott and Huskinsson (1976) and utilized by Victor, Mainardi, and Shapiro (1978) for the cold pressor test. All subjects were instructed to record blood pressure, and pain ratings as well as to "submerge" and "withdraw" their feet from the cold pressor in accordance with tape recorded instructions that were played to each subject during the pre- and posttest sessions (Appendix F). Subjects were also provided with data recording sheets upon which they entered all of their blood pressure, and pain ratings (Appendix G).
The subjects in the two treatment groups attended five 66 minute sessions consisting of either CT or BF blood pressure control training. The initial sessions were conducted in groups wherein the experimenter provided recorded conceptualization training (Appendices H and I) and tape recorded procedural instructions (Appendices J, K and L) for the respective treatments. A credibility check was next administered to each treatment group (Appendix M). The remaining four treatment sessions were self-directed by each subject and included 45 minutes of blood pressure self-control training. The specific instructions for biofeedback were provided on cassette tapes that the subjects played during each training session (Appendix K). Cognitive groups were provided with written instructions during these sessions that guided them through a series of exercises to acquire cognitive self-control skills to lower their blood pressures (Appendices L, T, U, V, W, X, Y).

The subjects were also instructed to record their blood pressures during minutes 1, 2, 3, 13, 14, 15, 25, 26, 27, 28, 29, 30, 40, 41, 42, 52, 53, 54, 64, 65, and 66 of these sessions. The experimenters monitored the self-directed treatments of the subjects via one-way mirrors. This insured that the training procedures were performed correctly and alerted the experimenters to any equipment failures during training.
During biofeedback training, the subjects were seated and erect with the left arm extended and supported at the level of the heart. They received feedback in the following manner. They were told to inflate the cuff to a level above their last systolic pressure and then gradually reduce the pressure at a rate of 2 to 4 mm Hg per second until the tone sounded and the light appeared (systolic blood pressure). Subjects were then instructed to close their eyes and make the light and tone go away. They were informed that a decrease in frequency or cessation of these signals provided feedback of lowered blood pressure. No instructions were given as to how they were to accomplish this. These training procedures have been used by Bradley and Hughes (1979) and were similar to those employed by Kristt and Engel (1975) for the use of the apparatus described above.

Each subject completed 30 biofeedback trials. Each trial was 90 seconds in duration, and biofeedback procedures were initiated by three verbal commands. The first command of "pump up" marked the onset of this period, at which time each subject pumped up the cuff to over each subject's estimated systolic blood pressure (200 mm Hg or greater). Then the subjects reduced cuff pressure until the systolic level was indicated by K-sounds, and attempted to make the tone and light go away.
A second command that stated, "perform biofeedback" occurred after 30 seconds had elapsed, and subjects continued blood pressure biofeedback. When a third command of "deflate and rest" marked 60 seconds, they rapidly deflated. Subjects rested for 30 seconds until another command stated that they "pump up" again. This signaled the start of a new cycle.

During the cognitive therapy sessions the subjects developed skills for lowering blood pressure under the no-stress and stress conditions. CT for stress conditions consisted of devising self-statements, self-instructions, imagery, self-labeling, reattributions, or distractions aimed at minimising the effects of autonomic thoughts that enhance distress during the cold pressor application. These procedures were based upon variations of the stress inoculation technique that have been used in the control of pain perception (Avia & Kanfer, 1980; Meichenbaum, 1977; Turk, 1978). These procedures differed from the stress inoculation technique in that the relaxation component of training omitted. The formulation of cognitive strategies for no-stress conditions consisted of devising a set of general self-instructions and images for lowering blood pressure. These cognitions were aimed at lowering arousal caused by daily life stress.
Subjects participated in exercises in which they devised control strategies based upon the above mentioned techniques (Appendices K, W, X, Y). Subjects were then instructed to choose those strategies that they felt would work best in lowering blood pressure under both the no-stress and stress conditions. During treatment sessions number 1 and 2 the subjects completed worksheets (Appendices T, U, V) and exercise (Appendix J) devised to pinpoint their negative self-statements during cold pressor. Next, they were to formulate alternative, adaptive self-statements that would alleviate the discomfort and pain arising from cold pressor so that blood pressure elevations would be minimized during these exposures. Sessions number 3, 4, and 5 consisted of providing subjects with one set of written instructions per session (Appendices W, X, Y) to formulate their own individualized imagery and stress inoculation approaches to lower blood pressure under both stress and no-stress conditions. Additional handouts were provided to aid subjects in completing the written instructions. These handouts included a brief summary of imagery techniques to regulate blood pressure (Appendix Z), and a reaction sheet to the cold pressor to help them identify maladaptive cognitions that accompanied the stress condition (Appendix AA). During the last three sessions, the subjects were also provided instructions for rehearsing
their self-control strategies in a fashion analogous to that used by Hughes, Pinkerton, and Wenrich (1981 in press). The experimenters reviewed the work of the subjects after each session and provided written suggestions for improving the cognitions to control blood pressure that the subjects had devised. Time was allotted during the sessions for the subjects to make these improvements.

The procedures for the posttraining phase for measuring blood pressures under no-stress and stress was identical to the pretraining baseline, except that the subjects from each treatment group were instructed to utilize their biofeedback or cognitive self-control procedures to lower their blood pressure during the assessment periods. Instructions for performing biofeedback were recorded on tapes that also provided the subjects with directions to record their blood pressures, and pain experiences. During this period the HC group received the instructions for self-directed relaxation. Finally, after the posttest an involvement questionnaire was given to the subjects to assess the degree to which they had carried out the treatment instructions appropriately (Appendix BB).

Results

Reliability of Blood Pressure Readings

The experimenters co-observed with each subject a minimum of 4 blood pressure recordings before the pretest,
and 4 before the posttest. There were a total of 259 co-readings between the experimenters and subjects. A Pearson product moment correlation coefficient is calculated to determine the degree of reliability between the experimenters' and subjects' readings for both systolic and diastolic blood pressure levels. The correlation coefficient for systolic pressure is 0.97, and for diastolic pressure 0.98.

Comparison of Cognitive Therapy Biofeedback and Habituation Control Groups

Two dependent measures of systolic blood pressure and diastolic blood pressure were utilized to evaluate differences among the three groups of CT, BF, and HC. A three way analysis of variance (ANOVA) with repeated measures on two factors (conditions and phases) is computed separately for each variable. These ANOVAs compare the three groups CT, BF, and HC during the three conditions of no-stress, stress, and return-to-no-stress from the pretest, and posttest phases (see Tables 1 & 2).

Systolic and diastolic blood pressures. The analysis indicated that there are no significant three-way interactions for either the systolic or diastolic blood pressures (see Tables 1 & 2, Appendices M & N). Likewise, there are no significant two-way interactions for either of these variables. Condition main effects for
both systolic and diastolic blood pressure levels are shown
to be significant (F = 74.33, p < .000001 and F = 44.22,
p < .000001 for systolic and diastolic respectively). This
demonstrates that the cold pressor significantly elevated
systolic and diastolic blood pressure levels during stress
conditions and that these pressure levels returned to their
approximate no-stress levels during the return-to-no-stress
condition for both the pretest and posttest phases (see
Tables 3 & 4, Appendices 0 & P). No significant main
effects are found for either the group or the phase factors.

Subjective Ratings of Pain

Pain data are collected only during the stress
condition. To compare the effects of treatments upon pain
ratings across the group factor for the pre- post phases
of the study, a two-way ANOVA (groups X phases) is
performed (see Table 5, Appendix Q). There are no signif-
icant two-way interactions and only a significant phase-
factor main effect is demonstrated (F = 13.27, p < .001).
This significant phase main effect shows that the required
level of pain by subjects was decreased for all groups
from the pre- to the posttest (see Table 6, Appendix R).

Credibility and Involvement Questionnaires

A credibility scale was administered after the
conceptualization training period to the CT and HC groups
to evaluate the subjects' expectancies for blood pressure
change from their respective treatments. A t-test reveals no significant differences in expectancies for the two groups (t = .10, p < .53). An involvement scale was given to subjects in the two treatment groups after the completion of the posttest, to assess the degree to which the subjects were emotionally committed to the success of the treatment and the degree to which they performed the self-control procedures correctly. A t-test reveals that there are no significant differences between the two groups on the involvement measure (t = .03, p < .63).

**Discussion**

Cognitive therapy and biofeedback were evaluated for their effects upon blood pressure under no-stress and stress conditions. The cold pressor procedure utilized during the stress condition was shown to significantly elevate blood pressures above that observed during the no-stress condition. The elevated blood pressures returned to the previous levels during the return-to-no-stress period. The cold pressor procedure was successful in elevating blood pressure levels during both the pretest and posttest periods. However, both the cognitive and biofeedback treatments were ineffective in reducing blood pressure under either the no-stress or stress conditions. By examining how the procedures employed in this study differed from those of past research some important
considerations for future research in comparing biofeedback to cognitive therapy may be highlighted.

Cognitive therapy was hypothesized to mitigate against blood pressure elevations resulting from cold pressor by minimizing the aversive sensations accompanying this stressor. While cognitive therapy was not shown to reduce blood pressure, the treatment did significantly reduce reported pain demonstrating that the aversiveness of the cold pressor was attenuated. However, pain perception was also reduced in the biofeedback and habituation control groups. One explanation for the reduction of pain occurring in all groups was that subjects habituated to the cold sensation of the stressor, since the reduction of pain for the two treatment groups approximated those of the habituation control group. These results differed from those of Victor et al., (1978). They found that the pain levels reported by an habituation control group were not reduced during the presentation of two cold pressors that served as pre- and posttest respectively. The findings of the present study may have occurred due to the greater amounts of stress utilized in this study. Three cold pressors were administered during the pretest, and three during the posttest period as opposed to one in the Victor et al., (1978) study. Subjects were exposed to 60 seconds of stress for each cold pressor provided in this study.
while only 30 seconds were given for the cold pressors by Victor et al., (1978). The additional stress may have facilitated habituation effects. Future studies might provide less stress to prevent these possible effects of the cold pressor.

The two studies also separated the pretest and posttest cold pressor administrations by different time intervals. Victor et al., (1978) separated their pre- and posttest cold pressors by 30 minutes while in this study the pretest and posttest phases were apart for four weeks in order to provid training. It is possible that the subjects in the habituation control and biofeedback groups may have spontaneously formulated their own cognitive strategies for coping with the stress during the four week interval. By recalling the cold pressor experiences during that time interval, they may have suggested to themselves that the stress was less aversive than they had originally anticipated. Thus, any reductions of pain perception resulting from the cognitive therapy would have been indistinguishable from the similar cognitive effects upon pain perception present in the other groups. The subjects in the Victor et al., (1978) study may not have been able to formulate effective cognitive strategies due to the limited time provided, and their engagement in a distraction task between the cold pressors.
These findings also demonstrated that blood pressure elevations were not consistently related to the reported aversiveness of the cold pressor stimuli. The attenuation of the aversive stimulation in the groups did not result in concommitant blood pressure reductions. Cognitive therapy has been directed toward attenuating noxious stimuli that contribute to blood pressure elevations. Research aimed at establishing cognitive therapy as a treatment for lowering blood pressure should then utilize laboratory stressors where there is a clear relationship between perceived aversiveness and blood pressure elevations occurring from the stressor.

Cognitive therapy also did not reduce blood pressure under the no-stress condition. This was inconsistent with the findings of Hughes and Cunningham (1980). Hughes and Cunningham (1980) demonstrated that hypertensives could reduce pressure levels employing cognitive therapy. Analogue stressors were not presented during training or blood pressure evaluation periods. The amount of treatment provided for subjects was more extensive than that provided to the normotensives of this study. The conflicting outcomes of these studies likely occurred from the use of different populations of subjects. Hughes and Cunningham (1980) utilized hypertensives while normotensives participated in this study. The elevated blood pressures
of hypertensives have been shown to be related to diverse psychosocial and other daily life stressors (Patel, 1977). In a sense the elevated blood pressure of the hypertensives resulted from the stress conditions that occurred in their lives. Hughes and Cunningham's subjects learned how to attenuate noxious stimuli that were associated with life stresses contributing to blood pressure elevations. Aversive stimuli from life stresses related to blood pressure elevations may have been limited for the normotensive subjects. Consequently, cognitive therapy was ineffective in lowering blood pressure by transforming aversive stimuli into neutral ones in these subjects.

Biofeedback was also shown to be ineffective in reducing blood pressures under no-stress conditions. However, other studies have demonstrated the efficacy of biofeedback in reducing blood pressure. Several studies that used normotensives and found blood pressure reductions under no-stress conditions employed an increase blood pressure biofeedback group in addition to a decrease biofeedback group (Fey & Lindholm, 1975, 1978; Schwartz, 1972; Schwartz et al., 1971; Shapiro et al., 1970a, 1970b). Several differences in evaluating blood pressure changes contrast these studies from the present one. This study evaluated the effect of decrease blood pressure biofeedback by comparing within group pretest and posttest blood
pressure levels. In the other studies, blood pressure changes were compared between the increase and decrease biofeedback groups. It is possible that if the blood pressure levels of the decrease biofeedback groups had been evaluated independently from the increase biofeedback groups that no significant differences would have been found. This interpretation would be congruent with the present findings.

Other studies have reduced blood pressures with normotensives under no-stress conditions using biofeedback without the use of increase biofeedback groups (Blanchard et al., 1976; Brener & Kleinman, 1970; Elder et al., 1974). During the test sessions of these studies biofeedback was administered for an average of 45 minutes before the effects of the biofeedback on blood pressure was assessed. The present study only provided for 15 minutes of biofeedback during the posttest period before blood pressure changes were measured. The 15 minutes of biofeedback were interrupted by two self-administered blood pressure measurement periods. No biofeedback was provided during these measurement periods. In effect, blood pressure reductions resulting from feedback occurred after three different periods of 5 minutes of biofeedback compared to being evaluated after 45 minutes of biofeedback in the other studies. Possibly if longer periods of uninterrupted
biofeedback had been provided to subjects, blood pressure reductions comparable to the other studies would have been observed.

Surwit et al, (1978) reported difficulties replicating blood pressure reductions reported in experiments utilizing systolic pressure feedback for severe hypertensives. Their subjects were borderline hypertensives. They hypothesized that their failure to replicate past results was partly due to their subjects initial blood pressure values being lower than the initial values of the severe hypertensives. They reasoned that the "law of initial values" was applicable to explain some of the differences between the studies. That is, the higher the initial baseline range of blood pressure values evidenced by subjects the more readily treatment effects can be demonstrated. Surwit's borderline hypertensives evidenced lower levels of initial blood pressures in contrast to the severe hypertensives of the other studies. Thus, treatment effects would have to be more powerful in the borderline populations in order for blood pressure changes to be detected. By using normotensives in this study, the "law of initial values" limited the magnitude of blood pressure reductions possible. Consequently, treatment effects became more difficult to observe with normotensive subjects because of their narrower range of possible blood pressures.
Surwit et al., (1978) speculated that the replication of past research might be achieved if the number of training sessions provided to their subjects had been extended or if more severe hypertensives had been used. The same suggestions of extending treatment sessions or including subjects with more elevated blood pressures were also suggested by the findings of this study.

An additional method for increasing the sensitivity of experimental designs to offset the effects of the "law of initial values" in limiting treatment effects in normotensives would be to increase the number of subjects assigned to each of the experimental conditions. The systolic biofeedback group reduced both systolic and diastolic pressure means from the pretest to the posttest under both no-stress and stress conditions. Though these differences were not significant, perhaps a greater number of subjects would have enabled these changes in pressure to attain significance even if treatment effects were limited by the "law of initial values."

Though no other studies were found that used the cold pressor to evaluate the effects of biofeedback treatment in lowering blood pressure, Victor et al., (1978) utilized the cold pressor to evaluate the effects of heart-rate biofeedback upon heart-rate accelerations resulting from the stressor. Victor et al., (1978) provided subjects with
30 minutes of biofeedback training between the two cold pressor exposures. Heart rates were increased less during the second cold pressor. Thus the biofeedback treatment significantly reduced heart rate accelerations during cold pressor compared to an habituation control group. As mentioned earlier the present study provided subjects with a greater number of cold pressors with a longer period of presentation compared to the Victor et al., (1978) study. Thus, too much stress may have existed in this study for the blood pressure biofeedback treatment to overcome it. If this study had provided either extended biofeedback training or less stress exposures, then the biofeedback treatment might have had an effect similar to the heart rate biofeedback of Victor et al., (1978) in diminishing arousal from cold pressors.

In summary several conclusions were drawn concerning the findings of this study. A major purpose was to evaluate the efficacy of cognitive therapy and biofeedback training as self-control treatments for regulating blood pressure under the no-stress and stress conditions. Though the cold pressor effectively elevated blood pressure under the stress conditions, some unexpected effects of the cold pressor limited the assessment of the effectiveness of these two treatments under stress. The cognitive therapy was thought to lower blood pressure by enabling subjects
to decrease their subjective discomfort to stress stimuli. The stress exposures resulted in diminished pain perception for all groups. Therefore, the possibility of comparing the blood pressure changes of cognitive groups achieving diminished pain to other groups with baseline pain could not be assessed. The findings also demonstrated that blood pressure levels and subjective experiences of pain from the cold pressor were not directly related for normotensive subjects within the range of cold pressor stimuli employed.

In order for the effects of cognitive therapy to be evaluated in future research, stress stimuli should be chosen that have a clear relationship to blood pressure elevations. Classes of analogue stressors that might possess this characteristic include stimuli associated with various problem solving activities (i.e., avoiding shock) and psychosocial situations (i.e., public speaking). Researchers should be careful not to administer these stimuli too frequently thereby enhancing habituation effects. Controls might also be instituted to prevent subjects in non-cognitive treatment groups from spontaneously implementing cognitive strategies to cope with stress. If these precautions were to be followed the effects of cognitive therapy in attenuating noxious stimuli may result in blood pressure reductions.
The findings of this study also suggested that biofeedback treatments would be more effective if several different procedures were implemented. When using stress, the amount of treatments should be matched to the quantity and intensity of the stressors. If a large amount of stress was applied in future research, training that has usually been shown to be effective under less stressful conditions would have to be extended to achieve similar results. The biofeedback treatments could also be improved by increasing the number of training sessions provided to the subjects. In addition, the periods of biofeedback provided to subjects prior to assessing blood pressure reductions could be extended.

When evaluating the effects of cognitive therapy and biofeedback, it would also be optimal either to utilize subjects that were hypertensive with blood pressure elevations that were as severe as possible or to increase the number of subjects if normotensives were used in research. These changes would offset the tendency of low initial blood pressures to limit treatment effects. Hypertensives might also be employed instead of normotensives, since blood pressure elevations from aversive life stimuli have been more readily demonstrated in hypertensives. By implementing these changes, a more extensive comparison of the cognitive and biofeedback treatment in reducing blood pressure would be possible.
Appendix A

CONFIDENTIAL QUESTIONNAIRE
AUTONOMIC SELF-CONTROL RESEARCH

Name______________________________ Age_____ Sex____

Address__________________________ City________ Zip_____

If student, state major______________ Telephone__________

Marital Status_________ Height______ Weight_______

Education______________________ Occupation____________________

If you smoke, how much per day?

Are you currently taking any form of medications or drugs? Please describe.

Have you ever been diagnosed as hypertensive, or had any cardiovascular health problems? If yes, explain.

In general, I would describe my present health status as:

___ Very Healthy ___ Healthy ___ Average ___ Ill ___ Very Ill
Appendix B

Informed Consent Agreement

I, ___________________ hereby give consent to Roger E. Daftor and associates to perform or supervise the following investigational procedure and treatment: recording of blood pressure, utilizing electronic instruments; biofeedback training, utilizing electronic instruments to monitor blood pressure; and training in psychophysiological therapy techniques for the self-control of blood pressure. I understand that the use of the above described procedures to control blood pressure is experimental, but if they are successful, I may expect to develop some degree of control over my blood pressure. I further understand that this investigation does not involve either medical diagnosis or medical treatment and is not intended to substitute for consultation with a physician or medical treatment for any present symptoms that I possess.

I have (seen, heard) a clear explanation and understand the nature and purpose of the procedure or treatment, the attendant discomforts or risks involved, and the possibility of complications which might arise. If hypertensive, a clear explanation of alternative procedures for my condition and the experimental procedures have been
clearly explained to me and understood by me. I understand that the procedure or treatment to be performed is investigational and that I may withdraw my consent for my participation. With my understanding of this, having received this information and satisfactory answers to the questions I have asked, I voluntarily consent to the procedure or treatment designated in the paragraph above.

DATE

SIGNED: ___________________ SIGNED: ___________________
Witness Subject

or

SIGNED: ___________________ SIGNED: ___________________
Witness Person Responsible

Relationship

Instructions to persons authorized to sign:
If the subject is not competent, the person responsible shall be the legal guardian or legally authorized representative. If the subject is a minor under 18 years of age, the person responsible is the mother or father or legally appointed guardian. If the subject is unable to write his name, the following is legally acceptable:
John H. Doe (his X mark) and two (2) witnesses.
Appendix C

Instructions for Blood Pressure Monitoring

Introduction: The following instructions are a standardized procedure for measuring your own blood pressure. For research purposes and for your own efforts to control your blood pressure, it is important that these factors be held constant. In this way, you and the researchers will know that any changes in the blood pressure reading obtained are the result of real changes in your blood pressure and are not due simply to differences in the procedures for measuring your blood pressure. Therefore, the procedure outlined here should be followed exactly throughout the duration of your participation in this research project.

Throughout your participation in this project you will be asked to take your blood pressure to obtain readings of both your systolic and diastolic pressures. The systolic pressure is the higher number, and the diastolic the lower number in a pressure reading. During the pre- and post-treatment sessions you will take 18 blood pressure readings during a 57 minute period. During the five treatment sessions you will take blood pressure up to 21 times over a 66 minute period. You will be provided with cassette recordings that will instruct you as to when your blood pressure should be taken. You are requested to record all the blood pressure readings as accurately and as neatly as
you can on the data sheets provided to you. Now take the blood pressure recording units out of their cases, and perform the procedures as I talk to you about them. The experimenters are there to assist you with learning the procedure.

**Preparation for Recording Blood Pressure:** When you are ready to begin measuring your blood pressure, sit still and assume a position where you can rest your nondominant arm at about the same level as your heart. It is important that you position your arm with the palm turned upward and the arm extended so that it will rest perfectly still while blood pressure readings are being taken. Movements of the arm may cause false readings. It is also important that you assume exactly the same position every time you take your blood pressure. During this presentation, you need not worry about your arm position while you are becoming familiar with the blood pressure monitoring unit and procedure for blood pressure recording. However, throughout the rest of the experiment every time you take your blood pressure in your assigned therapy room, it is essential that your arm is always in the same position at the level of your heart if the readings are to be accurate.

**Fitting the Equipment:** At the beginning of each session remove the blood pressure cuff from its carrying case. Slide the cuff up your nondominant arm making sure that
no clothing is between the cuff and your arm. The hoses and inflation gauge should be on the side of the cuff toward your hand. Wrap the loose end of the cuff back under and around your arm and press together the velcro tape to secure the cuff around your arm.

Rotate the cuff and slide it either up or down until the dot on the cuff (just above where the rubber hoses go into the cuff) is on the inside of your arm over the large artery near the hollow of your elbow where your arm bends. This artery can be found by feeling for the pulse of the artery. Straighten your arm completely and use the index finger of the other hand. The artery is located with the arm outstretched and palm up, about 1/2 inch to the bodyside of the center of the arm just above the hollow of the elbow. Once you have placed the dot over your artery you may want to adjust the cuff to fit snugly around your arm. Next place the pressure gauge in a convenient location where the sphygmomanometer dial can be easily read.

**Taking Your Blood Pressure:** Be sure the power switch is turned off before you begin to take your blood pressure. Rotate the air flow valve screw on the bulb clockwise in order to close the air valve. Begin taking your blood pressure by squeezing the bulb with your dominant hand. Always inflate as quickly as you can. This point about inflating quickly cannot be emphasized enough as it will make it easier for you to collect your data.
After inflating rapidly, move the sphygmomanometer power switch to the "on" position. You will generally get an immediate "beep" sound and the light on the gauge will "flash". If the unit continues to "beep" and light continues to "flash" for more than 5 seconds and you feel sure that your arm is not moving, deflate the cuff by turning the air valve screw in a counterclockwise direction, and turn off the power switch.

When the cuff is completely deflated, repeat the procedure again raising the cuff pressure 30 mm Hg over your last systolic pressure reading. After the cuff becomes deflated to this level turn the unit on, and if the unit is not continuously "beeping" and "flashing" begin decreasing the pressure in the cuff by turning the air flow valve screw slightly in a counterclockwise direction. Adjust the valve so that the needle of the sphygmomanometer is falling at the rate of about 2 to 4 mm per second or one to two marks per second. Continue decreasing the pressure in the cuff, keeping your arm as stationary as possible, until the unit "beeps" and "flashes". Immediately close the air flow valve by turning the screw clockwise. The unit should continue "beeping" and "flashing" in a regular manner corresponding to your pulse rate. If this is indeed occurring, record your systolic blood pressure on the forms provided at the point that the continuous beeping and flashing started. Be sure to record only the level that
was indicated just at the point where the continuous beeping and flashing started.

If the unit does not continue to "beep" and "flash" regularly, you probably have a false reading and should continue to decrease the pressure in the cuff as before until you get another "beep" and "flash". Shut the air flow valve immediately as before and notice if you are getting regular "beeps" and "flashes". If so, this is your systolic blood pressure. Record the reading from the sphygmomanometer dial at the point where the beeps and flashes first started. If the unit is still not "beeping" and "flashing" in a regular manner, continue decreasing the pressure following the same procedure until regularly spaced "beeps" and "flashes" occur. If after these three efforts regularly spaced "beeps" and "flashes" are not obtained, deflate the cuff completely, turn off the power and begin the procedure again.

After your systolic pressure has been obtained and recorded according to the above instructions, again begin to reduce the cuff pressure to take your diastolic reading. Continue decreasing the cuff at the same rate of (1 to 2 marks per second) until this time the unit stops beeping and flashing. Close the air flow valve immediately by turning the screw in a clockwise direction. The unit should at this point not be "beeping" and "flashing" or at
least should beep only infrequently. Again, record the sphygmomanometer reading at the very point where the "beeping" and "flashing" stopped. If the unit begins beeping and flashing at regular intervals within a few seconds, again reduce the cuff pressure until the regular beeping and flashing ceases while the cuff pressure is held stable for five seconds. After completing your diastolic reading, decrease the cuff pressure to zero.
Appendix D

Pointers on Taking Accurate Blood Pressure Readings

SETTING UP

1. Slide the cuff onto your nondominant arm, and find the brachial artery. Make sure the dot on the cuff is over it.

2. Then tighten the cuff to fit snugly around your arm.

3. Place the gauge near you so that you can easily read it.

PUMPING UP

1. Be sure the unit is turned off before you pump up.

2. Turn the air valve clockwise to close it (not too tight).

3. Inflate the cuff as quickly as you can to about 30 mm Hg over your last systolic reading or to 180 mm Hg during cold pressore readings.

RECORDING BLOOD PRESSURE

1. Turn the switch on.

2. Slowly release the air pressure by turning the air valve counterclockwise.

3. The needle should fall at about a rate of 2-4 mm per second (1 to 2 marks per second).

4. Watch the light, not the gauge needle.

5. When the light comes on, close the air flow valve immediately (the unit should be "beeping" and "flashing" regularly).

6. Record the level that was indicated at the exact point where the light first started to flash in your data notebook.

7. Release air pressure again, and watch the light.

8. When the light goes out and the "beeping" stops, close the air valve immediately (the unit should not "beep" and "flash" regularly).
9. Record the level that was indicated just when the light and beeping stopped in your data notebook.

10. Open the valve completely by turning it counterclockwise.

11. Turn the unit off and rest until you receive further instructions.

EQUIPMENT CARE

1. When putting equipment away be sure the unit is turned off and that the cuff is completely deflated.

2. Avoid getting the cuff or gauge wet.
Appendix E

Instructions for Self-Directed Relaxation

You are about to begin the pretest phases of the study to assess your ability to lower your blood pressure under stress and no-stress conditions. Some people have been shown to have the ability to lower their blood pressure prior to undergoing any specific training for this skill. Decreasing your blood pressure is possible if you concentrate on calming yourself and relaxing the muscles in your body.

During this session you will be recording your own blood pressure or skin temperature and reporting your reactions to the cold pressor on the sheets provided to you. Be sure to pump up quickly and to make all your readings as accurate as you can. Remember to keep your arm in the same position for every blood pressure recording. I will turn on this cassette recorder with taped directions which will indicate whether you are to actually take these readings and record your reactions. Sometime during the sessions after completing all of your cold pressors you will have to turn this tape over. (This is demonstrated). If you are not finished completing one reading before further directions are given for taking a second reading, then just finish taking the first reading and proceed with completing the second one as soon as you can.
As you immerse your foot in the cold water, an experimenter will observe you through a one-way mirror to insure that you place your foot in the cold pressor for the exact amount of time that you are instructed to by the tape. The cold pressor can be a very painful and shocking experience. Do not let the shock of the cold pressor interfere with the accuracy of your blood pressure recordings. Be sure to take good blood pressure readings even when you experience upset from the cold pressor.

Now for the next 57 minutes you are to use any skills that you have to relax and lower your blood pressure under both stress and no-stress conditions.
Appendix F

Taped Instructions for Pretest and Posttest

<table>
<thead>
<tr>
<th>Minutes</th>
<th>Recorded Instructions Given to Subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Record Blood Pressure</td>
</tr>
<tr>
<td>2</td>
<td>Record Blood Pressure</td>
</tr>
<tr>
<td>9</td>
<td>Record Blood Pressure</td>
</tr>
<tr>
<td>10</td>
<td>Record Blood Pressure</td>
</tr>
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<td>17</td>
<td>Record Blood Pressure</td>
</tr>
<tr>
<td>18</td>
<td>Record Blood Pressure</td>
</tr>
<tr>
<td>19</td>
<td>a) Prepare to Submerge</td>
</tr>
<tr>
<td>20</td>
<td>a) Submerge Now</td>
</tr>
<tr>
<td></td>
<td>b) Record Blood Pressure</td>
</tr>
<tr>
<td>21</td>
<td>a) Withdraw Your Foot</td>
</tr>
<tr>
<td></td>
<td>b) Record Blood Pressure</td>
</tr>
<tr>
<td></td>
<td>c) Rate the Cold Pressor Experience</td>
</tr>
<tr>
<td>22</td>
<td>a) Prepare to Submerge</td>
</tr>
<tr>
<td>28</td>
<td>a) Submerge Now</td>
</tr>
<tr>
<td></td>
<td>b) Record Blood Pressure</td>
</tr>
<tr>
<td>29</td>
<td>a) Withdraw Your Foot</td>
</tr>
<tr>
<td></td>
<td>b) Record Blood Pressure</td>
</tr>
<tr>
<td></td>
<td>c) Rate the Cold Pressor Experience</td>
</tr>
<tr>
<td>Minutes</td>
<td>Recorded Instructions Given to Subject</td>
</tr>
<tr>
<td>---------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>30</td>
<td>a) Prepare to Submerge</td>
</tr>
</tbody>
</table>
|         | (Five minutes of self-directed relaxation or initiation of treatment skills) | a) Submerge Now  
|         |                                         | b) Record Blood Pressure |
| 36      |                                         | a) Withdraw Your Foot  
|         |                                         | b) Record Blood Pressure  
|         |                                         | c) Rate the Cold Pressor Experience |
| 37      |                                         | a) Prepare to Submerge |
| 38      |                                         | Record Blood Pressure |
| 39      |                                         | Record Blood Pressure |
| 40      |                                         |                        |
|         | (Five minutes of self-directed relaxation or initiation of treatment skills) | a) Submerge Now  
|         |                                         | b) Record Blood Pressure |
| 47      |                                         |                        |
| 48      |                                         |                        |
| 55      |                                         |                        |
| 56      |                                         |                        |
# Appendix G

## Data Sheets

<table>
<thead>
<tr>
<th>Blood Pressure</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
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</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>
NO PAIN

PAIN AS BAD AS IT COULD BE

CP# _____
BLOOD PRESSURE: 

BLOOD PRESSURE: 

BLOOD PRESSURE: 

BLOOD PRESSURE: 
NO PAIN ———— PAIN AS BAD AS IT COULD BE
BLOOD PRESSURE: ________
BLOOD PRESSURE: ________
NO PAIN — PAIN AS BAD AS IT COULD BE
BLOOD PRESSURE: ____________
BLOOD PRESSURE: ____________
BLOOD PRESSURE: ____________
BLOOD PRESSURE: ____________
BLOOD PRESSURE: ____________
Appendix H

Introduction to Biofeedback Training

Internal physiological processes such as brain waves, body temperature, heart rate, and blood pressure are normally controlled by the autonomic nervous system rather than by our conscious efforts. Since the development of biofeedback devices, which provide a record of the body's internal processes, researchers have developed ways for individuals to voluntarily control their physiological processes. People who are given visual or auditory feedback of their physiological responses have been shown to gain the ability to consciously control these responses.

Over the past ten years, biofeedback has received a great deal of attention and scrutiny from researchers around the world. Early research on blood pressure control, for example, demonstrated that people with normal blood pressure could learn with the help of feedback to raise and lower their blood pressures when asked to do so. Physicians, psychologists, and medical researchers have applied this new technology to the treatment of hypertensives, enabling them to reduce their pathological blood pressure elevations. These results have been replicated many times in the clinic as well as in the laboratory. Furthermore, the ability to initiate blood pressure reductions acquired from biofeedback training has been reported to last for a year or more.
Researchers have shown that blood pressure elevations naturally occur in times of stress. You have observed your own blood pressure elevate while you were exposed to the cold pressor, a laboratory analog stressor. Studies have demonstrated that such elevations resulting from stressful conditions can be minimized or eliminated with the help of biofeedback training. In this study, you will learn to control, or lower, your blood pressure under stress and no-stress conditions, using blood pressure biofeedback.

Acquiring the skill to gain control over one's physiological activity to influence blood pressure is a similar learning process to refining one's muscle movements when throwing darts to hit a bull's-eye. These two learning situations require that feedback about one's success in acquiring these skills be provided so that improvement occurs. For example, if you are learning the response of throwing a dart accurately, and you are blindfolded during this process, your brain receives no information about your performance. As a result, you will show little improvement in throwing darts no matter how long you practice or how hard you try to do well. With the blindfold removed, you receive visual feedback about the success of your efforts. This feedback is necessary for refining your motor skills to achieve the goal of hitting the bull's-eye. In the same way, you cannot learn the skill of controlling physiological processes without learning
about how your conscious efforts influence your physiological responding. Biofeedback gives information through visual or auditory signals about your successes in affecting physiological processes. This enables individuals with practice to consciously influence and voluntarily regulate some of their body's physiological responses. You will be learning to alter your body's physiological responses to achieve the goal of lowering your blood pressure.

The mechanisms by which you will learn to control and lower your blood pressure reside within your nervous system. The neocortex, the part of your brain that mediates conscious awareness, has direct connections to the hypothalamus. The hypothalamus is a part of the brain that regulates autonomic processes that control blood pressure. Brain researchers have shown that neural activities of the neocortex associated with conscious activity are continuously influencing blood pressure levels through these connections to the hypothalamus. These processes of the neocortex also influence the magnitude of blood pressure elevations resulting from the cold pressor.

Biofeedback training will provide you with information about your physiological responses enabling you to identify those conscious thoughts and feelings (i.e., states of peace or calm) that normally lower your blood pressure. As training proceeds, you will begin to let these conscious states occur so that blood pressure reductions will take
place under the no-stress conditions. When you are exposed to the cold pressor again, you will initiate these same states to eliminate or minimize the blood pressure elevations that occur during the cold pressor experience.

The remaining time you spend in training will involve specific instructions to undergo biofeedback training. You will receive information about changes in your blood pressure in the form of visual and auditory feedback to gain voluntary control over the processes that affect your pressure levels. You will be assisted by a doctoral student in clinical psychology during training. Be sure to follow all instructions and training procedures exactly, as these methods have been shown to work for many people who have undergone this training before you. In doing this, you will maximize your learning of skills to influence your blood pressure. Good luck. Be sure to do your best.
Appendix I

Introduction to the Cognitive Control of Blood Pressure

Many people believe that their emotional reactions following undesirable events are determined by the events themselves. Psychologists have produced evidence that it is not the events that determine the quality and extent of emotional reactions, but our cognitions. These are the thoughts, ideas, mental images, or beliefs that we entertain concerning the events in our lives. A simple example will illustrate the way that cognitions affect our emotions.

Two students were enrolled in the same class. The students were both quite capable of performing well in this class. On the night before the first examination, the students decided to go to a party instead of staying home to study. Upon receiving the results of the examination, they discovered that they both had failed the test. Their cognitions or thoughts about this event differed greatly and this had an effect upon their emotional reactions to the situation.

The first student began to think, "I can never do better. This test proves that I am stupid. I'll fail the whole course." These cognitions had the effect of making him panic, become increasingly upset, and fearful of subsequent tests. These thoughts led to a state of
distressful emotional arousal that interfered with his future studying and test-taking during the course. When he studied, he had thoughts about how he was too stupid to learn the material. This upset him so much that his studying was poor. During the tests, he had an image of the future where he would receive the test back with a failing grade on it. This generated much anxiety and decreased his ability to concentrate on answering the test questions correctly. This student's cognitions were maladaptive since they resulted in emotional reactions that interfered with the goal of succeeding in the course.

The second student responded with different cognitions. He thought that, "I'm disappointed, but I can improve my grade by studying hard for the rest of the exams. This is a temporary setback." This student's emotional reaction was quite different from that of the first. He did not feel as disappointed, have as much fear, or feel any extreme loss of self-esteem. This second student's thoughts facilitated a more composed emotional response and did not disrupt future studying or test-taking. His cognitions were fruitful in enabling him to cope well emotionally in a difficult situation. This example illustrates how different cognitions arising from the same event can produce totally different emotional reactions to that experience.
All of us at times tend to make uncomfortable situations we encounter seem worse by the way we think about these events. Our thoughts can alter the kind of emotion we have about that event and the degree to which we experience its intensity. Individuals can be taught to control their cognitions and learn to minimize the distressing emotional reactions which may occur during stressful events. Cognitive therapy enables a person to identify those cognitions that lead to distressful emotions. In addition, cognitions are formulated in therapy that minimize panic and facilitate calmer emotional states related to coping or a sense of self-control over unpleasant situations.

It is well known that changes in our emotional states are accompanied by physiological changes in brain waves, body temperature, myoelectrical potentials (that control muscle tension), and blood pressure, to name a few. If, for example, we measured the heart rate, blood pressure, muscle tension, and rate of vasoconstriction of the first distressed student, we would discover that the levels of these physiological states would be increased as compared to his resting, normal levels. In contrast, the second student who remained calm would not have shown these physiological changes as dramatically. Research has shown that when we are emotionally at ease our bodily processes, such as heart rate, blood pressure, muscle tension, and vasoconstriction, are decreased.
Since thoughts directly influence our emotional responses, they also affect the physiological changes that accompany emotions. Therefore, if one changes his or her cognitions concerning an event, one can either magnify or minimize his or her emotional and physiological arousal while experiencing that event. In fact, a pattern of severely magnifying one's degree of distress and physiological arousal continuously in one's life through a maladaptive cognitive style can result in real physical illnesses in people with a predisposition for them. These psychosomatic disorders include ulcerative colitis, migraine headache, and hypertension.

Blood pressure is one physiological process that is especially influenced by cognitions. Cognitive processes have been shown to be associated with normal blood pressure variations that occur daily in all individuals. Evidence from the research literature will illustrate instances in which cognitions have been shown to impact upon changes in blood pressure. These examples include common daily experiences and situations that do not occur on an everyday basis. For example, people involved in public speaking usually display changes in blood pressure that are influenced by cognitions. People who reported before their speeches that they thought their presentations would be poorly received had higher blood pressure elevations.
while speaking than speakers who thought their speeches would be received well. Blood pressure elevations have been reported to occur in people engaged in heated arguments, in individuals who believed that they needed to perform a task more quickly than was necessary so that they were rushed, and in subjects who thought they were about to get an injection which they never received. Blood pressure elevations have been observed in people while they solved simple mental arithmetic problems, and when they were engaged in normal daily active problem-solving. People with a fear of heights showed blood pressure elevations when they imagined that they were standing on the edge of a narrow ledge. These examples demonstrate how events that might occur in our lives and the cognitions we form about them contribute to normal daily blood pressure changes.

Your cognitions have an affect on your blood pressure as well. Perhaps you can recall some of the cognitions you had during the ice water submersion. Although you were told that it is a harmless experience, you probably had thoughts about how it was hurting you, that it was unbearable, and maybe even causing you tissue damage. You may have been shocked and felt panic over the experience due to your surprise that it was so unpleasant. The cold pressor naturally causes blood pressure elevations, and research has shown that these changes can be influenced by your cognitions. As your cognitions about the cold pressor
alter your degree of emotional responding (i.e., feeling distress, panic, impatience), this will impact upon your physiological arousal that included blood pressure elevations.

The mechanisms by which your cognitions are able to affect your physiological responding reside within your nervous system. The neocortex, the part of your brain that produces cognitions, has direct connections to the hypothalamus. The hypothalamus is the part of the brain that regulates physiological responses such as changes in the level of your blood pressure. Brain researchers have shown that neural activities of the neocortex associated with cognitive processes are continuously influencing levels of blood pressure through these connections to the hypothalamus. These processes of the neocortex also influence the magnitude of blood pressure elevations resulting from the cold pressor.

Your cognitive training is designed to help you identify cognitions that contribute to blood pressure elevations, and learn alternative cognitions that will help you to lower your blood pressure. Under nonstress conditions, you will eliminate cognitions that would contribute to your normal daily blood pressure elevations and replace these with thoughts that facilitate an emotional state of peace and calm. For the cold pressor conditions, you will be taught cognitive techniques that
will enable you to either minimize or eliminate your distress, panic, shock, pain, and discomfort that you may have experienced during the ice water submersions. These cognitive strategies have been shown to be effective in controlling emotional distress and pain in patients with cancer, low back injury, migraine headache, depression, and other medical or psychological disorders. Hypertensives have also been taught to lower their pathologically elevated blood pressures that result from cognitively mediated reactions to stress with these techniques. By minimizing your emotional distress during cold pressor, you will be able to eliminate the blood pressure elevations from this experience.

During the remaining time you spend in training you will receive step-by-step instructions and exercises for formulating cognitive strategies for controlling your blood pressure under both stress and no-stress conditions. You will be assisted by a doctoral student in clinical psychology during this training. Be sure to follow all the instructions and training procedures exactly as they are presented as these methods have been shown to work for many people who have undergone this training before you. In doing this, you will maximize your learning of cognitive skills to influence your blood pressure. Good luck. Be sure to do your best.
### Examples of Cognitions that Increase and Decrease Blood Pressure

<table>
<thead>
<tr>
<th>Self-statements</th>
<th>It's so cold, I can't stand it.</th>
<th>These sensations will only last for a short time.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-instructions</td>
<td>I'll never be able to bear this awful pain for much longer.</td>
<td>I can make this sensation bearable.</td>
</tr>
<tr>
<td></td>
<td>It's just terrible that the experimenter is making me do this.</td>
<td>This is an experiment, the results will help people with hypertension.</td>
</tr>
<tr>
<td>Imagery</td>
<td>It's getting worse as my foot is in the water longer. I won't be able to stand it soon. I can't stand it. It's unbearable. I wish I could bring my foot out. I wish I could bring my foot out soon. The experimenter better give me the signal.</td>
<td>I've been through this before, and once it's over you feel better quickly. Just keep your foot in the water. It will be o.k. I can focus on other sensations like looking around the room and thinking about the usual sensations when it's over. Just keep the foot in a little while longer and don't let this bother you.</td>
</tr>
<tr>
<td>Self-labeling</td>
<td>Image your foot is turning to ice.</td>
<td>Image-think of your foot basking in the hot Texas summer sun.</td>
</tr>
<tr>
<td>Distractions</td>
<td>This sensation is extremely painful.</td>
<td>It's only cold. That's all.</td>
</tr>
<tr>
<td></td>
<td>Your cognitions are focused on the cold pressor experience.</td>
<td>You direct your thoughts to other positive pleasant events.</td>
</tr>
</tbody>
</table>
Appendix K

Biofeedback Training Instructions

You have recorded your blood pressure and should be completely familiar with the blood pressure monitoring procedure. You are now ready to begin the biofeedback training period of this study where you will learn to lower your systolic blood pressure and minimize blood pressure elevations resulting from cold pressor immersions.

To a large extent, this is a trial and error process. Even people who have learned to control their blood pressure very effectively cannot satisfactorily explain how they do it. It seems to be similar to trying to tell someone how to wiggle their ears. The learning is very individualized, and it is difficult to put into words how one learns the skill. What works for one person will not necessarily work for someone else, so you will need to find the way that works for you. Whatever strategy you choose to try for learning to reduce your blood pressure, it is particularly important to assume a passive attitude. That is, be attentive, but just let it happen without trying to make anything happen. Don't try to force yourself to make your blood pressure go down; instead, let it go down. While you are learning to control blood pressure, try to avoid becoming discouraged if you don't succeed right away. Learning to control bodily processes frequently seems slow,
but if you continue to practice during the sessions, reductions will eventually occur.

The blood pressure instrument you have been using to record your blood pressure can be used as a biofeedback device to provide you with information regarding your systolic blood pressure. Begin biofeedback practice by preparing as if you were going to record your blood pressure, but during this period, you will hold the cuff pressure constant at the level of systolic blood pressure by turning the air flow valve off. Then, close your eyes, and let the "beeping" and "flashing" go away. When these signals stop or decrease in frequency, you have reduced your blood pressure below the level indicated on the gauge. Decreases in systolic pressure are almost always accompanied by proportional decreases in diastolic pressure. Whether or not the signals go away, at the end of the trial, release the cuff pressure and rest.

Each training trial will last approximately 60 seconds, and there will be a 30 second break between trials. A cassette tape with recorded instructions will signal the beginning and end of biofeedback trials. Before beginning a practice session, be sure the tape is completely rewound. The first taped instruction you will hear will be to "inflate" your blood pressure cuff. Begin the biofeedback procedure when the instruction "perform biofeedback" is
given you from the tape. End these trials when you receive
the instruction to "deflate and rest".

The following checklist summarizes the procedure to be
followed:

1. Prior to carrying out the procedure, set up the
tape recorder so that the cassette is rewound, nearby where
you can turn it on and off without getting up.

2. Turn on the tape recorder.

3. When the instruction "inflate" is given, inflate
the cuff to about 30 mm above your last self-monitored
systolic reading.

4. When the instruction to "perform biofeedback" is
given, turn the gauge unit power switch to "on" and reduce
the pressure in the cuff until the unit just begins "beeping"
and "flashing" at regular intervals. This is around the
point of your last systolic reading. Stop reducing the
pressure in the cuff at this point.

5. Close your eyes and begin practicing whatever
strategy you have chosen to employ to let the "beeping" and
"flashing" go away. If it does, simply continue with
whatever strategy you are employing until the next tone
occurs.

6. Stop biofeedback immediately when the instruction
to "deflate and rest" is given by opening the air flow valve
and letting the pressure in the cuff drop to zero.
Completely deflate the cuff.
7. After you rest for 30 seconds, the cycle will repeat itself.

Thank you for your continuing efforts. Good luck during the training.
Introduction to Cognitive Training Instructions

This is the first of a series of five sessions in which you will learn to identify cognitions that raise your blood pressure and to formulate alternative cognitions that lower your blood pressure under stress and non-stress conditions. During each session you will receive a brief presentation or handout which will introduce to you a type of technique for formulating cognitions and an explanation of the rationale for the use of this method. You will also be given a list of examples of cognitions that raise blood pressure and a list of alternative cognitions for controlling blood pressure that are related to the particular cognitive approach presented. At this point during the sessions you will be instructed to formulate your own cognitions in writing for lowering blood pressure within the guidelines provided to you during the presentation. The experimenters will review your work and give you feedback about your performance in formulating these cognitions. Before the posttest, you will select from the various sessions cognitions you have formulated that you feel will work best for controlling your blood pressure under the stress and non-stress conditions. You may find that there will be some overlap between the strategies you chose to use to control your blood pressure under these two conditions. After you
select the approaches you want to use, you will practice
them so that you can initiate these cognitions while you
are going through the posttest.

While you are learning to control your blood pressure
for the non-stress conditions, do not get discouraged if
you are unable to lower your blood pressure during the
practice sessions. Learning to control your blood pressure
under the non-stress conditions may not become evident until
during the posttest period. Learning to control bodily
processes frequently seems slow but if you continue to work
on your exercises during the sessions reductions will
eventually occur.

This first session will be concerned with enabling you
to learn to control the discomfort and pain you feel during
the ice water submersion which will in turn enable you to
minimize the blood pressure elevations that occur from these
experiences. Submerging your foot in ice water is a stressful
experience for almost everyone. All of us have methods that
we use to enable us to cope with such stresses. You will be
encouraged to examine some of your usual methods for
controlling stress as well as be introduced to other methods
that have been shown to be highly effective for controlling
pain and discomfort in clinical settings as well as in
research projects. These methods included the use of
adaptive self-statements or self-instructions to maximize
coping, and positive imagery, relabelling, reattribution,
or distraction methods to mentally ignore or transform the feelings of distress, discomfort, or shock that sometimes occur during cold pressor submersions. A few examples of each of these methods have been provided to you in the handouts you just received. Take a few minutes to read these examples. This session will concern working on formulating **self-statements** to minimize blood pressure elevations that arise from the distress of the cold pressor. If you remember the example of the two students who reacted to failing the test, you will be able to understand how self-statements may influence physiological processes. The one student had maladaptive self-statements which caused him to be emotionally and physiologically aroused, while the second student had self-statements that calmed him. To learn skills to control your physiological responding you will first work through a list of self-statements that have been shown in the past to raise blood pressure further during cold pressor submersions, and then formulate alternative self-statements that you feel would help you remain calm and cope with the cold pressor experience. Next, you will attempt to remember any maladaptive self-statements that you had during the ice water submersion. The questionnaire on which you reported your experiences to us concerning your last ice water submersions will aid you in making a list of maladaptive self-statements. After making this list, you will make alternative adaptive
self-statements for each maladaptive statement. These alternative adaptive self-statements help you remain at ease during future submersions. The experimenter will be spending time with you to go over your statements and help you if any problems should arise. If you finish with these lists, you might want to try to make a list of self-statements that you think may elevate your blood pressure during the course of one of your routine days. Again, the experimenters can provide examples of typical maladaptive statements that normally elevate blood pressure and you will want to make lists of alternative adaptive self-statements. I think that you will find these exercises both challenging and enjoyable. Remember, these are important steps for you to control your blood pressure.
Appendix M

Credibility Chart

Please read the following questions and circle the number which best describes your present beliefs about the blood pressure control instructions that you just received.

1. How logical does this treatment seem to you?

not logical  somewhat  very logical
1  2  3  4  5  6  7

2. How confident are you that this treatment will help you control your blood pressure when your foot is in the ice water?

not confident  somewhat  very confident
1  2  3  4  5  6  7

3. How confident are you that this treatment will help you control your blood pressure under non-stress conditions?

not confident  somewhat  very confident
1  2  3  4  5  6  7

4. How confident would you be in recommending this treatment to a friend who was to participate in an experiment in which he or she was asked to place his or her foot in ice water and control their blood pressure responses?

not confident  somewhat  very confident
1  2  3  4  5  6  7

5. How confident would you be in recommending this treatment to a friend who was to participate in an experiment in which he or she was asked to lower his or her blood pressure under non-stress conditions?

not confident  somewhat  very confident
1  2  3  4  5  6  7
6. How willing are you to use this treatment for lowering your blood pressure while your foot is in ice water?

not willing somewhat willing
1 2 3 4 5 6 7

7. How willing are you to use this treatment for lowering your blood pressure under non-stress conditions?

not willing somewhat willing
1 2 3 4 5 6 7

8. How successful do you feel this treatment will be in controlling pathological blood pressure elevations resulting from stress found in such diseases as hypertension when antihypertensive medication was ineffective?

not successful somewhat successful
1 2 3 4 5 6 7
<table>
<thead>
<tr>
<th>Source</th>
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<th>MS</th>
<th>F</th>
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<td>18357.61</td>
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<td>3601.36</td>
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<tr>
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<td>455.87</td>
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* p < .000001
Table 2

Three-Way Analysis of Variance —
Diastolic Blood Pressure

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<td>58</td>
<td>465.34</td>
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* p ≤ .000001
Table 3
Summary of Systolic Blood Pressure Means across Three Conditions

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<tr>
<th>Treatment groups</th>
<th>Pretest</th>
<th>Posttest</th>
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<tr>
<td></td>
<td>No-Stress</td>
<td>Stress</td>
</tr>
<tr>
<td></td>
<td>$\bar{x}$</td>
<td>$\bar{x}$</td>
</tr>
<tr>
<td>Cognitive Therapy</td>
<td>107.0</td>
<td>114.0</td>
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<tr>
<td>Systolic Biofeedback</td>
<td>113.3</td>
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</tr>
<tr>
<td>Habituation Control</td>
<td>111.5</td>
<td>124.0</td>
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</tbody>
</table>
Table 4

Summary of Diastolic Blood Pressure Means Across Three Conditions

<table>
<thead>
<tr>
<th>Treatment groups</th>
<th>Pretest</th>
<th></th>
<th></th>
<th>Posttest</th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>No-Stress</td>
<td>Stress</td>
<td>Return-to No-Stress</td>
<td>No-Stress</td>
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<td>Cognitive Therapy</td>
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Table 5

Two-Way Analysis of Variance — Pain Ratings

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| Pre-post phases               | 5016.00 | 1  | 5016.00 | 12.43*
| Treatment groups X Pre-post phases | 151.01 | 2  | 75.50   | 0.19 |

* $p < .001$
Appendix S

Table 6

Summary of Pain Rating
Means across Phases

<table>
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<tr>
<th>Treatment groups</th>
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<td>Cognitive Therapy</td>
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<td>Systolic Biofeedback</td>
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<td>Habituation Control</td>
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<td>55.8</td>
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Appendix T

Cold Pressor Self-Statements Worksheet

Increase Blood Pressure

This pain in my foot is so bad, I don't think that it is going to go away very quickly.

What's happening to my foot? Those tingling sensations must mean I'm getting frost bite.

I can't stand this forever.

I can feel my body tightening up. My body is reacting. This proves how unbearable, and excruciating this is.

This is much, much more painful than I ever expected.

How much longer? How much longer? How much longer?

My veins must be freezing up.

This could make me sick.

Is this really worth the extra credit I'm getting?

It's painful. It's painful.

I can't stand it. I can't make it through the entire sixty seconds.

I'm squeezing my hands and gritting my teeth and can't stop.

If my blood pressure is going up, this must be hurting me.

Hurry up. I want out soon.

It's unbelievable how awful this is.

I can't keep my foot in the whole time.

This cold is biting into my foot. Pain this strong must be doing something bad to me.

It's below freezing.

I feel faint. My heart is beating fast.

Oh no. Another foot submersion. I can't do it.
Appendix U

Self-Statements Worksheet for Cold Pressor II

The tendons in my foot are in complete discomfort.

Horrible pain.

How did I get into this?

The effect of my foot coming out of the ice water will be a strong burning, stinging sensation.

Acute stinging.

The pain effects my entire body, and ruins my concentration.

I'm locked into this chair. If I could only stand up.

Many tiny needles are sticking in my foot.

My foot is throbbing and burning.

I'm helpless in the face of this experience.

I'm losing my breath, and my foot is in agony.

I'm through the first one and now I remember how bad this can be despite my training. It's harder to control myself during the second one, or the third one.

A dull pain is in my foot and shooting through my body.

It's near the end, but I don't think I can keep my foot in any longer.

I can see how blood pressure rises when I panic and hurt and can't get away from this pain.

The immersion is about to start. I feel panicky already.

I'm angry at the experimenters for such a stupid test to do again.

That terrible pain has hit again. I can't control it.

My techniques aren't working. I still feel that pain.
This chills to the bone. It's frightful.
It's only ice water. But, I don't care what I say to myself. It's still painful.
I wonder if I will be able to keep my foot in for the entire time?
I can hardly move to take my blood pressure.
I wish I could take my foot out and dry it off.
I dread pulling my foot out because it hurt worse when the foot just comes out.
I've lost all my feeling in my foot. What's wrong now?
Appendix V

Troublesome Self-Statements that Raise Blood Pressure

If I don't do what my boyfriend or girlfriend wants me to do all the time, I will not have their approval all of the time.

If I ever disagree with a friend, they won't like me at all.

My car broke down. It should always run. If I'm late for class from this my professor will think I don't like the class.

If I did not look my best during football practice everyone will think I'm a lousy player.

I did not get the highest grade in the class. I should feel ashamed.

I did not do as well as I could have on the test. This proves I'm incompetent.

I must be outstanding in one important area to have any value as a person.

This test was unfair. It really bothers me when things are unfair.

My girlfriend or boyfriend was to meet me here, and they didn't show up. It shows they don't care.

I didn't have time to look my best at the party. People must think I'm ugly.

I worked really hard in completing this project and nobody noticed. My efforts are worthless.

I can never escape the mistakes of my past.

My dinner did not turn out as I hoped. It makes me feel bad.
Appendix W

Session Number Three Format

During this session you will continue to be introduced to cognitive strategies to control your blood pressure, and to formulate coping cognitions. You may find that some of the different methods presented are similar to each other, and that the cognition you worked with during one exercise might also be used during another exercise. Though this may indeed be the case, you want to try to be as imaginative as possible in formulating many different cognitions throughout the exercises. These exercises are in part a way to stimulate your creative processes by exposing you to a number of coping approaches. The purpose of training you in a number of different cognitive techniques is to enable you to have a choice of methods to use during the posttest. After you have been introduced to all the methods, you will be given time to select the strategies that you feel will work best for you. You will then be shown in later sessions how to combine these methods that you selected into an effective package for lowering your blood pressure under both the non-stress and stress (cold pressor) portions of the posttest.

On the following pages are programmed instructions for this session. These are directions about what cognitive therapy task you are to complete during each of the five
10 minute intervals that occur between the three blood pressure recordings on the tape. After you finish a set of three blood pressure recordings, you are to complete the exercises outlined for you in the Instruction Paragraphs. For example, after you take your first blood pressure readings, you will follow the directions under Instruction Paragraph I. After you take the second set of blood pressure readings, you will carry out the exercises indicated in Instruction Paragraph II, and so on. Any handouts or worksheets that you will need will be provided to you and paper clipped with your blood pressure recording sheets. If you finish all of the exercises that you are instructed to complete during a 10 minute interval before that period is up, go on to the Instruction Paragraph provided for you for the next 10 minute interval. However, if you do not complete all of the exercises that you are to carry out during a 10 minute interval stop working on these exercises at the end of that 10 minute period. Then when the next 10 minute period begins, follow the directions for the exercises that are provided in the Instruction Paragraph for that next 10 minute period. Alert the experimenters as they enter your therapy rooms at the end of the session if you have questions. The experimenters will read over all of your exercises, and provide you with further suggestions if they think that changes will make the cognitions more effective. The following paragraphs will provide you with
instructions for each of the five 10 minute periods between your blood pressure recordings.

Blood Pressure Recording #I
Instruction Paragraph #I

Now that you have completed the first three blood pressure readings, you are to work on formulating a list of ten of your own maladaptive self-statements that you experienced during the cold pressor test. The reaction sheet you filled out concerning your cold pressor experience will help you to recall some of the self-statements that you had at that time that contributed to your distress. Once a list of maladaptive self-statements is completed, create coping self-statements that you feel will help you to remain calm and at ease during future cold pressor experiences. When the experimenter enters the room, be sure to get him to read over your statements even if it is during one of the later 10 minute periods.

Blood Pressure Recording II (take as indicated on tape)
Instruction Paragraph II

During this ten minute period you are to work through the work sheet entitled, "Troublesome Self-Statements that Raise Blood Pressure". You are to create alternative self-statements to these maladaptive ones that you feel would lessen anxiety, and enhance coping. You may find that some of these self-statements are similar to some of your cognitions.
Blood Pressure Recording III (take as indicated on tape)

Instruction Paragraph III

During this period, you are to formulate a list of self-statements that you feel normally cause you anxiety, discomfort, or distress during your everyday life. You may recall that it was mentioned on the Introduction to Cognitive Therapy Tape that everybody undergoes daily blood pressure changes that are in part mediated by our cognitions. Recall the examples of the two public speakers (public speaking naturally raises blood pressure) who either thought their speeches would be received well (this speaker had minimal elevations) or poorly (this speaker had large elevations), the people who were afraid of heights that imagined that they were on a ledge (this elevated pressure), and the people who solved simple mental arithmetic problems (this also raised pressure). These examples can act as guides to help you pinpoint some of your cognitions triggered from events that contribute to your normal, daily blood pressure changes. In addition, the list of "Troublesome Self-Statements that Raise Blood Pressure" that you have worked on will also help you to decide what cognitions you have during a normal day that might elevate your blood pressure. After you make a list of 10 maladaptive self-statements, you will want to create alternative calming statements that will lower your blood pressure. Be sure to finish incompleted worksheets from
past sessions, if you have time left during this period.

Blood Pressure Recording IV (take as indicated on tape)
Instruction Paragraph IV

a) Read handout on **Imagery Approaches to Lowering Blood Pressure**. b) At this point after reading the handout, you should be able to review the three imagery approaches to control distress to yourself mentally. For the remaining time that you spend during this interval, you will make up two goal-directed fantasy imagery sequences. One sequence will be for you to use during the no-stress periods of the posttest. The other fantasy will be for you to use during the subsequent cold pressor experiences. To formulate these sequences you will want to write out two paragraphs. You can either use the fantasy of going on a vacation, or make up another fantasy if you prefer. Do not be inhibited. Remember as you create more elaborate, involved, and detailed imagery, the pain and distress tolerance will also be increased. The imagery that will work best under the stress and no-stress conditions for lowering blood pressure is the imagery that you feel will work best for you. This is a very individualized process, so be creative in making your fantasies.

Blood Pressure Recording V (take as indicated on tape)
Instruction Paragraph V

a) If you have not finished your two paragraphs from
part b of Instruction Paragraph IV, or want to add more to your paragraphs, take the time to do so here. Then carry out the directions that follow. b) During the remaining time in this 10 minute interval, you will try to recall the nature of the sensations that you felt during the cold pressor. You may want to use your cold pressor reaction sheets again to stimulate your memory for listing these sensations. Try to list as many as you can. After you have devised a list, you will want to describe how you would transform these images so that they will not cause you distress or discomfort. You will also want to formulate alternative contexts under which you might experience the sensations from the cold pressor, that would make these sensations pleasant ones. In this exercise you are making use of the transformation and change of context imagery techniques.
 Appendix X

Session Number Four Format

During this session you are to complete each of the exercises outlined for you in the instruction paragraphs that follow. Remember that if you finish all of the exercises that you are directed to complete during a 10 minute interval before that period is up, go on to the Instruction Paragraph provided for you for the next 10 minute interval. However, if you do not complete all of the exercises that you are to carry out during a 10 minute interval stop working on these exercises at the end of that 10 minute period. Then when the next 10 minute period begins, follow the directions for the exercises that are provided in the Instruction Paragraph for that next ten minute period. Alert the experimenters as they enter your therapy room at the end of the session whenever you have any questions. Now proceed with completing the instructions that are given to you during this fourth session.

Blood Pressure Recording #1 (take as indicated on tape)

Instruction Paragraph #1

During this first 10 minute period complete the exercises indicated from the last session in the notes attached to your paper clipped packet of handouts. If you have remaining time left, complete Exercise V from the last
session or complete any other incomplete exercises from the past session.

Blood Pressure Recording #11 (take as indicated on tape)

Instruction Paragraph #11

You have completed exercises concerning the use of several cognitive techniques that are used successfully for blood pressure control. At this point in your training, you will select those methods that you feel will work best for you to lower your blood pressure. You will choose one set of strategies for the cold pressor conditions, and another set of strategies for the non-stress conditions. During this session you will select those strategies and cognitions that you will use to control your reactions during the stress, or cold pressor conditions.

First the important thing to remember is that there are several strategies for you to use during the cold pressor. If the one you selected doesn't work next week, you will have others that you can use. During this ten minute interval, you are to devise a set of self-instructions to cope with the cold pressor. These self-instructions are a chain of adaptive self-statements that will provide you with guidance and support through the cold pressor experience. Self-instructions usually consist of statements to a) prepare for the cold pressor, b) confront and handle the cold pressor, c) cope with feelings at critical
moments, and d) reinforce adaptive or successful self-statements and coping efforts. The list of self-statements that follow are organized according to these four categories. The lists are made up of general self-statements which might be used to cope with any stressor (Meichenbaum, 1977).

Preparing for the Painful Stressor
What is it you have to do?
You can develop a plan to deal with it.
Just think about what you have to do.
You have developed a plan to deal with it.
Don't worry. Worrying won't help anything.
You have lots of different strategies you can call upon.

Confronting and Handling the Cold Pressor
You can meet the challenge.
One step at a time; you can handle the situation.
Don't think about the discomfort, just do what you have to do.
This tenseness can be an ally, a cue to cope well.
Remember, you are in control.
This anticipation is what the experimenter said you might feel.
That's right, it's a reminder to use your coping skills.

Coping with Feelings at Critical Moments
When pain comes just pause; do what you have to do.
What is it you have to do?
Don't try to eliminate the pain totally; just keep it under control.
Just remember, there are different strategies; they will help you stay in control.
When the pain mounts you can switch to a different strategy, you are in control.

Reinforcing Self-Statements
Good you did it.
You handled it pretty well.
You knew you could do it.

In making up a set of self-instructions for yourself you are to select statements from the list just presented, and from the self-statement worksheets that concerned the
cold pressor. You also have a list of your own self-statements that you experienced during the cold pressor. String together a number of alternative, coping statements, so that you have a number of self-statements you can use, if one is not working for you. Select at least five self-statements (preferably more if you find that more are appropriate for a given category) under each category. Do this for the remaining time during this period.

Record Blood Pressure #III (take as indicated on tape)

Instruction Paragraph #III

During this time interval you will review the other strategies that you have been exposed to that other people have found helpful for them in coping with the cold pressor. You will also be introduced to other very simple strategies. You will then want to create for yourself an overall game plan using these strategies, so that your next confrontation with the cold pressor will be a much more pleasant one. This will be a set of other strategies to cope with the ice water in addition to the self-instructions you have been formulating. Before you select what strategies you will use, we will review what methods you have available for you to choose from and will comment upon some of the other simple techniques that have not been thoroughly covered yet. First, you may select from three imagery techniques that include a) your goal directed
fantasy for stress or other single images that you make up that you feel will help you cope with the cold pressor, b) the use of transformation images in which one acknowledges the presence of the unpleasant sensations, but transforms or interprets them as something other than painful or minimizes the sensations so that they seem trivial or unreal, c) change of context images such as when you imagine you are lost in the desert, your skin is badly sunburnt, and you are very hot and thirsty, so that the experience of putting your foot in ice water becomes a very pleasant experience. In addition, you may also want to consider somantization and attention diversion techniques that both involve the use of distraction. In somantization methods, you focus on the existence of bodily processes and sensations so as to exclude your awareness of the sensations of the cold pressor. The attention diversion technique works by directing yourself to focus your awareness on other events or perceptions that are a part of your therapy room environment. If you choose to utilize either of these techniques make a list or at least give self-statements that specify on what you will focus your attention upon during the cold pressor whether it be bodily sensations or external features of your therapy room. No let's summarize what you are to do for the remainder of this session. The key task is to create an outline of all the types of strategies that you will want to use reviewed
in this Instruction Paragraph for the cold pressor. First write out headings for the types of strategies that you want to use. Then list under each heading (i.e., goal-directed fantasy; somantization method; transform images) the specific images, fantasies, or self-statements that you have created that will enable you to carry out the strategy. Write out this outline on the same page that you wrote out your self-instructions. If you choose to use your goal-directed fantasy, you already have one made. Just recopy it onto this other page with the self-instructions on it, and label it "goal-directed fantasy to cope with the cold pressor." If you choose transformation images or change of context images, again, label these as such and then list the images you feel will work. You may either use images that you have already created, images that have been provided to you by the experimenter, or new images that you want to create now. The more elaborate, involved and detailed you make the imagery, the greater the pain and distress tolerance will result. You want to select those images that seem real to you even though you will be just imagining them during the cold pressor. Finally, if you select to use distraction methods label these "distraction methods to cope with the cold pressor" and list the self-statements below this heading that will redirect your attention to other bodily sensations or to other features of your therapy room. Try to get as much
of this done during the rest of this ten minute period as possible.

Record Blood Pressure #IV (take as indicated on tape)

Instruction Paragraph #IV

During this interval it is important that you complete Exercises II and III. Spend the time during this ten minute period finalizing your two cognitive strategies for coping with the cold pressor. These will include a list of self-instructions (with 4 categories of self-statements) and an outline of imagery and/or distraction techniques.

Record Blood Pressure #V (take as indicated on tape)

Instruction Paragraph #V

Before you formulate your strategy for lowering blood pressure under the no-stress conditions, you will want to rehearse the methods you have put together for coping with the cold pressor. Rehearsal of cognitions is an essential part of learning how to lower your blood pressure. Rehearsal will enable you to automatically remember the cognitions that you have devised for both the stress and no-stress conditions. Rehearsal will be made easier by working with the other subject that is in the room with you. If the other subject is absent during this session, then the experimenters will make arrangements for another person to participate with you. Rehearsal will consist of the following steps: a) Spend several minutes silently
reading your self-instructions and outlines to yourself,
b) exchange your sheet with your partner and take your
partner's sheet, c) try to recall all the self-statements,
strategies, and images that you have written on your sheet
while your partner checks off each self-statement, image,
or strategy as you verbalize them. You don't have to
memorize the list exactly, nor do you need to get the order
of the self-statements correct. Instead, you simply want
to have the basic meaning of all the self-statements, and
major details of your images available to you in your
memory so that you can recall them at will in any order
that they come to you, d) after you have remembered all the
self-statements that you can, your partner will tell you
the ones you missed, e) rehearse these missed items
silently to yourself, or visualize the images that you could
not recall, e) then have your partner recall his or her
list. Provide him or her with feedback about the items
that he or she did not remember after he or she indicates
that he or she recalled all that they could, f) the
partner will then rehearse the ones they missed silently
to themselves. Repeat this rehearsal procedure if any time
remains during this ten minute interval.
Appendix Y

Session Number Five Format

Blood Pressure Recording #I (take as indicated on tape)
Instruction Paragraph #I

During the first ten minute period follow the instructions on the notes attached to your packet. If no further instructions are given in your notes, or you finish your instructions before the ten minute interval is over, then silently rehearse the strategies you have developed to control your responses during the cold pressor to yourself.

Blood Pressure Recording #II (take as indicated on tape)
Instruction Paragraph #II

During this time you will want to rehearse your coping strategies for the cold pressor that you have formulated. Follow the rehearsal format from Instructional Paragraph V of session number four in which you work with the other person in the room.

Blood Pressure Recording #III (take as indicated on tape)
Instruction Paragraph #III

At this time you will formulate your strategy for lowering your blood pressure under the no-stress conditions. During the posttest on Wednesday, you will have a total time period of 30 minutes of no-stress. These 30 minutes of no-stress will be divided up into six 5 minute time
intervals. There are several considerations to make in formulating your plan to lower your blood pressure. First like lowering your blood pressure under the stress conditions, you have several methods that you can choose from when you devise your plan. These include selecting calming self-statements that counteract your maladaptive cognitions that cause you to elevate your blood pressure (either from the Troublesome Self-Statement Worksheet or your list of your own maladaptive self-statements), your goal-directed fantasies (or others you may want to create) and the selection of any images that you feel will help you to lower your blood pressure. Second, you will want to formulate some different strategies for each of the six 5 minute periods, even though you may want to repeat one strategy over again across the no-stress time intervals. For example, during the two 5 minute periods that occur before the cold pressor, you may want to make use of your "preparing for the cold pressor self-statements" in addition to other images or fantasies you have selected to calm yourself during the no-stress period. Also, when formulating images for the no-stress period, you may want to create a number of different images for each of the 5 minute periods. In this way, if you get tired of using one image, you will have others in which you can engage your thoughts upon. At this point outline the strategies you plan to use during each of the six 5 minute periods of no stress.
Appendix Y—Continued

Place in front of you a) your lists of your own self-statements about your daily life, b) your Troublesome Self-Statements Worksheet, c) your goal-directed fantasy for the non-stress condition, d) any list of images you have formulated that you may want to make use of to lower your blood pressure, e) your self-statements for "preparing for the cold pressor." Next, select those strategies that you plan to use during each of these six 5 minute periods. Label the methods that you choose to use for each 5 minute time interval (for example, Interval 1, Interval 2, and so forth so that you have six plans).

Record Blood Pressure #IV (take as indicated on tape)
Instruction Paragraph #IV

During this time you will continue to work on completing the last exercise. Then start to rehearse these strategies by yourself. If you and your partner both finish before the end of this interval, begin to rehearse your strategies as you did in the last session following the format of Instruction Paragraph V of session #4.

Record Blood Pressure #V (take as indicated on tape)
Instruction Paragraph #V

Rehearse your non-stress strategy with your partner according to the usual format that was established last session. Once you have completed this, you will be ready to lower your blood pressure with these cognitive methods
during the stress and no-stress conditions of the posttest on Wednesday. Be sure that you have all your strategies well memorized so that you can use them at this time. The important thing to know is that there are several strategies to handle these situations. If the one you are using does not seem to be working for you, remember that this is not the only one you have. Be sure to tell yourself once and a while that you are doing well. Thank you for all your efforts and cooperation throughout the course of the study.
Appendix Z

Imagery Approaches to Lowering Blood Pressure

This handout will familiarize you with the major imagery approaches that have been successfully used to control the pain, discomfort, or distress that people experience during the cold pressor, or during painful illnesses. There are three basic imagery approaches that will be discussed and these include: a) goal-directed fantasy, b) transformation and, c) change of context images.

Goal-directed fantasies are composed of images that one creates and imagines which if real, would be incompatible with the experience of pain or distress. Two examples of goal-directed fantasies include developing a paragraph about traveling on one's ideal vacation with one of their favorite people or lying comfortably on a beautiful beach in the blazing hot sun. When confronted with a stressful event, or when one wants to shut off the usual self-statements that raise blood pressure, one would start to image one's goal-directed fantasy. In addition, one can create isolated images which are calming such as a pleasant visual scene, a mantra such as those used in transcendental meditation, or spiritual images that are part of religious symbologies. These images tend to distract a person from the discomfort or stress one confronts, or displace the usual cognitions that elevate blood pressure.
The more elaborate, involved, and detailed the imagery, the greater the pain and distress tolerance that results. You will want to create fantasies and images that seem real to you even though you are merely imagining them.

When using transformation images one acknowledges the presence of noxious sensations, but transforms or interprets them as something other than painful or uncomfortable (i.e., it's just cold instead of painful) and that minimizes the sensations so that they seem trivial or unreal. The use of change of context images is similar to that of the use of transformation images. In change of context images, the context in which the aversive stimuli is experienced is changed rather than the aversive stimuli itself. For example, the cold pressor is an unpleasant experience in the context of being a subject in an experiment to gain extra credit, or to satisfy one's curiosity. The cold pressor is usually thought of as a discomfort that is not desirable to experience in one's normal life in Denton. But, if one were to imagine that they were lost in a desert which was hot, and in which their skin was badly sunburnt, and they were very hot, sweaty, and thirsty, then the experience of putting their foot in ice water would be a very pleasant, desirable experience. You may think of other contexts in which putting one's foot in ice water was a pleasant experience.
Now that you have read this handout carefully, continue to follow the exercises outlined for you in the Instruction Paragraph III.
Appendix AA

Write a paragraph that describes as accurately as possible what you experienced while your foot was in the ice water. Include an account of the sensations in your foot, any thoughts that you might have had, and what emotions you experienced. Please be as honest and as thorough as you can.

Please describe any strategies, or methods that you may have used to help you cope with the ice water submersion experience.

Report any other adjectives that you would like to use to describe the cold pressor experience that may have not been included in the pretest data forms.

Please write about any other comments you would like to make about your experience with your foot in the ice water.
Appendix BB

Posttest Questionnaire

1. To what extent did you follow your instructions for lowering your blood pressure?

<table>
<thead>
<tr>
<th>not at all</th>
<th>somewhat</th>
<th>completely</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

2. How involved personally do you think that you were in performing biofeedback during the posttest?

<table>
<thead>
<tr>
<th>not at all</th>
<th>somewhat</th>
<th>involved</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
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</table>

3. If part of the cognitive group, how clearly were you able to remember your self-statements, fantasies, and images during the posttest?

<table>
<thead>
<tr>
<th>not at all</th>
<th>somewhat</th>
<th>clearly</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
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</table>

4. If part of the biofeedback group, do you think your efforts to lower your blood pressure during the posttest were as strong as your efforts during the training period?

<table>
<thead>
<tr>
<th>not as strong</th>
<th>just as strong</th>
<th>stronger</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
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</table>

5. If part of the cognitive group, while your foot was in the ice water, what percentage of the time were you able to use your cognitive techniques?

<table>
<thead>
<tr>
<th>0%</th>
<th>50%</th>
<th>100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
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</table>

6. If part of the biofeedback group, while your foot was in the ice water, do you think that the biofeedback helped you to control your responses during the immersion?

<table>
<thead>
<tr>
<th>not at all</th>
<th>somewhat</th>
<th>much so</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
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