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A PSYCHOLOGICAL EXAMINATION OF LEARNING VOLUNTARILY TO CONTROL ESSENTIAL HYPERTENSION

by

Jonathan Cohen

A dissertation submitted to the Graduate Faculty
in Psychology in partial fulfillment of the requirements
for the degree of Doctor of Philosophy,
The City University of New York

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Abstract

A PSYCHOLOGICAL EXAMINATION OF LEARNING
VOLUNTARILY TO CONTROL ESSENTIAL HYPERTENSION

by

Jonathan Cohen

Adviser: Paul Wachtel, Ph.D.

The present controlled outcome study sought to examine the following two questions: (1) Can essential hypertensive adults learn to voluntarily regulate blood pressure and maintain reductions after the initial treatment program?, and (2) What happens to various psychological processes, like attention and perception, as individuals learn or fail to learn to voluntarily regulate physiological states that are usually involuntary and unconscious? Thirty essential hypertensive adults were randomly placed in one of the following three groups: (a) an intensive ten week biofeedback/self-regulation treatment program that involved biofeedback (EMG and peripheral temperature), a variety of cognitive strategies and contact with a psychotherapist; (b) a ten week "Relaxation Response" treatment program (modeled on Benson's work) and contact with a psychotherapist; and (c) a Waiting List Control Group. The pre/post treatment results support the notion that hypertensive adults can learn to significantly reduce high blood pressure at the end of the treatment, and at a four month follow-up point. These clinically and statistically

significant reductions in blood pressure were seen in the "biofeedback/self-regulation" treatment, and contrast the lack of blood pressure changes in the other two groups. The group that was able to reduce blood pressure (the biofeedback/self-regulation treatment group) also became significantly more field independent; more able to become absorpted; and more able to deploy attention. In addition, this group became significantly more sensitive in their right hand. Although the Relaxation Response Group did become more field independent on one of the three field independent measures, no other significant pre/post psychological changes were evident in the Relaxation Response or Control Groups. The results support the notion that as individuals learn to regulate autonomic processes, concomitant psychological processes--like attention and perception--become restructured. A post hoc assessment of the fear to be alone (or awareness of one's separateness) was able to significantly differentiate successful versus unsuccessful learners in the two treatment groups. These results are discussed in terms of biological, interpersonal and intrapsychic factors. A psychological (with particular reference to object relations) theory of the voluntary controls of internal states is proposed.

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CHAPTER 1

INTRODUCTION

It seems widely believed that biological feedback and various self-regulation procedures (e.g., meditation, self-hypnosis, autogenic training, visualizations) represent successful methods of learning how to relax and voluntarily regulate autonomic nervous system processes. Prior to 1960 it was generally thought that the autonomic nervous system could not be voluntarily regulated. However, with the development of biofeedback and a variety of cognitive procedures it was demonstrated, clinically, and in a number of small experimental studies, that a wide variety of autonomic processes can be voluntarily controlled (see Schwartz, 1975, for review).

In recent years, however, scientists have begun to question how useful biofeedback and related self-regulation procedures really are in enabling people to regulate autonomic processes. This is partly due to the fact that as in any new field, the study of biofeedback was initially marked by many small scale studies. There were few controlled outcome studies. These limitations have hampered our understanding of how this learning occurs.

Nonetheless, preliminary small scale studies in several areas of autonomic self-regulation (e.g., essential hypertension, epilepsy, Raynaud's disease) have been quite encouraging and hence do seem to justify large, phase II scale or controlled outcome trials. The present controlled outcome study will examine whether essential hyper-

tensive adults can learn to voluntarily regulate their high blood pressure and will furthermore attempt to describe what occurs psychologically as these patients learn, or fail to learn, autonomic self-regulation skills. As will be described below, most of the clinical studies examining self-regulation procedures and essential hypertension have been phase I type studies--that is, studies where individuals receive a given treatment to determine its basic physiological effects. Phase II type studies--where controlled comparisons of a given treatment to placebo or other agents in small groups of patients--have been very small in number. The present study will be one of the first controlled outcome studies in the area of essential hypertension. In the last year, since the inception of the present study, several controlled outcome studies have appeared in the literature, as will be described below.

The second primary task of this research will be to study the role of attentional, perceptual and affective factors in this learning process. Further understanding of what occurs psychologically during this learning process may shed light on mind-body relationships in general and more specifically, on how some patients are able (or unable) to relax and voluntarily control internal states. In addition, a description of psychological changes that occur concomitant to physiological changes will enable more sophisticated hypotheses to be generated in our search to understand the nature of autonomic learning.

CHAPTER II

THE VOLUNTARY CONTROL OF ESSENTIAL HYPERTENSION

It has been estimated that 15 percent of the American population suffers from hypertension--chronically elevated arterial blood pressure accompanied by increased risk of coronary artery disease, atherosclerosis, and cardiovascular accidents. Between 90 and 95 percent of hypertension cases are labeled "essential," which means that they have no demonstrable biological cause (Weiner, 1977), nor are they cases of hypertension secondary to renal or endocrine disturbance. There is evidence that essential hypertension is related to various behavioral, social and environmental conditions (Gutmann & Benson, 1971). The high rate of incidence of this potentially dangerous "psychosomatic" syndrome has provided the incentive for researchers to devote considerable effort to develop self-regulation procedures for blood pressure.

A number of behavioral and psychophysiological techniques have been reported to reduce the blood pressure of hypertensive patients, sometimes to an impressive degree. These procedures include a variety of biofeedback modalities (electromyographic or EMG, peripheral temperature, blood pressure), meditation, relaxation training and hypnosis, either alone or in combination.

Biological Feedback

Benson and his co-workers in the first report of the use of

blood pressure feedback in a study of essential hypertension found clinically significant decreases in blood pressure in five out of seven outpatients treated with systolic blood pressure feedback (Benson et al., 1971). In other studies of systolic blood pressure feedback, researchers found significant decreases in blood pressure between and during laboratory sessions in outpatients undergoing nine weekly training sessions (Goldman et al., 1975; Kleinman et al., 1977). Kristt and Engel (1975) were able to teach four out of five hospitalized patients to both raise and lower systolic pressure during three weeks of training. In a recent study both systolic pressure feedback and meditation-relaxation procedures were found to reduce blood pressure statistically but not to a clinically significant level (Hager & Surwit, 1978).

In studies with diastolic blood pressure feedback, Miller (1972) reported the reduction of diastolic blood pressure from 97 to 77 mmHg in an intensively treated patient with a cerebrovascular accident. Interestingly, Elder and his co-workers significantly reduced diastolic but not systolic blood pressure in intensively treated hospitalized hypertensives, but were unable to achieve comparable results with outpatients (Elder et al., 1973; Elder & Eustis, 1975). Schwartz and Shapiro (1973) found no reduction in diastolic blood pressure in six of seven outpatients. Recently a study revealed no significant decreases

in blood pressure in any group when they compared the anti-hypertensive effect of combined heart rate and systolic blood pressure feedback with those of electromyographic (EMG) feedback or a meditation-relaxation procedure (Surwit & Shapiro, 1976). More recently, Frankel and his co-workers (1978) also found no significant differences in blood pressure reduction between a diastolic blood pressure feedback/relaxation group and the sham blood pressure feedback and no treatment groups. In another recent controlled study systolic blood pressure and heart rate biofeedback was compared to neuromuscular biofeedback and a third meditation group. Although all groups showed moderate reduction in blood pressure after the six treatment sessions, no technique could be seen to produce a reduction in pressure greater than that observed in the baseline sessions (Surwit et al., 1978).

Studies with other forms of biofeedback (e.g., EMG, thermal and/or GSR) have yielded clinical results that are more impressive than blood pressure feedback. Patel (1973) reported that out of 20 hypertensive patients who were treated with biofeedback (EMG and GSR) and yoga exercises, five patients ceased to need anti-hypertensive medication altogether and seven others reduced their needs for medication by 33-60 percent. The average blood pressure reduction was 20 mmHg. In one of the first control follow-up studies, Patel and North (1975) reported that a

yoga relaxation/biofeedback (GSR and EMG) group (N = 17) reduced blood pressure (average reduction equals 20/40) and 12 of these patients lowered their need for anti-hypertensive medication by 40 percent. The placebo therapy group (N = 17) did not significantly reduce blood pressure levels or need for medication. These changes persisted over a twelve month period. In a small, non-controlled clinical study Sedlacek (1976) found that relaxation procedures used in conjunction with biofeedback (either GSR and EMG or EMG and peripheral temperature feedback) yielded impressive blood pressure reductions comparable to those reported by Patel. A more recent clinical pilot study utilizing EMG and thermal biofeedback in conjunction with a variety of cognitive and somatic procedures (e.g., visualizations, autogenic training, progressive relaxation) also resulted in impressive clinical blood pressure reductions similar to Patel's findings (Sedlacek & Cohen, 1978).

These results indicate that biofeedback may be a useful tool in helping essential hypertensive patients to lower blood pressure. However, most of these studies (Patel & North, Frankel et al., and Surwit's work being the outstanding exceptions) have lacked control procedures or other methodological features (e.g., baseline measures, follow-up evaluation) that would permit firm conclusions to be drawn about the effectiveness of this method of treatment. The present research investigation of the effect of biological feedback and other self-regulation procedures will

include methodological features designed to enable more firm conclusions to be drawn.

Meditation-Relaxation

Under the general rubric of meditation and relaxation procedures fall a wide and diverse group of ancient and modern religious and secular practices. These may be considered self-induced, non-pharmacological, altered states of consciousness. They include transcendental meditation, the Relaxation Response, various forms of yoga, progressive muscle relaxation, hypnosis and autogenic training. All of these have been used either recently or in the past to control blood pressure (see Benson, 1974, for review). In Benson's review it is stated that there are four basic elements that are common to many of these relaxation-meditation procedures: a) constantly repeating a stimulus (sound, phrase, fixed gaze at an object), which produces a "shift from logical, rationally oriented thought"; b) a passive attitude; c) decreased muscle tone; and d) a quiet environment usually with the eyes closed. Benson feels that trained instructors increase the efficiacy with which the various methods are learned.

Benson fails to mention that there is another major school of meditation-relaxation which importantly differs with the four-fold schema described above. Although many meditation-relaxation strategies are characterized by a focused attention or concentrative stance (e.g., constantly repeating a given stimuli), and do

require a passive attitude, other forms of meditation are characterized by a broad attentional stance (not unlike "free-floating attention") and an active and/or receptive attitude toward one's experience. Thus, these various attentional stances and concomitant attitudes toward one's experience result in a large number of permutations and yield many related "types" of meditation-relaxation procedures (see Goleman, 1972, and Davidson & Schwartz, 1976, for review).

In any case, all of the meditation and relaxation methods that have been used in the treatment of essential hypertension seek to elicit calmness and a hypometabolic state called the trophotropic response by Hess (1957). The trophotropic response (which is akin to what Benson calls "the relaxation response") is associated with decreased sympathetic arousal and heightened activity in the supra-optic and pre-optic areas of the anterior hypothalamus (Benson, 1975). This integrated state of lowered sympathetic activity might be expected to lower blood pressure since essential hypertensive patients show a hyperactive depressor response to stimuli and the sympathetic nervous system is the major mediator of this response (Abboud, 1974; Shapiro, 1961).

As mentioned above, there are several relaxation methods that have been proposed for the treatment of hypertension.

1. Transcendental meditation: a cognitive technique derived from Vedic practices in which individuals assume a comfort-

able position, breathe peacefully, close the eyes and repeat a "mantra" (a Sanskrit word or sound) as each breath is exhaled (Benson & Wallace, 1972; Wallace, 1970; Pollack et al., 1977).

2. The Relaxation Response: a simplified and standardized meditative technique developed by Benson and his co-workers (Benson, 1975) based on transcendental meditation and Zen and specifically directed to relaxation but more tailored to the Western culture.

3. Zen meditation: methods of meditation involving passive concentration on respiration and logical exercises (koans) to elicit the relaxation response (Fisher, 1971; Maupin, 1969).

4. Hatha yoga: relaxation is elicited through bodily postures and exercises (asanas), breath control (paranayana), and meditation (dhyana) (Hoenig, 1968).

5. Progressive relaxation (Jacobsonian): a technique directed at relaxation of major skeletal muscle groups, that involves actual tensing and then letting go of muscle groups (Jacobson, 1938; 1967).

6. Autogenic training: standard "autosuggestive" exercises (e.g., patients say to themselves "my right arm is warm and heavy") for inducing altered physiologic and mental states (Luthe, 1969).

7. Hypnotic relaxation: hypnosis and post-hypnotic suggestion to induce physiologic and mental relaxation (Dearbler et al.,

1973).

Studies using these meditative and relaxation procedures have involved small numbers of subjects and have not always differentiated between patients receiving or not receiving hypotensive medication. Controls have been sparse. The decrements in blood pressure vary by method and by degree of blood pressure elevation at the time of training. Large blood pressure decreases are often observed in patients with higher baseline pressures (Jacob et al., 1977). Reported reductions in pressure have a wide range, from 7/4 mmHg to 37/22 mmHg (see Shapiro, 1977, for review). Virtually all investigators except Pollack et al. (1977) reported degrees of encouraging results. The most impressive and one of the few controlled outcome studies has been Patel and North's work (1975) mentioned above which combined yogic procedures with biofeedback (EMG and GSR). Although Benson and his co-workers have carried out an extensive series of clinical experiments utilizing his "Relaxation Response" method, they lacked control procedures or other methodological features that would permit firm conclusions to be drawn about the effectiveness of this method of treatment. This statement also characterizes most of the studies in this area with the exception of Patel and North (1975) and Hager and Surwit (1978), studies which, interestingly, report clinically impressive and insignificant results, respectively.

Psychotherapy, and the Placebo Effect

Although it is beyond the scope of this thesis to describe all of the non-pharmacological approaches to blood pressure reduction, it is important to note that there are many; dietary reduction, physical exercise, psychotherapy, placebo and suggestion factors, and environmental modification (see Shapiro et al., 1977, for review). However, psychotherapy and so-called placebo factors are often unspoken or at least unpublished variables in most (if not all) biofeedback and relaxation treatment programs for essential hypertensive adults. Hence, a brief review of psychotherapy and then the placebo effect as methods of blood pressure control are in order.

Because anxiety raises blood pressure it is thought that its relief by psychotherapy should lower blood pressure. Verbal psychotherapy as a method of lowering blood pressure is derived from a second concept as well. Insofar as the hypertensive individual may not be able to cope with aggressive and hostile impulses, psychoanalytically oriented therapy may lead to resolution of such problems and thus to blood pressure improvement. Before the development of current pharmacologic agents, long term psychotherapy studies revealed declines in blood pressure of up to 20-40/10-30 mmHg (Reisner et al., 1951; Moses et al., 1956). Supportive therapy is always indicated, especially when drugs are used because it augments compliance. Subsequent studies indicate that any successful provider-patient relationship can provide this basic support. Psychoanalytic-

ally oriented psychotherapy is a useful way for some people to lower blood pressure, but it is highly selective and the patient's suitability and psychological needs, independent of hypertension, determine its use. Furthermore, its expense and time demands make it a limited mode of treatment for hypertension. It is also important to note that psychotherapy has not proceeded beyond phase I type studies. There are no control trials or planned comparisons with other methods (see Reisner et al., 1951; Davies, 1971; and Gutmann & Benson, 1971, for reviews).

Placebo effects are not treatment modalities per se but can interact and confound the results achieved by specific therapies, pharmacologic, and non-pharmacologic. The placebo has been defined as any therapy (or component of therapy) that is used for its non-specific psychologic or physiologic effect, but which has no specific pharmacologic effect on the condition being treated (Shapiro, 1968). Placebo effects are variable and not always reproducable. Placebo factors fall within one of three general categories (Shapiro, 1971; Liberman, 1962): a) situational variables--location and form of treatment; interactions with staff and family; content and meaning of instruction and suggestions; b) patient variables--attitudes toward doctor, the treatment and the illness; levels of anxiety and expectations, education and past experience with illness; c) doctor variables--credibility, enthusiasm, authority, empathy and sympathy.

A current review of the placebo effect reveals that attempts to identify a "placebo reactive" personality have failed (Shapiro,

1971). Interestingly, placebo effects may adversely as well as supportively effect the course of a given treatment.

In most studies of the placebo effect, blood pressure changes have reportedly been in the same range of magnitude as those described with procedures discussed above (about 5 to 25 mmHg, systolic or diastolic). For instance, in one study, 31 outpatients were given intensive reassurance combined with "a therapeutic electron gun" therapy. Blood pressure fell an average of 20/14 mmHg. Although the effect lasted only several weeks and a precise experimental design was lacking, this data is relevant to biofeedback, relaxation and psychotherapy studies.

Placebo influences represent a hodgepodge of psychological, social and environmental factors that we do not fully understand. These factors effect blood pressure levels of hypertensive patients. A growing understanding of these factors may help to clarify how visceral learning occurs. To further this aim, we will shortly turn to the role of psychological processes in the voluntary control of internal states.

Summary

In summary, this brief review of the non-pharmacologic management of hypertension reveals an interesting paradox: diverse methods and a similarity of results. All methods seem to produce modest --although often statistically significant--declines in blood pressure. The declines reportedly are up to 22/14 mmHg for biofeedback, 8/6 to 37/22 mmHg for relaxation-meditation, 20/10 to 40/20 mmHg

for psychotherapy, and 20/14 mmHg for placebo factors. However, any apparent differences of effects among the different approaches cannot be assessed because of the paucity of phase II trials. Moreover, the fact that baseline blood pressure levels and follow-up evaluations as well as severity of illness and duration of disease are often unreported, further compounds the difficulty of understanding these results.

Although the above-mentioned methods are diverse, as Shapiro and his co-workers point out (1977), there is a common theme that marks them all and therein lies a resolution to the aforementioned paradox. Essential hypertension is a disorder of blood pressure regulation with multiple mechanisms and causes, pressor and depressor effects (Weiner, 1977). The autonomic nervous system is a major mediator of this responsiveness, both peripherally and centrally, although the Renin-angiotensis system, adrenocortical and medullary secretions, and vasodepressor humoral materials from the kidney and other sites all play various mediating and moderating roles. These mechanisms are all to some extent under the central nervous system (CNS) control. The CNS is subject to influence from environmental stimuli that is filled through the individual's perception of his experience (Schwartz, 1974). To the extent that the various non-pharmacological treatments counteract pressor stimuli, operating through these various mechanisms, particularly the autonomic nervous system, blood pressure will be lowered and this may be why the apparently different types of treatment pro-

duce essentially similar results. In brief, they all tend to ameliorate the psychological stress factor, thereby lowering blood pressure.

Whether these methods can do more than ameliorate is still an open question. The lack of controlled studies and follow-up evaluation make it difficult to know whether autonomic learning can be assimilated and integrated into the daily lives of patients. One of the contributions of this thesis is that it will be a controlled outcome and follow-up study of two of the reportedly most successful non-pharmacological approaches to blood pressure self-regulation: 1) biofeedback (EMG and thermal) used in conjunction with a variety of relaxation/self-regulation strategies and 2) Benson's Relaxation Response treatment program (Benson, 1975).

CHAPTER III

PSYCHOLOGICAL FACTORS, HYPERTENSION AND THE VOLUNTARY CONTROL OF INTERNAL STATES

As evidence accumulates that essential hypertensive adults can learn to regulate their blood pressure there has been increasing interest in how this occurs physiologically and psychologically. In fact, many of the recent review articles and editorials conclude with a call for more attention to be paid to what the mechanisms are that allow and/or determine autonomic learning (Henry, 1978; Jacob et al., 1977; Shapiro et al., 1977). What follows are brief reviews of the relationship of psychological factors in 1) essential hypertension; 2) the voluntary control of internal states in general; and 3) the voluntary control of hypertension in particular.

The Psychology of Essential Hypertension

While there is general agreement that psychological factors play a significant role in the etiology of essential hypertension, there remains considerable controversy as to their precise nature (see Weiner, 1977; McGuinn et al., 1964; Cochrane, 1971). An analysis of this literature suggests the association of numerous specific personality factors with essential hypertension. The particular facets of personality chosen for study at a given time seem to parallel the conceptual trends in vogue at that time in psychology.

For example, the authors of the early studies of patients with essential hypertension tended to focus on the psychological conflicts of their patient. They concluded that patients with essential hypertension have lifelong and largely unconscious conflicts about the expression of hostility, aggression, resentment, rage, rebellion, ambition or dependency (see Weiner, 1977, for review). The psychological mechanisms used to defend against the emergence of these conflicts led to certain characteristic personality traits; e.g., many patients covered up their anger by outer friendliness or by exercising self-control (Alexander, 1939; 1950). Psychological studies using well standardized objective tests are rare up to this day. Although attempts to isolate specific intrapsychic characteristics of all hypertensive patients seem unlikely to be successful, there have been a number of interesting relationships identified between psychological factors and cardiovascular functioning.

The cardiovascular system is extremely sensitive to our psychological state. Common experience (supported by empirical evidence) indicates that cognitive processes and/or emotion can elicit changes in the cardiovascular system. For example, fear produces an increase in heart rate as does the cognitive task of asking a person to quickly multiply 38 by 547. It has been suggested that in fact the cardiovascular system may be more sensitive to cognitive tasks and emotions than other physiological systems (Elliot,

1974). From another perspective it is important to note that prolonged high blood pressure occurs coincidentally with indices of impaired cognitive and cerebral functions (Jenkins et al., 1974; Goldman et al., 1974; Reitan, 1954; Wilkie & Eisdorfer, 1971).

The Psychology of the Voluntary Control of Internal States

There has been surprisingly little work done systematically relating various psychological factors to the process of voluntarily controlling internal states. The patient's experience of the doctor (provider), however, is one of the facets of psychological life that has been noted by many clinicians in this area (Shapiro et al., 1977; McGrady et al., 1977) as powerfully affecting the visceral learning process. For example, Paul and Trimble (1970) found that people were significantly more able to relax and inhibit stress responses with the therapist present than with taped instructions alone.

Specific thoughts can act as potential stimuli of autonomic responses (Schwartz, 1971). Although numerous investigators have commented on how ideation affects learning, Meichenbaum (1977) has developed these ideas most extensively in the area of autonomic self-regulation. He has described how patients' thoughts affect stress reactions and has developed clinical "stress inoculation" training programs designed to foster autonomic self-regulation abilities. Carlson (1977) and other investigators have also demonstrated that

beliefs about locus of control (e.g., that one is or is not fundamentally in control of one's own actions) can have a significant effect on one's capacity to relax and voluntarily regulate autonomic processes.

The role of emotions has also been commented on by many clinicians and researchers but there has been very little research done in this important area. However, in a small scale study Kappes and Michaud (1978) found that learning to control internal processes tends to decrease test anxiety. In another recent study Braud (1978) found that hypertensive children who practice progressive relaxation and EMG, biofeedback, became less aggressive, explosive, impulsive and irritable. Interestingly, nonhypertensive children in the study improved on the Digit Span and Coding subtests of the Wechsler Intelligence Scale for Children (WISC), as well as the Bender Gestalt and Visual Sequential Memory Test of the ITPA. This is one of the only investigations that has systematically examined the affect of autonomic self-regulation practice on psychological (as opposed to physiological) processes.

Attention plays a central role in all learning. As early as 1890, William James contended that attentional processes are at the very core of self-control phenomena. From the beginning of autonomic self-regulation research until the present, clinicians and researchers alike have noted that attention is an active if not fundamental part of the learning process (Bair, 1901; Mulholland & Runnals, 1963;

Green, Green & Walters, 1970; Meichenbaum, 1976; Pribram, 1976; Jacob et al., 1977). However, there has been surprisingly little systematic research on, or thought given to, the relationship of attention to autonomic self-regulation. Of notable exception is the work of Davidson and Schwartz (1976) in which they define relaxation techniques in terms of the locus (either cognitive or somatic) of attention and the active versus passive demands of the technique. Also, significant recent work by Brown (1977) and Davidson and Goleman (1977) underscore the importance of attention in meditation, hypnosis, and so-called altered states in general. One of the few actual studies that have examined the effects of relaxation procedures on attention is Braud's (1978) work, in which he found that seven out of ten children who learned to practice progressive relaxation and EMG feedback increased Digit Span scores--a measure of attention--after six weeks of relaxation/self-regulation training.

Although clinically we teach and then support the patient in developing an array of attentional strategies so that he may become aware of internal sensations and relationships, we have not sufficiently distinguished what it is that we teach. Learning to voluntarily control internal states may involve learning to voluntarily deploy attention in a variety of ways. Attention deployment refers to how we consciously and willfully focus mental energy on one object or one component of a complex experience (Rapaport, Gill & Schafer, 1968; Schwartz & Schiller, 1970). This attentional process has been likened to a beam of light (Wachtel, 1967; Hernandez-Peon, 1964), in

that it has the capacity of being very narrow or focused on one spot, or it may expand and become very broad, illuminating a wide area. Cognitive or ego activity interacts with a focused-expansive dimension of attention deployment. Cognitive activity or receptivity is akin to the arm that holds the light; it may actively point the light to one spot and then the next, or it may become receptive and let the light fall where it may. Some of the clinically critical issues of what the forces are that motivate and control the "movement of the arm" might be understood by examining the relationship of emotions to the voluntary control of internal states. One of the major questions that the present research will examine is how various aspects of attentional functioning are affected as people learn or fail to learn to voluntarily control essential hypertension.

Clinically, the effects of various modes of attention deployment are closely related to the quality of sustained interest or absorption in what we are attending to. The quality of absorption relates to the emotions and strivings that are mobilized when we deploy attention. Although there has been no autonomic self-regulation research in this area one may speculate that individuals who have a high degree of ability to become absorbed (e.g., who tend to get lost in an activity, who can tune out the environment because of their deep absorption) will be more able to deploy attention internally in the service of relaxation and self-regulation. Those individuals who have a low ability to become absorbed will tend to have more difficulty disembedding particular internal sensations from

the stream of internal "noise" (e.g., imagery, thoughts, affects, and sensations) and regulating autonomic states. Although the capacity to become absorbed may interact with perceptual disembedding abilities, these two attentionally related operations are independent factors (Sacks & Rice, 1974; Blowers, 1976).

Another important area of psychological study is the relationship between perceptual style and autonomic self-regulation. As will be mentioned below, several investigators have examined the relationship between autonomic self-regulation and field articulation or the degree to which appropriate information is selected for the solution of the problem. In other words, field articulation refers to how able we are to select and disembed the figure from the ground.

It has been demonstrated in a multitude of laboratories over the last three decades that each person has a characteristic style of perceptual functioning (see Witkin et al., 1962, for review). This perceptual style seems to reflect the individual's ability to distinguish and select the figure from the ground, or to "keep things separate in experience." Individuals who are very field dependent tend to utilize external cues and have difficulty disembedding or "keeping things separate in experience." At the other end of the continuum, individuals who are field independent tend to utilize external cues to a lesser extent, and are more skilled at "keeping things separate in experience." This ability to disembed the figure from the ground or level the field dependence seems to reflect a relatively stable cognitive dimension.

Hein and his co-workers (1966) found that subjects' level of field dependence significantly predicted their differing cardiac conditioning experiences. Tutone (1974) found that one's capacity to disembed the figure from the ground was highly correlated (R = .72) with capacity to voluntarily control EEG and alpha rhythms.

It may be that this cognitive ability is utilized in autonomic self-regulation learning. As self-regulation training fundamentally involves the disembedding and discriminating of appropriate sensory cues (the figure) from a vast internal field of sensations, images, feelings and thoughts (the ground), operationally this learning process utilizes a cognitive disembedding ability. The significance of emerging biological feedback technology is that it may assist and thus tend to accelerate this perceptual selection and identification of appropriate sensory cues. One may speculate that if self-regulation training utilizes this cognitive capacity successful learning will result in an increased capacity in the cognitive areas that have been utilized.

Although it will be beyond the scope of this study, one may speculate that individuals who have a high capacity to discriminate and disembed before autonomic self-regulation training might tend to be more successful in autonomic learning tasks than those subjects who are more field dependent initially. Research on brief sensory deprivation tends to confirm the notion that individuals who are field independent will have significantly greater ability to discriminate sensory cues (Silverman et al., 1963; Cohen et al., 1962).

In these studies it was found that field dependent individuals remained more aroused, had more intense psychological discomfort and greater discomfort with bodily sensations, in brief (two hour) sensory deprivation situations. The ability to discriminate sensory processes may be hampered by all of these factors. Although self-regulation training does not constitute a sensory deprivation situation, it does entail a radical sensory input reduction. In fact, the actual practice of becoming deeply relaxed in a dimly lit, closed space, often approaches a very brief, sensory deprivation situation with the important exception of auditory (or at times, visual) biological feedback and/or the frequently hypnotic-like voice of the therapist.

As self-regulation training utilizes the ability to distinguish sensory cues, I will hypothesize that successful practice will reflect itself in an increased capacity to select and distinguish perceptual cues. In other words, successful self-regulation abilities will result in increased field independence. This phenomenon would be significant because perceptual styles have been shown to be remarkably stable cognitive indices (Witkin, Goodenough & Karp, 1967; Schwartz & Karp, 1967; Schimek, 1968). However, recent research in related attentional practices suggest that the level of field articulation may be significantly increased when individuals meditate (Pelletier, 1974; Linden, 1973), or practice guided affective imagery (Cohen & Twemlow, 1979) and interestingly in sensory deprivation (Kirie & Mordkoff, 1970; Jacobson, 1966). Like self-regulation train-

ing, all of these practices or procedures intentionally (as in meditation and guided imagery) or unintentionally (as in sensory deprivation) involve an internal focusing of attention over a period of time in hypoaroused-states.

It is interesting to note that in these states of hypoarousal and an internal focusing of attention, patients often describe themselves as becoming increasingly aware of sensations as well as thoughts, images and emotions. There has been no research in the field of autonomic self-regulation that has attempted to define what factors may account for these shifts in awareness and/or sensory threshold levels. One might speculate that actual sensory thresholds may decrease, resulting in an actual increase of sensory information available for conscious processing. This study will begin to systematically examine this question.

In summary, a wide variety of psychological processes have been thought to relate to a person's capacity to voluntarily control internal states. However, there has been virtually no controlled outcome studies as of yet examining the relationship of cognitive and emotional processes to autonomic learning.

Psychological Processes and the Voluntary Control of Essential Hypertension

There has been hardly any research directly related to the psychological processes that may effect or be affected by voluntary control of essential hypertension. Of notable exception are two

studies by Goldman and his co-workers (1975). In the first study they trained seven male essential hypertensive adults to lower their blood pressure with blood pressure biofeedback and found: a) a significant positive correlation between systolic blood pressure and number of errors on the category test (rho = .75, N = 7), the latter known to be a clinically useful indication of cerebral impairment and a subtest of the Halstead-Reitan Battery; b) that biofeedback training produced decreases in systolic pressure within training sessions and decreases in diastolic pressure between sessions; and most interestingly, c) subjects showing the greatest decreases in systolic and diastolic pressure during biofeedback training showed the most improvement on the category test administered subsequent to training. Although it is tempting to interpret these results as indicating a direct relationship between blood pressure and cognitive functioning as well as the potential to reverse cognitive impairment (see Guyton, 1961, for a review of the effect of sustained hypertension on brain functions), three methodological shortcomings make definitive conclusions premature--small sample size, difference in number of sessions under control and experimental subjects and the lack of "post" category test scores obtained from the control subjects. Although these patients were also administered full WAIS before and after training, pre/post subtest analysis was unfortunately not performed to determine if various components of cognitive functioning (e.g., attention) changed (Goldman, 1979).

In a second study, Kleinman, Goldman, and their co-workers (1977) studied eight male essential hypertensives who went through a systolic blood pressure biofeedback training program. Replicating their initial findings, a significant correlation was found between systolic pressure and number of errors on the category test given prior to biofeedback training, and between magnitude of decrease in systolic pressure recorded during biofeedback training and improvement in category task performance measured subsequent to training. Although this study also lacked an adequate control group, these two studies taken together indicate an apparently strong relationship between essential hypertension and cognitive impairment. The authors interestingly reported that the impairment appears prior to any hard neurological signs. They speculate that the reversibility of the impairment after only nine weeks of training may indicate cerebrovascular constriction as the physiological mechanism linking blood pressure and cognitive functions.

In summary, there has been virtually no research exploring what occurs psychologically as essential hypertensive patients learn or fail to learn to voluntarily control their blood pressure. The two studies in this area, however, do suggest that cognitive changes occur concomitant to autonomic learning. In addition, they suggest cognitive impairment possibly due to prolonged hypertension may be reversed as a function of biofeedback/self-regulation learning. Further controlled outcome studies are called for to more clearly understand how autonomic learning may effect psychological processes

in essential hypertensive individuals. The present study will examine how various aspects of attentional and perceptual processes are affected as essential hypertensive adults learn or fail to learn how to relax and voluntarily regulate blood pressure.

Hypotheses

The major interest of this study is twofold: 1) Can essential hypertensive adults learn to voluntarily regulate their blood pressure and maintain reductions after an initial treatment program? and 2) What happens to various psychological processes as patients learn or fail to learn to voluntarily regulate physiological states that are usually involuntary and unconscious?

It is the intent of this research to study in a controlled outcome fashion the effects of two self-regulation treatment modalities that have reportedly been useful in developing autonomic self-regulation skills on blood pressure and various aspects of attentional and perceptual processes. Although there have been many clinical descriptive reports that hypertensive patients can learn to voluntarily control blood pressure, recent phase II or controlled outcome studies--with the notable exception of Patel and North's work (1975) --report rather unimpressive clinical results.

The first of the two self-regulation treatment modalities will be referred to as the "biofeedback treatment group" and is designed to insure the greatest opportunity for successful autonomic learning. This treatment will include the following basic components:

twice weekly meetings with a therapist for ten weeks, during which time patients will practice a variety of attentional and somatic strategies, while receiving EMG and/or peripheral temperature biofeedback. This treatment program is modeled on pilot work done by Sedlacek (1976) and Sedlacek and Cohen (1978).

The second treatment group will be a mediation-relaxation modality modeled on Benson's (1975) Relaxation Response treatment. Patients in this group will meet with a therapist once a week for five weeks and then five weeks later to learn how to practice the Relaxation Response--a simple concentrative procedure--and then talk about their experience with a therapist. Patients in this group will be seen weekly for five weeks because this represents Benson's reportedly successful model for treating essential hypertensive adults. However, it is important to note that the present investigator had intended to equalize the amount of therapist-patient contact in the biofeedback and relaxation response groups to adequately control for the important therapist-attention factor. Unfortunately, the sponsoring hospital would not permit more therapist contact in the relaxation group due to time demands.

There will be a third Waiting List Control Group that will enable the effects of attention from the pre/post treatment evaluation to be partially controlled for.

Psychologically it is suggested that successful autonomic self-regulation learning utilizes and hence will increase and develop the following psychological capacities: 1) to discriminate

and disembed the figure from the ground; 2) to sustain attention or become absorbed; and 3) to deploy attention. In addition, it is suggested that successful learners' tactile sensitivity will increase.

Hypothesis I. The biofeedback group will demonstrate the greatest decreases in blood pressure at the end of the ten week treatment program and four months after the completion of the program.

Hypothesis II. It is predicted that the biofeedback group will become relatively more able to disembed figure from ground or become field independent after the ten week training program on the Embedded Figures Test, the Block Design and Picture Completion subtests of the WAIS as well as the Draw-a-Person Test.

Hypothesis III. It is predicted that the biofeedback group will be relatively more able to become absorbed on the Tellegen Absorption Scale after the ten week training program.

Hypothesis IV. The biofeedback group is predicted to increase their scores on the Digit Span subtest of the WAIS after the ten week treatment program.

Hypothesis V. The biofeedback group is predicted to become relatively more sensitive to tactile stimuli after the ten week treatment program on the Semmes-Weinstein pressure aesthesiometer.

CHAPTER IV

METHOD

Subjects

Male and female volunteer subjects with essential hypertension were referred by their private or clinic physician to a "hypertension study" at St. Luke's Hospital, New York, New York. After a preliminary telephone screening potential subjects were interviewed by a psychiatrist for possible inclusion in the study. On the basis of specific inclusion and exclusion criteria to be described below, thirty-three patients were accepted into the study and baseline recordings of blood pressure began. During the initial psychiatric interview patients were informed of the nature of the study and medical history was gathered focusing on factors relevant to hypertension; all patients were taught to use a sphygmomanometer and instructed to record their blood pressures daily. These were used to evaluate any differences between home and office (taken by the therapist and bimonthly by "blind" nurses). Preliminary analysis of these three sets of blood pressures reveal no significant differences. Subsequently a description of the intent of the study was mailed to the volunteer's physician. Volunteers had to have their own physician agree to their participation in the study. The investigators did not assume the role of primary care physician.

For inclusion in the study patients had to have been diagnosed as essential hypertensive for at least two years. Further-

more, patients were excluded if there is any evidence of organic etiology for their hypertension, major complications related to the disease, or other serious medical or psychological illnesses (i.e., psychosis).

Potential subjects whose histories met these criterion were seen for an extensive psychological assessment and bilateral sitting and recumbant blood pressure measurements. Subjects were then randomly assigned to one of the three groups. Subjects were requested to continue their current dietary and medication practices and inform the investigators of any change in their regime during the study. In the course of pretreatment evaluation, three subjects dropped out leaving ten subjects in each group (see Table 1 for a description of patient characteristics).

Therapists

Two different male therapists, an advanced doctoral student in clinical psychology and a psychiatrist, conducted the treatment. The doctoral student saw 90 percent of the biofeedback group patients, 50 percent of the Relaxation Response patients, and 50 percent of the control group patients. The psychiatrist saw the remaining patients. Statistical analysis indicated no differential effectiveness for either therapist in terms of blood pressure changes.

Dependent Measures

Physiological variables. Blood pressure was derived by taking

Table 1

Characteristics of Patients

Biofeedback Treatment Group			Relaxation Response Treatment Group			Control Group		
Age	Sex	BP	Age	Sex	BP	Age	Sex	BP
53	F	154/110	48	F	145/90	33	F	144/98
65	F	130/90	68	F	130/84	28	F	130/92
46	F	122/82	63	F	146/96	39	F	220/120
49	F	130/104	40	F	120/100	31	F	140/92
53	F	136/92	44	F	140/98	37	F	120/90
33	F	160/94	45	M	134/94	53	F	132/84
41	F	150/92	44	M	140/106	34	M	140/100
72	M	150/96	43	M	160/100	37	M	140/100
36	M	142/86	56	M	158/100	54	M	140/98
26	M	160/100	31	M	140/90	32	M	140/96

three measurements using the standard method. These readings were averaged and used as the blood pressure for that moment. The patients at home, the "blind" nurse and the therapist used this method.

Medication index. This variable was an indication of the amount of medication used and its relative potency. The medication index was derived by multiplying the scale potency by the number of tablets taken. This scale was developed by a physician who specializes in the care of hypertensive patients (Carlton Boxhill, M.D.).

Psychological Variables

Measures of Field Dependence/Independence

Embedded Figures Test. The Embedded Figures Test is an instrument that has been shown to be a measure of one's capacity to disembed the figure from the ground, or one's level of field dependence/independence (see Witkin, Oltman, Raskin & Karp, 1971, for review). Although strictly speaking, the Embedded Figures Test assesses a relatively stable style of visual perception, research has demonstrated that this visual perceptual style seems to be associated with a particular cognitive style (Witkin et al., 1962). This test consists of two sets of twelve drawings (to enable separate pre- and post-administrations) in which the subject is instructed to locate a simple geometric shape in a more complex drawing. The subject's score is derived from the average time that it takes the subject to disembed the simple geometric shape from the more complex drawing. This measure is frequently employed alone in studies of field

dependence. A number of considerations suggest, however, that quite misleading conclusions are often drawn from such studies (Wachtel, 1972a; 1972b). Accordingly, the present study will also include several other measures which purportedly measure the construct of field dependence/independence, as indicated below.

Block Design. The Block Design measure is a subtest of the Wechsler Adult Intelligence Scale (WAIS). This is a measure of one's ability to perceive forms (synthetic or abstract approach) and break them up into component parts (analytical) (psycho-motor conceptualization); it also measures visual motor coordination and space orientation. This measure is one of the most vulnerable subtests on the WAIS for the effect of cerebral pathology and organic deterioration (Rapaport, Gill & Schafer, 1968). This measure as well as the Picture Completion and Object Assembly subtests of the WAIS appear to involve the capacity to overcome embeddedness and in fact correlate highly with the Embedded Figures Test and other standard measures of field dependence/independence (Goodenough & Karp, 1961). These three subtests have been used in many field articulation studies (Witkin et al., 1973). This test consists of nine blocks that have red, white, and red-and-white sides. The subject reproduces designs of increasing complexity requiring from four to nine cubes. Score is a function of how long it takes to reproduce the designs.

Picture Completion. As mentioned above, the Picture Completion measure is also a subtest of the WAIS which has been used as

a measure of field dependence/independence. This measure assesses an individual's ability to differentiate essential from unessential details, as well as basic perceptual and conceptual abilities in visual recognition and identification of familiar objects and forms. The test is made up of 21 cards, each containing a picture from which some part is missing. The subject must tell what part is missing in each picture. The score is derived from the number of correct identifications.

Draw-a-Person. This measure requires that the subject draw a person and then a second picture of a person of the opposite sex. This measure reportedly reflects maturity of body image and has been correlated to various measures of field dependence/independence and psychological differentiation. Form level (including proportion and perspective), role and sex differentiation and level of detailing contribute to a final score on a 5 point scale from most sophisticated to most primitive and infantile drawings. However, it should be noted that the correlations between this measure and other more standard measures of field articulation range from 0.24 to 0.63, making it a relatively unstable index of field articulation.

Attention Deployment

Digit Span. The Digit Span subtest of the WAIS has traditionally been considered a measure of attention deployment (Rapaport, Gill & Schafer, 1968; Schwartz, 1979). It also assesses what has been called mental control and the ability to do intellectual work which requires concentrated effort. Anxiety can interfere with per-

formance on this test, in which the subject orally reproduces three to nine digits that have been presented orally. In the second part of this test the subject must reproduce lists of two to eight digits backwards.

Absorption or the Capacity to Sustain Attention

Tellegen's Absorption Scale. Tellegen's Absorption Scale (TAS) is a psychometric instrument designed to assess the disposition for having episodes of total attention that fully engage one's representational resources (Tellegen & Atkinson, 1974). Among other things, Tellegen and Atkinson (1974) suggest that people scoring high on the TAS are relatively impervious to normally distracting events, or can sustain their attention. A number of additional lines of research all suggest that absorption is associated with the capacity to attend in a sustained fashion. For example, absorption has been found to correlate with hypnotizability in the range of .4 (Spanos & McPeake, 1975; Tellegen & Atkinson, 1974). It is interesting that differences in attentive ability have been noted between high and low hypnotizable subjects using both behavioral (e.g., Van Nuys, 1973) and electrophysiological (e.g., Galbraith, Cooper & London, 1972) measures. Davidson and his co-workers have demonstrated that people practicing meditation have higher scores on the TAS than non-mediators (Davidson, Goleman & Schwartz, 1976). It was also demonstrated that high scores on the TAS are associated with a flexible attentional style and that given the requisite task demands, attentionally absorbed

subjects show greater mode specific cortical patterning during selective attention than do low absorption scale scores (Davidson, Schwartz & Rothman, 1976).

The TAS to be used in this study is an updated version of the Absorption Scale used by Tellegen and Atkinson (1974). It consists of a 37 item scale that is interspersed with 38 additional filler items to make a 75 item questionnaire. Subjects who feel the following kinds of attitudes, opinions and interests primarily to be true for themselves would be considered very able to become absorbed, on this scale: "I like to watch cloud shapes change in the sky," "If I wish I can imagine or daydream some things so vividly they hold my attention in the way a good movie or story does," "Sometimes I can change noise into music by the way I listen to it," and "Sometimes thoughts and images come to me without the slightest effort on my part."

Tactile Sensitivity

Semmes Weinstein Pressure Aesthesiometer. The Semmes Weinstein Aesthesiometer is a modern adaptation of the long recognized Von Fry technique for the establishment of sensitivity thresholds. Von Fry originated the technique of using horsehairs of differing lengths bent against the skin to produce differing pressures. The force exerted against the skin is a function of the length and diameter of the hair and remains constant, producing a simple means of exerting a constant known force.

The Semmes Weinstein Set consists of a precisely calibrated

series of nylon filaments of equal length (38 mm) and varying diameters set into individual lucite rods. The log force exerted by these filaments yields a linear function, providing an interval scale for the computation of thresholds (Semmes, Weinstein, Ghent & Teuber, 1960). The procedure employed in the present study is similar to that employed by Semmes et al. (1960). Using the method of limits, six ascending and six descending trials were administered (with ten filaments applied in each trial) to the center of the whorl of the middle finger of each hand. Testing was administered while the subject was seated and in such a manner as to prevent the subject from seeing when the actual filaments were applied.

Thematic Apperception Test (TAT). Three TAT cards (Numbers 14, 8GF, 12M) were presented in the standard form (Rapaport, Gill, & Schafer, 1968) to all subjects in the Biofeedback and Relaxation Response groups during their post treatment evaluation. The three TAT stories will be assessed in the following two ways: 1) average number of disavowal and negation statements (e.g., "He is not going to jump out of the window," "She looks lonely but she really isn't," "He's just sleeping; he is definitely not going to die") in all three stories (two raters; inter-rater reliability = .937); 2) average latency time or number of seconds between the time when the subject takes the TAT card and begins to articulate the story. These three cards tend to pull for the following kinds of themes: being alone, suicidal preoccupation, worries and hopes, and attitudes toward passive dependency.

In the course of the study, the present investigator discovered that these types of psychological themes--in particular, the fear of being alone--seemed to inhibit successful visceral learning. The rationale for utilizing these two scales was as follows: if patients are uncomfortable with the themes that these three TAT cards typically produce, they might defend themselves by disavowing the fear (i.e., the Disavowal/Negation Scale) and being more hesitant to even begin to imagine and/or articulate the story (i.e., the Latency Time Scale). Preliminary analysis of presense of themes did not appear to be fruitful.

Procedures

There are certain commonalities between the three groups. Patients in all groups were seen for psychiatric and psychological evaluation, and taught to use a sphygmomanometer and record their blood pressures daily. In the two treatment groups, sessions lasted approximately 50 minutes. Recording of frontalis electromyogram (EMG) and finger temperature were made during sessions. A Cyborg Biolab model BL533 and a Biofeedback Instrument Company model P775-1 were used for the EMG recordings. A Cyborg Biolab temperature trainer model BL562 and model P442 were used for the temperature recordings. Half of the patients in the Biofeedback and Relaxation Response groups receded in a semi-recumbent lounge chair and half laid down during sessions. There was no significant difference in physiological or psychological change scores between these two conditions.

The Biofeedback/Self-Regulation Treatment Group

Patients were seen individually twice a week for ten weeks. Session time began by discussing the patient's treatment experience and then listening to two sets of prerecorded relaxation visualization and self-regulation audio tapes (developed by K. Sedlacek, M.D., and T. Budzynski, Ph.D.). These tapes were used while the patients received EMG feedback for four weeks and then peripheral (finger) temperature feedback for the next four weeks. For the last two weeks either EMG, thermal or no feedback were used depending on the patient's wish. At the end of each session the patient's experience was discussed with the therapist. The nature of these supportive psychotherapeutic interactions ranged from the relatively superficial to the highly personal.[1] Patients were instructed to

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1. Although it is beyond the scope of this thesis to describe in detail the nature of the therapeutic interaction, a brief description may be useful. Both therapists conceptualized the ten week treatment program to be a short term, time-limited therapeutic program that would attempt to address both physiological, symptom-based and more general psychological factors. The sessions usually began on time and provided patients with an opportunity to discuss their experience with the relaxation exercises. The nature of these conversations ranged from brief experiential reports to extended exploration and discussions about the meaning of a given experience. Although both therapists conceptualized their task to be primarily supportive, their styles were somewhat different. The psychiatrist's stance may be characterized as encouraging, enthusiastically supportive and symptom-oriented. In contrast, the other therapist's style was somewhat more reserved and psychoanalytically-oriented in the sense that the meaning of a given experience was attended to, in addition to the symptom. (As noted above, the therapist variable seemed to have no effect on amount of blood pressure change.) Some patients formed a close working relationship with the therapist and had difficulty separating, and some patients maintained a distant, relatively "non-relating" stance throughout the work.

practice specific exercises at home twice a day for fifteen to twenty minutes. Blood pressure was recorded by the therapist before and after each session as well as by "blind" nurses (e.g., someone who did not know which group the patient was in) every two weeks for all patients in the biofeedback and Relaxation Response treatment groups. There was no significant difference between "blind" blood pressure assessment, home pressure levels and therapist's recordings of blood pressure. Because home blood pressure and "blind" blood pressure recordings were not taken as consistently as therapist's recordings, it was decided that all pressures reported would be the pre-session blood pressure gathered by the therapist.

At the initial treatment session the operation of feedback hardware was explained to the biofeedback group patients. They were given the expectancy that learning to relax, warm their hands and lower EMG recordings would lead to therapeutic improvement.

The Relaxation Response Treatment Group

Relaxation Response training was chosen as a control condition because 1) it was thought to be active enough to serve as an adequate attention-placebo control (Paul, 1969) condition and 2) there have been many reports of its usefulness in the treatment of essential hypertension (see Benson, 1975, for review).

Patients in this group were given instructions outlined by Benson (1975). They were seen once a week for five weeks and then five weeks later. Initially patients were taught to practice the Relax-

ation Response which involves sitting quietly, relaxing their muscles, and then reciting the number "one" silently to themselves on each exhalation. They were instructed to concentrate on this recitation and passively bring their attention back to it if their minds wandered. After learning this simple meditative procedure, patients in this group practiced it for fifteen minutes and then discussed their experience with a therapist. Subsequent sessions began by the patient discussing the treatment experience with the therapist, practicing the Relaxation Response, and then again discussing their experience with their therapist. As in the biofeedback group, the nature of this supportive psychotherapy varied. Patients were instructed to practice the Relaxation Response procedure at home twice a day for fifteen to twenty minutes. Similar expectations for improvement in hypertension as they mastered the Relaxation Response procedure were given.

The Waiting List Control Group

Since essential hypertension can run a somewhat fluctuating course, it was thought useful to include a group who received no treatment other than monitoring their blood pressure but who expected to receive treatment. If patients had sought hypertensive treatment during an acute phase of their disorder and had improved spontaneously, this condition should detect the phenomenon.

The patients in this condition were told that due to the large number of volunteers in the project, not everyone could be treated initially. They were asked to continue keeping their daily blood

pressure records and told that they would receive whichever treatment seems superior. At the time of this writing, plans are underway to begin a treatment program for these patients, the results of which will be reported in the future. Physiological and psychological evaluation was completed before and after a ten week period.

Follow-up Evaluation

All patients were seen four months after the completion of the initial ten week program for a brief interview that consisted of blood pressure assessment as well as a brief, overall psychiatric evaluation.

CHAPTER V

RESULTS

The Data and Their Analysis

The statistical operations for this study were performed at the CUNY computer center. The SPSS program was used for all statistical analyses (Nie et al., 1975). All p-values given represent two-tailed probabilities, except where one-tailed p-values are specifically indicated. All measurements and tests were scored "blindly" by research assistants.

Intercorrelations Between Attentionally Related Test Measures

A correlation matrix was computed for the six attentionally related pretreatment measures and is presented in Table 2. The Embedded Figures Test, Block Design and Picture Completion measures are all significantly correlated ($p < 0.001$) supporting the notion that these are all measures of field independence/dependence (though the correlations could also be due to intelligence, cf. Wachtel, 1972a). However, the Draw-a-Person which is also reported to be a measure of field articulation, did not correlate with any of the other three field articulation measures in a significant fashion. The only other significant correlations are between the Digit Span measure and the Block Design measure ($r = 0.61$, $p < 0.001$), Picture Completion measure ($r = 0.42$, $p < 0.01$), and the Embedded Figures Test ($r = 0.52$, $p < 0.01$). The absorption index was statistically

Table 2

Attentionally-Related Measures (Pre-treatment)

Pearson Correlation Coefficients

	EFT	BD	PC	DAP	Absorp.	DS
EFT	1.00	-0.80***	-0.62***	-0.006	-0.27	-0.52**
BD		1.00	0.63***	-0.05	0.33*	0.61***
PC			1.00	0.05	0.36*	0.42**
DAP				1.00	0.08	-0.20
Absorp.					1.00	0.21
DS						1.00

*p < 0.05
**p < 0.01
***p < 0.001

independent of the other attentional measures and hence may be deemed an independent aspect of attentional functioning. As the Draw-a-Person measure did not appear to be an adequate index of field independence/dependence, it will not be utilized in the analysis of field articulation changes.[1]

Pretreatment Baseline Data

To determine if any of the three groups differed in average physiological or psychological levels prior to the beginning of training, a series of t-tests were performed between groups assessing baseline blood pressures, amount of medication, and pretreatment psychological measures. To establish baseline blood pressures, three pretreatment pressures were used: 1) average blood pressure obtained in the patient's prior medical history, 2) average blood pressure obtained in three recordings taken during the psychiatric screening examination, and 3) average blood pressure obtained in a psychological examination which included the supine as well as sitting blood pressure. Results of the t-test showed that baseline blood pressure differences, amounts of medication and pretreatment psychological measures were not significant between groups ($p > .10$). In other words, the three groups had comparable blood pressure values, medication and psychological functioning as assessed by the measures administered prior to the beginning of active treat-

1. Pre/post Draw-a-Person scores did not significantly change ($p > .10$) for any group.

ment.

Although the average amount of medication did not differ between groups, random assignment of patients to groups resulted in the only patients not on medication happening to fall into the biofeedback group. However, amount of blood pressure change between patients on no medication versus patients on medication reveal no significant differences ($p > .10$).

Test of Hypotheses

Hypothesis 1. The comparison of blood pressure changes across treatment groups. Examination of the average pre/post treatment changes for diastolic and systolic blood pressure presented in Figure 1 and Table 3 confirm Hypothesis 1. The biofeedback treatment group decreased blood pressure more than the other groups. The Relaxation Response treatment group showed some slight indications of decreased blood pressure. The control group showed none. Because there were no significant baseline pressure differences between groups, change at mid-treatment, post-treatment and follow-up (four months after the completion of the ten week treatment period) were assessed relative to baseline blood pressure levels. Although the biofeedback group did not significantly decrease diastolic and systolic blood pressure at mid-treatment (diastolic blood pressure: $t = 1.85$, $p < 0.10$; systolic blood pressure: $t = 0.93$, $p < 0.10$)[1]

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1. Please note that all "df" equals nine unless otherwise specified.

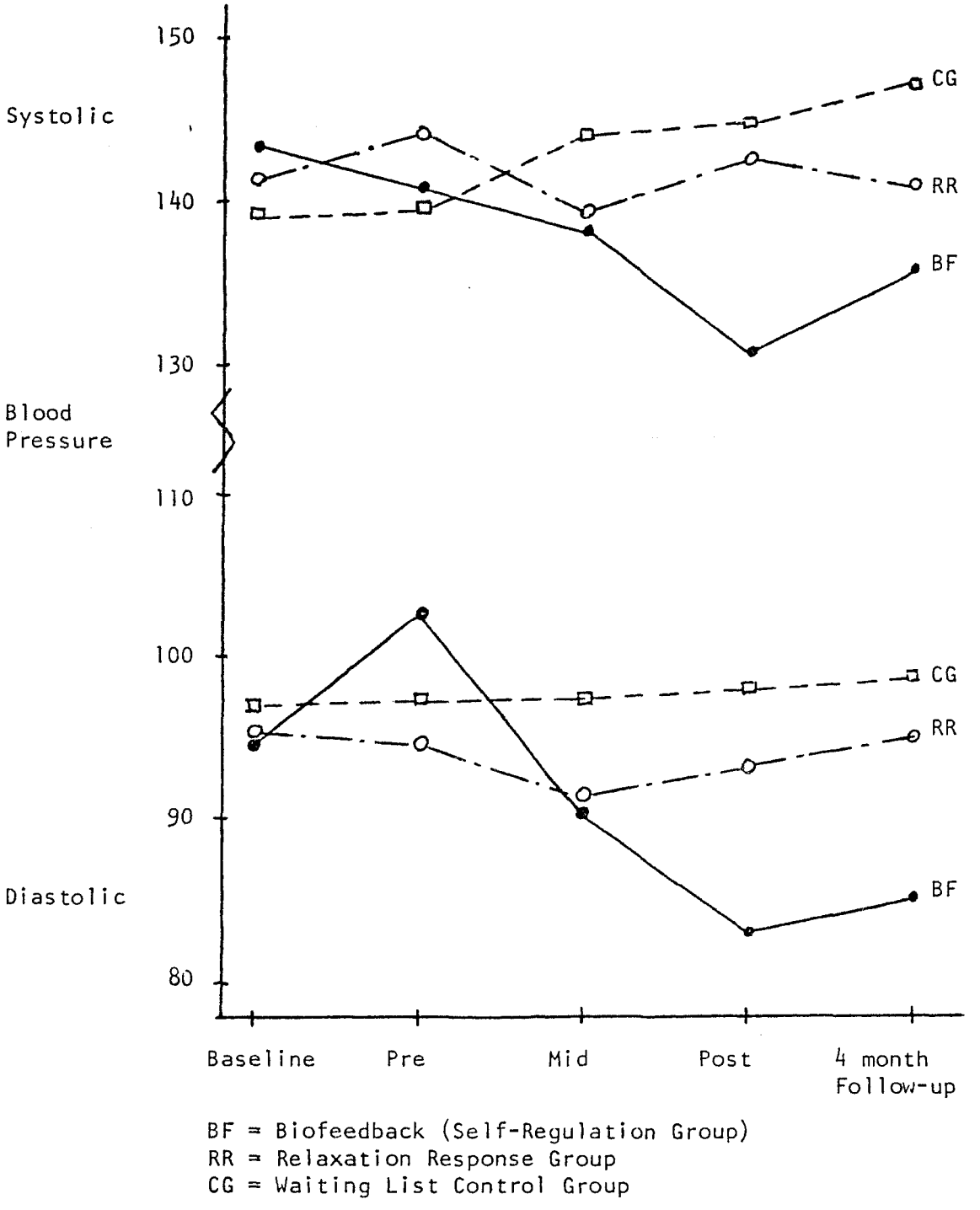

Figure 1. Average blood pressure by treatment group across time.

Table 3

Mean Blood Pressure for Each Group Across Time

		Biofeedback/ Self-Regulation (N=10)	Relaxation Response (N=10)	Control Group (N=10)
Baseline				
Systolic BP	$\bar{x}$	143.6	141.3	139.1
	SD	13.2	12.0	10.2
Diastolic BP	$\bar{x}$	94.6	95.8	97.0
	SD	8.3	6.4	9.5
Pre				
Systolic BP	$\bar{x}$	141.1	144.2	139.8
	SD	13.8	8.1	9.1
Diastolic BP	$\bar{x}$	102.6	94.8	97.3
	SD	34.2	8.4	9.8
Mid				
Systolic BP	$\bar{x}$	138.1	139.2	144.0
	SD	13.4	10.1	11.3
Diastolic BP	$\bar{x}$	90.3	91.8	97.4
	SD	6.8	5.8	8.5
Post				
Systolic BP	$\bar{x}$	130.8	142.8	144.9
	SD	11.7	12.3	10.9
Diastolic BP	$\bar{x}$	83.2	93.8	98.1
	SD	6.3	8.7	9.7
Follow-up				
Systolic BP	$\bar{x}$	135.8	141.0	147.2
	SD	13.7	8.0	9.8
Diastolic BP	$\bar{x}$	85.4	95.1	98.4
	SD	5.5	7.6	7.2

there were significant decreases at the end of the ten week treatment period (diastolic blood pressure: $t = 4.27$, $p < 0.01$; systolic blood pressure: $t = 5.53$, $p < 0.0001$). The average biofeedback treatment group reduction was 20/12 (baseline blood pressure equals 150/95; post-treatment blood pressure equals 130/83). At four month follow-up, the biofeedback group continued to reflect a significant decrease in diastolic blood pressure (baseline blood pressure equals 150/95 to follow-up blood pressure equals 136/85; $t = 3.34$, $p < 0.01$) and a strong trend in decreasing systolic blood pressure ($t = 2.11$, $p < 0.06$).

The Relaxation Response treatment did significantly reduce diastolic blood pressure, baseline to mid-treatment, that is five weeks: 140/96 to 140/92 ($t = 2.27$, $p < 0.05$). Systolic blood pressure did not show any significant change ($t = 0.68$). At the end of the ten week treatment period neither aspect of blood pressure reductions was significant: 140/96 to 142/94 (diastolic blood pressure: $t = 0.88$, $p < 0.4$; systolic blood pressure: $t = 0.28$, $p < 0.78$). At four month follow-up blood pressure changes were not significant: 140/96 to 141/95 (diastolic blood pressure: $t = 0.69$, $p < 0.4$; systolic blood pressure: $t = 0.09$, $p < 0.93$).

Control group patients did not experience any significant blood pressure changes over the course of the initial ten week period or at four month follow-up. The change from baseline to follow-up is 143/97 to 148/98.

In the biofeedback group 30 percent of the patients reduced

their hypotensive medication by 50 percent or more (two patients reduced it by more than 66 percent and one patient by 50 percent). One patient in the Relaxation Response group increased medication by 50 percent. In the control group, one patient increased medication by 50 percent and one patient decreased medication by 20 percent. These changes in antihypertension medication underscore the clinical significance of the blood pressure change reflected in the biofeedback treatment group.

In summary, the results for pre/post change in blood pressure across the three groups support the prediction that the biofeedback treatment program facilitates a statistical and clinically significant lowering of blood pressure. Significant decreases in medication for several patients in this group underscore the clinical significance of this treatment program. Although the Relaxation Response treatment did lower blood pressure, this decrease appears to be short-lived as it only manifested itself in mid-treatment, that is, five weeks after the beginning of treatment. It is of significance that although the Relaxation Response treatment program was officially ten weeks, patients in this group only saw therapists in an ongoing weekly fashion for the first five weeks, and it was for this period that some change was evident. The importance of ongoing therapist-patient contact will be addressed in the Discussion section.

Hypothesis II. The comparison of field independence/dependence changes across treatment groups. The biofeedback group became significantly more field independent as predicted in Hypothesis II. As

indicated in Table 4, the biofeedback treatment group became significantly more field independent as reflected in the Embedded Figures Test ($t = 5.57$, $p < 0.0001$), Block Design ($t = 3.50$, $p < 0.01$), and Picture Completion ($t = 5.28$, $p < 0.001$). The pre/post field articulation results for the Relaxation Response group are mixed; although the Relaxation Response group did become significantly more field independent on the Embedded Figures Test ($t = 2.84$, $p < 0.01$), the Block Design and Picture Completion measures do not reflect any change. The control group did not change in their pre/post levels of field independence/dependence.

The pre/post results on the Embedded Figures Test, the Block Design and Picture Completion measures support the prediction that the biofeedback group would become more field independent. The biofeedback group became significantly more field independent after the treatment experience. The Relaxation Response treatment group did become more field independent on one of the three field articulation measures. The control group did not change in their pre/post levels of field dependence.

Hypothesis III. The comparison of absorption or the capacity to sustain attention changes across treatment groups. The biofeedback group became more able to sustain attention or become absorbed as predicted. Table 4 shows that this change reflects a significant increase in capacity to sustain attention ($t = 2.17$, $p < 0.05$). The Relaxation Response and control group conditions did not reflect any significant pre/post changes.

Table 4

Attentionally-Related Changes Across Treatment Groups

Pre and Post Measures of Field Independence/Dependence (or the capacity to disembed the figure from the ground)	Biofeedback/ Self-Regulation (N=10)	Relaxation Response (N=10)	Control Group (N=10)
Embedded Figures Test			
Pre $\bar{x}$	89.7	123.3	88.7
SD	40	51	40
Post $\bar{x}$	57.9	109.5	86.3
SD	28	60	39
Post-Pre $\bar{D}$ ($\bar{x}$ diff.)	31.8 ($t=5.57$ $p < 0.0001$)	13.8 ($t=2.84$ $p < 0.01$)	2.1 ($t=1.04$ NS)
Block Design			
Pre $\bar{x}$	31.5	27.3	33.8
SD	9	12	8.5
Post $\bar{x}$	35	26.9	34
SD	8	12	8
Post-Pre $\bar{D}$	3.3 ($t=3.50$ $p < 0.007$)	0.4 ($t=1.0$ NS)	0.2 ($t=0.29$ NS)
Picture Completion			
Pre $\bar{x}$	12.3	10	14.4
SD	4	4.7	3.2
Post $\bar{x}$	14.5	10.6	14.6
SD	4	4.5	3
Post-Pre $\bar{D}$	2.2 ($t=5.28$ $p < 0.001$)	0.6 ($t=0.82$ NS)	0.2 ($t=0.36$ NS)

Table 4, Continued

Attentionally-Related Changes Across Treatment Groups

	Biofeedback/ Self-Regulation (N=10)	Relaxation Response (N=10)	Control Group (N=10)
	Pre and Post Measure of Absorption (or the capacity to sustain attention)		
Absorption Scale			
Pre $\bar{x}$	16.4	12.6	18.8
SD	7.8	6.9	7.5
Post $\bar{x}$	19.3	13	19.1
SD	9	8.7	8.9
Post-Pre $\bar{D}$	2.9 ($t=2.17$ $p < 0.05$)	0.4 ($t=0.21$ NS)	0.3 ($t=0.43$ NS)
	Pre and Post Measure of Attention Deployment		
Digit Span			
Pre $\bar{x}$	9.8	7.8	8.4
SD	3.2	1.7	3.0
Post $\bar{x}$	10.7	8.7	8.3
SD	2.7	2.1	2.9
Post-Pre $\bar{D}$	0.9 ($t=2.86$ $p < 0.01$)	0.9 ($t=1.59$ NS)	0.1 ($t=0.56$ NS)

Hypothesis IV. The comparison of attention deployment changes across treatment groups. As predicted, the biofeedback group became more able to repeat digits forward and backward ($t = 2.86$, $p < 0.01$). As displayed in Table 4 the other two groups did not significantly change in this regard.

Hypothesis V. The comparison of perceptual sensitivity (tactile) changes across treatment groups. Table 5 shows that the biofeedback group did become more able to perceive tactile pressure on their right hands ($t = 2.39$, $p < 0.05$), providing partial support for this prediction. Interestingly, there is no significant pre/post change in the biofeedback group for the left hand ($t = 1.27$, $p < 0.20$). The Relaxation Response and control group did not show any significant pre/post changes on the right or left hand. However, the Relaxation Response group's tactile sensitivity of their right hand did show a marginally significant trend for becoming more sensitive ($t = 1.88$, $p < 0.10$).

Individual Changes

Although the hypotheses did not address the question of individual changes, Appendix A lists the amount of changes that all thirty subjects showed after the ten week treatment period.

Table 5

Pre and Post Measure of Tactile Sensitivity

	Biofeedback/ Self-Regulation (N=10)	Relaxation Response (N=10)	Control Group (N=10)
Von Frey (Right Hand)			
Pre $\bar{x}$	2.80	2.74	2.77
SD	.29	.31	.29
Post $\bar{x}$	2.57	2.61	2.72
SD	.21	.36	.32
Post-Pre $\bar{D}$ ($\bar{x}$ diff.)	.23 ($t=2.39$ $p < .05$ $df=9$)	0.12 ($t=1.88$ NS)	0.05 ($t=0.68$ NS)
Von Frey (Left Hand)			
Pre $\bar{x}$	2.63	2.69	2.55
SD	.25	.42	.27
Post $\bar{x}$	2.52	2.59	2.65
SD	.31	.48	.22
Post-Pre $\bar{D}$ ($\bar{x}$ diff.)	.11 ($t=1.27$ NS)	.09 ($t=1.42$ NS)	-0.10 ($t=1.46$ NS)

CHAPTER VI

DISCUSSION

The results of the present study generally support the hypotheses it set out to examine: 1) that biofeedback used in conjunction with a variety of cognitive/somatic strategies within a short term therapeutic relationship appear to be a useful way for essential hypertensive adults to learn to voluntarily control their blood pressure, 2) attentional and perceptual processes appear to be restructured concomitant to physiological (in this case, blood pressure) changes. In the following section the nature and implications of these findings will be discussed. The implications of these findings for a general psychological theory of the voluntary control of internal states is then explored. Finally, suggestions for further research are enumerated and the clinical treatment implications are discussed.

The Voluntary Control of Blood Pressure Reductions in Essential Hypertension

In this study a combination of biofeedback (EMG and thermal), cognitive/somatic strategies, twenty meetings with a therapist, and practice, did effect clinically meaningful reductions in blood pressure in a group of patients with essential hypertension. In light of the fact that an active control group (the Relaxation Response treatment) and evaluative attention alone (the control group condition) did not reduce blood pressure, one may speculate that the bio-

feedback treatment is more than an active placebo. However, it is premature to conclude that this is the case due to the difference in the therapist contact between the Biofeedback and Relaxation treatment groups. Thus, several questions remain: What factors in the biofeedback treatment group allowed and/or fostered these fairly impressive clinical results? and, Why do these results differ from the majority of other controlled comparison studies with the important exception of Patel and North's (1975) work?

The design of this study does not enable one to differentiate what components in the biofeedback condition were most important and therapeutically powerful. For example, the biofeedback group differed in a number of important ways from the relaxation group (e.g., the number of sessions, amount of contact with the therapist, biofeedback, and the use of a variety of cognitive strategies rather than one (e.g., the Relaxation Response group cognitively focused on one stimulus alone, whereas the biofeedback group practiced a number of cognitive strategies as described above), to facilitate relaxation and self-regulation). We cannot comment on the impact of any one facet of this treatment (e.g., biofeedback per se). It is interesting, however, to note that other controlled comparison studies that have yielded unimpressive results (e.g., Frankel et al., 1978; Surwit et al., 1978; Hager & Surwit, 1978) have been studies that have not combined various therapeutic regimes (e.g., more than one type of biofeedback or biofeedback and various cognitive strategies). These studies have made an effort to create a design and

adhere to a protocol that has strict control procedures. The results of this study may support Frankel and his co-workers' (1978) speculation that these procedures may have interfered with maximizing clinical efficacy and may have been an important factor in some patients failing to achieve meaningful blood pressure reductions. Unlike all the controlled comparison studies--again with the exception of Patel and North's work--the biofeedback treatment in this study was designed to enable individual tailoring of treatment plans. For instance, if a given patient became upset due to certain memories and/or emotions that emerged during the training session, the therapist would terminate the self-regulation practice and work with the patient psychotherapeutically; patients were encouraged to discover for themselves which cognitive and somatic strategies (for example, progressive relaxation or autogenic phrases or imagery) felt best and seemed most useful for them.

This study is similar to Patel and North's (1975) work and different from the other controlled comparison studies in a number of other important ways. For example, the biofeedback group in the current study met with a therapist for twenty sessions, whereas patients in many of the other less successful treatment studies met for many fewer sessions. The different amounts of time spent with the therapist may partially account for some of the different results in studies of this kind. The amount of contact with the therapist (and obviously the quality of the relationship) may be as important if not more so than the biofeedback or relaxation procedures per se.

In this regard it is interesting to note that patients in the Relaxation Response treatment did effect blood pressure reduction for as long as they were seeing a therapist on a weekly basis. When weekly contact ended the Relaxation Response group's blood pressure returned to a baseline level. Although this study does not permit firm conclusions to be drawn in this regard, one may speculate that the relationship between doctor (provider) and patient enable the patient to practice the procedures that allow autonomic learning to develop. Winnicott (1965) described a metaphorical concept of the "holding environment." This may be useful in understanding autonomic self-regulation study results. This term is derived from the parental function of holding the infant but more broadly implies the provision of safety and protection from danger. Perhaps it is only by providing such a background for safety in the autonomic self-regulation learning process that the therapist can help the patient come to the point of being able to "let go" or relax, focus internally and begin to learn to regulate processes that are usually involuntary and unconscious. The opportunity to meet with the therapist may serve another important function; to give a patient the opportunity to label, discuss, and differentiate the ambiguous and often unfamiliar sensations, feelings, ideations and imagery which may be experienced during self-regulation practice.

The vast majority of hypertension/self-regulation studies--both phase I and phase II type studies--have not included an examination of how long patients are able to maintain blood pressure reductions.

The results from this study indicate that patients are able to maintain clinically significant blood pressure reductions four months after the completion of training. However, it is interesting to note that the biofeedback group's blood pressure levels are somewhat higher at the four month follow-up point than at the end of the ten week initial treatment program. It would be premature to state whether this learning has been and will continue to be integrated into the everyday lives of these people. One and two year follow-up studies are necessary to more clearly understand this important clinical issue. It seems that patients need to continue to practice the relaxation/self-regulation procedures at least a year if not longer, for blood pressure reductions to be maintained. Non-compliance with regular practice leads to elevated blood pressure as does non-compliance with antihypertension medication. To begin to understand what factors may support (or inhibit) regular practice, it may be useful to examine what occurs psychologically during the self-regulation experience.

Psychological Changes During the Voluntary Control of Essential Hypertension

There were a number of psychologically related changes that occurred within the treatment group that demonstrated voluntary

control and reduction of blood pressure.[1] Patients in the treatment group that learned to lower blood pressure became more able to discriminate and disembed a figure from the ground, sustain attention or become absorbed, and deploy attention. Furthermore, this group interestingly seemed to become more sensitive to tactile stimuli in their right hand.

It is striking that learning to successfully regulate autonomic processes seems to result in attentional and perceptual restructuring. It had previously been reported that several of these measures (i.e., Embedded Figures Test, Block Design, Picture Completion) are rather stable cognitive indices (Witkin, Goodenough & Karp, 1967; Schwartz & Karp, 1967; Schimek, 1968). These changes in field articulation are consistent, however, with other recent research findings that suggest that internal focusing of attention over a period of time in hypoaroused states results in increased field independence (Pelletier, 1974; Linden, 1973; Cohen & Twemlow, 1979).

One might contend that autonomic self-regulation training requires disembedding internal "figures" from the "ground" (e.g., a given sensation from the total internal experience). This would then suggest that these attentional and discriminative capacities might

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1. To assess how much actual "voluntary" control patients experience, biofeedback and Relaxation Response group patients were asked to warm and then cool their fingers several times, in the post-treatment evaluation. An increase or decrease of peripheral temperature of more than three degrees were interpreted as reflecting high capacity to voluntarily regulate vasodilatin and/or vasoconstriction. Preliminary analysis reveals a significant correlation between this and amounts of blood pressure reduction.

be developed or restructured in the course of training. When asked, in the current study, what one learns in autonomic self-regulation training, patients answered, "I'm learning how to pay attention," "It's hard to put into words, but I'm learning how to sort out the different parts of my internal world, to concentrate and to watch what goes on inside of me for periods of time." Patients in the biofeedback group, who had the most support interpersonally and most opportunity to practice a large array of attentional and somatic strategies, demonstrated significant shifts on virtually all of the attentional and perceptual dimensions studied. Although the Relaxation Response group did not maintain blood pressure reductions, decreases were intially present. It is interesting to speculate that the Relaxation Response treatment also supported developing the voluntary control of attentionally related functions but in a more limited fashion than the biofeedback group. Nevertheless, it is unclear why the Relaxation Response group became more field independent on the Embedded Figures Test but not on the other field independent/dependent measures.

Many patients commented on the experience of becoming more aware of internal states during the relaxation and self-regulation practices. They noted that this increase in awareness helped them to relax and experience voluntary control of internal states. It is interesting that the group that demonstrated successful autonomic learning became more sensitive to tactile stimulation in their right hands only. Although it is tempting to speculate that this right

handed increase in sensitivity is related to an increase in sensitivity of left hemispheric processes, this would be premature for several reasons. Changes in tactile sensitivity may not be due to an alteration of sensory threshold levels but rather simply to an increase of blood flow to the periphery. Increased peripheral temperature (enhanced blood flow) is a common concomitant of relaxation. If patients in the biofeedback group were generally more relaxed, this might manifest itself physiologically and result in increased sensitivity to peripheral pressure. Nevertheless, it is curious and not understood by the present investigator, why this alteration occurred only in the right hand.[1] In a recent pilot study designed to examine the state effects of relaxation/self-regulation training on tactile sensitivity, Cohen (1979) found that tactile sensitivity increased dramatically during actual relaxation/self-regulation practice. The amount of increase was roughly three times as great as the right handed increase in sensitivity of the biofeedback treatment group after training.

Another cause for caution in interpreting these results is that the increasing ability to distinguish and detect what were unconscious sensory signals may be due to either an actual lowering of sensory thresholds and/or a cognitive criterion shift. De-

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1. There were no changes in the subject's daily activity that could account for skin or callous changes between pre and post evaluation (i.e., being laid off of a construction job, perhaps resulting in callous reduction and hence increased sensitivity).

tection theory has developed a distinction between sensory and criterion measures (Swets, 1964). Sutton (1973) summarizes the development of this distinction:

> In traditional psychophysics, except for the use of catch trials, the experimenter is at the mercy of the subject's degree of caution in making a psychophysical judgment. In the method of limits if a subject feels that he must be quite sure before he is willing to say that he detects the stimulus, thresholds will be quite high. On the other hand, if he is willing to take risks, thresholds will be lower. One would like to obtain an estimate of the subject's threshold performance that is independent of such criteria factors. Detection theorists have worked out the rationale and calculations to permit the obtaining of a separate measure for the sensory factor (d') and the criterion factor (β). They have shown that under certain conditions d' can be constant despite experimental manipulations of β (the degree of cautiousness of the subject) (Sutton, 1973, p. 47).

For example, hypnosis as well as placebo functions primarily by altering the subject's criterion for reporting pain (β), but have no significant effects on sensitivity (d'). Future research will need to clarify to what extent this increase in sensitivity discovered in the present study is due to an actual shift in threshold (d') and/or criterion (β) factors. This type of research will help to clarify to what extent these procedures are actually effective in developing increased autonomic perception and self-control skills as opposed to being an "ultimate placebo" (Stroebel & Glueck, 1973).

When patients in the two active treatment groups practiced their relaxation and self-regulation procedures, they often became aware of sensations, images, emotions and ideations that were novel, confusing, and at times frightening. In fact, several patients wanted

to stop practicing, either temporarily or forever, during the initial treatment phase and particularly after the initial ten week treatment program. In an attempt to explore what was disturbing about the experience, patients described how they became increasingly aware of the following kinds of disturbing issues: loneliness; how different they were from other people; death. During the practice sessions many patients remembered family members dying, began to think about their own death, loneliness, separation, and so on.

To begin to assess whether this seeming fear of being alone or awareness of their separateness in the world predicted relatively successful learners from those patients who did not demonstrate any sustained blood pressure reductions, the following test was administered: All patients in the active treatment conditions were given three TAT cards (numbers 14, 8GF, and 12M) during the post-treatment evaluation. Standard TAT administration was followed (Rapaport, Gill & Schafer, 1968). These TAT cards pull for themes related to aloneness, loneliness, death, suicide, worries and hopes, and attitudes towards passive dependency. As Table 6 depicts, successful learners had a significantly lower number of disavowal/negation statements (e.g., "She's not lonely," "He looks like he's sleeping and he is definitely not going to die") and a shorter latency period (e.g., amount of time between taking the TAT card and actually beginning to articulate the story) than those subjects who did not demonstrate any sustained reduction in blood pressure.

Table 6

Comparison of Successful vs. Unsuccessful

"Self-Regulators" on Two Affective Measures

		Successful Learners (N=11)	Unsuccessful Learners (N=9)
A.	Median number of disavowal/negations on TAT stories	1.17	5
B.	Median latencies on TAT stories (in seconds)	9"	29"
		Mann Whitney U	
	A.	96	$p < .01$*
	B.	78.5	$p < .05$*

*(two-tailed)

Although this post hoc measure did differentiate successful versus unsuccessful learners, it is difficult to define what exactly this measure measures. We may speculate, however, that the stimuli was more frightening to those subjects who did not demonstrate successful learning. In other words, their higher number of disavowal and negation statements reflected a need to deny disturbing associations. It is, however, premature to speculate whether this fear is related to a fear of being alone or any number of other equally plausible explanations. Why latency time would differentiate the two groups is somewhat confusing. One might speculate that if the stimuli were frightening, a delayed association would also serve a protective function. On the other hand, fearful associations might also facilitate impulsivity.

In summary, the experience of successfully learning to regulate normally involuntary physiological processes results in concomitant attentional and perceptual restructuring. Self-regulation training also seems to result in alterations in tactile sensitivity in both the state (Cohen, 1979) and trait related fashion. These attentional, perceptual and threshold related processes may represent psychological mechanisms or processes that allow and/or determine successful autonomic self-regulation learning.

Toward a Psychological Theory of the Voluntary Control of Internal States

In light of the present results, it is suggested that the capacity to regulate normally unconscious physiological processes may

reflect a reorganization of both somatic and cognitive networks. It is suggested that self-regulatory learning takes place as a function of enhanced attentional capacities. Learning to voluntarily control internal states may represent learning to voluntarily control attentional and perceptual processes. However, the developing ability to voluntarily deploy attention and sustain attention, as well as being able to disembed the "figure from the ground," may constitute only a first phase in a complex sensory motor learning process. It is suggested that as the individual develops these attentional skills, there is an increasing experience of de-automatization (e.g., an interruption and undoing of action and internal processes which have become routine and automatic) which may act to lower sensory thresholds. These variables, de-automatization and lower sensory thresholds, may allow the individual to become conscious of normally involuntarily and unconscious internal events and thereby support the developing ability to regulate them.

By deploying attention to internal states, self-regulation procedures minimize interaction with the external world and tend to interrupt stimulus-novelty. As research from the fields of hypnosis, sensory deprivation, and meditation have shown, this acts to cause information processing mechanisms (e.g., categorization) to become de-automatized (Gill & Brenman, 1959; Cohen et al., 1962; Deikman, 1966). The notion of de-automatization was developed by Gill and Brenman; the term refers to the re-organization of actions and internal mechanisms which have become routine and automatic (i.e.,

automatized), and hence function without conscious effort or direction. In self-regulation training we reinvest attention in simple perceptual events while deinvesting attention from higher thinking processes. It seems likely that as a result physiological, cognitive and affective processes that were routine, automatic and "outside" of conscious awareness may enter the realm of consciousness.

If self-regulation training does result in significant cognitive changes, as the results from this study suggest, we must understand this process from a temporal perspective. In a phenomenological analysis of one form of meditation (which implies one mode of attentional functioning), Brown (1977) described how over time meditation practice results in a systematic and progressive "destructuring" of perceptual and cognitive operations. What is particularly interesting is that this process seems to occur developmentally in the reverse order of that of the child, as described in the developmental theories of Jean Piaget. This suggests that research in self-regulation and all of the so-called altered states of consciousness must understand change within a developmental context. Alterations in sensory thresholds may be one of the results of internal focusing attention and the de-automatization process. These alterations in sensory threshold levels may allow for an increased awareness of internal states.

Although cognitive functions play a central role in the voluntary control of internal states, emotions and associated memories may also be fundamental components in this learning process. Emo-

tions motivate and may thus support or inhibit learning. The capacity to voluntarily control internal states may in fact be predicted by certain aspects of our emotional life.

In the process of undergoing autonomic self-regulation training, we flounder in a state where there is little orientation. The following common clinical reports of the biofeedback/self-regulation treatment experience illustrate this process of de-automatization: decreased ability to abstract and generalize; difficulty in logical thinking or problem solving; disorganization of thought and inability to concentrate; alterations in the individual's perceptions of his body and the surrounding physical environment; visual and auditory imagery; inaccurate perception of time; difficulty differentiating ideas from fantasy, ideas from imagery, ideas from illusory phenomena due to extraneous stimuli; fears of going insane, and of losing the ability to talk or move and fears of dying; memories of loved ones who are dead or unreachable.

Although it is just this state of "unconnectedness" which may in part allow new cognitive-somatic connection to be made (e.g., autonomic self-regulation), it also creates a state which allows and perhaps even fosters impulses, primitive emotions and memories to stir. I suggest that this dissolving of boundaries and connections may evoke the archaic fear of being alone. Although a variety of factors that help to define the self-regulation training experience (such as radical cognitive shifts, physical isolation, low arousal and psychological uncertainty) may help to explain how these fears

are generated, there is no "realistic" way of completely explaining the unconscious fear of going into deeply relaxed states--just as there is no "realistic" way of understanding a child's fear of the dark. The origin of this fear probably rests on the fact that as infants, we are totally dependent on others for survival. Being alone for an extended period will result in death. As Bowlby (1973) describes:

> A tendency to react with fear to each of these common situations--presence of strangers or animals, rapid approach, darkness, loud noise, and being alone--is regarded as developing as a result of genetically determined biases that indeed result in a "preparedness to meet real dangers." Furthermore, it is held such tendencies occur not only in animals but in man himself and are present not only during childhood but throughout the whole span of life. Approached in this way, fear of being separated unwillingly from an attachment figure at any phase of the life-cycle ceases to be a puzzle and, instead, becomes classifiable as an instinctive response of the naturally occurring clues to an increased risk of danger (Bowlby, 1973, p. 86).

I think that the ongoing practice of relaxation and self-regulation procedures may activate the experience of being alone. At a literal level, when the patient practices self-regulation procedures, the "other" (be it therapist, family, or friends) usually goes away, leaving the patient in solitude. I think that the actual social aloneness and somatic relaxation stimulates unconscious sensations and memories of others moving away and related emotions of fear. Although not always conscious, the experience of "<u>others moving away</u>" is anxiety provoking.

I think that the experience of "others moving away" and the

fear of being alone may motivate individuals to stop relaxation/self-regulatory practice. As a defense against anxiety, patients may become "bored," "disinterested," or "forgetful" with home practice. (Practice of relaxation and self-regulation exercises is essential for the long-term assimilation of autonomic self-control into everyday life.) This "bordeom" and "forgetfulness" may psychologically represent the patient's moving away from an anxiety-provoking experience. Motivation not to practice may be experienced in both the initial treatment phase and particularly when the patients are, for all practical purposes, practicing on their own. It is not surprising that the fear of being alone would become heightened when the patient is practicing without the emotional support and attention of the therapist. In fact, this fear may help to explain a current clinical enigma; why so many individuals who initially demonstrate autonomic self-control abilities later stop practicing, even when this may significantly aggravate psychosomatic disorders and personal discomfort.

In light of this, it is suggested that the therapeutic alliance is a critical factor in successful self-regulation treatment, for it provides an unconscious counter-balance to the potentially overwhelming fear of being alone and a medium for working with these fears. At an unconscious level, I believe that the therapeutic relationship prevents the fear of being alone from becoming a major source of resistance in the initial treatment phase. It is a common occurrence that patients can both relax more easily in the office

than at home, and describe how they reassuringly imagined hearing the voice of the therapist during home practice. It may only be by providing an environment of safety that the therapist can help his patient to learn to relax and voluntarily control internal states. My own clinical observations suggest that for a significant number of patients either the self-control procedures or the therapeutic relationship alone is ineffective, but rather the combination of the two enables successful learning to occur.

The process of discovering new parts and inter-relationships within oneself--be it autonomic or otherwise--and the ability to integrate this learning into everyday life may be more dependent on the therapeutic relationship than we have realized. If the therapeutic environment is experienced as much more safe and conducive to self-regulatory learning than home practice, perhaps we need to ask ourselves how we can best allow patients to "internalize" the therapeutic relationship into their own lives. Initially this "environment" helps to regulate forces that interfere with the learning process for the patient. These forces that we attempt to regulate for the patient include both external and internal factors. There are a variety of environmental factors (e.g., loud noises and people inadvertently walking into the treatment room) and internal concerns (e.g., the fear of being alone) that may interfere with this learning process. I think that it is important to recognize that the therapeutic environment consists of interpersonal, emotional, procedural, spatial and temporal factors, combining to provide a model

that patients adopt as they gradually integrate self-regulatory learning into their lives. If eventually the patient, for whatever reason, is unable to adopt, integrate or internalize this environment, I think that long-term assimilation of learning will tend to fail.

The fear of being alone may be a factor that inhibits autonomic self-regulatory learning. However, self-regulatory learning may also increase the emotional capacity to be alone for some individuals. By "being alone" I mean an existential and emotional sense of one's separateness. I am not speaking of literally being alone, or when we fantasize that we are with "others." I am not speaking of an anxious sense of loneliness or a defensively withdrawn state that often implies an expectation of persecution. I think that the capacity to be alone on an emotional level represents a highly developed sense of autonomy or individuation. I think that cognitively the capacity to voluntarily regulate autonomic states represents a highly developed level of attentional functioning. When we develop the latter--as in self-regulation treatment--we may indirectly aid in the capacity to be alone, because the practice itself invites the discovery of new parts of ourselves and the experience of our essential aloneness in the world.

To be alone in the sense that I am using it, depends in part on the extent of our self-awareness. As successful self-regulatory treatment enables us to become aware of "new" aspects of ourselves, it aides in our capacity to be alone. Winnicott (1958) suggests

that the capacity to be alone depends upon the experience "of being alone, as an infant and small child, in the presence of the mother" (p. 36). In self-regulation training, it is the therapist (like the mother with the infant) who assists and validates the reality of discovering "new" parts of the patient, and the experience of separation. Although biofeedback hardware significantly aids the sensory recognition process, the patient often needs to have the reality of sensation (not to mention imagery, ideation and emotions) validated, for they are often novel, bewildering and at times frightening. It may only be via the therapist's validation of these experiences that the patient comes to accept these parts of himself. Thus, in a fundamental sense, the therapist may allow the patient to be alone with his "hidden" parts. The discrimination, recognition and acceptance of internal states may enable self-regulation to occur, and may simultaneously enable a developing capacity to be with new parts of oneself, to be alone. This raises a number of questions: Do individuals at different psychological levels of maturity or individuation, have differing capacities to learn autonomic self-regulation? Will successful training increase psychological maturity in all individuals, or only those who have reached a certain level of individuation or emotional development? Even if self-regulation training increases our awareness of new parts of ourselves, does it also support an integration of this awareness into everyday life?

In summary, it has been suggested that before we may fully interpret physiological information in biofeedback/self-regulation

learning, we must understand the psychological organization of the learner. Although the nature of biofeedback learning is multi-determined, little attention has been paid to the social, emotional and cognitive processes that enable and/or inhibit autonomic self-regulation.

Biofeedback/Self-Regulation Procedures as a Therapeutic Approach

The results of the current study support the notion that biofeedback/self-regulation procedures may be a useful approach for essential hypertensive adults to regulate blood pressure, when used in conjunction with the therapeutic relationship. It is suggested that each treatment program should be individually tailored for each patient to insure maximal clinical efficacy and that the potentially disturbing aspects of the self-regulation practice be recognized and perhaps even anticipated by the therapist. However, it is premature to speculate on the therapeutic merits of these relaxation/biofeedback procedures without more long term follow-up data. For instance, it is possible that many patients who in fact learn to voluntarily regulate blood pressure and other physiological processes will stop self-regulation practices after the initial treatment phase. This will result in all likelihood in a return to pretreatment pressure levels. This would raise serious questions about the therapeutic value of biofeedback/self-regulation procedure as a short term treatment. Research in how long patients need to continue relaxation/self-regulation practice to maintain sustained reductions and what

factors support (and inhibit) home practice is sorely needed. Research of this kind will help to answer the question of how useful biofeedback and self-regulation procedures are as a therapeutic approach.

Furthermore, the importance of the therapist-patient relationship per se, is an important aspect of self-regulation treatment programs that needs to be more fully understood to assess the value of biofeedback/self-regulation procedures as a therapeutic approach.

Suggestions for Further Research

From the perspective of both methodological and clinical/theoretical issues, the results of the current study suggest a variety of further research questions, some of which have already been mentioned above. Regarding the physiological data of this study, it would be worthwhile to assess in a series of controlled comparison studies, the relative importance of various potentially therapeutic factors in self-regulation learning (e.g., biofeedback, amount of contact with the therapist, various kinds of cognitive/somatic strategies alone and in various combinations). As mentioned above, it will also be important to understand how long patients need to continue to practice relaxation/self-regulation procedures in order to maintain sustained reductions. Long term follow-up studies are in order at this time.

It would also be of interest to assess whether the attentional and perceptual changes noted in this study remain stable over time. It would be theoretically important as well to assess how other

aspects of cognitive and emotional processes were effected during this type of learning. For example, as perceptual disembedding abilities overlap with one's general intelligence, it will be important to differentiate the relative importance of the two cognitive indices in the voluntary control of internal processes. This will enable a more comprehensive understanding of the role of psychological processes in autonomic self-regulation learning to be developed. In particular it is important that those factors that inhibit learning be more fully understood. Furthermore, understanding the developmental nature of these changes (e.g., attentional restructuring) over time provides an interesting opportunity to examine how learning occurs.

Another very important and exciting area of study is the relationship between autonomic learning and individual differences. What impact a variety of personality factors have on successful learning will further help to clarify the nature of autonomic learning.

Appendix A

Individual Change Scores

Subject	(Decrease in) Post Blood Pres.	Fol-up Blood Pres.	EFT	BD	PC	DS	Absorp.	Right Von Frey	Left Von Frey
Biofeedback Group									
1	14/26	18/26	50	5	1	2	4	.12	-.34
2	12/20	6/14	47	4	5	2	2	.81	.12
3	12/4	+2/+4	50	4	2	2	3	.10	.47
4	10/22	0/14	27	2	2	0	-3	.31	-.05
5	6/4	2/6	52	9	3	1	5	.08	.49
6	18/0	0/+4	5	-1	0	0	10	-.31	-.24
7	20/12	22/12	2	0	2	0	0	.51	.14
8	28/20	+10/10	37	6	2	2	0	0	-.34
9	26/8	20/4	14	1	2	0	9	.32	.23
10	20/10	22/12	27	3	3	0	-1	.39	.11
Relaxation Group									
11	14/10	14/0	28	0	-1	1	-1	.42	.49
12	+40/+8	+20/+2	2	-4	0	-2	-5	.06	.03
13	+4/+10	0/+6	0	0	0	0	8	.35	.13
14	+10/6	+12/6	7	0	7	1	-2	.31	-.19
15	+4/4	+4/2	20	0	0	2	1	-.34	-.20

Individual Change Scores, continued

Subject	(Decrease in) Post Blood Pres.	Fol-up Blood Pres.	EFT	BD	PC	DS	Absorp.	Right Von Frey	Left Von Frey
Relaxation Group, continued									
16	0/0	0/0	0	0	0	0	0	-.01	0
17	+8/+4	0/+2	0	-1	-1	-1	0	.14	.12
18	24/10	10/2	43	0	0	4	-1	.13	.33
19	8/6	8/2	8	0	1	1	0	.18	.04
20	4/4	6/6	29	1	0	3	2	.02	0
Control Group									
21	4/+2	0/0		-1	-1	0	0	-.31	-.33
22	0/4	+10/+6		0	0	0	2	-.21	.19
23	0/0	0/0		1	5	-1	-1	-.06	-.40
24	0/0	0/0		3	-1	-1	2	.40	-.22
25	0/+2	0/+2		0	-1	0	-1	.00	.02
26	2/0	+2/0		0	0	0	0	-.02	-.01
27	+2/4	0/2		4	0	0	-1	.34	.26
28	0/0	0/0		-4	0	1	-3	.34	.20
29	0/+2	+6/+6		0	0	0	0	0	0
30	0/+4	0/0		-1	0	0	5	.03	-.27

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