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The Effects of Instructions and Cue Controlled Relaxation Training on Cardiovascular Reactivity to Social Stressors

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THE EFFECTS OF INSTRUCTIONS AND CUE CONTROLLED RELAXATION TRAINING ON CARDIOVASCULAR REACTIVITY TO SOCIAL STRESSORS

by

Patricia A. Fettes

A Thesis Submitted to the Faculty of The Graduate College in partial fulfillment of the requirements for the Degree of Master of Arts Department of Psychology

Western Michigan University Kalamazoo, Michigan August 1986
Cue controlled relaxation (CCR) training was compared to simple instructions to relax and control blood pressure on the basis of their effects on cardiovascular reactivity to role played social stressors. The CCR intervention consisted of training subjects to say a cue word ("calm") that had been previously paired with muscular relaxation responses, during presentation of stressors. The instructions intervention was associated with significant reductions in blood pressure reactivity, regardless of whether this condition preceded or followed the CCR condition. Factors that may relate to the relative ineffectiveness of CCR are discussed, as well as those that may have been responsible for the effectiveness of instructions. This study lends support to previous research suggesting that cardiovascular reactivity can be attenuated without specific behavioral training, and demonstrates a need in future research on behavioral interventions for cardiovascular reactivity to separate the effects of instructions alone from effects of specific treatments involving instructions.
ACKNOWLEDGEMENTS

I would like to express deep appreciation to several people who provided invaluable help throughout this study. Without the assistance of Wayne Fuqua, Bernie Pinto, Sue Keller, and especially my patient husband Mark, this thesis would not have been possible.

Patricia A. Fettes
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INTRODUCTION

Coronary heart disease (CHD) is the leading cause of death in many industrialized countries, including the United States. The disease, of which there are many types, will strike one man in five, and one woman in 17, by the age of 60 (Castelli, 1984). Hypertension has been estimated to affect 15% of the U.S. population, approximately 25 million persons (Hypertension Detection and Follow-up Program Cooperative Group, 1979; Kannel & Dawber, 1973), and if left untreated can lead to CHD, heart failure, stroke, kidney failure, and blindness (e.g., Herd & Weiss, 1984). The staggering physical, social, and economic costs of these diseases have prompted researchers to investigate methods of predicting and controlling cardiovascular pathologies. Various risk factors, such as elevated blood pressure, elevated serum cholesterol, and cigarette smoking, have been associated with the incidence of CHD (e.g., Rosenman, Sholtz, & Brand, 1976). However, taking these traditional risk factors into account, only about 50% of the incidence of CHD is predicted (Keys, 1972).

The search for alternative predictor variables has led scientists to the notion that psychological stress may contribute to pathology. The Type A behavior pattern, characterized by time urgency, competitive striving, and
hostility, has been established as a separate risk factor for CHD (Rosenman et al., 1975). Although this behavior pattern accounts for only a small portion of morbidity, and although recent evidence suggests that the hostility component of the Type A pattern may account for most of the CHD risk (e.g., see Lenfant & Schweizer, 1985), these findings lend support to the notion that stressful stimuli and behavior styles interact with physiological processes, and may increase the risk of cardiovascular disease.

The processes that mediate between stress and disease have not been clearly established, although a number of potential mechanisms have been suggested. One theory is that emotional stress elicits various physiological reactions which activate the disease process (e.g., Obrist, 1981). This idea is supported by evidence that humans exposed to laboratory stressors (e.g., timed arithmetic problems) experience marked reactions in cardiovascular measures as well as other physiological indices, such as plasma and urinary catecholamine levels (e.g., Brod, Fenc1, Hejl, & Jirka, 1959; Frankenhaeuser, 1971).

Krantz and Manuck (1984) recently reviewed hypotheses and evidence regarding a relationship between physiological reactivity to environmental stimuli and the development of CHD and essential hypertension. Many researchers suggest that injury to the inner walls of coronary arteries can be caused either mechanically, by increases in
cardiac output, or chemically, by the release of toxic blood lipids and endocrines, such as catecholamines (e.g., Krantz & Manuck, 1984). Arterial damage in turn leads to an accumulation of smooth muscle cells and cholesterol in the vessels (atherosclerotic plaque), which is believed to contribute to essential hypertension and CHD. Regarding essential hypertension, Obrist (1981) has additionally suggested that stressful stimuli which promote active coping behavior in the individual serve to heighten peripheral vasculature resistance over repeated presentations, resulting in a continual state of elevated blood pressure. Despite research on these and other models, Krantz and Manuck (1984) concluded that excessive cardiovascular (CV) reactivity should not yet be regarded as an established risk factor for CHD, but stated that the evidence is suggestive, and warrants further research.

In accordance with the hypothesis that excessive physiological reactivity to psychological stress potentiates CV disease, researchers in recent years have attempted to modify reactivity to laboratory stressors via psychological and pharmacological treatments. These treatments include relaxation training (e.g., Bradley & McCanne, 1981; Connor, 1974; English & Baker, 1983; Green, Webster, Beiman, Rosmarin, & Holliday, 1981; Harris et al., 1984; Hiebert, Cardinal, Diemka, & Marx 1983; Kallinke, Kulick, & Heim 1982; Lehrer, Schroikett,
Various relaxation training methods, including progressive muscle relaxation, autogenic relaxation (emphasizing muscle warmthness/heaviness and imagery), and training in the "relaxation response" (Benson, 1975) have been employed to reduce CV reactions to laboratory stressors, such as slides or films of accidents and surgical procedures, reaction time tasks (i.e., pushing a button as quickly as possible after hearing a tone), mental arithmetic tasks, and aversive tones and lights. A number of CV measures were assessed during both resting and stress periods to obtain an index of reactivity based on the amount of change between the two periods. These measures
include heart rate, blood pressure, pulse transit time (the interval between the onset of a pulse in the heart and the peripheral detection of that pulse--relating inversely to blood pressure), and finger temperature (an index of peripheral blood flow). Several investigators reported that at least one index of CV reactivity to stress was lessened in relation to control groups or pretreatment levels following relaxation training (e.g., Bradley & McCanne, 1981; Connor, 1974; English & Baker, 1983; Kallinke et al., 1982; Puente & Beiman; Steptoe, 1978; Steptoe & Greer, 1980; Steptoe & Ross, 1982). The reductions range from moderate attenuation (e.g., English & Baker, 1983) to virtual elimination (e.g., Steptoe & Greer, 1980) of CV reactivity. Although the results of relaxation interventions are mixed, the trend of the evidence suggests that relaxation training may be an effective treatment for persons experiencing excessive physiologic reactivity.

One of the limitations of previous research in this area has been the reliance on analog situations to elicit stress reactions. The relatively contrived tasks and stimuli described above are easily controlled in a laboratory situation, but are of questionable similarity to the types of stressful situations typically encountered by the average person in everyday life. While relaxation training may be effective in reducing CV reactions to
mental arithmetic tasks and slides of surgical procedures, its clinical value lies in the possibility that reactivity to naturally occurring stressors is lessened as well. A main purpose of the present study was to determine whether progressive muscle relaxation training would attenuate physiological reactions to more naturalistic laboratory stress situations: role played scenarios of common situations, such as being interrupted when in a hurry, having to confront an employee about poor work performance, or a minor automobile accident.

A second aspect of this study which has not been addressed by previous literature relates to the logic of using relaxation training to reduce stress reactions. Relaxation training, when practiced frequently, has been demonstrated effective in reducing resting levels of heart rate and blood pressure during and between training sessions (e.g., Graham, Beiman, & Ciminero, 1977; Taylor, Farquar, Nelson, & Agras, 1977). However, practicing progressive or autogenic relaxation exercises whenever confronted by stressful situations would be inconvenient and probably embarrassing for the user, and may even preclude the accomplishment of other tasks. Simply instructing the subject to recall the relaxation during stressor presentation was associated with lessened reactivity in previous studies (e.g., Connor, 1974; Steptoe, 1978; Steptoe & Ross, 1982). The basic relaxation-by-recall method was
augmented in this study with a variation on the counting recall technique described by Bernstein and Borkovec (1973). Rather than cueing relaxation by counting, however, subjects were asked to pair covert verbalizations of a cue word (i.e., "calm") with the relaxing of muscles during progressive relaxation training and practice exercises, and later cue relaxation during stressor presentation by repeating the word (this method was described by Harris, et al., 1984). This technique, called cue controlled relaxation (CCR) may be a practical solution to the problem of reducing CV reactivity to stressful stimuli at times when relaxation exercises would be inconvenient.

A final purpose of the present research was to examine the effects of simply instructing subjects to relax and control their blood pressure during stressor presentation, prior to CCR training. Previous research suggests that simply telling subjects to relax may be as effective as specific relaxation or biofeedback training in reducing CV reactivity to psychological stressors (e.g., Puente & Beiman, 1980; Steptoe, 1977). To detect such effects in this study, a subset of subjects participated in a phase (prior to CCR training) in which they received instructions to relax and control their blood pressure during role plays via any methods they typically used outside of the laboratory setting. Any additional reductions in CV reactivity observed following CCR training would suggest
that the treatment was effective. Another subset of subjects participated in the instructions phase following the CCR phase, to examine whether treatment effects can be enhanced with additional instructions.

The instructions component of the study will address the possibility (suggested by research cited above) that formal relaxation training may not be essential in reducing CV reactivity. If CV reactivity is attenuated following simple instructions to relax and control blood pressure, future research might be better directed at discovering the mechanisms by which such instructions function, rather than simply developing relaxation training methods, which may also involve various instructions, but which are ultimately more time consuming and costly than instructions alone. It is important to note, however, that relaxation might not be the universal mechanism by which these instructions function. Currently there is little evidence that any subjects relax muscles (as determined by electromyographic activity) on command (e.g., Paul, 1969). Lowered CV reactivity following such instructions may be produced by means other than relaxation (e.g., breathing regulation or postural changes).
METHOD

Subjects

Of forty university faculty and staff members whose blood pressure measurements had fallen in the borderline range (systolic: 140-158 mmHg and/or diastolic: 90-94 mmHg) during a campus-wide blood pressure screening, eight volunteered and seven (five men, two women) participated to the conclusion of the study. The age range was 44 to 63. One subject (S3, female) had been prescribed a diuretic antihypertensive medication (Oretic, 50 mg. daily) prior to the study, and continued to take the medication without prescription changes throughout her participation. Another subject (S4, male) was prescribed antihypertensive medication one week following his final experimental session (prior to the follow-up session). No other subjects were taking antihypertensive medications. Medical approval to participate was obtained from the personal physicians of all subjects. None of the participants reported prior formal training in relaxation.

All subjects signed informed consent agreements specifying potential risks and benefits of participation, and outlining precautions for confidentiality. Additionally, participants agreed to make no major changes in their dietary or exercise patterns during the course of 9
the study, and to notify experimenters if such changes were unavoidable. Subjects were paid a small fee for each experimental session, and a bonus at the conclusion of the study.

Setting

All sessions were conducted in a small laboratory room containing two lounge chairs (for subject and role play actor). Behind the subject's chair was a carrel housing physiological recording equipment, and shielding it and the experimenter from the view of the subject and actor.

Apparatus

Blood pressure (BP) and heart rate (HR) were measured with an self-inflating digital sphygmomanometer (Carolina Biological Supply, Model 69-1118). A standard mercury sphygmomanometer was employed during the initial sessions to assess BP for purposes of setting the inflation level on the automatic sphygmomanometer. Periodic checks with a stethoscope revealed that detection of Korotkoff sounds by the in-cuff microphone of the automatic sphygmomanometer was generally 100% accurate, and never inaccurate by more than two Korotkoff sounds.

Frontalis electromyographic activity (EMG) and finger electrodermal activity (EDG) were monitored with a three component system manufactured by J & J Electronics (EMG
Model M-52; EDG Model R-72; Digital Integrator Model D-200). A portable computer (Texas Instruments Model TI-99/4A), standard television monitor, and joystick were used for presentation of a video game (Texas Instruments TI Invaders) for one subject who displayed limited reactivity to social stressors. Three standard audiocassette tapes were provided to each subject during progressive muscle relaxation (PMR) training.

Dependent Variables

Physiological Measures

Systolic and diastolic blood pressure (SBP and DBP) and HR were the primary dependent variables. EMG and EDG were recorded as measures of muscle tension and emotional arousal. For each physiological measure, average reactivity values were individually calculated for each subject via the following method: (1) all rest period values within a session were averaged; (2) all stress period values within a session were averaged; (3) the rest period mean was subtracted from the stress period mean.

Self-Report Measures

Following each rest and stress period, subjects provided a rating of their average anxiety during the previous period using a 0-100 subjective units of
disturbance scale (SUDS; 0 = minimum anxiety). They also estimated their average BP during the previous period.

Questionnaires

Prior to participation, subjects completed a Participant Information Form, which solicited information regarding personal and family history of cardiovascular disorders, use of antihypertensive medications, dietary and exercise patterns, weight, and degree and types of life stresses. Similar questionnaires were given following the study to determine if changes had occurred which may have impacted BP.

A participant satisfaction survey was administered following the study and at follow up sessions to obtain subject ratings of ease and frequency of CCR application, intensity of distress experienced from daily stress, and satisfaction with participation in the study.

Two standardized inventories were administered prior to and following the study. The Jenkins Activity Survey Form C (Jenkins, Zyzanski, & Rosenman, 1971) provided an index of the Type A behavior pattern. The Daily Hassles and Uplifts Scale (Kanner, Coyne, Schaefer, & Lazurus, 1981) was administered to determine the range, severity, and types of everyday stressors experienced by the subjects. Responses made on this inventory were also used to
develop scripts for idiosyncratic role play stressors for each subject.

Experimental Design

A multiple baseline across subjects design was employed with two groups of subjects. Subjects were matched by sex and randomly assigned into one of two treatment groups. Each group originally contained four subjects. However, due to one dropout, and the removal of another subject who experienced limited reactivity to social stressors (S7, who was later assessed separately using video game play as a stressor), Group 2 contained only two subjects. The groups differed only with respect to the sequence of treatment conditions, with Group 1 receiving the CCR phase following baseline and instructions phases, and Group 2 receiving the instructions phase following baseline and CCR phases. Follow up sessions were scheduled at approximately 6 and 12 weeks following the final experimental session for each subject.

Procedure

Experimental Stressors

Role Plays

Seven standardized role play scenarios were developed. Each consisted of a brief description of a stressful
social interaction and the role to be assumed by the subject. Examples of standardized scenarios included: the subject is interrupted while hurrying to an important meeting; the subject is a professor who must confront a student suspected of academic dishonesty; the subject was involved in a minor traffic accident with an irate driver. Actors received written instruction which outlined their roles and provided examples of statements that might be delivered during each scenario. In an effort to standardize the "stressfulness" of each scenario, actors were coached to consistently act the role as described.

Several idiosyncratic role play scenarios were developed for each subject based on information solicited in the Hassles and Uplifts Scale and during an interview about personal sources of stress.

**Video Games**

One subject (S7) was instructed to play a video game (TI Invaders) during stressor periods, and to score as high as possible. Skill Level 1 was selected because the subject had never been exposed to the game prior to the study.

**General Experimental Procedures**

Subjects participated individually during all sessions. The following procedures were generic to all
experimental sessions regardless of phase. Those procedures that were specific to each phase are described in later sections. During all experimental sessions, the subject was escorted into the laboratory room, and physiological recording equipment was attached. The experimenter was seated at the carrel throughout the session (except while reading instructions) to record physiological measures. The subject was asked to sit quietly and relax during a five-minute adaptation period and subsequent five-minute rest period. BP and HR were measured during the second and fourth minute of the rest period, and one-minute averages of EMG and EDG were sampled at the first, third, and fifth minutes of the same period. Following the rest period, the experimenter obtained estimates of anxiety and BP, and read aloud the description of the first role play. The subject was instructed to interact with the actor until told to stop. A three-minute role play began when the actor entered the room. BP and HR were monitored at the first and third minute, and EMG and EDG were averaged over the three minute period. Following the role play the actor exited, and the subject was again asked for estimates of anxiety and BP. Rest and stress periods were then alternated until the subject had participated in three different role plays.

Due to practical considerations, four actors were varied across sessions for all subjects except one (S1)
who role played with the same actor throughout the study.

Experimental Phases

Baseline

Only standardized scenarios were presented in the initial baseline session. Subsequent baseline sessions were very similar, but novel role plays, both standardized and idiosyncratic, were presented. By the end of the third baseline session, the subject had participated in nine different role plays. At this point, the scenario that had elicited the greatest overall BP reactivity for a subject (SBP change plus DBP change), and the two that had elicited the least BP reactivity, were dropped. This left a unique set of six stressor scenarios for each subject, which were alternated throughout the remaining baseline and intervention sessions. Scenarios were ranked and matched for each subject based on reactivity, so that each subsequent session consisted of three role plays that, when averaged, had elicited approximately equal BP reactivity for that subject.

Instructions

During this phase, subjects were instructed to relax and attempt to control their BP using any techniques they had used in the past. The instructions were modified for
Group 2 subjects, who participated in this phase following the CCR condition; these instructions stipulated the use of any methods including, but not limited to, CCR.

**Cue Controlled Relaxation**

**Relaxation Training.** Subjects initially participated individually in PMR training sessions. These consisted of instruction and practice in standard PMR, using the procedures outlined by Bernstein and Borkovec (1973), while all physiological measures were monitored. Trainers said a cue word ("calm") aloud when instructing subjects to relax their muscles, and additionally asked subjects to say the cue word to themselves while relaxing. The following criteria were established to serve as evidence of training effects: (1) EMG levels at or below 3 microvolts following training; and (2) subjects' reports of reduced muscle tension on a 0 - 100 rating scale (0 = minimum tension) following training, relative to their tension rating prior to training. Only one subject (S2) failed to meet these criteria after one relaxation session and was scheduled for an additional training session to meet the requirements.

Following training, subjects received three audio tapes that progressively shortened the relaxation exercise sequence, and added autogenic imagery. All tapes presented the cue word ("calm") at appropriate points, and
encouraged subjects to say the word as well. Subjects were instructed to listen to the series of tapes at least once, and strongly encouraged to do so more than once. They were provided recording forms on which to note pre- and postpractice tension levels (on the 0 - 100 scale) and to record the three "secret words," one of which was embedded at an undisclosed point during each tape. This latter component was employed to insure that each subject listened to each tape at least once. Subjects were scheduled for CCR sessions after they reported that they had listened to all tapes (they were allowed one to two weeks for this task), and experienced at least a 10-point drop in muscle tension during each tape session (unless pre-practice rating was less than 10).

**CCR Sessions.** During CCR sessions, subjects were instructed to relax and control their BP while role playing by prompting muscle relaxation through the use of the cue word. The use of the word was insured by requiring subjects to say "calm" aloud at least twice during the role play (with prompting from the experimenter if the cue word had not been said by the time the role play was half over).

**Follow Up**

Subjects were scheduled for follow up sessions at approximately 6 and 12 weeks (Subject 4 was not available...
for the 6 week follow up and Subject 7 was unavailable for the 12 week follow up). During follow up sessions, subjects were instructed to relax and control their BP using any available methods including, but not limited to, the cue word. Use of the cue word was silent rather than aloud.

Variations

**Feedback Condition**

Subject 4 experienced a less than 4% decline in degree of BP reactivity following either intervention phase. He subsequently participated in a three session feedback phase in which the experimenter read aloud each BP measurement as it was taken during rest and stress periods. The subject was instructed to use this information to aid in the control of BP.

**Video Game Conditions**

Following the baseline sessions with social stressors, Subject 7 participated in a three session baseline phase in which stressors consisted of three minutes of video game play. He was instructed to score as high as possible, and to read his game scores aloud before beginning new games. Following this baseline he participated in the CCR condition consisting of PMR training and CCR
sessions in which he prompted relaxation by saying the cue word aloud during video game play.
RESULTS

Physiological Measures

Graphic Analysis

Figure 1 displays mean SBP and DBP levels during rest and stress periods across experimental sessions for all subjects. An analysis of this figure supports the following conclusions: (1) Between subject variability in baseline reactivity was high. (2) BP reactivity tended to drop for each subject by the third baseline session, indicating some physiological habituation to the stressors; reactivity did not totally drop out for most subjects, however. (3) The instructions condition appeared slightly more effective in attenuating BP reactivity than the CCR condition, with the exceptions of Subject 3, who experienced higher BP reactivity levels during rest periods than stress periods throughout much of the study, and Subject 6, who appeared to benefit most from the CCR condition. (4) Although Subject 7 did not experience lessened reactivity to the video games following CCR training, there was an overall shift downward of both rest and stress values between the video game baseline to the CCR condition. (5) During follow up sessions DBP reactivity tended to remain low, while SBP reactivity was...
Figure 1. Mean Systolic and Diastolic Blood Pressure Levels During Rest and Stress Periods Across Experimental Sessions. In all cases the top pair of data points are systolic, while the bottom pair are diastolic.
higher and more variable; follow up reactivity was typically lower than initial baseline reactivity, however.

Statistical Analyses

Table 1 presents the rest and stress period means and standard deviations for Groups 1 and 2 across baseline, instructions, and CCR phases for all physiological measures.

Analyses of Absolute Reactivity

Univariate repeated measures analyses of variance were conducted on the absolute change values between average rest and stress measures (mean stress minus mean rest for each session) across experimental sessions for each physiological measure in Groups 1 and 2 (Subjects 1 - 6). These analyses determined whether absolute reactivity differed significantly across phases. Only the final three baseline sessions for each subject were included in this and all other statistical analyses because initial session reactivity (as well as resting levels in some subjects) was high, perhaps in reaction to the novel laboratory setting, and was not representative of later baseline reactivity. Removing these initial sessions from statistical analyses results in a more conservative test of the differences between phases. Feedback sessions for Subject 4 were also excluded from the analyses, as were
<table>
<thead>
<tr>
<th>Phase</th>
<th>Group</th>
<th>Period</th>
<th>SBP (mmHg)</th>
<th>DBP (mmHg)</th>
<th>HR (bpm)</th>
<th>EMG (uV)</th>
<th>EDG (mV)</th>
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<tr>
<td>Base</td>
<td>1</td>
<td>Rest</td>
<td>127(12.8)</td>
<td>90(6.8)</td>
<td>74(16)</td>
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<td>Stress</td>
<td>135(17.6)</td>
<td>94(8.4)</td>
<td>77(14.9)</td>
<td>4.9(1.6)</td>
<td>10.2(6.0)</td>
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<td>2</td>
<td>Rest</td>
<td>133(15.2)</td>
<td>90(8.9)</td>
<td>67(8.4)</td>
<td>4.3(1.8)</td>
<td>4.0(1.8)</td>
</tr>
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<td></td>
<td></td>
<td>Stress</td>
<td>144(19.1)</td>
<td>99(12.6)</td>
<td>70(9.6)</td>
<td>9.7(0.8)</td>
<td>5.9(2.9)</td>
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<td>Instr</td>
<td>1</td>
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<td>124(10.6)</td>
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<td>77(18.4)</td>
<td>2.6(1.6)</td>
<td>7.1(4.3)</td>
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<tr>
<td></td>
<td></td>
<td>Stress</td>
<td>127(13.8)</td>
<td>89(6.3)</td>
<td>79(13.2)</td>
<td>4.2(0.6)</td>
<td>10.1(5.4)</td>
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<tr>
<td></td>
<td>2</td>
<td>Rest</td>
<td>131(16.3)</td>
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<td>2.8(1)</td>
<td>3.7(1.5)</td>
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<td>Stress</td>
<td>138(16.6)</td>
<td>95(3)</td>
<td>68(6.9)</td>
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<td>CCR</td>
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<td>Rest</td>
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<td>89(4.8)</td>
<td>77(14.9)</td>
<td>2.8(1.5)</td>
<td>8.5(6.4)</td>
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<td>11.3(7.3)</td>
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<td>85(4.4)</td>
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<td>Stress</td>
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<td>11.7(1.6)</td>
<td>6.6(3.5)</td>
</tr>
</tbody>
</table>
follow up sessions for all subjects, because these phases were not standardized across subjects. For treatment comparisons, physiological values observed during the instructions phase for both Groups 1 and 2 were analyzed together, as were those observed during CCR phases. However, the order of treatments was also analyzed as it related to treatment effectiveness.

Systolic Blood Pressure. A main treatment effect was not found for SBP change values, although the probability was near significant at the .05 level: $F(2,8) = 4.56, p = .0637$. Multiple comparisons between phase means (baseline, instructions, CCR) revealed that only instructions phase reactivity was lower than baseline reactivity: $F(1,4) = 16.76, p < .05$. Although CCR phase reactivity was not significantly lower than baseline, it was also not significantly different from instructions phase reactivity. The order of treatments (i.e., instructions before CCR versus after) did not interact with treatment effectiveness. There was a significant effect for sessions within phases ($F(2,8) = 5.86, p = < .05$), and multiple comparisons revealed that reactivity values for the first session within a phase were significantly greater than those observed during the second session of a phase: $F(1,4) = 7.91, p < .05$. Average SBP reactivity was 9.56 mmHg and 4.83 mmHg for sessions 1 and 2 respectively within each phase.
Diastolic Blood Pressure. A main treatment effect was found for DBP change values across phases: $F(2,8) = 10.40, p < .05$. Multiple comparisons between phase means revealed, as with SBP, that instructions phase reactivity was lower than baseline reactivity ($F(1,4) = 51.23, p < .01$), while CCR phase reactivity was not significantly different from that observed during either baseline or instructions phases. As with SBP, the treatment order did not interact with treatment effectiveness.

Additional Physiological Measures. Significant treatment effects were not found (at the .05 level) for absolute change values in either HR, EMG, or EDG, indicating that absolute reactivity on these measures did not differ across experimental phases. Order of treatment did not interact with treatment effectiveness on any of these measures.

Analyses of Adjusted Reactivity Levels

In addition to the above analyses of absolute reactivity levels, univariate repeated measures analyses of covariance were conducted on the reactivity values (mean stress minus mean rest within a session) using the resting value as a covariate across experimental sessions for all measures in Groups 1 and 2. Krantz and Manuck (1984) suggested that covariance techniques are appropriate when baseline measures correlate reliably with the
amount of reactivity observed. Although within subject correlations between resting and change values in CV measures (reported below) were generally low, and highly variable across subjects in the case of BP, these analyses were performed for comparison with those discussed above. However, the results should also be interpreted very cautiously, because for a clear analysis, the covariate should not be influenced by the treatment (Neter & Wasserman, 1974). Obviously, resting values in this study may be affected by the various conditions employed.

**Systolic Blood Pressure.** Pearson correlations between SBP resting and change values for each subject across the entire study ranged from -0.72 to 0.39 ($M = 0.05, SD = 0.41$). In contrast to the analysis of absolute SBP reactivity, a main treatment effect was obtained for SBP change values adjusted for resting values ($F(2,10) = 7.15, p < 0.05$), although none of the multiple comparisons were significant at the 0.05 level. Again, order of treatments did not interact with treatment effectiveness.

**Diastolic Blood Pressure.** Pearson correlations between resting and stress period values for each subject across the entire study ranged from -0.76 to 0.49 ($M = 0.03, SD = 0.42$). As with SBP, there was a main treatment effect for DBP change values adjusted for resting values: $F(2,10) = 7.66, p < .01$. The only significant multiple
comparison was between baseline and instructions phase means ($t_{(10)} = 2.26, p < .05$). Order of treatments did not interact with treatment effectiveness.

**Additional Physiological Measures.** As with the analyses of absolute change values, significant treatment effects were not found for change values adjusted for rest values in HR, EMG, or EDG, indicating that reactivity adjusted for rest levels did not differ across phases. Order of treatment did not interact with treatment effectiveness for HR or EDG, but a significant order effect was obtained for EMG values: $F_{(1,4)} = 208.74, p < .01$. Therefore, order served as an error term in the analysis of treatment effects using adjusted change values for EMG. The order effect can best be explained by the fact that the two subjects in Group 2 experienced much greater EMG reactivity across the study than the subjects in Group 1.

**Analysis of Rest and Stress Levels**

In addition to the above analyses of reactivity levels, univariate repeated measures analyses of variance were performed on combined rest and stress values across experimental sessions for all physiological measures in Groups 1 and 2, to determine whether rest and stress levels varied across phases in unison, rather than simply the amount of reactivity (i.e., rest period levels may
have been reduced as well as stress period values across phases; this may not appear as a significant change in reactivity, but may be important information nonetheless). Significant treatment effects were not observed on these comparisons for any physiological measure at the .05 level, indicating that combined rest and stress levels did not differ across phases.

To determine whether stress period values were significantly greater than resting levels, overall differences between rest and stress values were also analyzed for statistical significance in all measures. Stress period levels were significantly greater overall than rest period levels in the following physiological measures: SBP \( (F(1,4) = 10.94, p < .05); \) DBP \( (F(1,4) = 9.13, p < .05); \) EMG \( (F(1,4) = 12.92, p < .05); \) and EDG \( (F(1,4) = 22.09, p < .05) \). Surprisingly, HR stress period levels were not significantly greater than rest period values, and Pearson correlations between HR rest and stress period values for each subject across phases tended to be negative \( (M = -.34, SD = .08) \) indicating that higher rest period values were associated with lower stress period scores, and vice versa.

Differences between rest and stress period levels within each phase were compared by correlated \( t \) tests for SBP and DBP, to determine whether stress period values were significantly greater than rest period values.
throughout the study, or only during specific phases. For SBP, these $t$ values were only significant in baseline and CCR phases ($t(5) = 3.91, 2.93$ respectively, $p < .05$), but were not significant in the instructions phase for both groups combined. A similar effect was observed for DBP; $t$ values were only significant in baseline and CCR phases ($t(5) = 4.01, 2.74$ respectively, $p < .05$). As with SBP, DBP rest values did not differ significantly from stress values during the instructions condition. These results indicate that SBP and DBP reactivity was reduced in the instructions phase to the point at which stress period levels were no longer significantly higher than rest period levels.

Self Report Measures

Anxiety Ratings

A repeated measures analysis of variance was performed on the change values between mean rest period SUDS ratings and mean stress period SUDS ratings across experimental phases within groups. This comparison was significant for Group 1 only ($F(2,6) = 6.61, p < .05$), although no pairwise comparisons of mean SUDS change values between phases were significant. The mean SUDS change values for Group 1 were baseline: 14.5; instructions: 7.2; CCR: 10.5; these means indicate that reported increases in anxiety for Group 1 subjects were slightly lower during
the instructions phase than during the baseline and CCR phases.

**Blood Pressure Estimates**

Pearson correlations were computed between each subject's actual SBP and DBP values during rest and stress periods and their estimated SBP and DBP value during the same periods across each experimental phases. Table 2 presents the average correlations and standard deviations for all subjects combined.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBP</td>
<td>.37(.34)</td>
<td>.12(.46)</td>
<td>.19(.45)</td>
</tr>
<tr>
<td>DBP</td>
<td>-.09(.47)</td>
<td>-.05(.44)</td>
<td>.12(.60)</td>
</tr>
</tbody>
</table>

In this case Phase 2 refers to instructions for Group 1 and CCR for Group 2, while Phase 3 refers to the opposite combination; these calculations were performed in this manner to determine whether subjects' ability to detect increases and decreases in BP improved over time. Analysis of this table reveals that these correlations tended to be low and highly variable across subjects, but that no major increases in correlation values occurred.
across phases, although DBP correlations moved from negative values to positive.

Questionnaires

Participant Information Forms

Subjects typically reported only small changes in the following areas from the onset of the study to the conclusion: caffeine, alcohol, and sodium consumption; aerobic exercise participation (except Subject 5, who decreased participation from six times weekly to three); stressfulness of everyday life; and weight (+ or - 5 lbs.). All subjects were nonusers of tobacco at the onset and conclusion of the study. Again, only minor changes were observed in these self-report variables across follow up sessions. Medication usage and changes were previously reported.

Satisfaction Survey

Table 3 presents the satisfaction survey administered at the conclusion of the study, as well as mean responses for both groups combined. All questions except number 1 were also administered at all follow up sessions. Responses given at the end of the study were not largely different from responses given at either of the two follow up sessions.
Jenkins Activity Survey

Correlated \( t \) tests were performed on pre- and post-test overall mean values for raw scores, standard scores, and percentile ranks on the Jenkins Activity Survey. None were significant at the .05 level, although mean percentile ranks decreased from 69 to 42, indicating a minor shift from the Type A range to the Type B range.

Hassles and Uplifts Scale

Correlated \( t \) tests were performed on pre- and post-test overall mean values for frequency, cumulated severity, and intensity of both Daily Hassles and Daily Uplifts ratings. While a general decreasing trend was observed in all six values, none of the \( t \) tests were significant at the .05 level.
Table 3

Participant Satisfaction Survey and Mean Ratings

1. How easy was the CCR treatment to understand and apply?

<table>
<thead>
<tr>
<th>Very Difficult</th>
<th>Difficult</th>
<th>Slightly Easy</th>
<th>Easy</th>
<th>Very Easy</th>
<th>Mean Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>4.5</td>
</tr>
</tbody>
</table>

2. Since receiving CCR training, I have used the skills:

<table>
<thead>
<tr>
<th>Not At All</th>
<th>Very Infrequently</th>
<th>Not Infrequently</th>
<th>Frequently</th>
<th>Very Frequently</th>
<th>Mean Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>3.0</td>
</tr>
</tbody>
</table>

3. Before receiving CCR training, stressful situations in everyday life distressed me:

<table>
<thead>
<tr>
<th>Very Much</th>
<th>Much</th>
<th>Not Much</th>
<th>Very Little</th>
<th>Not At All</th>
<th>Mean Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>2.5</td>
</tr>
</tbody>
</table>

4. Since receiving CCR training, stressful situations distress me:

<table>
<thead>
<tr>
<th>Very Much</th>
<th>Much</th>
<th>Not Much</th>
<th>Very Little</th>
<th>Not At All</th>
<th>Mean Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>2.0</td>
</tr>
</tbody>
</table>

5. Please rate how satisfied you are with your success as a participant in this study:

<table>
<thead>
<tr>
<th>Very Dissatisfied</th>
<th>Dissatisfied</th>
<th>Neutral</th>
<th>Satisfied</th>
<th>Very satisfied</th>
<th>Mean Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>3.8</td>
</tr>
</tbody>
</table>
DISCUSSION

The main purpose of this study was to determine whether providing either cue controlled relaxation training or simple instructions to relax and control BP would attenuate physiological reactivity to role played social stressors. During the baseline phase, stressors were associated with significant increases over resting levels for all physiological measures except HR, indicating that social interactions functioned to produce physiological reactivity. Instructions to relax and control BP were accompanied by significant decreases in DBP reactivity to social stressors, and near significant decreases in SBP reactivity, regardless of whether these instructions preceded or followed CCR training. Significant decreases in reactivity were not observed in other physiological measures during the instructions condition. Reactivity was not significantly attenuated on any physiological measure following CCR training.

The clinical significance of the effects of the instructions intervention is unclear, considering the modest evidence relating CV reactivity to CHD risk. During the instructions condition, BP reactivity was reduced below baseline reactivity by approximately 5 mmHg on systolic and by 3-4 mmHg on diastolic. These
reductions are comparable to those observed in previous investigations of specific behavioral treatments (e.g., Kallinke et al., 1982; Ewart et al., 1983). Further research may illuminate whether reductions of this magnitude are clinically relevant. However, some validity is suggested by the fact that BP reactivity during the instructions phase was lowered to the point at which BP values during stress periods were no longer significantly greater than those observed during rest periods.

Physiological reactivity was not significantly attenuated following CCR training. These results lend support to the notion that specific training in relaxation may be unnecessary and perhaps insufficient to reduce CV reactivity to psychological stressors. However, while CCR training did not result in significant reactivity decrements, overall reductions in relation to baseline were observed in the BP reactivity levels of most subjects, and this treatment was more effective than instructions for one subject. Thus, although the trend of the results clearly indicates a need for future research in the area of instructions, CCR training should not be abandoned. Rather, further investigations may seek to improve the effectiveness of CCR in reducing CV reactivity, as well as to determine which subjects may benefit most from this intervention.
The relatively limited effectiveness of CCR training in this study may be due to several factors. First, the CCR method is based on the assumption that subjects learn and apply novel skills. Although frontalis EMG data indicated that some muscular relaxation occurred during training, there exists no physiological evidence of muscular relaxation during CCR phase stressors (i.e., mean EMG levels during CCR phase stressors were well above the 3 microvolt criterion for completion of relaxation training). The lack of significant decreases in EMG reactivity from baseline to the CCR as well as the instruction phase is surprising, given that subjects were trained to a specific EMG criterion during relaxation training; however this finding supports the notion that muscle relaxation skills were not consistently applied during stressors. Secondly, the voiced cue word was employed to aid generalization of relaxation responses to stressor conditions, but may have functioned instead as a distraction, preventing concurrent relaxation responses. Despite subject reports that the CCR intervention was easy to apply during stressors, reported ease of application and actual application may not necessarily correlate.

A third possible reason for the relative ineffectiveness of the CCR method is that despite the EMG criterion, the relaxation training may have been inadequate, due to the relatively brief time period over which it was
administered, and the use of standardized audio tapes for part of the training. Although some researchers have reported reductions in CV reactivity to psychological stress following very brief (one session or less) relaxation training (e.g., Connor, 1974; Steptoe & Greer, 1980), other research suggests that taped relaxation instructions are slightly less effective than live instruction in training relaxation skills (see Borkovec & Sides, 1979). Further research with CCR may address the issues of adequacy of training and application of skills during stressors.

The effectiveness of simple instructions to relax and control BP in reducing CV reactivity to social stressors in this study, while supporting similar results reported by previous authors (e.g., Puente & Beiman, 1980; Steptoe, 1977), poses even more pressing research questions than the relative ineffectiveness of CCR. This finding stands in contrast to previous evidence that simply telling subjects to relax was not associated with CV reactivity reductions (e.g., Falkowski & Steptoe, 1983; McGowan et al., 1979). Methodological or procedural variations may account for these discrepant results, one of which is the difference between the type of stressors employed in this study and in the ones cited above. Interacting verbally with an actor is qualitatively different than solving visual puzzles (Falkowski & Steptoe, 1979) or imagining
covert phobic stimuli (McGowan et al., 1979). However, researchers are only beginning to hypothesize about the critical variables upon which stressors differ with respect to CV reactivity (e.g., see Obrist, 1981, for a discussion of active coping). Therefore, the suggestion that the type of stressor interacted with the treatment effectiveness of instructions must remain speculative at present, until further research can address this possibility. Nonetheless, the stressors employed here were probably better simulations of everyday sources of stress than visual puzzles, and the usefulness of instructions under these conditions provides additional evidence of clinical validity.

Another procedural variable that may account for the contrasting results of this study is that subjects were university professionals who may have been more sophisticated regarding relaxation methods than the university and medical students who served as subjects in the previous studies. A history of using various relaxation techniques may be essential to benefit from an intervention composed solely of simple instructions to relax. Although the relaxation instructions given in this study were very similar to those provided in the previous studies, the subjects in this investigation were also instructed to attempt to control their BP; this minor variation
may additionally account for some of the effectiveness of the instructions intervention here.

The instructions method may have been associated with attenuated reactivity for reasons other than the ones discussed above, one of which may relate to the intensity of the stressors. Although attempts were made to standardize the "stressfulness" of the actors' roles, and although no major differences in intensity between actors or across sessions were noted by experimenters, perhaps actors were less "stressful" during this phase. However, this possibility seems remote, considering that four different actors were employed, and that instructions phase sessions occurred at different points in the experimental design and in time for different subjects.

Given the assumption that the instructions to relax and control BP were responsible for reactivity reductions, these instructions were probably effective through different mechanisms for different subjects. A wide range of methods used for relaxation during this phase were reported by subjects, including: relaxing the muscles of the upper torso, regulating breathing, lowering voice volume, reducing body movement, and using self-verbal instructions (e.g., "stop and give yourself 30 seconds," or "you're getting angry") and interpersonal methods (e.g., staying out of a confrontation; trying to make the actor calm down). Those subjects who received the instructions
condition following the CCR phase reported saying the cue word covertly during instructions phase stressors, but not using PMR skills. Given this variability, any general statement regarding the mechanisms by which instructions function is unwarranted at present, but future research in this area may reveal which techniques are typically employed by which subjects, and the specific methods associated with clinical gains. However, it is important to note that some of these methods were relatively sophisticated, and were probably developed over a much longer period of time than that devoted to learning CCR skills in this study. Persons employing less sophisticated or even ineffective methods of relaxation may benefit from specific training in relaxation skills; this possibility is suggested by the observation that Subject 6, who benefited most from CCR training, reported using mainly interpersonal methods of relaxation during the instructions phase.

The efficacy of simple instructions to relax in controlling CV reactivity in this study as well as others calls into question the interpretation of other behavioral interventions for CV reactivity that include similar instructions as a part of the treatment. Instructions provided during relaxation/biofeedback training and experimental conditions may prompt subjects to engage in these typical methods in addition to or instead of specific treatment responses, thus obscuring the effects of the
intended treatment. Further investigations of behavioral treatments for CV reactivity should include similar instructions conditions, to assess separately the effects of instructions alone versus instructions combined with a specific treatment.

Une minor finding of this study deserves a final note. Subjects were unable to accurately discriminate increases and decreases in BP during rest and stress periods. Unfortunately, the effectiveness of behavioral methods for reducing CV reactivity during stress may be largely dependent on accurate discrimination of physiological reactions to stimuli as a prompt for initiating reactivity attenuating exercises. This is one area in which biofeedback training may provide a distinct advantage over relaxation training, for such equipment may be employed as an adjunct to improve skills in discriminating BP fluctuations during a range of conditions and different BP values.
FOOTNOTES

1 The degrees of freedom were modified using the Greenhouse-Geisser epsilon for the global F tests in order to adjust calculations for the assumptions of the univariate method (see Barckowski & Robey, 1984). These adjusted F values are more conservative than unadjusted F values.

2 The Greenhouse-Geisser epsilon adjustment was not available for multiple comparisons in the statistical package employed, hence this F value may be significant because it was slightly less conservative.
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