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**LA THÈSE A ÉTÉ
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A COMPARISON OF THE BIOFEEDBACK AND COGNITIVE
STRESS REDUCTION METHODS IN COMPETITIVE
MOTOR PERFORMANCE USING PERSONALITY
VARIABLES AS MODERATORS

by Thomas John O'Hara

Thesis presented to the School of Graduate Studies
in partial fulfillment of the requirements for the
degree of Doctor of Philosophy

UNIVERSITY OF OTTAWA

OTTAWA, CANADA, 1978

Abstract

This thesis is concerned with the understanding of motor performance in a competitive situation. Since competition induces stress in some individuals, one objective of the thesis is to explain the nature of this stress. Another more applied objective is to compare the biofeedback muscle relaxation training with cognitive training with respect to their validity as stress reduction methods. It is assumed that the results of such a study might be of some importance to sport psychology. In the empirical procedure, introductory psychology students, 48 males and 48 females, completed the Differential Personality Questionnaire, the Sixteen Personality Factor Questionnaire, and the Test of Attentional and Interpersonal Style. Task performance was measured on three motor tests involving different levels of difficulty. The subjects were scored in three pretraining assessment sessions, practice alone, with experimenter present, and in a competition with two other subjects. Subjects were randomly assigned by sex to attentional skills, EMG biofeedback, or cognitive coping skills training, or to a motivation-placebo control group. Four 40 minute training sessions were given, followed by the final competition. In separate analyses for full groups and for subgroups of subjects less adept in competition, final performances were compared using analysis of covariance. Both analyses were repeated to compare pretraining competitive performances with final scores adjusted by the removal of the entire gains made by the control group. A cross product

analysis of interaction examined non-linear effects of psychometric variables and training group upon final gain scores. Training for skills of attention helped less adept subjects improve performance on a task still being learned. Training in interrupting self-evaluative thoughts improved group performance on a well learned task. Biofeedback was ineffective in improving performance on any task. Interaction of treatment and psychometric variables specified attentional training for over-intuitive subjects while learning a task who need to plan their performance, analyse, and identify task cues and for over-analytic people who possess the basic task skills, but who need to adopt a more spontaneous reactive awareness during performance. Cognitive training was specified for subjects likely to see themselves as too competent for the challenge presented. A psychological model for stress and its reduction was developed. It was found to fit not only all empirical results obtained in the study, but also several of those reported in the literature.

CURRICULUM STUDIORUM

Thomas John O'Hara was born July 6, 1941, in Toronto, Ontario. He received the Bachelor of Arts degree in Economics and Psychology from Saint Patrick's College, Ottawa, Ontario, in 1966. He received the Master of Psychology degree from the University of Ottawa in 1970. The title of his 1976 interim report was A Demonstration of the Relationship Between Cognitive Experience and Performance Debilitation in High Evaluation Conditions.

ACKNOWLEDGEMENTS

The author expresses grateful appreciation to his advisor, Dr. O. R. Porebski, for his invaluable insight, criticism, and statistical counsel as well as for his generosity of time.

Sincere appreciation is also extended to Jocelyne Côté-O'Hara for her enduring emotional and intellectual support, love, discussion of ideas, and correction of tests.

The author recognizes the considerate help he received from many people at the University of Ottawa including Mme Marie-Claude DeKoninck, Dr. Jean-Louis Boucher, Mr. Ajaz Mirza, and the students who served as subjects or experimental assistants, particularly Ian Coulter, Pat Sparling, Monika Draeger, Susan Antof, Robin Mallory, Gae Lemaire, and Ron Rusnak.

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INTRODUCTION

For ages man has expressed himself in sporting activities. At the same time, sport has allowed a closer examination of the nature of man. Psychology of sport is concerned with the understanding of the ability and character of individuals as revealed in competitive situations.

The actual ability a man brings to the competitive situation is a function of his natural endowment and, even more so, of improvement due to learning. It has been the role of a technical coach to select individuals with natural talent and to develop their skills through training. Recently sport psychology has begun to make its contribution to competitive performance largely by examining and correcting personality characteristics which are associated with less than maximum performance. It has been recognized that some individuals are disposed to experience, more than others, an unusual degree of stress under competitive conditions.

One group of sport psychologists has associated stress with muscular tension and has concentrated on biofeedback techniques as a means of reducing this tension. Another group has recognized stress as a psychological phenomena and has attempted to remove stress directly by psychological cognitive treatment.

This study allows for a comparison of biofeedback and cognitive approaches to the treatment of stress and examines the effects on performance of training methods derived from these approaches.

Methodologically the study will be based on samples from a university population in which a broad range of motor ability and resistance to competitive stress should be found. Furthermore, the study will involve the use of psycho-motor laboratory tests rather than actual sport performance to control the amount of familiarity with the tasks. The tasks will vary in degree of difficulty which should allow a closer examination of the relationship between learning, stress, and performance. These methodological considerations are noted here because of a prevailing tendency in sport psychology to study only skilled athletes in a given sport.

The contents of the thesis comprise an extensive review of literature (Chapter I); a description of the experimental design and procedures (Chapter II), a statistical analysis and interpretation of results (Chapter III), and a general discussion with conclusions (Chapter IV). The appendices contain protocols for the assessment sessions, a sample of a less known psychometric test, excerpts from the training methods, information relevant to sampling, an addendum to one of the statistical procedures, and a rationale for combining task trial scores.

CHAPTER I

REVIEW OF THE LITERATURE

The central problem of this investigation is to provide psychological training to improve motor performance under competitive conditions. This includes, but is not limited to, overcoming motor performance impairment under competitive conditions.

The review of the literature begins with an organization of research relating competition to performance. Task difficulty and the individual's ability to do the task are shown to influence this relationship in a manner which is compatible with a model of psychological stress. The research on psychological stress and performance is arranged to argue for a perceptual and cognitive basis for psychological stress, for the univocally negative influence of psychological stress upon motor performance, and for the capacity of the individual to learn to cope with and reduce psychological stress.

Finally, research is presented to analyse three approaches to stress reduction which are suitable as psychological training to improve competitive motor performance. These approaches are: electromyographic (EMG) biofeedback to teach control of general muscular tension; cognitive coping training to teach recognition of self-defeating

appraisals of situations and appropriate substitute coping techniques; and task attentional training to teach sensory awareness and attentional focusing techniques appropriate to task performance. The chapter concludes with an examination of the important issues identified by the literature review which provides the basis for the derivation of the research hypotheses.

Psychological Stress and Motor Performance in Competition

Task Difficulty and the Effect of Competition upon Motor Performance

The difficulty of the motor task seems to influence whether performance is improved or impaired when competitive and non-competitive conditions are compared. Task difficulty is often assessed in terms of the task demanding simple motor responses or complex motor responses.

There have been several studies in which competitive conditions have proven beneficial to the group performance of simple motor tasks. In a study of the effects of rivalry on hand grip strength, Moede (1914) found that performance during dual competition exceeded that of solitary performance. He further found that best strength scores were attained by individuals participating in a form of group competition. Forlano (1932) investigated the effects of competition on speed of cancelling out the letter "E" on a typed page. The subjects performed the task under four different conditions:

- 1) Individual competition.
- 2) Working for the class.
- 3) Competition between the teams comprised of both sexes.
- 4) Competition between the sexes.

The study demonstrated that competition between the sexes was the most effective incentive condition, followed by individual personal gain, team competition, and a desire to help the class. Noble, Fuchs, Robel and Chambers (1958) found that a social-competitive situation uniformly improved discriminative reaction time for their subjects. Church (1962) found that mean simple and discriminative reaction time was significantly better under competitive conditions for his sample of 92 subjects. Wilmore (1968) investigated the work capacities of 20 college males on a bicycle ergometer under competitive and non-competitive conditions. The mean work output and riding time for competitive conditions was significantly greater than for the control conditions.

Competitive conditions appear to impair performance on more complex motor tasks. Shaw (1958) studied the effectiveness of co-operation and competition in motivating performance on a perceptual tracking task. Competition was the least effective condition, co-operation was the most effective, while an individual condition fell between the two. Petre and Galloway (1966) gave their three subjects practice on a motor task until acquisition of a high level of proficiency. The task was a road racing track set driven by a hand-held trigger.

The effect of introducing dual competition after the motor skills were well learned led to a very significant performance decrement which the authors attributed to a tendency for competitors to drive their cars too fast, thus causing them to go off the track.

Subject Ability and the Effect of
Competition upon Motor Performance

The level of performance achieved in pretesting on the experimental task has been employed as a direct measure of the subject's ability to do the task. Ability, so defined, has been found to influence whether motor performance is improved or impaired when competitive and non-competitive conditions are compared.

The introduction of competition led to improved task performance for subjects of low ability when speed was measured on a tapping task (Moede, 1914) and when speed of response was assessed independent of accuracy on an assembly task. (Whittemore, 1924). Subjects who had high ability on Moede's task deteriorated in their performance with the introduction of competition. The author attributed the deterioration to a sentiment of this being an easy win for those high in ability. There was no significant difference between speed of response under competitive and non-competitive conditions for Whittemore's high ability subjects.

On complex task performance, Whittemore (1924) found that accuracy for all subjects decreased with competition. In a repeated measures design, competition impaired low ability

subjects' stabilometer performance in an early stage of the experiment and improved the performance of high ability subjects in a late stage (Wankel, 1969). Competition improved physical fitness test performance of high ability subjects but not low ability subjects (Strong, 1963). Hrycaiko (1977) did not find an ability level by competition interaction. The high ability group performed significantly better on the ball roll-up task than the medium or low initial ability group over the 40 trials under both competitive and non-competitive conditions. It is likely that strong similarities between Hrycaiko's conditions account for his results. Both conditions involved coaction, two subjects working simultaneously. In the competitive condition, the two subjects were joined by four "research experts interested in how young boys learned skills." At no time were the subjects encouraged to compete with each other. A subject was never able to observe his coactor's performance.

The effect of competition upon motor performance seems to be modified by the interplay between task difficulty and subject's level of ability or skill. A tentative conclusion from the research presented is that when a rough equilibrium exists between difficulty and ability, possibly just favoring ability, competition improves performance. However, when a pronounced imbalance exists, competition impairs performance (cf. Moede's explanation of the poor performance on an easy task by high ability subjects; also Wankel's low ability subjects in an early stage on a complex task). There are stimuli in the

competitive environment, such as the presence of an opponent and judges, which can trigger thoughts about the balance between task demands and one's abilities. Such thoughts may occur much less frequently in a non-competitive setting where the triggering stimuli are absent. Moreover, performance impairment may be less a function of the objective differences between the task demands and the subject's capacities to meet these demands and more the result of the subject's estimate of that difference. This line of reasoning is presented in an examination of psychological stress as the agent of performance impairment under competitive conditions.

The Nature of Psychological Stress and Its Effect on Performance

According to McGrath (1970), psychological stress occurs when a person perceives or anticipates an imbalance between an environmental demand and his own response capability, when the consequences are perceived to be important. Stress occurs when there is either too much or too little demand placed upon the person's capabilities. The ideal state occurs when some demand is made upon a person's capabilities, but a demand roughly equivalent to those capabilities.

Martens (1975) modified McGrath's stress definition, "competitive stress can be defined as a perceived imbalance between the demand or expectation of the objective competitive situation and the response capability of the person under conditions where failure to meet the demand has important consequences for the person" (page 82).

It has been the practice of most researchers to manipulate the environmental demands so as to observe the effects of stress on performance without, at the same time, measuring or modifying the subjects' perceptions of their own ability, or imbalance. In a common research paradigm on the effects of stress on motor performance, the experimenter manipulates some stimulus such as electric shock, threat of failure, requirement that a task be finished in a short period of time, or a film portraying industrial accidents. The experimenter selects a situation which seems to be threatening to most people. In his experiment he manipulates this situation to induce stress in those subjects in contact with the threatening stimulus. As Lazarus, Deese and Osler (1952) point out, the assumption herein is that the motivations of people are the same vis-à-vis the stress. In failure induced stress it is assumed that the subjects all aspire to the same level of success.

Lazarus, Deese and Osler (1952) reviewed research on verbal and perceptual motor performance in stressful situations and concluded that although a large number of studies indicate impairment of performance under psychological stress, some subjects' performance will be facilitated and others may not be affected at all. Thus the effects of stress on performance are not general but "will depend upon what the individual expects or demands of himself" (page 296). Thus, though they recognize individual differences, Lazarus et al (1952) continue to equate stress with external factors

or stressors.

A search was made for literature which examined the effect of psychological stress on performance rather than the effect of various stress-inducing stimuli or stressors on performance. Two studies (Ganzer, 1968; and Fenz, 1975) demonstrated that subjects who performed poorly in the same threatening situations demonstrated, in various ways, that they perceived an imbalance between the demands of the situation and their response capabilities. Ganzer's high test anxious subjects during the task on which their performance was at a lower level than the other groups, often made comments critical of themselves. Fenz, in 1973, administered pictures similar to the Thematic Apperception Test pictures to good experienced jumpers and to poor novice jumpers. Responses to the pictures testify that the experienced jumper becomes increasingly more externally task-oriented whereas the novice jumper ruminates on his own fears or expends much of his energy fending against them. Here is an example of comments made by poor novice jumpers:

A parachutist is sitting in an airplane thinking about what it's going to be like to go out for the first time--kind of anxious, kind of wondering, looking at the ground so far below, and praying to God that he is going to make it, and wondering whether he is going to have the nerve once he gets out on the step to push himself off, and waiting for his chute to open. (Fenz, 1975, p. 331.)

In research more related to competitive stress, O'Hara (1977) found that basketball players whose performance

showed the greatest deterioration when foul shooting in competition, reported having the habit of criticizing themselves after making an error and reported being aware of the thoughts of others evaluating their performance while they were shooting.

In summary, psychological stress in competition involves a preoccupation or concern about measuring oneself to the task, the opponent, one's own expectations. Stress, so defined, hurts performance. Reduction of such stress should bring benefits to performance.

The review of the literature proceeds to examine research on the stressors in the competitive situation and the internal mechanisms of stress, in order to derive hypotheses concerning methods of stress reduction for performance improvement under competitive conditions.

Factors in the Competitive Situation Capable of Contributing to Psycho- logical Stress

In a review of over 200 studies relating to stress research, McGrath (1970) catalogues the varieties of settings for stress research. These are the antecedent conditions involved in the stress situation. They involve manipulation of physical stimuli, manipulation of social-psychological conditions, or manipulation of task-inherent conditions in real life or experimentally contrived studies. There are approximately 17 stimulus classifications upon which stress research has been based. The potentially stress-provoking

stimuli of the competitive environment are treated in four types of studies on McGrath's list:

- 1) Studies based upon evaluation threat.
- 2) Studies based upon failure.
- 3) Studies of distraction stimuli.
- 4) Studies of the effects of time pressure.

Evaluation threat may be found in the competitive situation in the presence of an evaluative and knowledgeable audience, in ego-involving instructions regarding the meaning of winning and losing, or in the use of recording devices such as cameras. Each of these has been found to facilitate or impair performance of different individuals on the same task (Cottrell, Wack, Sekerak & Rittle, 1968; Ganzer, 1968; Kukla, 1974; Liebling & Shaver, 1973).

Failure and success, error and good play occur frequently in competitive situations. Research indicates that both success and failure influence future expectations of success and performance, with certain individuals improving their performance, while for other individuals, performance deteriorates (Weiner, 1966; Feather, 1966; Gallwey, 1974).

The competitive situation often differs from the practice situation, in the presence of additional stimuli which can distract the competitor from attending to task performance. Most research on distraction stimuli as provokers of stress has centered on noise and extraneous visual stimuli. The competitive situation itself may contain a number of

distracting stimuli: an audience, cameras, and the presence and actions of one's opponent. The past behaviours in the form of successes and failures can be thought of as distractors from the present focus on the task. Reminders about the amount of time remaining in a contest can be distracting from task performance. Certain authors conclude that impaired performance under evaluative situations is primarily the result of distraction of attention (Kelley & Thibaut, 1954; Jones & Gerard, 1967; Wine, 1971).

In summary, stimuli are found in the competitive setting, which are often assumed in research design to be at least moderately threatening to a wide range of people. These stimuli increase the objective demands of the situation or task. They are stressors, but it is unlikely they produce stress in all subjects, nor do they lead automatically to performance impairment:

Factors Within the Individual Which Regulate Psychological Stress

The following model relies heavily upon the theories of Lazarus (1966, 1967); McGrath (1970); and Scott and Howard (1970). A first step in the process leading to a state of psychological stress is the cognitive appraisal of some circumstance as a threat to the realization of some goal. Such an appraisal is energizing and thus, some form of action, a coping process, is evoked to dissipate the felt tension accompanying the perception of threat. When, for whatever

reason, the individual continues, beyond a time of his own tolerance, to perceive the threat as unmastered, a state of psychological stress exists. The concomitants of psychological stress that interfere with motor performance are muscular tension inappropriate to efficient performance and a focus of attention inadequate for the demands of the task and the level of skill of the individual.

Cognitive appraisal and coping processes in stress and motor performance. Stress reaction depends upon whether or not events are cognitively appraised as threatening (Lazarus, 1966). Lazarus, Speisman, Mordkoff and Davison (1962) reported that most of their subjects were highly disturbed while watching a silent film entitled Subincision. The film depicts a puberty ceremony in an Australian stone-age culture during which the penis of the adolescent is partly dissected by means of a stone knife. Later, Speisman, Lazarus, Mordkoff and Davison (1964) demonstrated that the magnitude of the disturbance could be reduced through the introduction of experimentally created sound tracks based on the ego defensive concepts of denial and intellectualization. Finally, Lazarus and Alfert (1964) were able to preventatively lower self reports of disturbance to the film as well as lower the stress indicators of heart rate and skin conductance by playing the denial and intellectualization passages to the subjects before they viewed the Subincision film. Lazarus (1966) concluded that the experimental subjects did not undergo the stress experienced by the control group

because, as a result of the pre-played sound track, the experimental subjects came to cognitively appraise the events depicted in the film in a neutral manner.

Through changes in self-reports of discomfort and in physiological measures of tension, the Subincision studies demonstrate the effect of different interpretations on the perception of a situation as threatening. The cognitive appraisals alone are not stress. Rather, stress results from the failure of the individual's efforts to deal to his satisfaction with the threat he perceives. Success or failure is a function of the coping processes or techniques he employs.

As soon as something is appraised as a threat, some coping process is activated to deal with the perceived harm (Lazarus, 1967). In terms of the 1970 theory of Scott and Howard, from the moment of threat appraisal tension builds up but is gradually dissipated insofar as the coping process effectively deals with and resolves the perceived problem. Should the individual's efforts be insufficient to resolve the threat, tension will not be dissipated. It is at this point, with high tension and the awareness of not handling the perceived threat appropriately, that the individual is thought to be in stress (Scott & Howard, 1970).

Houston (1975) had judges categorize the coping mechanisms of university students taking examinations. He then observed the correlations of the various coping mechanisms with reported anxiety and with examination performance. Some coping techniques were effective in reducing tension or

anxiety but were ineffective for exam performance, e.g., denial. Intellectualization was associated with low anxiety and good performance, while worry was associated with high anxiety and poor performance. It would seem that intellectualization would avoid a stress reaction entirely. Denial would be similarly effective unless the person was forced to acknowledge his poor performance, as would no doubt be the case in a competition with clear presentation of results. Worry would seem to lead directly to stress.

The differential effectiveness of coping techniques is demonstrated in the sport of gymnastics in a study by Mahoney and Avener (1977). The investigators interviewed male gymnasts at the trials for the 1976 U.S. Olympic Team and later compared, on the results of those interviews, those who made the team with those who did not. Each group appraised the competition as threatening. The interviews suggested that the more successful athletes tended to "use" their anxiety as a stimulant to better performance. The less successful gymnasts seemed to arouse themselves into near panic states by self verbalizations and images which belied self doubts and impending tragedies.

Adaptive behavior and better performance in situations such as competition may demand more appropriate cognitive appraisals and/or more effective coping reactions. Research on training methods which take this approach of reducing stress will be described in another section of the literature review.

Muscle tension, stress, and motor performance. There is widespread acceptance within clinical sport psychology that stress increases skeletal muscular tension, that this is inappropriate for good performance, and that the athlete must learn to control excess muscle tension (Nideffer, 1976; Tutko & Tosi, 1976; Vanek, 1977). Perhaps because of this acceptance, insufficient attention has been devoted to testing hypotheses relating muscle tension, stress, and motor performance. Two related propositions have been studied by investigators: that muscle tension varies directly with stress; and that changes in muscle tension are accompanied by changes in performance.

There is some research that indicates an increase in muscle tension accompanies an increase in stress. According to Hellebrandt (1958), when an individual under extreme stress wishes to make a move in one limb, action potentials in muscles located in all four extremities, the head, neck, and trunk can be measured. This finding is supported by Lundervold (1961). Malmo (1970) compared chronic anxiety patients and normals on their return to baseline muscle tension after a loud tone was sounded. In both groups there was an identical rise in muscle tension with the onset of the tone but the normal group returned to baseline levels at a significantly faster recovery rate. Anxiety weakens the inhibition of muscle tension so that increased tension of the skeletal muscle is found as a symptom of anxiety (Malmo, 1970). Muscle tension should likewise accompany the anxiety present

during a state of stress.

The level of muscular tension has been related to performance in at least two ways. Stennett (1957) measured performance on an auditory tracking task and muscle activity in the muscle groups of the wrist and upper forearm of the passive arm that corresponded to three incentive conditions: a high incentive condition where large money bonuses for good performance were offered and strong electric shock was threatened for poor performance; an intermediate incentive condition where less money was offered for performance and shock was not mentioned; and a low incentive condition where the individual was told his performance was not important. Stennett found that the condition with threat of strong electric shock produced the highest muscle tension and tracking performance was impaired in this condition relative to the intermediate incentive condition which yielded the best performance of all. A second way in which muscular tension is related to performance has been through the procedure of relaxation. The relief of muscular tension, through relaxation, has been shown to lead to improved performance in some cases. This literature will be presented in the section on stress reduction.

Inappropriate focus of attention, stress, and motor performance. Stressful circumstances have been related to changes in attention in several ways. Easterbrooke (1959) and Solley (1969) report that stress narrows the focus of attention so that the subject becomes relatively blind to

stimuli on the periphery of his visual field. When the individual feels very threatened, the attentional field may become so narrow that no stable orientation towards the environment can be maintained and attention will be distracted by the slightest variation in the external and/or internal environment (Wachtel, 1967; Nideffer, 1976).

Berkout (1973) tested highway patrolmen on a high-speed driving task against time and errors. The most successful drivers were those whose attention did not wander, as defined by fewer unnecessary eye movements and greater incidence of beta wave in the occipital electroencephalogram.

The theoretical literature relating focus of attention, stress, and motor performance is represented in the writings of Nideffer (1976), Wine (1970, 1971, 1974), and Gallwey (1974). Nideffer (1976) proposes two dimensions of attentional focus, a broad to narrow continuum, and an internal-external dimension. Each task has certain attentional demands, for example, a football quarterback planning to pass has a narrow external focus as he follows his prime receiver. If the latter is not in position to receive the pass, the quarterback must quickly shift to a broader external focus of attention in order to determine the one secondary receiver best in position to catch the pass. According to Nideffer (1976, 1976a), individuals vary in attentional style, their skill in dealing with the wide variety of attentional demands, and this skill affects the amount of stress which different individuals experience and

consequently, the different levels of performance they attain.

Wine (1971) proposed an attentional interpretation to account for poorer academic performance by test-anxious subjects. As the potential for evaluation in a situation increases, high test-anxious subjects tend to focus more of their attention internally upon thoughts of self-evaluation and less of their attention is focused upon the task so that performance impairment results. Psychological stress, as defined by McGrath (1970), is internally directed attention; to the extent the individual continues to attend to his perceptions of the unmastered threat, his task performance can suffer. Correlational support for Wine's (1971) hypothesis is found in the previously cited study by Fenz (1975); the better parachute jumpers gave stories containing task-oriented thoughts while the poorer jumpers indicated self-evaluative focus of attention. Similarly, Morris, Smith, Andrews, and Morris (1975) found poorer typing performance among business college students who reported having greater worries about their performance prior to the test.

Gallwey (1974) repudiates any time spent on self-evaluation while playing a sport. He teaches people to occupy their minds with simple repetitive phrases which allow sensory-motor responses to occur independent of and uninterrupted by intellectual and affective responses. Studies by Berlin (1947) and Cugini (1958) show that when subjects carry out additional verbal tasks such as reading a story or

counting dots simultaneously while practising a motor skill, they learn the skill just as well if not better than subjects not so "distracted."

Training Approaches for Reduction
of Psychological Stress

For at least some individuals, motor performance is impaired in the competitive situation, relative to the non-competitive situation, as a result of psychological stress. Such stress is called psychological in the sense that it is based upon a cognitive appraisal of a circumstance within the competitive situation as threatening to an outcome or state important to the individual. This is in contrast to a physical stress involving physical tissue damage to the organism. If the individual does not manage the perceived threat to his own satisfaction, stress is manifested in a distraction of attention from the motor task (anxiety) and an increase in skeletal muscle activity (muscle tension). Distracted attention and excess muscle tension, either alone or in combination, interfere with efficient motor performance.

It may be possible to improve performance in the competitive situation through methods which help the individual to develop skills instrumental in reducing or circumventing psychological stress. Three approaches are presented. In one approach, the individual learns to recognize and change his maladaptive cognitive appraisals and to cope with threat

more effectively. This approach has been given several names, for example, rational-emotive therapy (Ellis, 1958; Trexler & Karst, 1972), systematic rational restructuring (Goldfried, Decentecio & Weinberg, 1974), stress inoculation training (Meichenbaum & Cameron, 1972), and stress-coping training (Holroyd, Andrasik & Westbrook, 1977). The methods of this approach all try to change the stress process in its early stages. The next two approaches work directly on the two factors that interfere with motor performance. In task-attending training or attentional training (Wine, 1970; Nideffer, 1976), the individual learns to analyse the attentional demands of the task, gets practice in maintaining the right focus of attention for the task, and learns techniques for returning his focus of attention to the task. In this approach it is assumed that the individual will experience less stress because, occupied with a new attentional set, he will not notice the "threatening" stimuli. The third approach teaches the individual to control, primarily lower, his muscle tension. This is a relaxation approach which until recently was most commonly taught by verbal instructions and demonstration (Jacobson, 1934; Bernstein & Borkovec, 1973; Goldfried, 1971). Budzynski and Stoyva (1969) developed an electromyographic (EMG) feedback technique for teaching voluntary relaxation which provides the subject with continuous objective evidence of his muscular activity level. Relaxation could decrease any muscle tension involved in the stress reaction. With lower muscle tension, the competitor

may be better able to control his motor performance and thus avoid the stress that could be provoked by errors. All three approaches assume that learning to control the stress reaction in the training sessions can later be transferred and applied to reduce stress in the target situation, in this case, the competition.

Changing Maladaptive Cognitive Appraisals

Method. This training begins with the presentation of the rationale: instructions and exercises designed to assist the individual become aware that distressful emotions, physical sensations, and even unwanted actions are the consequences of negative thoughts about the events that happen within and around him. The individual then gets practice in self-monitoring, noticing, and recording his own stress-provoking negative thoughts particularly in the target area of his life, that is, in social interactions in the case of interpersonal anxiety, in academic settings in the case of test anxiety, or in game moments in the case of competitive stress. Next, the person is taught to interrupt negative thought and to substitute behavior that will relieve his distressful emotion. Thus, the method teaches the person to cope first with the feeling of stress rather than with the threat. Three coping techniques used at this point by Holroyd et al (1977) are reappraisals of the provoking stimulus, direction of attention to some other stimulus in the environment, and escape into calming imagery. A second

level of coping is the use of self-instructions to guide one's behavior in a situation so as to avoid stress. During training the trainee practices the coping skills using mental rehearsal, role playing (behavior rehearsal), and the actual experiences of his daily life.

The steps up until the coping skills are practiced form the "insight" component (Meichenbaum, Gilmore & Fedoravicius, 1971). Within this phase, some training methods also help the trainee to identify the irrational beliefs that sustain his maladaptive cognitions (Ellis, 1958; Trexler & Karst, 1972; Goldfried, Decentecio & Weinberg, 1974; Holroyd, Andrasik & Westbrook, 1977). Practice of the coping skills is called the "coping imagery" component (Meichenbaum, 1972). Together these two components form what Meichenbaum (1972) called "cognitive modification." Practice of the coping skills during exposure to one or more "stressful" stimuli is called "application training" and these three components form what has been called "stress inoculation training" (Meichenbaum & Cameron, 1972).

Outcome studies in evaluation settings. Recent research indicates that therapeutic intervention procedures designed to alter cognitive appraisals in anxiety arousing situations are effective in reducing self-reported discomfort of speech anxiety (Meichenbaum, Gilmore & Fedoravicius, 1971; Trexler & Karst, 1972) and test anxiety (Meichenbaum, 1972; Osarchuk, 1974; May, 1975; Holroyd, 1976; Goldfried, Linehan & Smith, 1976).

The findings with regard to performance improvement after cognitive appraisal training are equivocal. Test performance was not improved by the procedures in the studies of May (1975) and Osarchuk (1974). However, Meichenbaum's (1972) results show that cognitive modification was more effective than standard desensitization on grade point average. Formerly high speech anxious subjects who received cognitive training gave test speeches with fewer behavioral indications of anxiety as rated by independent observers than control subjects (Meichenbaum, Gilmore & Fedoravicius, 1971; Trexler and Karst, 1972). Trexler and Karst found significant behavioral improvement only appeared in a delayed post-treatment measure whereas self reports of anxiety had decreased in the first test speech right after training.

Goldfried and Trier (1974) put forth the view that a longer time has to pass before coping training can fully "take effect" in order for subjects to have the opportunity to encounter and cope with a sufficient number of situations for the new coping skill to fully develop through practice. On the other hand, rapid results may be possible. The anxiety and ability to cope of surgical patients was rated by nurses to have significantly improved after one coping skills session of 20 minutes as compared to subjects in control and information-only groups (Langer, Janis & Wolfer, 1975).

Perhaps cognitive coping training, like systematic desensitization, needs to be supplemented with some skills

training applicable to the task if task performance is the target of training. Reviews of the systematic desensitization for test anxiety research literature argue for skills training as the agent of any performance improvement (Allen, 1972; Anton, 1976). Cognitive coping training, as Goldfried and Trier (1974) claim, may be more effective than no training in the long run, but perhaps not because the coping skills require refinement. Instead, as a result of cognitive coping training, the person does not become as threatened in the evaluative environment and he can now devote his attention to learning how to perform the task better. It is the consolidation of the new task learning that delays task improvement for the cognitively trained individual. Methods of stress reduction that help the individual deal productively with the task may be even more effective especially insofar as the task has not yet been mastered. On the other hand, cognitive training may be associated with rapid improvement of task performance when the task is well learned and feelings of stress had held back full realization of this mastery. Task-centered methods should ignore the main contribution of cognitive coping training which seems to be teaching the individual to cope with his feeling of stress. Adequate comparison of these two approaches to stress reduction requires at least two tasks. In this way, cognitive coping training will be compared with a method which teaches the person how to deal with the real source of threat in the evaluative environment, the task. Such a training method, attention

training, is described in the next section.

Directing Attention to the Task and
Maintaining Task Focused Attention

Method. The attentional training to be discussed in this section refers to the practice of thoughts and actions that help the person identify and concentrate on the key elements in the task that will enable successful task completion. The training does not directly deal with attentional errors. It does not try to correct faulty and maladaptive cognitive responses to people, events, objects, or to internal sensations, e.g., worrying about how well one's opponent has done. Instead the training attempts to teach and build success-favoring attentional response habits to these same stimuli, e.g., "During play, I say 'Bounce,' everytime the ball bounces on the ground, and 'Hit,' whenever I or my opponent hits the ball" (Gallwey, 1974).

Attentional training was the name used by Wine (1970, 1971) for a self-regulatory technique in the treatment of test anxiety. Wine hypothesized "that directing the highly test-anxious subject's attention to task-relevant variables and away from self-relevant variables will effect performance improvement" on academic tasks.

Wine (1970, 1971) combined techniques to help trainees become aware of the debilitating effects of self-evaluative thoughts with practice on tasks during which the trainee heard reminders to attend to the task. Wine's (1974a) training manual includes relaxation training, attentional

exercises, and modeling procedures of substituting task analysis remarks for worries. The task analysis remarks are chosen by the trainee after a very detailed skills analysis of the task. While the manual is specific to academic tasks, the approach conforms with the clinical sport psychology techniques of Gallwey (1974) and Nideffer (1976). It is important to note that these latter techniques have not been experimentally investigated. Moreover, there have been extensive changes in the Wine method (Wine, 1970, 1971, 1974, 1974a) and this method has consistently provided some amount of cognitive coping training.

Attentional training presents the rationale that the trainee can avoid stress by practicing the right attention for performance of the task and allowing his body to do the task. Steps in attentional training involve: awareness exercises to help the trainee become aware of sensation as opposed to reflection-based-upon-sensation; the discussion of the broad-narrow and internal-external dimensions of attention; mental replay of the tasks and discussion of the important sensations in the performance of each task; mental rehearsal of attending to these sensations and making appropriate task-oriented reminders; practice of concentration techniques such as attending to one's breathing as a means of remaining aware of the present surroundings; mental rehearsal of using the concentration techniques while performing the tasks.

Outcome studies for variations of attentional training.

Wine (1970) reported the results of four studies designed to test her hypothesis. Subjects were female university students. In the first three, which were laboratory studies that compared instructions designed to direct attention to the task with instructions designed to direct subjects' attention to themselves, there was no significant effect on task performance due to type of instructions. The fourth study, a treatment study, compared the effects of six hours of task practice with attention directed to the self versus six hours of attentional training versus six hours of attention training and relaxation. The last two treatments were equally and highly effective at improving performance on standardized academic measures and at reducing self reported text anxiety, in comparisons of within-group posttraining measures with pretraining measures uncorrected for between-group differences.

Little and Jackson (1974) did a modified replication of Wine's (1970) treatment study. Grade 7 and 8 students who scored high in test anxiety but moderately in generalized anxiety, were randomly assigned to one of five conditions. These were attentional training, relaxation training, attentional training plus relaxation training, a placebo expectancy test practice group, and, finally, a no treatment group. A significant decrement in text anxiety and general anxiety was obtained by subjects in the third condition, the combination treatment of relaxation and attentional training.

On the other hand, performance improvements on subscales of the Wechsler Intelligence Scale for Children and the Differential Aptitude Test were obtained for subjects in each of the four treatment conditions. Greatest gains on an academic task occurred for subjects given attentional training.

Twenty-one high test anxious male undergraduates were assigned to a modeling and scripted roleplaying treatment or a delayed treatment condition by Malec and Park (1976). Subjects in the treatment group viewed a videotape of two scenes in which a character first became anxious about a test and then redirected his attention to productive task-oriented behavior. Subjects then took turns playing the role of the videotaped character by acting according to the script. When the second group was later treated and the results of both groups combined and compared to pre-test scores, test anxiety had been changed in that the subjects now tended to label their arousal positively. Performance on the Wechsler Adult Intelligence Scale digit symbol task was not changed significantly.

Performance on the Wonderlic Personnel Test was likewise not improved by the mental rehearsal of substituting self-instructions of attending to the task for anxiety-arousing self-verbalizations while imagining being in one of a series of 16 graded scenes related to taking tests (May, 1975). Treatment was carried out over four weekly one-hour sessions.

Contrary to the description of attentional training, each of the studies reported to this point included training

on the avoidance of irrelevant self-thinking. Finger and Galassi (1977) had subjects practice attention directing responses without reference to what they were replacing. Their test anxious college student subjects were assigned to one of four groups: attentional treatment, relaxation treatment, a combination of these two, or a waiting-list control group. Each of the three trained groups practiced the imagination of three scenes:

- 1) A stimulus scene related to test taking or study.
- 2) A response scene.
- 3) A reinforcement scene.

The stimulus scene was described for the subject to imagine; the subject was asked to imagine himself making an adaptive response in the scene; finally, the subject was allowed to imagine a scene especially reinforcing to him. The stimulus scenes were standardized for all treatment groups. Attentional responses were cognitive responses involving task attention, e.g., "If I just read the questions and pay attention to what they are asking, I'll be just fine." Relaxation responses focused on lowering emotional arousal, e.g., "The important thing to remember is to take a slow deep breath and let the tension leave your body." The combination group practiced both responses. Both cognitive and emotionality indicators of test anxiety were reduced significantly by each treatment. Again, however, significant changes were not obtained by any group on performance measures, the Wonderlic

Personnel Test, and the Digit Symbols Test.

The practice of self statements such as, "I will pay attention and I'll do alright," seems insufficient to develop a task-oriented focus of attention. In Wine's (1970) treatment study, where performance improvement was found on the Wonderlic, Digit Symbol, and arithmetic problems, subjects shared task strategies and discussed to what task elements attention was best directed. Similarly, Sarason (1973) found that test anxious subjects can benefit from training to be more attentive to relevant task stimuli when task-related cues are modeled for them. What are needed to have effective attentional training, according to this explanation, are described by Nideffer (1976) as exercises in discriminative cue analysis. Through mental rehearsal of the motor task, the individual is helped to make such an analysis of various situations, in order for his task attention to be adequately focused on the appropriate elements of the task. In other words, while training people to pay attention to the task, some time must be devoted to the 'what-is-to-be-attended.'

Learning to Decrease Muscle Tension with Biofeedback Training

Method. The electromyographic (EMG) biofeedback training that will be discussed in this section refers to a series of sessions during which a subject monitors his muscular activity by watching a visual display or listening to an auditory signal. This signal is an analogue representation

of the subject's muscular activity produced by amplifying the electrical potential picked up by electrodes at the surface of the skin and transducing this amplified electrical signal so as to drive an oscilloscope trace, to activate a digital counter, or to generate a tone or series of clicks. Under instructions to change the display or signal and over time, the subject learns to control his muscular activity. With instructions to diminish the display or sound, the subject learns to relax the muscles at the site to which the electrodes are attached. As will be covered later, this relaxation has been found by some investigators to generalize so as to promote general relaxation.

EMG biofeedback provides subject and experimenter with objective evidence of muscular activity, while verbally instructed relaxation techniques rely on subjective tension. The correlation between EMG and subjective tension in untrained subjects has been found to be low (Lader & Mathews, 1971). After EMG biofeedback training, some investigators have found this correlation to improve significantly (Reinking & Kohl, 1975).

As a technique for stress reduction and ultimately performance improvement, EMG biofeedback does not demand a cognitive rationale for performance impairment. It can be viewed as behavioristic, a body approach to stress control, rather than a mind or cognitive approach. On the other hand, several authors (e.g., Green, Green, Walters, Sargent & Meyer, 1975; Meichenbaum, 1976; Reeves, 1976) claim a strong

role for cognitive factors in the process of learning to control muscle tension aided by EMG biofeedback. Green et al (1975), for example, claim that the biofeedback process is greatly assisted when the subject is instructed to be passively detached from the goal of change and to try to visualize the change taking place within the body.

Outcome studies of relaxation and EMG biofeedback.

Athletes must be able to tense and relax their striated muscles "at every stroke" (Green & Green, 1975). Methods of training subjects to relax have had some success in leading to improved or comparatively better athletic motor task performance. Benson (1958) found Jacobson's (1938) Progressive Relaxation had some merit under certain conditions of learning to swim. Subjects who "learned to relax" were found better able to learn a new paddleball skill in Paben and Rosentsweigh's (1971) study. The progressive relaxation treatment of Bernstein and Borkovec (1973) improved both batting performance and state anxiety scores under conditions pretested for potential stress in Kukla's (1976) study of 51 high school baseball players. Finally, Nideffer and Deckner (1970) present a case study of an intercollegiate shot putter whose performance improved dramatically while following a relaxation training procedure.

EMG biofeedback training has been demonstrated effective in reducing EMG muscle activity (every study observed) in reducing anxiety measures such as the incidence of panic episodes (Canter, Kondo & Knott, 1975), state anxiety (Coursey,

1975; Hartman, 1976), and ~~test~~ anxiety (Garrett & Silver, 1976).

The frontalis muscles beneath the forehead are the most commonly used muscles for EMG biofeedback ever since the pioneer work of Budzynski and Stoyva (1969). There is some controversy as to the assumption of generalization of lowered muscular activity from the frontalis muscle to other muscles (Alexander, 1973, 1975; Stoyva, 1976; Shedivy & Kleinman, 1977). It seems unusual that Stoyva (1976) describes "transfer" obtained by false feedback--a 39% decline in forearm EMG as compared to 45% in the test group who were trained on true feedback of frontalis activity. Shedivy and Kleinman (1977) introduced a questionable procedure of instructing their subjects to alternate the change in direction of muscular activity, repeating periods of first increase, then decrease. It is possible that the lack of significant transfer was influenced by subject confusion. There are other ways to look at generalization of relaxation. Eschette (1976) found partial support for her hypothesis that increase in body temperature was matched by decreases in EMG at the frontalis muscle and decreases in subjective tension and increases in subjective relaxation. DeGood and Redgate (1976) found that trained decreases in EMG levels of "nervous and tense" volunteers were matched by decreases in heart and respiration rates. These studies provide weak support for the hypothesis that EMG biofeedback training does indeed promote relaxation.

Most research testing the application of EMG biofeedback training in stressful environments has delivered negative results. Mercadal's (1975) trained subjects were no better than controls on nonsense syllable performance under stress, even though they reported themselves to be less tense than control subjects.. Lawrence (1976) reviewed U.S. army-supported biofeedback research on a variety of electrophysiological parameters to assess their value for performance enhancement in stress environments. While largely negative results were found using parameters like EEG alpha waves, Lawrence (1976) cites the positive indication that EMG biofeedback trained subjects performed better than control subjects during their check flight in the trainer plane even though they had not excelled in an earlier simulator test.

Derivation of Research Hypotheses

Predicting the effects of three stress reduction training methods upon performance of difficult and easy tasks, during competition. To this point the review of the literature has presented somewhat separate examinations of motor performance impairment in competition, of psychological stress as the agent of such impairment, and of three training approaches for the reduction of psychological stress. It is now appropriate to link these considerations and to outline a theoretical basis for predicting the main effects on performance of the training methods.

There are three cases when competitive conditions are likely to be associated with motor performance impairment.

These are:

- Case Ia) When the task is very difficult, all subjects are affected.
- Case Ib) When the task is moderately difficult, subjects of low ability are affected.
- Case II When the task is simple, subjects of high ability are affected.

In relating psychological stress to these cases of motor performance impairment it is first necessary to recall that daily life presents each person with numerous challenges to meet, problems to solve, and threats to one's goals which need to be overcome. Challenges, problems, and threats are also posed by the people, objects, and events in the competitive environment and of especial importance in this regard is the behavior of one's opponent or opponents. Fortunately, adaptive living is facilitated by the recognition of a problem, for problem recognition is energizing. This energization involves psychological and muscular tension which is appropriate for action, whether fight or flight. As a result of this energizing appropriate tension, the individual attempts to deal with the perceived threat, employing the task skills and coping mechanisms available to him. Psychological stress only results when these responses do not resolve the threat to the individual's own satisfaction. Two performance related concomitants of

psychological stress are excessive muscular tension and a variety of negative psychological conditions (such as anxiety, distractibility, etc.) which could be grouped under a general term, psychological overtension. The psychological and muscular overtension is known to deteriorate the quality of motor performance.

The psychological stress reaction springs out of the relationship between appropriate and inappropriate tension levels, the appraisal of threats, and whether or not the required task and coping skills have been learned. These relationships are illustrated in the following discussion of the three cases of motor performance impairment in competition. The competitor notices some circumstance which he appraises as a threat to his goal of winning. For example, a tennis player may observe that when he hits the ball cross court from his own forehand to about mid court depth, his opponent consistently hits a winning shot. This perception is energizing. The competitor, now in a state of appropriate arousal, quickly selects a course of action from among those in his repertoire. He may slow down or speed up his movements; he may focus his attention more closely upon the ball; he may relax his shoulders and arms between each point; he may choose to hit down the line or deeper shots; he may spend time analysing his forehand swing searching for the modifications which will allow for a deeper shot; etc. To the extent that the competitor has learned and now chooses a set of appropriate responses, then

good performance will result until the game or the opponent poses some new threat which may or may not be recognized by the competitor.

On the other hand, the actions employed may be inadequate. Perhaps the competitor has not yet learned how to hit deep forehand shots without excessive risk of hitting out-of-bounds. Muscular tension continues to build up as long as the threat is perceived to be present and unresolved. At some point, largely a matter of individual tolerance, the competitor is in psychological stress where muscular tension is excessive, anxiety distracts attention from the play, and tennis performance deteriorates even further. This is an example of Case Ib), motor performance impairment in competition where the task is too difficult for a subject who has inadequate ability in the form of tennis skills and problem solving coping mechanisms. An example of Case Ia), impairment would be two beginner tennis players who have practised hitting forehand shots each with a coach but who now play each other in a game, are presented with a greater variety of ball angles and speeds, become stressed at their inability, and as a consequence they hit much poorer forehands than in practice.

Now suppose that a competitor before the competition is so confident of his success that he does not take his opponent seriously. He may even be bored. He does not appraise his opponent's performance as any threat to the realization of his own goal of winning. Even though a task

is very simple, good performance in the task requires an appropriate level of psychological and muscular tension. In so far as the very capable competitor does not adopt a serious approach to even the simplest of tasks or in so far as the competitor does not respect his opponent's capacity for the extraordinary, then it can be said that the competitor is psychologically and muscularly 'undertense' and will not immediately put forth his best performance. It may be parsimonious to claim that such is the full description of Case II competitive performance impairment. However, when the task continues over a period of time and the competitor can see how well the opponent is doing, it is a common experience, even among superior athletes, to have feelings of boredom one minute and feelings of panic the next time they notice. In other words, Case II involves a rapid transition from overconfidence to psychological stress, from undertension to overtension. At this point the individual seems unable to employ the task skills and problem solving behavior which he has learned and previously demonstrated. His motor performance is impaired even further.

A further note should be made with regard to Case I impairment, when the individual perceives himself as inadequate for the task. A certain proportion of the population may spend time considering potential threats rather than attending to ongoing events. Such people are unlikely to be confident, bored, and undertensed. Rather,

these individuals tend to worry, be anxious, and generally overtense, irrespective of prevailing conditions.

Accordingly, as competitors, these individuals are likely to become psychologically stressed more readily than others.

They might even possess well-developed task skills, although their coping mechanisms may be counterproductive.

The literature review has described three stress reduction training methods:

- 1) Cognitive appraisal and coping training teaches ways to recognize the thoughts and feelings associated with stress as well as those associated with boredom, to reappraise the situation and to cope with these inappropriate thoughts and feelings.
- 2) Electromyographic biofeedback training seeks to reduce psychological stress by means of muscular relaxation.
- 3) Attention training develops effective attentional habits appropriate for the tasks to be performed, so that the trainee is less likely to develop psychological stress when performing the tasks.

Outcome studies for each of the three stress reduction training methods were reviewed. While each method has been shown to reduce felt discomfort and self-reports of anxiety, no method has been associated with performance improvement in any systematic way. Moreover, a tendency was found for researchers to contaminate one method with components of other methods. For example, cognitive appraisal and coping training would include a progressive relaxation component. Accordingly, it seems appropriate

to test the differential effects on performance in competition of these three training methods each of which is specifically directed to correcting a different element in the stress complex. In this research, three motor tasks will be employed; the tasks will vary in difficulty so that at least one of the tasks will have been very well learned and one of the tasks will be not well learned by the majority of subjects at the time of stress reduction training. Performance impairment of the Case I variety (initial overtension) is more likely to occur when the latter task is performed in competition. Performance impairment of the Case II variety, which springs out of overconfidence, is more likely to occur with the well learned task. Performance impairment of both varieties is associated with deviation from the level of psychological tension appropriate for effective action whether the deviation be undertension or overtension. Performance improvement after training should result when a training method can promote appropriate psychological tension under the constraint of the degree of learning of the task and its requisite skills. In the following paragraphs each stress reduction training method will be examined for its potential to improve motor performance so as to theoretically derive testable hypotheses.

A method which teaches individuals to recognize and discard the thoughts and feelings of stress or of boredom may minimize overtension and undertension until the consequences of competitive action themselves regulate

tension. Cognitive appraisal and coping training (CC) is such a method.

When the task is well learned, CC trained competitors, having eliminated undertension or overtension, apply the skills they have learned. As each new challenge occurs in the competition, these competitors deal with that challenge. If the consequences of action include a setback, and associated with it elevation of tension, these competitors have sufficient task skills to find success with another approach. If the consequences of action lead to a success, and associated with it decrease in tension, these competitors know how to avoid boredom and overconfidence and so remain ready for changes in the competitive situation. Moreover, CC training also helps certain exceptionally anxious competitors to control overtension which may be disproportionate to the immediate task.

When the task is not well learned overtension is a more common experience than undertension. CC trained competitors, having reduced their initial overtension, apply what task skills they have learned. Often these are insufficient. Tension builds up as a consequence of failure. Attention is refocused on cognitive appraisals of threat associated with the task demands being greater than the abilities possessed. The more the new attempts are unsuccessful, the more the feeling and thoughts of overtension crowd the mind. The competitors have learned to reject these thoughts, but the lack of success in

competition provides no tension dissipation. The competitors are in psychological stress and performance is impaired. It is possible that through CC training competitors may learn to dispel stress in a competition involving a not well learned task by opting out of the goal of winning. Competitors may lower their goals thus lowering perceived task demands or they may use fantasy to remove themselves from experiencing the competition as stressful. Lowering the goal would effectively correct against competitive performance impairment (the basis for worry and tension is the perceived ratio of task demands to abilities), but fantasy would be associated with undertension and low levels of performance. All three outcomes are possible for CC trained competitors when the task is not well learned, and so the average performance results are likely to continue to reflect competition impairment.

In conclusion, it is predicted that CC trained subjects will show significant performance improvement in competition on the task that is well learned.

A method which teaches individuals to analyse the experience of performing a task in competition in order to identify and attend to the stimuli essential for cueing effective behavior adjustments, may increase the likelihood that psychological and muscular tension levels will be regulated most efficiently and best performance will result. Attention training (AT) is such a method.

When the task is well learned, the majority of competitors may not benefit from AT. It is generally expected that people who have learned to perform a task well have also developed task attending skills. However, as was stated previously, performance impairment occurs in a competition involving a well learned task because many competitors have initial undertension from overconfidence. Yet AT does not correct this undertension. With its emphasis on task analysis, it tends to be boring for these individuals and thus further contributing to their undertension. Similarly AT does not correct subsequent overtension which is likely to occur when some losses are recorded.

The only possible individuals to benefit from AT, when the task is well learned, are those who are overtense due to exceptional anxiety. While not directly correcting this anxiety AT teaches these individuals how to focus their attention on the task. With one's attention on the task there is less chance for being preoccupied with one's anxiety.

With a task that is not well learned, AT is likely to be effective in decreasing the overtension associated with performance impairment. Competitors so trained learn to plan concentration strategies before the competition and to focus their attention only on the key elements of the task during the competition. The practice of good attentional habits specific for a task, in effect, contributes to

learning how to perform the task better, especially in competition. AT does not teach competitors how to deal with overtension; instead, it provides better concentration skills so that the competitors make fewer errors and get overtense less frequently than competitors without this training.

In conclusion, it is predicted that AT trained subjects will show significant performance improvement in competition on the task that prior to training was not well learned.

Electromyographic biofeedback training (BF) is a method which teaches individuals to recognize and reduce muscle tension independent of task demands. This method is likely to benefit the individual when the reduction of muscle tension is required. Otherwise it is likely to have a negative effect on his performance.

When the task is well learned, the average competitor tends to start in a state of undertension. The challenges of the competition such as his mistakes would produce worry and increase the psychological and muscular tension. BF trained competitors learn to adjust muscular tension levels downwards. Either the low muscular tension would be out of phase with the psychological tension derived from the cognitive appraisal of threat, or there would be a recurrent state of undertension. The former response might lead to no change in performance while the latter response would lead to more performance errors. Competitors who tend to be overtense may perform better. No consistent BF effect

is expected.

When the task is not well learned, BF trained competitors have not received any task related skills and so continue to make task errors during competition. These events are perceived by the competitors as threats and such an appraisal stimulates increased psychological tension. Here the relaxation response is triggered. The relaxation response may guard against some performance impairment to the extent that the BF competitors perform at appropriate levels of psychological and muscular tension. The danger is that performance may be further impaired when the competitors relax too much. No consistent BF effect is expected.

In conclusion, it is predicted that BF trained subjects will not show significant improvement in motor task performance under competitive conditions.

Subject factors which might limit or enhance the effect of stress reduction training methods upon competitive performance. In the following paragraphs arguments will be developed leading to predictions that the effect of stress reduction training upon competitive performance will be affected by subject's sex and scores on certain self-report scales of attentional and perceptual style.

The previous discussion of the main effects of each training method makes reference to anxiety habits and task skills as factors influencing the levels of psychological and muscular tension. If males and females differ in

relevant ways on these two factors, the stress reduction training methods, all of which moderate tension, may affect males and females differently.

Maccoby and Jacklin (1974) review several studies which show that girls have higher scores on existing anxiety scales. In several biofeedback studies, females have shown correspondingly higher physiological indicators of anxiety than males: higher heart rate (White, 1975); lower finger temperature (Schneider, 1975); and, higher frontalis muscle EMG levels (Modell, 1977). As argued previously, an anxiety habit operating during competition may produce over-tension disproportionate to a realistic appraisal of task demands and one's abilities. Competitors who respond in this manner are expected to get some benefit in task performance from each training method, CC, AT, and BF. Because of their higher anxiety, females may tend to show some performance improvement after any of the stress reduction training methods and such might not be the case for males. This important relationship was not examined in any of the outcome studies on the three stress reduction approaches. In a research comparing the effects of different practice procedures on the learning of a gymnastic movement, Gilmore (1972), did find that males benefitted more from some methods than from others while females benefitted equally from every practice method. Although Gilmore was not directly employing stress reduction training, it is possible that each practice procedure (uncontrolled mental

practice, controlled mental practice, a combination of controlled mental practice and physical practice, and physical practice) relieved, in females, the overtension associated with task performance in front of an evaluator.

In conclusion, no significant performance improvement differences are expected between the training groups of female competitors.

Sex differences in the task skills are likely to depend upon perceptual motor abilities and the amount of previous competitive experience. Boys are favoured on tasks involving speed or coordination of gross body movement; girls are favoured when manual dexterity is required (Maccoby & Jacklin, 1974). In general males are likely to have had more competitive experience than females even though recent changes in North American society would provide females with greater opportunities to compete in sports than were previously available.

If males do have higher pretraining performance scores than females, then some training methods might be more effective than others for males. If this male superiority were on a task that for most people was well learned, then undertension would be the problem. When task skills are high, undertension may be corrected by CC, unaffected by AT, and aggravated by BF. The largest difference would be between CC and BF. If males were superior on a task that no one had yet learned well, then in competition males would be likely to experience small variations on either side

of appropriate tension. In other words, they would tend to have less tension than if they had less skill and more tension than if they had mastered the task. They would learn affective concentration habits from AT; they might control tension through CC but would probably not improve their performance since this method does not teach any task-related skills; and, finally, they would risk reducing tension too much for successful performance after BF. The largest difference would be between AT and BF.

In conclusion, it is predicted that males will benefit from the training methods of CC in a mastered task and AT in a not yet mastered task, and will perform less effectively after BF training.

The practice of diagnosis and therapy in clinical psychology rests upon the premise that individual differences call for different treatments. Various psychometric tests are used for assessment of individual differences. However, existing assessment instruments and their use for selection of treatment have been criticized in recent years (Nideffer, 1976a; Rotter, 1973). Rotter (1973) states that effective assessment for treatment requires better theory to unify the diverse elements in assessment instruments, life situations, and psychometric treatment procedures. Nideffer (1976a) found confusion in the research and practice related to psychometric assessment and declared that in order for an assessment scale to have utility for treatment selection it should be possible to measure the

need in the life situation for the characteristics assessed by the scale. It follows that the treatment selected should be relevant to assessment scale and to the life situation through these characteristics. On the one hand treatment should build required strengths where there are weaknesses. On the other hand, it is possible that the treatment procedure as a situation itself might require that the client have strengths in certain characteristics in order to benefit from that treatment and be effective outside of treatment.

Of the treatment procedures for this study, two are predicted to be most effective under certain conditions. An examination of these predictions can be used to identify certain subject characteristics that might prove to be indicators of readiness to benefit from the treatment procedures.

CC training is predicted to be most effective when the task is well learned. Placing the reasoning into a subject characteristic framework, the most competent individuals are least challenged, most susceptible to boredom and undertension, and so are ready to benefit from CC training. But task motor skills and task-related attentional skills are included in this competence. Fortunately, it has recently become possible to measure attentional characteristics with a new psychometric assessment instrument, Nideffer's (1976a) Test of Attentional and Interpersonal Style (TAIS).

According to Nideffer (1976a) the ability to direct and control one's attention is the most central variable influencing level of performance. Six of the 17 TAIS scales are attentional style scales:

- BET - ability to effectively integrate many external stimuli at a time.
- OET - susceptibility to mistakes of confusion and overload by external information.
- BIT - ability to be analytical and to effectively integrate diverse ideas and information.
- OIT - susceptibility to mistakes of confusion and overload by thought.
- NAR - ability to narrow attention.
- RED - susceptibility to mistakes of oversight and too narrow a focus of attention.

The six attentional scales have positive as well as negative poles. Individuals who perform well would tend to score towards the positive poles on each of the scales. These individuals are most likely to benefit from cognitive appraisal and coping training because it corrects their undertension in the competitive situation but it does not supply the requisite task motor skills nor task-related attentional skills.

In conclusion, it is predicted that there will be a significant correlation between improved performance after CC training and favorable scores on TAIS attentional scales, i.e. positive correlations involving BET, BIT, and NAR and negative correlations involving OET, OIT, and RED.

AT is predicted to be most effective when the task has not yet been well learned. In addition it is predicted that AT training will help individuals who have learned how to do the task but who have a habit of experiencing high anxiety in the competitive situation. AT develops effective concentration habits specific to the tasks. It should be of benefit to individuals who have concentration difficulties, that is, individuals who tend to score towards the negative poles on the TAIS attentional scales. Low scores in BET, BIT, and NAR and high scores in OET, OIT, and RED are likely.

Another potential indicator of readiness to benefit from AT is one's score on the absorption scale of Tellegen's (1977) Differential Personality Questionnaire (DPQ). This scale measures the ability and disposition to have strong perceptual and imaginative experiences. Individuals who scored high on the absorption scale benefitted more from relaxation training than did other individuals (Harrell and Coles, 1976). The capacity for productive uses of sensory, visualization, and mental rehearsal exercises would be expected from people scoring high on the absorption scale. Since AT makes extensive use of mental rehearsal and sensory awareness exercises, the strength of high absorption might be associated with readiness to benefit from AT.

In conclusion, it is predicted that there will be a significant correlation between improved performance after AT and high scores on absorption, high scores on OET, OIT,

and RED and low scores on BET, BIT, and NAR.

Hypotheses

- 1) By reason of continued task practice, all subjects are expected to learn to perform each task more effectively as measured by significant differences between trials performance within each assessment session.
- 2) It is expected that all subjects will continue to show improved performances over more assessment sessions on some tasks than in others, to identify tasks as still being learned or well learned at the time of posttraining competition.
- 3) It is expected that AT trained subjects will show significant performance improvement in competition on the task that prior to training was not well learned.
- 4) It is expected that CC trained subjects will show significant performance improvement in competition on the task that is well learned.
- 5) It is expected that BF trained subjects will not show significant improvement in motor task performance under competitive conditions.
- 6) It is expected that there will be no significant differences in the effects made on competitive performance by AT, CC, and BF stress reduction training for female subjects.

7) It is expected that males will perform a not well learned task significantly better after AT than males after BF.

8) It is predicted that males will perform a well learned task significantly better after CC than males after BF.

9) It is predicted that there will be a significant correlation between improved performance after CC training and favourable scores on TAIS attentional scales.

10) It is predicted that there will be a significant correlation between improved performance after AT and high scores on absorption, high scores on OET, OIT, and RED and low scores on BET, BIT, and NAR.

CHAPTER II

EXPERIMENTAL DESIGN

Objectives of the Study

The primary objective of this study is to institute stress reduction training programs and evaluate their relative efficiency in improving motor performance in a competition. There are three training programs:

- 1) EMG biofeedback training.
- 2) Attentional training.
- 3) Cognitive appraisal and coping training.

There are three tasks. This permits an examination of the generality of training effects across variations in difficulty, from tasks well learned at the time of final performance to less well learned tasks.

There are an equal number of male and female volunteer introductory psychology students randomly assigned to the control group and to each of the training groups. This permits an examination of the generality of training effects to the total sample, males only, females only, and to that half of the subjects whose prior performance indicates impairment in competition.

The three training programs can be evaluated separately as well as when grouped according to dimensions of contrast. The cognitive methods of attentional training and cognitive appraisal and coping training contrast with the non-cognitive biofeedback training. Two tactical programs contrast with a strategic program. Biofeedback teaches muscle relaxation and attentional training teaches concentration techniques; however, cognitive appraisal and coping training explore the basis of the stress response, self-evaluation. Finally, two general methods contrast with a specific one. Cognitive appraisal and coping training and biofeedback training both provide stress control skills independent of the task. Attentional training provides stress control skills which include skill in task analysis.

The secondary objective of the study is to administer psychometric tests to evaluate selected subscales as moderator variables in the relationship between training and performance, and to validate the task performance measures which operationally define competitive stress. There are three psychometric tests:

- 1) Test of Attentional and Interpersonal Style,
(Nideffer, 1976a).
- 2) The 16 Personality Factor Questionnaire,
(Cattell & Eber, 1964).
- 3) Differential Personality Questionnaire,
(Tellegen, 1977).

Variables and Instruments

Research Tasks

In this section are presented considerations related to the tasks employed to measure the dependent variable of task performance. The use of more than one task is primarily based on the desire to test the generality of training effects on performance across different tasks, especially to the degree that they vary in difficulty at the time of final performance.

Criteria for task selection. A task should sample a set of motor skills different from those of the other selected tasks. Each task should, however, place attentional and muscular control demands upon the subjects so that lapses in concentration and/or increases in muscle tension would be likely to manifest themselves in deteriorated task performance. Each task should be within the moderate range of difficulty so that the introduction of a competitive condition may lead to performance variability among the sample of subjects. Finally, each task apparatus should be available and reasonably resistant to mechanical or electrical breakdown so that data collection is not jeopardized.

Several perceptual motor tasks found in the literature were rejected for not meeting one or more criteria, e.g., the slot car racing task used by Petre and Galloway (1966) was rejected as being subject to breakdown. Final selection of tasks was based on logical and intuitive expectations

that these tasks would meet all criteria.

Task 1, labyrinth. The subject, seated at a table, attempts to move a steel ball $\frac{1}{2}$ inch in diameter along a wooden maze avoiding holes through which the ball might fall. The flat maze, housed in a 12 x 12 x 4 inch wooden frame can tilt on two planes: toward or away from the subject, to the right or the left. The subject controls the tilting and thus the movement of the ball by two control knobs, one located on the front side of the frame, the other on the right side. There are numbers from 1 to 60 which indicate movement along the maze. Task score on a subtrial is 60, for a perfect manipulation of the maze, or the number corresponding to the hole through which the ball drops. The subject begins from the start on each subtrial. One trial consists of the total of the best three of four subtrials, all of which must be completed within the time limit of 5 minutes. The labyrinth is shown in figure 1.

Task 2, bean bag toss. The subject, with an underhand motion, throws a 3 x 4 inch bean bag (average weight, 4 ounces) at a target placed flat on the floor with the nearest edge at a distance of 9 feet from the throwing line (figure 2). Between the subject and the target, at a distance of 5 feet from the subject, a $\frac{1}{8}$ inch diameter cord is tautly strung horizontal to the floor and 5 feet 6 inches above the floor. The subject's throw must go above the cord en route to the target. The target is a 30 x 40 inch illustration board covered by a $\frac{1}{8}$ inch sheet of lucite. Coloured bands are

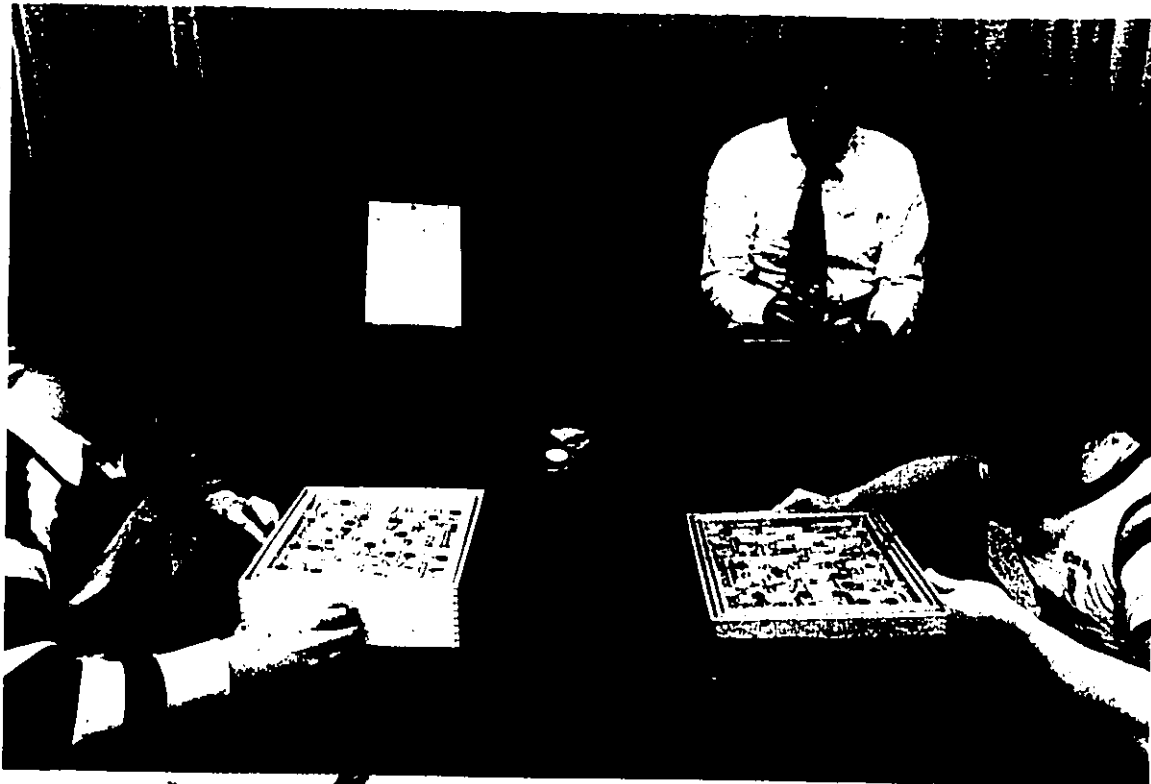


Figure 1
The Labyrinth Game



Figure 2
The Bean Bag Toss

drawn on the illustration board to delimit the point values of each shot. These bands appear to be horizontal but are actually arcs of circles whose centre is the throwing point. There are five black bands; the middle 2 inch band has two 1 inch bands on either side of it. These black bands or lines are separated by $6\frac{1}{2}$ inch coloured bands. Moving away from the middle black band, both towards and away from the subject, these colours are yellow, buff, then orange. A bean bag which touches anywhere on the middle black band is five points, touching the black bands between the yellow and buff bands or entirely in the yellow band is four points; three points for a shot to the band between the buff and orange or entirely in the buff; two points in the orange or touching the front or back edge of the target; and one point for any shot completely off target. Shots which overhang the side of the target are scored as if the arcs were extended beyond the sides. In this scoring and design method, the subject's score represents a distance score and does not consider deviations from a central line. The target was designed in this way due to the indication in an earlier study (O'Hara, 1977) that stress impairs the distance dimension of a throw more than the line dimension.

In task 2, the subject throws two sets of five bean bags in one trial, within a time limit of 90 seconds. The score for a throw is the score appropriate to where the bag stops. All ten throws in the trial are summed to give the score of that trial.

Task 3, catch and deposit. The subject standing 4 feet from an elevated panel 4 feet from ground level is presented with a high bouncing polystyrene ball 1 inch in diameter which falls from one of four copper tubes that protrude from the panel. After the ball bounces once, the subject must catch and hold the ball on a flat palette held by the dominant hand, then transfer the ball and deposit it in a container on his non-dominant side (figure 3).

An operator stands behind the panel. On a hopper attached to the panel are a timing device and several balls. The operator delivers one ball to the mouth of one of the copper tubes every two seconds. His delivery is without pattern and varies over all four tubes.

In each trial 15 balls fall at a rate of one every 2 seconds. One point is awarded for controlling the ball on the palette and one additional point is awarded for depositing the ball in the container. Hitting the ball into the container gains one point only. Total score for the 15 balls is the trial score.

Assessment Sessions

The assessment sessions are the four occasions when the subject works with the tasks and task performance is measured. These sessions are practice, individual performance, pre-training competition, and posttraining competition. In all sessions, each task is located in a separate work space. The number of scored trials and subtrials and the time limits for



Figure 3
The Catch and Deposit Task

trials are the same in all sessions.

Psychometric testing and practice. This is the first laboratory session and the longest. The average duration is 2 hours and 45 minutes. Completion of the psychometric tests requires about 2 hours. Task practice alternates between unscored and scored practice, with each subject recording his/her own scores. Complete protocols for this session and for each of the other three assessment sessions are presented in Appendix A.

The practice period is included in the research to raise the skill of the majority of the subjects to a moderate level. With subjects' skill at a moderate level, the competitive conditions should increase group performance variability. Some subjects may improve while subjects who are stressed should deteriorate. Without a practice period, skill might remain at a minimal level where performance deterioration would be less evident.

Individual performance. This session takes place within two days of the practice session. A single subject is present with the experimenter or one of his assistants. The subject's performance is scored on three full trials of each of the three tasks. This session lasts about 20 minutes.

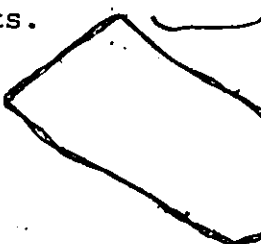
This assessment provides another observation of the subject's progress in the learning of each task. With only the experimenter or assistant present, this session provides fewer evaluation or social influence stimuli than the competitive session. Final competition scores of the training

groups will be adjusted for initial group differences in scores from this session and from the pretraining competition.

Pretraining competition. One or two days after the individual session, subjects return to the laboratory to compete on the tasks in groups of three people. As well as his two opponents, a subject encounters a judge who gives ego-involving instructions for the contest, announces previous scores to make known each contestant's performance standard, announces and comments upon results, and posts the results on a score board. Completion of the competition takes 1 hour.

It is assumed that some people are less efficient performing in competition than in an individual session. However, some gain in average performance should occur, reflecting the learning process. When individual scores are subtracted from pretraining competition scores, the lower resultant C-I gain scores should indicate performance impaired in competition. Accordingly, this session and the individual session provide the bases for an operational definition of stress-impaired performance prior to training. Scores from this session will also be used as covariates for adjusting final competition mean scores in the training groups.

Posttraining competition. One or two days after the final training session, subjects return to the laboratory for the final competitive performance measures. It is most likely that a subject will compete with two new opponents.



All other conditions are the same as for the pretraining competition.

This assessment session provides the final performance scores. Since pretraining and posttraining conditions are the same, final performance scores should reflect gains made by the control group due to learning, motivation, and expectation, which are common to all treatment groups, plus any change due to the specific training method.

Personality Variables

Prior to the measurement of individual performance, all subjects complete three standardized psychometric self-report questionnaires, the Sixteen Personality Factor Questionnaire (16 PF) (Cattell & Eber, 1964); an abbreviated form (Appendix B) of the Differential Personality Questionnaire (DPQ) (Tellegen, 1977); and the Test of Attentional and Interpersonal Style (TAIS) (Nideffer, 1976a). Three scales from the complete DPQ make up the form as abbreviated for this investigation: stress, absorption, and social potency. The latter scale was included to provide filler items. There are 17 TAIS scales. Only the 6 scales that reflect attentional processes were scored, although subjects completed the full test.

Each of the three psychometric tests includes one or more scales which are measures of stress-related experience. In this study it is contended that task performance impairment in competition is the consequence of inappropriate

muscular tension and focus of attention that accompany the stress reaction. Measures of such impairment should be correlated with measures of stress-related experience.

Accordingly, a test of the validity of this investigation's operational definition of stress-impaired performance can be made. This test uses the following 11 scales: overloaded by external stimuli (OET), overloaded by internal stimuli (OIT) and reduced attentional focus (RED), all from the TAIS; stress from the DPQ; low ego strength (C-), shyness (H-), tendermindedness (I+), protension (L+), apprehension (O+), low self-sentiment integration (Q₃-), and ergic tension (Q₄+), all from the 16 PF (Cattell, Eber & Tatsuoka, 1970, pp. 84, 118; 191).

The second function of the psychometric tests is as indicators of readiness to benefit from psychological training. Sarason (1975) presents and discusses evidence for significant interaction between test anxiety and coping instructions in facilitating performance on a serial learning task. While high test anxious subjects benefitted from coping instructions, low test anxious subjects performed better after neutral rather than coping instructions. In the present study of motor task performance in a competition, the six attentional process scales from the TAIS and the absorption scale from the DPQ are included to be tested as moderator variables in the prediction of benefit from psychological training. The attentional scales are chosen because the attentional focus model has been applied to sports

(Nideffer, 1976) and because attentional scale score and treatment choice relationships proposed by Nideffer (1976a, 1976b; Nideffer & McCartney, 1976) might be tentatively explored in this study. The absorption scale has been chosen for similar exploration. This scale is a measure of the "disposition for having episodes of 'total' attention that fully engage one's representational (i.e., perceptual, enactive, imaginative, and ideational) resources" (Tellegen & Atkinson, 1974). Harrell and Coles (1976) report that individuals scoring high in absorption were better able, through progressive relaxation training, to reduce pretraining levels of several parameters of electrodermal activity measured following the presentation of white noise (stress stimuli).

Treatment Groups

In this study there are four treatment groups: Group AT, attention training; Group BF, electromyographic (EMG) biofeedback training; Group CC, cognitive appraisal and coping training; and Group MC, motivation-placebo control group. Each treatment consists of four 40 minute sessions, given two sessions per week for two consecutive weeks. The treatment sessions for Groups AT, CC, and MC are group sessions for two to six subjects. These groups meet in a bright, well-ventilated room in the laboratories of the Department of Kinesiology of the University of Ottawa. Training for these three treatments is mainly carried out by the experimenter with less than ten percent of the training

load taken by senior students he has trained and supervises. Biofeedback training is an individual treatment carried out by trainers in the Department of Man and His Environment of Algonquin College in Ottawa. This department initiated a Biofeedback Training Program in 1974, which includes sessions in EMG, alpha wave, and skin temperature biofeedback. Since that time, over 1200 people have received EMG biofeedback training from the trainers at Algonquin College.

All four treatment programs present the rationale that the competitive situation can be stressful; task performance can suffer as a result of the psychological stress encountered in the competition; learning ways to reduce psychological stress can improve performance. Each treatment differs from the others in its approach to reducing stress. These four approaches are described in the following sections. Sample sessions from each treatment are presented in Appendix C.

Attention training. The aims of attention training are to develop the trainees' sensory awareness and control of their focus of attention, to teach a theory of the attentional demands of tasks, to provide practice in the analysis of task demands, to teach attentional focus appropriate to task and time, that is, a problem-solving analytical preparation before the task and during natural breaks in the task but a spontaneous responding to events as they happen without reflection during task performance. All of these aims are directed towards improving performance in competition. The basic assumption of the application of this training approach

to competitive stress is that, with the appropriate focus of attention in competition, the individual will not experience stress, and will thus perform more effectively.

Training procedures are adaptations from the work of Gallwey (1974), Wine (1974a), Nideffer (1976), and Nideffer and McCartney (1976). Subjects are given examples to illustrate that the appropriate focus of attention for the task reduces or eliminates psychological stress and improves results. The trainees, through directed awareness exercises, learn a set of dimensions for attention. They practice attending broadly and narrowly to various internal and external stimuli and shifting attention from one focus to another. As well as defining the attentional dimensions, this practice introduces and promotes the notion that the trainee can control his focus of attention. Trainees are told that concentration is required for good performance, but that it is normal to be aware of distractions. Learning that they can control their attention and stay aware of the present helps them to record, but not react to, the distracting stimuli so as to maintain concentration. Further stages in the training enable the trainees to analyze the attentional demands of task and the competitive situation in order to prepare an attentional plan. The trainees mentally practice the use of attentional cues in the future competitions. This mental rehearsal is structured so that the emphasis is upon attention control not practice of the tasks. In this way, the trainees imaginably encounter a set of situations and practice task oriented self-statements,

focusing on their breathing, and letting the body adapt to the demands of the task.

All techniques learned in this training are presented as appropriate for the focusing of one's attention before, during, and after competition, as well as in a wide variety of life situations.

EMG biofeedback training. The aims of EMG biofeedback training are to develop the trainee's awareness, sensitivity, and control of muscle tension through the ongoing provision of a signal of his muscular activity. A basic assumption in the application of this training approach to competitive stress is that learned muscle relaxation will reduce the effect of stressful situations upon the body, so that the phasic activity of the muscles required for task performance does not have to overcome inappropriately high tonic levels of muscular activity. Therefore, movement is more accurate and performance is improved.

Subjects in this group receive training individually. The subject sits in a comfortable chair in a room with bright normal lighting. Two silver/silver chloride reusable surface electrodes (1.7 cm. diameter) are attached to the subject's forehead (2 inches to the sides of the nasion and 1 inch above the brow). These are connected to a Model 300C 2 rms EMG (Acquarius Electronics) which is used to provide auditory (a tone rising with increases and falling with decreases in muscle activity at electrode site) feedback to the subject from speakers located in the apparatus.

Training procedures are adapted by the Algonquin bio-feedback staff from St-Jean's (1977) manual (Appendix C). The adaptation shortens the regular student procedure without damage to the biofeedback training, that is, training begins in the first session rather than having one full session of introduction; also, the stimulus generalization sessions of cognitive training for application of the relaxation skills are omitted and trainees are merely encouraged to practice relaxation in their daily lives.

In the first session the trainee reads a two page instructional manual during electrode placement. The sensitivity control is demonstrated and the trainee chooses a setting where getting the tone to shut off is just challenging. He practices getting the tone to turn off (tone is off when muscle activity is below the sensitivity setting during 80 percent of the time integrated) and lowering or raising the sensitivity setting to maintain the training at a challenging level. The trainer checks the progress every 10 to 20 minutes. In later sessions, periodic no-feedback checks of the trainee's ability to raise or lower his muscle activity are made by the trainer. When a trainee is consistently successful at the criterion of eight times in ten, the trainer can move the electrodes to the trapezius muscles. It is assumed that this variation does not introduce extra experimental error into the design because all subjects in this treatment receive a standard 160 minutes of biofeedback training.

Cognitive appraisal and coping training. The aims of cognitive appraisal and coping training are to sensitize the trainees to the role played by cognition, thoughts, images, evaluations, etc., in creating a state of stress, to teach them to monitor their own cognitive activity in stress related situations and to provide them with explicit cognitive strategies for coping with the cognitive component of psychological stress so that they learn to reduce stress and function more effectively. A basic assumption in the application of this training approach to competitive stress is that most, if not all, appraisal of threat in the competitive situation is a complete waste of time and does not lead to adaptive competitive performance.

Training procedures are adaptations from cognitive oriented therapy procedures (Ellis & Harper, 1977; Meichenbaum & Cameron, 1972; Meichenbaum, 1974; Meyers, Mercatoris & Artz, 1976; Holroyd, 1977; Holroyd, Andrasik & Westbrook, 1977). Trainees are first introduced to the notion that unrealistic expectations, concern about self-evaluation, concern about past or future errors and successes, and consideration of such irrelevant competitive stimuli as the observers are maladaptive thoughts which engender stress. Such thoughts lead to excess muscle tension and distract the person's attention from the task. Both of these effects promote deteriorated task performance. The trainees next try out this conceptualization (Meichenbaum, 1974) in the analysis of several potentially stressful

situations so as to identify: the stimuli that trigger anxiety; the nature of their anxious reactions; their thoughts; and the manner in which these thoughts contribute to poorer performance. The trainees learn to monitor their thoughts and come to recognize the maladaptive ones and the irrational beliefs that predispose them. Everyday life and the negative emotions experienced are observed. Once the trainees become adept in self-monitoring, they practice substituting their own personalized coping responses of the following types: reappraisal of the real danger in the situation; self-instructions to ignore maladaptive thoughts and focus instead upon the task; imagery of a more pleasant experience. The trainees learn to use the maladaptive thoughts and emotions as cues for the more adaptive coping responses. A part of the fourth training session is devoted to presenting a real or role played stressor against which the trainees can apply their new skills.

Cognitive reappraisal and coping training teaches redirection of attention as a coping device for reducing psychological stress. However, this training method acknowledges that the individual must first learn to discriminate stress engendering thoughts so that he will have appropriate cues for the employment of his attention-diverting coping skill. Moreover, the emphasis in this use of attention focusing is focusing attention away from certain thoughts and stimuli rather than analysis of what, in the task, is the appropriate object of attention. The

latter emphasis is present in attention training.

Motivation-placebo control group. The announced aim of this training is to help the trainees better understand themselves, especially their own values, goals, and motivations. Performance can easily be related to motivation in sports. A person in stress may have several conflicting motives and this conflict hampers him from working well on his task. By getting to know more about oneself, the trainee can decide what goal to pursue in competition, and subsequently can pursue that goal more singlemindedly which should lead to improved performance.

Training procedures are adapted from McClelland and Steele (1972). Trainees are presented a rationale relating stress with motivational conflict, and good performance with motivational harmony. Trainees introduce themselves and write a list of their values, then another list of their goals. A discussion follows on individual differences and identification of conflicts between values and goals. Each session has several exercises on self-knowledge and self-revelation. The training has considerable face validity for the preparation of competitors.

Subjects

The experimenter visited several introductory psychology classes at the University of Ottawa, to request students to volunteer as subjects in a study of the effects of four methods of coping with stress on improving performance in

various lab games played competitively. The experimenter described the four training methods and emphasized that each method would be effective for some people. Which persons would benefit from which training was to be determined using scores from personality tests the subjects would fill out on their first visit. Since the research would require about 12 hours spread over a definite four-week period from each volunteer, and since they would receive only six points towards their final grade as opposed to the going rate of one point per 30 minutes of research participation, only those students sufficiently interested in the project to commit themselves were encouraged to take one of the fixed appointment times and write their telephone numbers in the sign-up booklet.

The final sample includes 96 subjects. There are 12 males and 12 females in each of the four treatment groups. Because of the extensive amount of time involved in the experiment and the inability for the space and personnel to process 96 subjects in one period of time, it was decided to carry out the experiment on three separate subsamples. The subjects within each subsample were randomly assigned by sex to four groups. These groups, in turn, were randomly assigned a treatment. Random assignment was done immediately after completion of the pretraining competition. Subjects were contacted by telephone and given the time, date, and location of their first treatment session. In the first session, a schedule for the three other training sessions was

arranged. Subjects who missed any session, assessment, or treatment were telephoned and given another appointment. With this procedure, there would be very few dropouts from any phase of the experiment. Moreover, all subjects who could not be present during the four-week period for which they were being solicited but who gave their telephone numbers for possible future participation, were later called to participate. There would be few of those who did not eventually complete the project.

The distribution of subjects to training groups within each subsample and details concerning subject dropout are presented in Appendix D.

Procedures

The procedures of the study have been presented in each of the previous design sections. Here is a systematic overview of the research procedures, which are summarized in Table 1.

Solicitations were made for subjects in classes of introductory psychology. Students who volunteered as subjects for the first subsample were given appointments for the practice assessment session. Interested students unable to take part in the first subsample gave their names, telephone numbers, and an indication of when they would be available.

Subjects received practice and completed personality questionnaires in their first visit. Within two days they

TABLE 1

SUMMARY OF RESEARCH PROCEDURES

| Practice Assessment Session P | Individual Assessment Session I | Pretraining Competition Assessment Session C | Treatment Conditions | Posttraining Competition Assessment Session TC |
|---|---|---|--|--|
| Psychometric testing (TAIS, DPO, 16 PF). | | | Randomized assignment. | |
| Unscored practice separating three self-scored trials on each of the three tasks (labyrinth, bean bag toss, catch and deposit). | Three trials on each of the three tasks, scored by experimenter or assistant. | Three trials on each of the three tasks in competition between three subjects; atmosphere of competition enhanced by judge and results board. | Group AT Attention training, in groups led by experimenter. Group BF EMG biofeedback training, individuals assisted by one of two trainers at Algonquin College. Group CC Cognitive appraisal and coping training, in groups led by experimenter. Group MC Motivation-placebo control, in groups led by experimenter. | Same as pretraining competition assessment session C, but new groups of three competitors. |
| Time = 3 hours | Time=20 minutes | Time = 1 hour | Time = 160 minutes, i.e., four 40 minute sessions in two weeks | Time = 1 hour |

were recalled for individual performance measurement which was followed within two days by the pretraining competition measurement. Subjects were randomly assigned to groups which were randomly assigned to treatments. Four twice-weekly training sessions of 40 minutes were given within the next two weeks. Biofeedback training was individual. Attention training, cognitive appraisal and coping training, and motivation-placebo control training were done in groups of two to six subjects. All subjects returned for the posttraining competition measurement.

When the first subsample had completed the project, subsample two was formed. There were three subsamples for a total of 96 subjects.

Statistical Methods

Learning and Task Difficulty

To assess the learning effects throughout the course of the experiment, an analysis of variance with repeated measures of three trials and assessment sessions will be done separately on the performance scores of each of the three experimental tasks. The F ratio of the differences between mean scores on trial 1 versus trial 2 and on trial 2 versus trial 3 will be used to compare one task to another on stage of learning reached at each assessment session. If the tasks are found to be equivalent in

difficulty a composite variable, comprising scores on the three tasks, will be created to test the effects of training methods.

Each statistical test will examine a contrast between two means. Since the between-sets variance in that case has only one df, it is known that $\underline{F} = \underline{t}^2$. The use of the \underline{F} test above and in later analyses rather than the more common \underline{t} test will be adopted on the grounds of programming convenience.

Effects of Training Method

In the event that the three tasks are not joined to form a composite variable, the following are the statistical procedures for testing hypotheses concerning the effects of training method upon group performance in competitive conditions. In so far as pretraining inequalities could affect posttraining performance, final task scores will be adjusted for initial differences in both individual and pretraining competitive scores by residualization. On each task, three separate analyses of covariance, comprising only the control group and one of the three active training groups, will be computed. Posttraining competition means will be adjusted in each analysis of covariance for the within-classes regression in individual session scores and pretraining competition scores. This single contrast method is chosen over the

analysis of covariance involving all four treatments, since the latter is too complex to be interpreted directly and has, at any rate, to be resolved eventually into comparison of individual contrasts. Among those, the comparison of each training method with the control group is of primary interest, although the relative merit of biofeedback and cognitive training methods must also be investigated.

Effects of training for low C-I gain subjects. A segmented analysis of training groups will be confined to group members whose performance in the pretraining competitive session indicates impairment. Performance impairment is operationally defined as below the median gain score from the individual to the pretraining competition session (i.e., C-I). Each low C-I gain group will have six males and six females. Separate selections will be made for each experimental task. The significance of the difference between adjusted means for the control group and one training group at a time will be tested. Thus, the effectiveness of training methods on the competition-impaired subjects will be studied.

The previous analytical method is statistically sound in the classical sense. It is most appropriate when no difference between initial and final scores is expected apart from the treatment effect. Here, however, there should exist a powerful learning effect present in

all groups. Before any gain due to treatment is studied, it may be advisable to eliminate the effect of learning and its possible interaction with treatment. In this case the total effect should be eliminated rather than the amount determined by the degree of variate-covariate correlation as required in the classical residual analysis. It is assumed that the difference between pretraining and "posttraining" competitive scores (TC-C) in the control group is due to learning and is thus common to all groups. Accordingly, this amount can be legitimately subtracted directly from all final scores.

In the alternative and supplementary form of analysis the control group will be treated only as providing the standard of learning, competition, and other effects. Once these are eliminated, it is possible to study the residual effect of treatment within each training group. In view of the likely positive correlation between initial and final score, the error of estimate for the difference in the respective means may be substantially reduced, thus allowing greater sensitivity to an F test for the observed change due to the treatment. Then an F test of the difference between the correlated means from the pretraining and posttraining competitions will be made for each of these training groups. This analysis will be implemented first for the

whole group, and then for the segmented group selected for low C-I gain score.

Treatment by sex interaction. Segmentation of the treatments into male and female groups will next be done. This will test for differential improvement with training according to sex. As before, a test of significance of the difference between adjusted (residualized) means of the control group and each of the training groups will be applied.

Psychometric Scale Analyses

Construct validity of competitive stress. The psychometric scales selected from the TAIS, DPQ, and 16 PF have been included in the experiment for confirmation and exploration purposes. Eleven scales are accepted as self-report measures of stress-related traits. Pearson product-moment coefficients of correlation will be computed for the 11 stress scales with C-I gain scores. This analysis is planned to assess the construct validity of the low C-I gain score as an operational definition of competitive stress.

Treatment by readiness interaction. The exploration aspect of the psychometric analysis will be concerned with the further validation of the treatment methods, using, however, TC-C gain scores as a dependent variable. The six attentional scales of the TAIS and the absorption scale from

the DPQ, potential measures of readiness to benefit from psychological training will be used as moderators of the effect of training. This post hoc exploration, essentially for future research directions, will employ the cross product correlation method recommended by Porebski as discussed in his recent report (Porebski, 1976). New variables which are the cross products of deviation scores of two variables can be formed. They can be used as additional predictors of a dependent variable. They are known to be equivalent to the first order interactions in the analysis of variance, but are somewhat more convenient to use as they may be included together with other predictors in the same linear multiple regression (Porebski, 1976).

In application to the present problem, the ordinary deviations from the means will be computed for the psychometric variables and the product of these deviations with the membership of control or training group will be determined. The belonging to a group will be assigned a value of +1 for training and -1 for control, as one training method at a time will be studied. Only training methods which show some significant effect in the main analysis will be further explored in this manner (see Appendix E).

In the variables created by the cross products of training and various measures of readiness for training, as represented by the attention and absorption scales, the effect of interaction on the TC-C gain score will be studied. The distribution of values on these variables is a function

of both training and readiness. The multiplication process provides negative and positive values. Two groups of subjects obtain positive scores: people with high readiness scores who belong to the training group and people with low readiness scores in the control group. Two groups of subjects obtain negative scores: people with high readiness scores in the control group as well as people with low readiness scores who are in the training group. The size of these values, in either the positive or negative direction, is dependent upon the size of the psychometric scale score, that is, the readiness score.

This procedure seems to offer more information than the classical interaction effect where the psychometric scores would have to be dichotomized to be used in the analysis of variance design. At the same time, if significant results are found, this procedure could lead to a practical selection, on the basis of psychometric score, of those subjects who would benefit from a particular type of training. If, for example, there would be a significant positive correlation of treatment-gain (TC-C) with the cross product variable formed from absorption and training when attention training is the method, then attention training should be recommended for people with high absorption scores. People with low absorption scores would be advised to avoid attention training.

CHAPTER III

RESULTS

Learning Differences in Experimental Tasks

A four factor analysis of variance of sex by treatment group, having repeated measures on trials and assessment sessions (Winer, 1971: p. 574) was computed separately for each of the three tasks. Only the last three assessment sessions were included, since practice scores were available for fewer than the total $N = 96$ sample.

The analysis of variance is summarized to present the three tasks together on one of the two repeated measures, assessment sessions (Table 2) and trials (Table 3).

There was a significant main effect for assessment sessions. The difference was at the .001 level of confidence for tasks 1 and 3 and at the .05 level for task 2. The second repeated measures factor trials also produced a significant main effect on scores for each task. Interaction between the repeated measures factors was not significant: task 1 ($F(4,704) = .33$); task 2 ($F(4,704) = .79$); and task 3 ($F(4,704) = .83$).

TABLE 2

SUMMARY OF ANALYSIS OF VARIANCE OF ASSESSMENT
SESSIONS WITHIN SUBJECTS FOR ALL TASKS

| Task | Mean square between assessments | df | Mean square within assessments | df | F |
|-------------------------|---------------------------------------|----|--------------------------------------|-----|--------|
| 1. Labyrinth | 12980.98 | 2 | 246.05 | 704 | 52.76* |
| 2. Bean bags | 59.94 | 2 | 17.75 | 704 | 3.38** |
| 3. Catch and deposit | 165.45 | 2 | 5.46 | 704 | 30.30* |

* $p < .001$ ** $p < .05$

TABLE 3

SUMMARY OF ANALYSIS OF VARIANCE OF TRIALS
WITHIN SUBJECTS FOR ALL TASKS

| Task | Mean square between trials | df | Mean square within trials | df | F |
|-------------------------|----------------------------------|----|---------------------------------|-----|---------|
| 1. Labyrinth | 5521.54 | 2 | 246.05 | 704 | 22.44* |
| 2. Bean bags | 182.90 | 2 | 17.75 | 704 | 10.30** |
| 3. Catch and deposit | 79.29 | 2 | 5.46 | 704 | 14.52* |

* $p < .001$ ** $p < .005$

In order to observe whether the main effect for assessment sessions corresponded to performance improvement on the tasks over time, the changes in assessment session means were represented graphically (Figure 4).

Mean scores continue to rise over the four assessment sessions, albeit by apparently small amounts in the late stages for tasks 2 and 3. The most marked improvements in performance occur from practice to the individual session. In the last transition, from pretraining competition to post-training competition, task 1 shows the greatest acceleration. Tasks 2 and 3 present similarly shaped curves which are flatter than the curve of task 1. The maximum points possible per trial are 180 on task 1, 50 on task 2, and 30 on task 3. It would seem that learning is occurring on all tasks, that it is occurring at a more accelerated pace and over a longer period of time on task 1 than on either of the other two tasks, and that task 3 is the easiest task while task 1 is the most difficult. However, the graphic information can only be suggestive. Other analyses are required to verify whether learning is present and to assess the comparative difficulty levels of the three tasks.

Table 4 presents a summary of the analysis of differences between the trial means within each assessment session. It can be seen in Table 4 that the first trial in a session is often lower than the highest trial in the previous session. The phenomenon of motor performance at a less efficient level at the start of an activity than previously

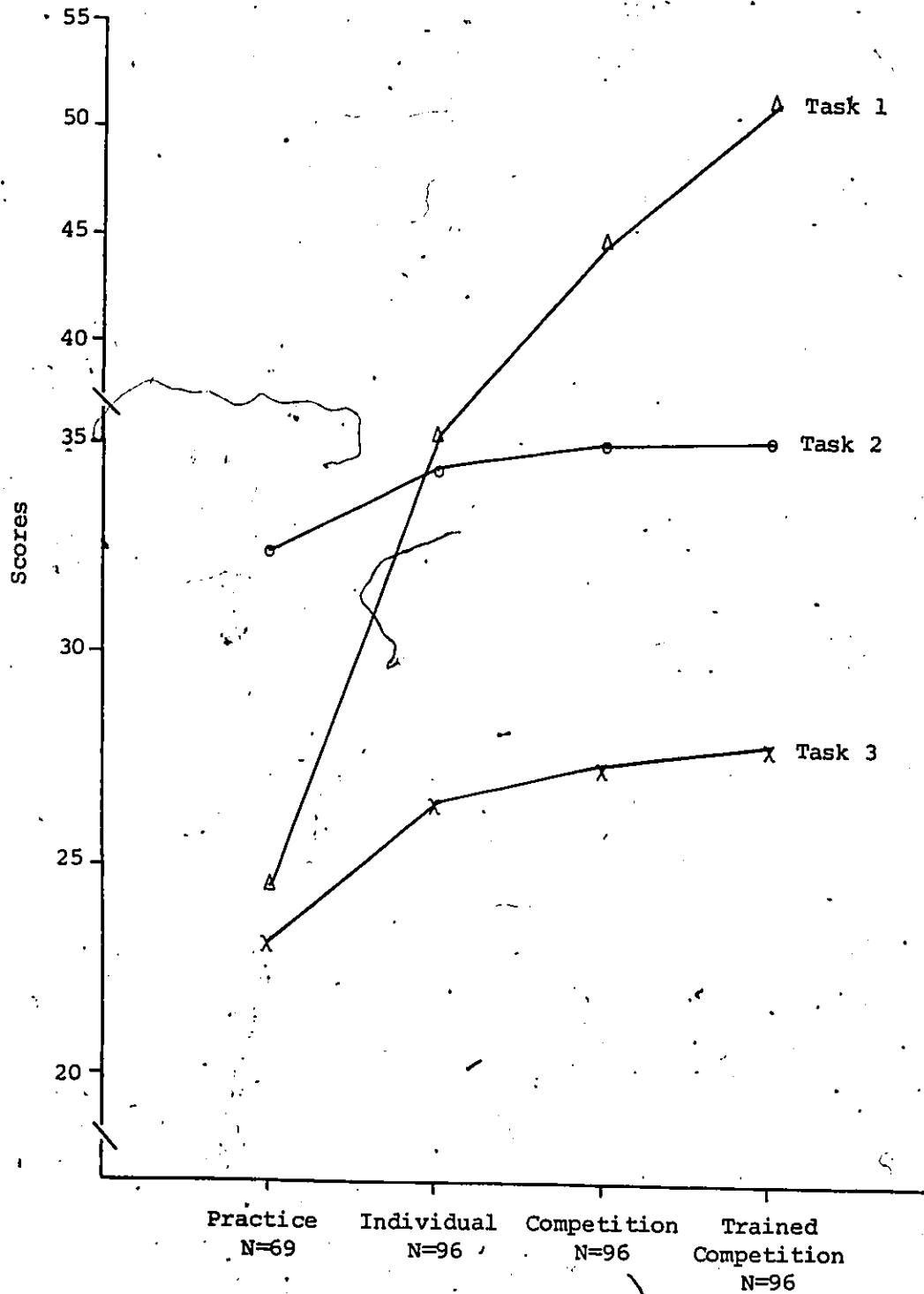


Figure 4
Change in Mean Task Performance Over
Four Assessment Sessions

TABLE 4

SUMMARY OF DIFFERENCES BETWEEN TRIAL MEAN SCORES
WITHIN ASSESSMENT SESSIONS FOR ALL TASKS

| Group | Task 1 | | | Task 2 | | | Task 3 | | |
|---------------------------------|-----------|---------|-----|---------------|---------|-----|-----------------|---------|-----|
| | Labyrinth | | | Bean Bag Toss | | | Catch & Deposit | | |
| | \bar{X} | F | r | \bar{X} | F | r | \bar{X} | F | r |
| Practice (N=69) | | | | | | | | | |
| Trial 1 | 17.58 | 5.77* | .46 | 29.74 | 18.42** | .30 | 19.13 | 66.68** | .45 |
| Trial 2 | 22.81 | 18.72** | .72 | 33.15 | 7.76** | .56 | 24.71 | 3.82 | .48 |
| Trial 3 | 33.06 | | | 34.86 | | | 25.70 | | |
| Individual (N=96) | | | | | | | | | |
| Trial 1 | 34.35 | 4.62* | .84 | 34.01wd | 2.23 | .13 | 25.82 | 4.02* | .73 |
| Trial 2 | 38.33 | 2.33 | .85 | 35.07 | 0.55 | .37 | 26.50 | 4.35* | .67 |
| Trial 3 | 41.27 | | | 34.65 | | | 27.18 | | |
| Pretraining Competition (N=96) | | | | | | | | | |
| Trial 1 | 40.37wd | 4.74* | .87 | 34.38wd | 4.39* | .41 | 26.89wd | 2.55 | .57 |
| Trial 2 | 44.06 | 8.89** | .86 | 35.58 | 0.05 | .31 | 27.42 | 4.01* | .75 |
| Trial 3 | 49.85 | | | 35.73 | | | 27.89 | | |
| Posttraining Competition (N=96) | | | | | | | | | |
| Trial 1 | 46.53wd | 3.54 | .72 | 34.12wd | 11.21** | .37 | 27.48wd | 8.45** | .49 |
| Trial 2 | 51.32 | 4.09* | .80 | 36.01 | 0.15 | .35 | 28.32 | 0.12 | .48 |
| Trial 3 | 56.39 | | | 36.24 | | | 28.22 | | |

* $P < .05$

** $P < .01$

wd--warm-up decrement

attained can be called warm-up decrement (Lawther, 1977). Accordingly, each time this phenomenon appears, it is indicated by the letters "wd" beside the first trial mean. This is done since it is likely that these trial means, to some degree, reflect the impairment of warm-up. It follows that any performance gain from such a first trial to the second trial is not due to learning alone, but is in part due to a recovery from warm-up decrement. In such cases, and there are seven such cases, the difference between trials 2 and 3 is likely to be a more valid indicator of ongoing learning. Consequently, this analysis adopts the significance of the difference between trials 2 and 3 as the criterion of learning, when warm-up decrement is present. If learning is still occurring, the difference should be significant; if the limit of skill development on the task has been effectively reached, the difference should be insignificant.

The first hypothesis, that all subjects would learn to perform each task more effectively, is generally supported by the analysis of trial means. On each task, subjects make some significant improvement in performance. There are significant differences between trials, which are most likely accounted for by increased task practice, on task 1 in each session (minimum significant difference is $F(1,190) = 4.09$, $p < .05$); on task 2 in the practice session only (minimum of two significant differences is $F(1,136) = 7.76$, $p < .01$); and on task 3 in the practice, individual and pretraining competition sessions (minimum significant difference is

$F(1,190) = 4.01, p < .05$).

The second hypothesis is also supported by the data from the analysis of means, when warm-up decrement is considered. Quite different patterns of learning are manifest for the three tasks. The significant amount of learning of task 2 is completed within the practice session. Subjects continue to improve their average score but insignificantly according to the conditions of this analysis. With a maximum score per trial of 50, task 2 seems to keep most subjects on a plateau, reflecting that it is a task that most people can quickly learn to do moderately well, but a task quite difficult to master. Task 3 shows slow but steadily significant growth of skill attained by the average subject, growth which continues up through the pretraining competition. This seems the least difficult of the tasks because the average subject achieves a trial score close to the maximum of 30. Finally, subjects continue to improve performance on task 1 through the entire range of assessments. Task 1 seems more difficult than task 3 in terms of distance between average and maximum per trial scores. It is easier to reach a plateau on task 2 than on task 1, but that may not be the appropriate comparison of task difficulty.

Although tasks 1 and 3 show similarities through the competitive session, task 1 continues to be learned after that session while task 2 and task 3 stabilize. It does, however, seem more appropriate to label task 3 a well learned task at the time of final competition and to say merely that

learning does not continue on task 2. In any event, the differences between the tasks makes the combination of the separate task scores into one or two composite performance variables misleading and impractical. Instead, the effects of training methods on performance in competition are tested separately for each task.

Effects of Training Methods on Task Performance in Competition

In all subsequent analysis, performance score is the assessment session score, the sum of the three trials. Consideration of this choice rather than some best selection of trials is presented in Appendix F.

Treatment with All Subjects

The posttraining competition scores were adjusted for pretraining differences between the treatment groups. Each training group was compared with Group MC (motivation-placebo control group) holding pretraining competition and individual session differences constant by analysis of covariance (Table 5).

Although there was a pattern of differences favoring Group AT (attention training) over Group MC and favoring Group MC over Group BF (EMG biofeedback training), the F ratios for between group differences were small and indicated equivalence for the treatment groups with all subjects considered.

TABLE 5

COMPARISON OF TRAINING METHODS WITH CONTROL GROUP
ON FINAL PERFORMANCE SCORES
ADJUSTED BY RESIDUALIZATION

| Comparison | | Adjusted Final Scores | | F |
|------------|--------|-----------------------|-------------------|------|
| | | Mean ₁ | Mean ₂ | |
| MC vs BF | Task 1 | 152.1 | 141.1 | 0.90 |
| | Task 2 | 106.8 | 104.1 | 1.35 |
| | Task 3 | 84.0 | 83.0 | 0.41 |
| MC vs CC | Task 1 | 154.6 | 151.1 | 0.08 |
| | Task 2 | 108.0 | 104.9 | 1.94 |
| | Task 3 | 83.6 | 84.5 | 0.36 |
| MC vs AT | Task 1 | 141.2 | 148.5 | 0.39 |
| | Task 2 | 107.7 | 109.0 | 0.28 |
| | Task 3 | 84.4 | 84.8 | 0.08 |

N = 24 per group

The differences between pretraining and "posttraining" competitive scores (TC-C) in Group MC were subtracted from the posttraining scores of each of Groups AT, BF, and CC (cognitive appraisal and coping training). The resultant TC scores were compared to pretraining competitive scores (Table 6).

In this analysis, subjects who had received either EMG biofeedback training or attention training did not significantly improve their competitive performance beyond pretraining levels on any of the tasks. Biofeedback training may impair performance on task 1 ($F(1,46) = 3.49, p < .10$).

TABLE 6

MEAN PRETRAINING AND POSTTRAINING PERFORMANCE
IN COMPETITION: POSTTRAINING SCORES
ADJUSTED FOR CONTROL GROUP GAINS

| Group | Task 1 Labyrinth | | | Task 2. Bean Bag Toss | | | Task 3 Catch & Deposit | | |
|--------------------|---------------------|-----------------|-----|--------------------------|-----------------|-----|---------------------------|-----------------|-----|
| | \bar{X} | \underline{F} | r | \bar{X} | \underline{F} | r | \bar{X} | \underline{F} | r |
| Biofeedback (N=24) | | | | | | | | | |
| C | 149.0 | 3.49* | .95 | 103.2 | 0.69 | .66 | 81.2 | 0.90 | .65 |
| TC | 133.8 | | | 101.6 | | | 82.5 | | |
| Cognitive (N=24) | | | | | | | | | |
| C | 153.7 | 0.78 | .94 | 107.2 | 3.17* | .68 | 80.8 | 4.36** | .73 |
| TC | 146.2 | | | 103.5 | | | 83.6 | | |
| Attentional (N=24) | | | | | | | | | |
| C | 122.4 | 1.02 | .88 | 106.7 | 0.10 | .44 | 83.1 | 0.97 | .49 |
| TC | 130.3 | | | 107.4 | | | 84.8 | | |

Legend: C--Pre-training competitive session; TC--Post-training competitive session.

* $\underline{p} < .10$

** $\underline{p} < .05$

Adjustments for gains by control group: Task 1--23.667; Task 2--1.792; Task 3--0.375.

Cognitive appraisal and coping training was effective in improving competitive performance on a well learned task. Group CC showed significant improvement on task 3, the catch and deposit game ($F(1,46) = 4.36, p < .05$). On the other hand, this same training method may impair performance on the bean bag toss, task 2 ($F(1,46) = 3.17, p < .10$).

Treatment with Subjects who had made Less Improvement in the Pretraining Competition

The foregoing analysis of stress reduction training methods used all subjects. The next analysis was based upon half the sample, those subjects in each group's male and female cohorts who had made the lower performance gains from individual to pretraining competition, that is, low C-I gains. On this segmentation of the sample, the previous two types of analyses were done, single contrast analyses of covariance (Table 7) and F tests of the TC-C performance changes after removal of the same changes made by Group MC (Table 8).

Residualized final competition scores on task 3 were significantly higher in Group MC than in Group BF ($F(1,22) = 5.26, p < .05$). The superiority of Group AT over Group MC on task 1, the labyrinth, approached significance ($F(1,22) = 3.96, p < .10$). Contrasts between Groups MC and CC and between Groups BF and AT showed no significant differences.

TABLE 7
 COMPARISONS BETWEEN TREATMENT GROUPS ON FINAL PERFORMANCE
 SCORES ADJUSTED BY RESIDUALIZATION:
 LOW C-I GAIN SUBJECTS

| Comparison | Adjusted Final Scores | | | |
|------------|-----------------------|-------------------|-------|--------|
| | Mean ₁ | Mean ₂ | F | |
| MC vs BF | Task 1 | 143.6 | 154.5 | 0.71 |
| | Task 2 | 103.0 | 102.0 | 0.96 |
| | Task 3 | 88.4 | 84.6 | 5.26* |
| MC vs CC | Task 1 | 118.1 | 127.0 | 0.58 |
| | Task 2 | 105.2 | 103.7 | 0.19 |
| | Task 3 | 87.0 | 85.4 | 0.81 |
| MC vs AT | Task 1 | 123.7 | 154.0 | 3.96** |
| | Task 2 | 105.3 | 106.7 | 0.12 |
| | Task 3 | 88.1 | 87.1 | 1.50 |
| BF vs AT | Task 1 | 152.2 | 172.5 | 1.73 |
| | Task 2 | 100.4 | 105.3 | 1.53 |
| | Task 3 | 84.0 | 86.9 | 2.66 |

N = 12 per group.

* $p < .05$

** $p < .10$

Low C-I gain subjects made significant performance improvement on task 1 after receiving attention training. The changes in Group AT from pretraining to posttraining were significant beyond the $p = .05$ level ($F(1,22) = 6.60$). The significant gains on task 3 associated with all subjects who received cognitive appraisal and coping training, were not found when only low C-I gain subjects were examined ($F(1,22) = 1.31, p > .10$).

TABLE 8

MEAN PRETRAINING AND POSTTRAINING COMPETITION PERFORMANCE
 BY LOW C-I GAIN SUBJECTS: POSTTRAINING SCORES
 ADJUSTED FOR CONTROL GROUP GAINS

| Group | Task 1 Labyrinth | | Task 2 Bean Bag Toss | | Task 3 Catch & Deposit | | | | | |
|--------------------|---------------------|-------|-------------------------|-----|---------------------------|------|-----|------|------|-----|
| | \bar{X} | F | \bar{X} | F | \bar{X} | F | | | | |
| Biofeedback (N=12) | C | 152.0 | 0.21 | .98 | 96.0 | 0.04 | .61 | 83.0 | 0.95 | .31 |
| | TC | 157.1 | | | 96.6 | | | 80.8 | | |
| Cognitive (N=12) | C | 95.1 | 2.02 | .97 | 101.5 | 0.13 | .72 | 77.8 | 1.31 | .75 |
| | TC | 104.3 | | | 100.4 | | | 80.2 | | |
| Attentional (N=12) | C | 106.3 | 6.60* | .82 | 101.6 | 0.26 | .17 | 80.3 | 1.05 | .76 |
| | TC | 136.8 | | | 103.6 | | | 83.1 | | |

Legend: C--Pre-Training competitive session; TC--Post-training competitive session.

* $P < .05$

Adjustments for gains by control group: Task 1--15.417; Task 2--2.750; Task 3--3.500.

Treatment by Sex Interaction

The analysis of variance with repeated measures first presented early in this chapter, revealed no significant treatment by sex interaction on any of the experimental tasks (Table 9). However, these results (task 1, $F(3,88) = .51$; task 2, $F(3,88) = 1.79$; task 3, $F(3,88) = 1.95$), were based across the individual, pretraining competition and post-training competition assessment sessions. Any treatment by sex interaction would properly be found in the final session, since all other sessions were scored prior to treatments.

TABLE 9

SUMMARY OF ANALYSIS OF VARIANCE OF TREATMENT BY
SEX INTERACTION ON ALL TASKS

| Task | Mean square Treatment x sex Interaction | df | Mean square Subjects within groups | df | F |
|-------------------------|---|----|--|----|------|
| 1. Labyrinth | 4029.64 | 3 | 7957.08 | 88 | 0.51 |
| 2. Bean bags | 119.79 | 3 | 67.13 | 88 | 1.79 |
| 3. Catch and deposit | 108.11 | 3 | 55.49 | 88 | 1.95 |

Treatment groups were segmented into male and female subgroups. In single contrasts, the training methods were compared

to Group MC for each sex separately, holding pretraining competition scores constant by analysis of covariance.

Table 10 presents the comparisons of residualized post-training scores for male subjects. Table 11 presents the same comparisons for female subjects.

TABLE 10
COMPARISONS BETWEEN TREATMENT GROUPS ON FINAL PERFORMANCE
SCORES ADJUSTED BY RESIDUALIZATION: MALE SUBJECTS

| Comparison | | Adjusted Final Scores | | |
|------------|--------|-----------------------|-------------------|--------|
| | | Mean ₁ | Mean ₂ | F |
| MC vs BF | Task 1 | 173.6 | 150.9 | 1.61 |
| | Task 2 | 113.7 | 108.2 | 3.75* |
| | Task 3 | 86.8 | 84.4 | 1.81 |
| MC vs CC | Task 1 | 189.3 | 181.3 | 0.20 |
| | Task 2 | 115.4 | 114.1 | 0.26 |
| | Task 3 | 87.6 | 88.5 | 0.59 |
| MC vs AT | Task 1 | 171.9 | 186.9 | 0.53 |
| | Task 2 | 115.2 | 114.5 | 0.05 |
| | Task 3 | 88.2 | 88.0 | 0.00 |
| BF vs AT | Task 1 | 160.5 | 201.7 | 5.92** |
| | Task 2 | 107.2 | 113.2 | 2.81 |
| | Task 3 | 84.2 | 86.7 | 2.30 |

N = 12 per group

* $p < .10$

** $p < .05$

Male subjects in the motivation-placebo control group had numerically higher adjusted final scores than subjects

trained with biofeedback. The difference approaches significance on task 2. ($F(1,22) = 3.75, p < .10$). A significant superiority of males in Group AT over males in Group BF ($F(1,22) = 5.92, p < .05$), indicates that task 1 competitive performance among male subjects was impaired as a result of EMG biofeedback training.

TABLE 11
COMPARISONS BETWEEN TREATMENT GROUPS ON FINAL PERFORMANCE
SCORES ADJUSTED BY RESIDUALIZATION: FEMALE SUBJECTS

| Comparison | Adjusted Final Scores | | | |
|------------|-----------------------|-------------------|-------|------|
| | Mean ₁ | Mean ₂ | F | |
| MC vs BF | Task 1 | 132.7 | 129.2 | 0.09 |
| | Task 2 | 99.9 | 100.1 | 0.01 |
| | Task 3 | 80.4 | 82.4 | 0.50 |
| MC vs CC | Task 1 | 119.3 | 121.2 | 0.02 |
| | Task 2 | 100.3 | 95.9 | 2.03 |
| | Task 3 | 78.8 | 81.2 | 0.56 |
| MC vs AT | Task 1 | 108.5 | 112.1 | 0.18 |
| | Task 2 | 100.3 | 103.5 | 0.85 |
| | Task 3 | 79.8 | 82.4 | 0.59 |
| BF vs AT | Task 1 | 127.4 | 133.1 | 0.32 |
| | Task 2 | 101.0 | 103.7 | 0.59 |
| | Task 3 | 82.6 | 82.5 | 0.01 |

N = 12 per group

Among female subjects, there were no significant differences between any of the contrasted treatment groups.

Treatment by Readiness Interaction

Group AT and Group CC were associated with significant improvements on tasks 1 and 3 respectively. Accordingly, these training groups qualified for involvement with Group MC in a further analysis. That analysis served to test the hypothesis that treatment would interact with selected psychometric scales which could be called indicators of readiness to benefit from a stress reduction training method. Each of the training groups were analysed separately with Group MC. The psychometric scales were absorption from the DPO and the six TAIS attentional process scales, BET, OET, BIT, OIT, NAR, and RED. Pearson product-moment coefficients of correlation were calculated for TC-C gain scores with the cross product variables formed from the deviation scores of the potential readiness scales and either membership of Group MC or Group AT (Table 12), or membership of Group MC or Group AT (Table 13).

Three psychometric scales significantly interact with the dichotomy of membership in Group AT versus membership in Group MC. This is revealed in Table 12 by the coefficients of correlation. On task 1, a task still being learned, absorption interacts with treatment ($r = .35, p < .05$). Absorption also interacts with treatment on task 2 gain scores, but in the opposite direction ($r = -.34, p < .05$). The habit of making errors of underinclusion through reduced attentional focus (RED) also interacts negatively with treatment on both tasks 2 and 3, two tasks for which learning appears stabilized

($r = -.36$ and $r = -.35$, respectively, both at $p < .05$).

Finally, the TAIS attentional scale, overloaded by external stimuli (OET) interacts with treatment on task 3 scores

($r = .30$, $p < .05$).

TABLE 12

THE INTERACTION OF SUBJECT CHARACTERISTICS WITH ATTENTION
TRAINING UPON TASK PERFORMANCE: CROSS PRODUCT
CORRELATIONS WITH TC-C GAIN SCORE

| Cross Product Variables | Task in Learning | Tasks with Learning Stabilized | | |
|----------------------------|---|---|---|--------|
| | Task 1 Labyrinth TC-C Gain score | Task 2 Bean Bag Toss TC-C Gain score | Task 3 Catch & Deposit TC-C Gain score | |
| | BET (<u>TAIS</u>) | .21 | .24* | .04 |
| | OET (<u>TAIS</u>) | .11 | -.22 | .30** |
| | OIT (<u>TAIS</u>) | .00 | -.14 | .21 |
| Treatment | NAR (<u>TAIS</u>) | -.23 | -.16 | -.24* |
| x | RED (<u>TAIS</u>) | -.02 | -.36** | -.35** |
| | Absorption (<u>DPQ</u>) | .35** | -.34** | -.04 |

Note: Correlation coefficients on each task reported only if at least one coefficient is greater than .20.

N = 48

* $p < .10$

** $p < .05$

Table 13 summarizes the interaction of psychometric scales with the dichotomy of belonging to Group CC as opposed to belonging to Group MC. There are five significant interactions involving five psychometric scales. On task 2 gain

scores, there are significant interactions of treatment with absorption and with the ability to shift to a narrow focus of attention (NAR) ($r = -.34$, $p < .05$ in both cases). On task 3 gain scores (OET), overloaded by internal stimuli (OIT), and (RED) interact with treatment ($r = -.31$, $p < .05$; $r = -.36$, $p < .05$; and $r = -.39$, $p < .01$ respectively). There is no interaction of cognitive appraisal and coping training with any of the selected scales upon task 1 gain scores. Although there are no interactions common to tasks 2 and 3, all signs of cross product correlations are negative for both of these tasks.

TABLE 13

THE INTERACTION OF SUBJECT CHARACTERISTICS WITH COGNITIVE APPRAISAL AND COPING TRAINING UPON TASK PERFORMANCE: CROSS PRODUCT CORRELATIONS WITH TC-C GAIN SCORE

| Cross Product Variables | Task in Learning | Tasks with Learning Stabilized | |
|-------------------------|---|---|---|
| | Task 1 Labyrinth TC-C Gain score | Task 2 Bean Bag Toss TC-C Gain score | Task 3 Catch & Deposit TC-C Gain score |
| OET (TAIS) | .13 | -.13 | -.31** |
| OIT (TAIS) | .10 | -.01 | -.36** |
| Treatment x NAR (TAIS) | -.14 | -.34** | -.02 |
| RED (TAIS) | -.01 | -.23 | -.39*** |
| Absorption (DPQ) | .04 | -.34** | -.09 |

Note: Correlation coefficients on each task reported only if at least one coefficient is greater than .20.

N = 48

* $p < .10$

** $p < .05$

*** $p < .01$

Construct Validity of Competitive Stress

Eleven psychometric scales were selected from the three standardized tests administered to the subjects as self-report measures of stress-related experience. These scales were correlated with the C-I gain score in a test of the construct validity of this measure of competitive stress.

Table 14 presents the correlations of C-I gain scores with each of the psychometric measures of stress-related experience. A high gain score indicates low competitive stress. All signs of the coefficients have been changed to reflect consistency between all scales. That is, despite the fact that the 16 PF scales are scored in different directions to indicate stress, a negative correlation indicates agreement between self-report and performance measures of stress.

There are no significant correlations of psychometric with task performance measures of stress among the coefficients presented in Table 14. This correlational analysis provides no support that the C-I gain score on any of the tasks is related to general trait variables of stress-related experience.

Summary of Results

A significant learning effect, independent of treatment effects, was observed on each of the experimental tasks. These tasks, as expected, varied in the degree of difficulty they presented to the average subject at the time of the

TABLE 14

CORRELATIONS BETWEEN PSYCHOMETRIC AND
PERFORMANCE MEASURES OF STRESS

| Psychometric Scales | Task in Learning | Tasks with Learning Stabilized | |
|--------------------------|--|--|--|
| | Task 1 Labyrinth C-I Gain score | Task 2 Bean Bag Toss C-I Gain score | Task 3 Catch & Deposit C-I Gain score |
| OET (TAIS) | -.04 | .04 | .01 |
| OIT (TAIS) | .01 | -.05 | .04 |
| RED (TAIS) | -.01 | -.02 | .03 |
| C- (16 PF) | -.01 | -.14 | .04 |
| H- (16 PF) | .13 | .11 | .04 |
| I+ (16 PF) | .05 | -.04 | .08 |
| L+ (16 PF) | -.03 | -.12 | .09 |
| Q+ (16 PF) | .04 | .10 | .18 |
| Q ₃ - (16 PF) | -.08 | -.13 | .03 |
| Q ₄ + (16 PF) | .05 | .00 | .13 |
| STRESS (DPQ) | .05 | -.09 | .15 |

N = 96

final assessment session. Task 1, still being learned, continues to present difficulty. Task 2, learned to a somewhat higher level, also presents some difficulty. Task 3, an effectively mastered task, can be performed with a near-perfect score by the average subject.

Attention training improved the task 1 performance of low C-I gain subjects. Cognitive appraisal and coping training improved task 3 performance. No significant performance improvements resulted from biofeedback training, and among low C-I gain subjects, control group scores were higher on task 3 than biofeedback group scores. Thus, the main hypotheses

concerning the main effects of the methods of stress reduction were supported.

In general, the hypotheses regarding treatment x sex interaction were supported. Females were not differentially affected by the three stress reduction methods. Task 1 performance by males in Group BF is inferior relative to males in Group AT.

Significant interaction upon final gain scores of the three tasks was observed when membership in Group AT was examined and of tasks 2 and 3 in examination of membership in Group CC. Interpretations of these interactions will be proposed in Chapter IV.

CHAPTER IV

DISCUSSION OF RESULTS AND CONCLUSIONS

Hypotheses

The hypotheses, as stated in Chapter I; predicted improved motor task performance following stress reduction training methods, in situations where competitive stress impairs group performance. Furthermore, it was predicted that Group AT (attention training) would show the greatest improvement when competitive stress interferes with performance of a task still being learned, that Group CC (cognitive coping training) would show significant improvement when competitive stress interferes with performance of a well learned task, and that Group BF (EMG biofeedback training) would not show improvement in motor task performance under competitive conditions. It was predicted that performance improvement following stress reduction training would be affected by the sex of the subject. Certain significant correlations were predicted between improved performance after AT training (and after CC training) and selected attentional scales of the Test of Attentional and Interpersonal Style (Nideffer, 1976a) as well as the absorption scale of the Differential Personality Questionnaire (Tellegen, 1977).

The Incidence of Competitive Stress

It was assumed that competitive stress interferes with performance when, for a given individual, the transition from performing alone (assessment session I) to performing in contest with others (assessment session C) results in C-I gains which are low.

The lack of strong, even significant, relationships between C-I gain scores on the tasks and the psychometric indicators of stress-related experience called for a further examination of low C-I gain score as an operational definition of competitive stress. On the one hand, there were no significant correlations of any of the C-I gain scores with any of the psychometric scales which had been suggested to be related to stress by the research reported in the test manuals of 16 PF, DPQ, and TAIS. On the other hand, there was an interaction between C-I gain scores and the stress reduction training method. On task 1, low C-I gain subjects improved as a result of attention training. On task 3, competitive performance improved after cognitive appraisal and coping training less in the low C-I gain group than when the subjects with high C-I gain score were included. A theoretical framework used in this study relates competitive stress to the relationship between task difficulty and subject ability or skill to do the task. Competitive stress can occur when task difficulty is so much greater than subject's skill or when subject's skill is so much superior to the task demand.

In the case of task 1, a not well learned task, those subjects who had less improvement from individual to competitive performance (low C-I gains) are less adept at the task (their scores are lower than the other subjects) and consequently should experience greater competitive stress. However, this experience of competitive stress is not so much a function of response habits of emotional instability, apprehension, and the like, as it is a function of the real differences between the subjects' capabilities for the task and good performance. Thus, C-I gain scores constitute more a scale which differentiates subjects on task skill or learning level, and less a measure of general traits of stress responding.

In the case of task 3, most subjects are capable of near perfect performance. Those with high C-I gain possess task skill to a great degree. The task presents little difficulty to them. Attention training for these people is completely redundant, or at least not as effective as for the people with low gain scores. In contrast, the high C-I gain scorers may be helped by cognitive coping training because it provides a realistic appraisal of the competition. This appraisal eliminates overconfidence in one's ability and the performance impairment associated with it.

The incidence of competitive stress can be inferred from C-I gain score in two situations. Performance in competition tends to be impaired when C-I gain is low on a task being learned and when C-I gain is high on a task that has generally

been mastered. Competitive stress is a situational response to the challenge perceived in the competition. It depends largely on momentary attitudes that develop according to the perceived imbalance in the difficulty/ability ratio. If the traits measured by the psychometric scales represent more enduring attitudes and dispositions, one should not be surprised at the observed absence of significant correlation between these traits and the more changeable competitive stress responses.

Attention Training (AT)

Readiness is the term previously used to describe the content of seven psychometric scales which could be relevant to selection of people who are likely to benefit from the various forms of stress reduction treatment. The treatment x readiness interaction, although providing results of low magnitude, suggests that the efficiency of the training methods can be enhanced by an appropriate selection of subjects.

Attention training is indicated according to the subject's score on absorption in two different motor learning situations. People with high scores on absorption seem to have diffused attention habits. They tend to be intuitive, emotional rather than analytic in their involvement with the task. While learning a task, they require help in identifying the appropriate cues for successful performance. Attention training helps these people check themselves against the task

demands to seek out the relevant cues for improvement, rather than continue to make the same mistakes. At the low score extreme on the absorption dimension, one finds individuals who may tend to be overly analytic, cognitive, and self-monitoring. These people may benefit from attention training when the task is moderately well learned but there is still room for improvement before maximum is reached. To these people attention training provides awareness exercises, kinesthetic focusing, and advice to let the body perform more spontaneously. Further research should be undertaken on the possible relationships between this training method, tasks, and the interpretation of absorption as a dimension contrasting intuiters with analysers.

Attention training consists of sensory awareness exercises, task analysis, and rehearsal of appropriate foci of attention for the periods before, during, and after competitive task performance. This type of training seems most helpful to subjects who have much to learn in performing a task, that is, those needing coaching in the right intellectualisation or awareness. In addition to this general application, attention training may have a number of specific applications, as revealed in the study of treatment x readiness interaction. At a low level of task skill, subjects with diffused attention are helped by analytic lessons so that before and after task performance they can rehearse or review the task. At a higher level of skill, attention training helps subjects who are too analytic to be more

kinesthetically focussed and spontaneous during task performance. At the highest level of skill, attention training provides the appropriate focusing for subjects who tend to be confused by the variety of stimuli in the external environment.

The findings with regard to attention training suggest a modification to Gallwey's (1974, 1976) "inner game" approach to playing sport effectively. Gallwey (1974) proposed that most people possess the models within themselves for efficient motor behavior and all that they must do is to suspend judgement of their own performance in order to allow the body to perform naturally. The trouble with this theory is that not all people possess these ready-made models. Particularly among unskilled athletes, the presence of relevant models is not expected. Attention training provides an opportunity to generate such models through a rehearsal of relevant movements and the observation of their consequences. The recreational athlete can, in time, develop skills by himself. He can, however, reach his objective much more efficiently with technical instructions and more efficiently still, if he is assisted by attention training. A good coach should be able to analyse a skilled performance not only with respect to its mechanics, but also with respect to its various attentional components.

Cognitive Coping (CC)

Cognitive appraisal and coping training, as presented in this investigation, consists of helping the individual interrupt his maladaptive appraisals of the competitive situation. This training seems effective when the task is very well learned.

It should be noted that there are two possible forms of debility that occur in competition. One, due to stress in the conventional sense, is associated with worry and concern about one's inability to perform well. The second is associated with boredom arising from a conviction that there is insufficient challenge in the task. It would seem that when the task is well learned, performance debilitation might be more associated with boredom than with worry. The interpretation advanced here is consistent with the results of Moede (1914) who found that high ability subjects lower their performance on an easy task. It is also consistent with the results of Wine (1974) who recognized in only about 15% of the population, an increase in worry sufficient to impair the performance of a well learned skill during public evaluation.

The specific effects of cognitive coping can also be better understood if a distinction is made between impairment due to worry and impairment due to overconfidence and boredom. The

only statistically significant improvement due to this training was on task 3, which had been mastered by nearly all subjects. These subjects must be assumed to have possessed a very high level of skill prior to the training phase and thus be prone to overconfidence and boredom with the task. Subjects in the control group have remained with this impairment during the posttraining assessment. The cognitive coping group, on the other hand, were taught that both worry and boredom thoughts are detrimental to performance. They learned to recognize such thoughts and to reappraise the real threat in the competition. It is the recognition that boredom might also be a source of impairment that is assumed to have provided the significantly improved result on task 3. In their cognitive training they were instructed to interrupt their current appraisal of the situation involving self-evaluation and to adopt instead a more objective attitude.

An examination of the treatment x readiness interaction further indicates that cognitive coping training removes the performance impairment due to worry or to boredom only when the subject is well skilled in the task. At a low level of skill, cognitive coping training is not effective. At a higher level of skill, cognitive coping training helps subjects who tend to be too analytic and self-monitoring and subjects who report difficulty shifting their focus of attention once it is fixed. Here the worry, that impairs the full realization of the subject's capabilities, is relieved through

the thought interruption and thought substitution techniques learned during cognitive appraisal and coping training. At the highest level of skill, cognitive coping training improves the performance of those people who report themselves to be most adaptive and capable of avoiding confusion and of attending to even the smallest detail. It helps them to interrupt thoughts of boredom or overconfidence. It is at this highest level of skill that cognitive coping training is most effective.

EMG Biofeedback (BF)

The assumption in the biofeedback training is that a relaxation of tension in the frontalis muscles leads to a relaxation of all muscular tension, which in turn causes a reduction of competitive stress and anxiety as psychological experience. Since competitive stress is associated with impairment of performance, the elimination of that stress must manifest itself in improved results.

In the present study, auditory biofeedback of muscle activity of the frontalis muscles did not significantly improve performance on any of the three experimental tasks when posttraining competition scores were adjusted for the gains achieved in the control group. This was as true when the analysis was restricted to subjects with low C-I gain scores as it was for the total Group BF. When all post-training competition scores were adjusted for initial

intergroup differences and compared, Group BF was found inferior to the control group on task 3 for low C-I gain subjects and to Group AT on task 1 for all male subjects. There was also a tendency for Group BF males to be inferior to control group and Group AT on all tasks. These results combine to indicate the inappropriateness of the biofeedback method as a treatment for competitive stress.

There appear to be three possible explanations for the poor showing of the BF group. One is that the tension that accompanies the cognitive appraisal of threat is salutary. According to Scott and Howard (1970), tension builds up from the moment a problem is identified. The tension has an energizing function stimulating the organism to solve the problem with the resources available. If the resources cannot solve the problem, the tension builds excessively and this state is stress. Assuming that EMG biofeedback training is effective in lowering general tension, it does not follow that the trainee ceases to perceive competition problems. The training has not increased his ability to resolve the problems, but simply has decreased his arousal level so that he is working less enthusiastically towards solution of these problems. It is possible, of course, that over many competitions a biofeedback-trained athlete can learn to adjust his tension level to the performance situation. This possibility, however, has to be demonstrated experimentally by those who promote the biofeedback technology.

Why male subjects should tend to be negatively affected by biofeedback may be explained by subject ability. Males were clearly superior to females on all tasks. When the subject does possess the motor skill, then threat-related tension derived from observing an opponent's high score or one's own error, would stimulate renewed effort to use one's full capabilities. Performance improvement should occur. But with general tension lowered by biofeedback, the high ability subjects decrease their performance level. Support for this explanation is also found in another analysis, Low C-I gain subjects on task 3 probably possess a high degree of mastery over this task because it is a well learned task; moreover, they are alerted to a performance problem, because their performance had slipped in the pretraining competition. Yet after biofeedback, they lack the internal goal to greater application of their own talents and, so, their performance is significantly inferior to that of the control group.

A second explanation for the results attained by Group BF is the need in motor skills for muscle control, i.e., a refined sense of tension and release in the exactly appropriate sequences necessary for skilled movement. Accordingly, EMG biofeedback should be employed only after it has been prescribed as therapy for a specific diagnosis. If an athlete complains of tension in his shoulders and neck, EMG biofeedback for the trapezius and sternomastoid muscle groups would be the treatment of choice. Even without a tension problem, an athlete might gain from the use of EMG biofeedback when the

goal is approximation of a model sequence of muscular activity. However, it is most likely that the present tasks are not essentially governed by differential firing in the cells of the frontalis muscles. Biofeedback training at this site will not add to the muscular control required for good performance on these tasks. This explanation is directed at accounting for the lack in improvement by Group BF subjects. Perfectly good medicines are ineffective with unrelated problems.

A third possible explanation of the failure of the biofeedback training in this study is derived from the questioning of validity of certain cause-effect assumptions which are associated with the use of biofeedback technique. For, if contrary to these assumptions one believes that psychological coping with competition stress is "central" while relaxation of a muscle is only "specific" and "local," and that all controls in the organism are hierarchically organized, i.e., those more central governing those which are specific, then one can clearly expect a cognitive training to be effective in adjusting muscular activity relevant to the task. But, with the same belief, it is difficult to conceive how a specific muscular control can affect the more central cognitive control. Perception of task difficulty and one's own ability, possible experience of anxiety, overconfidence or boredom, attentional and analytic demands of the situation, are all central in nature. They are not expected to be all controlled by specific changes in kinesthetic sensations.

A Psychological Model of Stress
and its Reduction

It seems that performance impairment in competition is a function of the relationship between task difficulty and subject ability or skill on that task. The competitive setting triggers the individual's thoughts of this relationship, insofar as he is required to perform once he enters the competition and his performance is visible to himself, his opponents, and any others in the environment. The situation is a threat to his homeostasis. The perception of difficulty greater than skill or skill greater than difficulty energizes the individual to correct the imbalance either by renewing his efforts to do well or by trying to find more challenge in the task. In the latter case, correcting the imbalance and performing at the maximal level can become incompatible. If the perception of imbalance prevails, this may lead to a decrease in performance level. Once this occurs however, a new difficulty/ability ratio is established and the individual may increase his score again. In the former case, the person finds the task beyond his skill. Unaided by any sudden insight into the nature of the task, he becomes frustrated when he increases his effort. Each new trial only reminds him of the task difficulty. Depending upon how much frustration the individual can tolerate, a more or less severe state of stress will result. With any increase in stress, a worsening of performance will occur.

Frustration tolerance is relevant not only in the case of poor performers. It is a trait found in non-anxious well-adjusted individuals. Such individuals have, on the whole, good perception of reality and even if they are high scorers, they are less likely to display debilitating overconfidence. They are expected to perform consistently high relative to their ability.

A good level of performance is also dependent upon the degree of involvement in the competitive situation. Those individuals with the desire to succeed are more likely to produce a consistently high level of effort in learning the task and to maintain high performance in competition with others once the task has been learned.

Cognitive factors are equally relevant in determining the level of performance and its consistency. General intelligence is undoubtedly effective in learning the task and in modification of strategies when problems are encountered during the competition. There are also specific skills which can contribute according to the nature of the task. Among cognitive factors which affect performance must also be included those related to the ability to broaden or narrow the focus of attention according to the situational demand.

Deficiencies in any of these contributing factors can at least be partially offset by appropriate treatment. Of specific interest in this thesis are the treatment of deficiency in attentional focusing relative to a given task and

the treatment of excessive self-evaluation in competitive situations. A psychological approach is adopted. It consists essentially in re-educating the individual in his perception of competitive reality. This approach is assumed to be "central" hence modifying all adaptive functioning of the organism. Since specific muscle activities must be subservient to the general operations of the organism, some adaptive correction in muscular tension must also occur.

Not all individuals can benefit equally from psychological treatment. This firstly depends on the degree of their mastery of the task. The learners who lag behind in their performance can benefit from attention training when they are over-intuitive in their approach and those who have learned the task can benefit from the same treatment when they are over-analytic with reference to the task. If they are over-analytic with respect to themselves and they have mastered the task, it is the cognitive coping training that can help them most.

Further research is of course needed on how to deal with other deficiencies which appear in competitive performance. A full understanding of variability among the competitors can only be attained by means of a comprehensive multivariate study of all factors contributing to success.

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APPENDIX A

PROTOCOLS FOR ASSESSMENT SESSIONS


Protocol for Psychometric Testing
and Practice PerformanceSet-up

Confirm that necessary materials (pencils, test booklets, answer sheets, subject self-scoring forms for practice, list of subjects' names, and appointment times) are in place near tables and desks in 319 and 320.

Confirm that task equipment is set up in separate rooms or enclosures (in each of the two partitioned areas in 321-- chair, table, labyrinth with ball, practice instructions taped to table; in left curtained enclosure in 319--15 polystyrene balls on hopper, container on floor between L-tape, hard wooden paddle on counter, practice instructions taped to wall; in right curtained enclosure in 319--floor target, string horizontally taut across the enclosure, five bean bags, practice instructions taped to wall).

Welcoming Subjects

Introduce yourself and confirm his/her name with appointment list. Show a place for coats and books. Show the subject to a chair.



Orientation to Subjects

"Thank you for coming. Today I want you to do two things: fill out some test forms and familiarize yourself through practice with three games or motor tasks. As I told you in class, the whole study demands about 12 hours of your time. Today's session, at about three hours, will be the longest of the eight sessions. I'd like you to begin with the tests. I will call you in groups of four to get an overview of the tasks and do your practice."

Presenting the Tests

"Let's begin with Dr. Nideffer's Test of Attentional and Interpersonal Style. Signal me when you are finished and I will give you another test. I will save the shortest of the three tests to be the last. Please read the instructions aloud." (Subjects read instructions aloud. Answer questions. Have subjects begin. For second test, 16 PF, go over instructions with each individual as soon as he or she signals completion of TAIS. Repeat with the abbreviated DPQ. Collect tests as they are completed and check to insure against error or omission.)

Presenting the Tasks

Assemble five people and proceed together to any of the task areas.

"There are three tasks for you to practice. This is the (give name of the task). Each of you has a self-scoring

sheet. Find the section on the sheet for this task. See the spaces for the trials. Now look at the practice instructions that have been taped on the wall (desk)." (Read the instructions pointing out that they must record certain trials and not record the ones in between.) "You alone are responsible for recording your own scores. I want this session to be as free as possible from the signs of being compared to or evaluated by others." (At the catch and deposit task.) "Here one of you drops the balls according to instructions for the other person. The ball dropper should not pay any attention to nor make any comments on the performance of the player. Just drop the 15 balls, nine times, waiting after each time for the player to return the balls to you. At the end of one player's completed nine trials of practice, switch roles." (Take the group from one task to another, giving an orientation to the task. Answer questions. Assign a subject to each task station, the two labyrinth stations, and the bean bag station, and two subjects to the catch and deposit station. Collect score sheets as each subject finishes all of his/her practice sessions. Begin the presentation of tasks with another group of subjects.)

Setting Next Appointments

If chief experimenter is available, he will arrange for the subject's next visit. Otherwise confirm subject's telephone number and promise him/her a call will be made within

two days. Thank subject heartily for his/her first visit.

Protocol for Session of Individually
Scored Performance

Set-up

Confirm that necessary materials (pencil, stop-watch, individual score sheets, list of subjects' names and appointment times) are in place at table in 319.

Confirm that task equipment is set up (at table in 319--two labyrinths with balls, in left curtained enclosure in 319--15 polystyrene balls on hopper, container on floor between L-tape, hard wooden paddle (steak board) on counter; in right curtained enclosure in 319--floor target, string horizontally taut across the enclosure and 5 bean bags).

Welcoming Subjects

Make introductions confirming his/her name with appointment list. Show a place for coats and books. Show the subject to his/her chair.

Orienting the Subjects

"Which of the two labyrinths did you use the other day? Today I want you to use the other one because you will have to compete on both of them."

"The other day you scored your own practice performance and also had some unscored practice. In the next day or three you will participate in a competition with two other

people. Today, I want you to do the three tasks and I will score your performance. There will be four subtrials from start on the labyrinth (these must be completed within five minutes), then we will go in there (point to left curtained enclosure) for three trials of 15 balls for catch and deposit. We will return here for four subtrials on the labyrinth. We will then go for your three trials of ten bean bag throws and will end up here with four subtrials on the labyrinth. Pay little attention to me and do the best you can."

Testing Session

"You can begin now."

Start the stop watch. Record the score for each of the four labyrinth trials in the score sheet and the total time for the four trials to the left of these trial scores on the individual score sheet. Write in name of subject and today's date.

Rise and ask the subject to go with you for the catch and deposit task. In that enclosure, set up container on the non-dominant of the subject. Get subject to place one foot on the start line saying, "Place one foot on the start line and stay there until the first ball has bounced. Then you are free to move your feet until the start of the next trial with 15 balls."

Take your place behind the hopper. Place the stop watch on the hopper tray so that you can see clearly the

second hand. Start the watch. Confirm that 15 balls are on the tray. Ask the subject to tell you when he/she is ready. Drop the balls one every two seconds beginning from the "Ready" response. Randomize the placement of the balls in the four copper tubes leading from the hopper tray.

Score the trial.

Repeat until three trials of 15 balls are done and recorded.

Return to labyrinth for four more subtrials.

Go to bean bag throw curtained enclosure. Ask the subject to throw ~~the~~ bags one at a time in sets of five for a total of six sets. Time the sets of ten bags. Enter time to left of trial row. Record each shot. Ask the subject not to step on the target. If one of the throws is under the string or hits the string have the subject immediately pick up and rethrow the bean bag.

Return to labyrinth for final four subtrials.

"Thank you for coming today. That's all until our next session. That will be a competitive session with at least two other students from the University. What are the best times available for you to return for the competition which will take place in the next few days?"

"Thank you. Good afternoon."

Protocol for Competition (For Pretraining
and Posttraining)

Present: Three competitors.
Referee-announcer (R-A)
Technician or scorekeeper

R-A--"I wish to welcome everyone especially our competitors to today's contests. My name is _____ and I shall be your announcer, referee, or master of ceremonies. We are fortunate to have with us _____ who shall serve as scorekeeper."

"Would you all notice the scoreboard over here and as I read out the names would each competitor step forward, please?"
(Read names . . .) Thank you!"

"On the score board are displayed each player's earlier scores. These are total scores for each round or trial. Then there are spaces for today's score and for the difference score which will show the improvement or the drop in performance when comparing today's score to the earlier score. In a very real sense the earlier score represents the performance standard of the player for each round." (Briefly comment on the standards of the players, e.g., "Mr. X is clearly the stronger player. Mr. Y has lots of room to improve his score, etc . . .").

"The winner of the round will be the player with the best difference score for that round. Winning earns the right or advantage to hold the hammer or go last in the next round. The loser of a round must go first in the next round."

"In each game you are competing against yourself--can you improve on your previous score?--and against the others--who will be the best? There are no prizes, but there could be two winners, the one who improves the most on his earlier trials, and the one who gets the highest total score."

"You are familiar with this game (give quick summary).
Let us now start round number one _____."

In the labyrinth, there is dual competition because there are two labyrinths. The competitors face each other across a table. They have a maximum of five minutes in which to complete four subtrials. The referee signals, with some showmanship, the start of the round. He watches one player; the scorekeeper watches the other. As one of the balls goes in a hole, the one watching calls out, "Four for Miss Jones on subtrial one." The scorekeeper records all scores no matter which player he is watching. The referee calls out "Four minutes" if one or both players are still at play after four minutes. At five minutes the referee says "Stop" and the player is given the point he has just passed for his last subtrial. The third competitor replaces one of the other two. The round begins again. No player plays more than two trials in a row. One player may play alone. When one player finishes his trial quickly, the third player may be started immediately. Players must not play two trials in a row with the same labyrinth.

When all three players have finished trial one, the scorekeeper records their scores on the board and comments are made about who is leading and how play compares with previous scores.

At the end of the three rounds, all players are congratulated for their fine play and the announcer tells everyone to move to the site of the next event. The results board is brought with the group to the next event.

Each later contest is briefly explained and comments are made on the performance standards of earlier scores.

In the throwing game and in the catching game, the scorekeeper gives the player's scores to the announcer before the second player begins to play. Where possible, the announcer makes separate announcements during play concerning the difference score of the previous player and the performance standard (earlier score) of the player now active. Such statements are better made by the scorekeeper in the catching game when the announcer is busy dropping balls. On the other hand, these announcements can be made just before the start of play.

One person can easily handle the scorekeeper and announcer duties in the throwing game. The presence of more people, if available, is desirable. At the finish of the last contest, thank everyone and refer the competitors to O'Hara for future appointments.

Labyrinth

Round 1--dual competition.

--one five minute trial period for the competitor to complete four subtrials.

--record the number score of each subtrial.

Competitor immediately starts over and repeats until all four subtrials are completed.

--total scores to enter as today's score for that person for that round.

Round 2 and 3 as above.

Throw

Round 1--the first player throws five bags and after receiving the bags again, rethrows them.

--record each score as the bag lands. Thus one gets ten scores per round--total these ten scores and enter in today's score.

--next player starts his first round, etc., etc.

Catch

--The first player takes the starting position (at least one foot touching the tape). For left handed persons, place the basket on their right hand side.

--Referee drops the 15 balls at a rate of one every two seconds. Dropping is randomly varied through the four pipes.

--Scorekeeper records when an error is made in control or hits--total controls and total hits are recorded at the end of the score sheet. These two numbers are then totalled to be entered as today's score for that round.

PREVIOUSLY COPYRIGHTED MATERIAL

IN APPENDIX "B", LEAVES 143 - 152,

NOT MICROFILMED

143 - 152 - Abbreviated Differential Personality Questionnaire
by Auke Tellegen, 1976.

APPENDIX C

SAMPLE TREATMENT SESSIONS

Attention Training--Session 3Outline

- 1) Review homework experiences. (10-15 mins.)
- 2) Task-orienting instructions. (15 mins.)
- 3) Review of treatment rationale. (5 mins.)
- 4) Concentration exercise--mirror image. (12-15 mins.)
- 5) Task-orienting instructions (cont'd.). (10 mins.)
- 6) Homework assignment (3-5 mins.)

Specific Procedures

Review homework experiences. (a) A listing of self-instructions for before each of the three laboratory tasks to help focus attention on the task; (b) mental practice (10 mins.) of what the good student would do on an exam after the same amount of preparation as you, i.e., design the role (behavior and self-instruction) of the good student, then play the role mentally; (c) review your exam (psychology)--how was your concentration? What did you do to optimize your concentration?

Task-orienting instructions. Using the self-instructions listed as homework for before a task, have clients rehearse the self-instructions using techniques. Choose one self-instruction for before the labyrinth task. Ask subjects to visualize themselves in the testing room waiting for their turn.

- 1) Trainer repeats chosen self-instruction.
- 2) Clients repeat self-instruction aloud.
- 3) Clients repeat self-instruction in whisper.
- 4) Clients repeat self-instruction internally.

Repeat procedure for catch and deposit task and then for bean bag throw task.

Briefly discuss the exercise.

Review of treatment rationale. Describe training program and purpose to learn attentional techniques for avoiding the effect of stress on our performance--playing games; speaking in public, taking examinations.

Relate the role of the competitions with the laboratory tasks to the training program and to the program's later purpose (competition provides an opportunity to try out our attentional techniques in a standardized performance situation. We are also encouraged to use these techniques in our daily lives, especially in any evaluation setting we encounter).

Concentration exercise--mirror image movement. Clients work in pairs. While standing, one client makes a movement.

(incoming event). The other client mirrors that movement (response). If the response is correct, the first client makes another movement (result and new incoming event) otherwise the first client waits for the correct move. The responder tries to be the mirror image of the first mover, responding so rapidly that continuous motion is made possible.

Switch roles after one minute.

After both clients in the pair have done both roles "In any human activity, events seem to come toward us, we respond, and then the events leave us, bearing the mark of our response." E.g., I see the dartboard, I throw the dart, I see where it lands; I see and hear a person talking to me, I respond, I watch and listen to the answer; I see a problem, I take an action, I observe the results of my action.

"The clarity with which we sense the oncoming event is crucial to the way we respond to it."

"Likewise our perception of the departing event--that is, the result of our action--has a great influence on the way we respond to similar events in the future. Seeing well is crucial to doing well at anything."

"This time try to be the mirror image of your partner by seeing better exactly what she/he is doing as they do it. Try not to see your thoughts--'hand up, that's wrong, this is stupid, funny, down, out, tough, twist foot, bend, etc.' Take away the concepts you have of the incoming and outgoing events."

"Respond to each event as it is, not to your concepts. Don't analyze."

Repeat mirror image exercise. Switch roles after one minute.

After this trial--"In order to respond rapidly to changes in your partner that could come from all parts of his/her body, it's necessary to have a broad focus or unfocused attention. This time see if you become more capable of responding to the events as they really are by attending passively to the rhythm of your breathing. It's important that you allow your breathing to do as it wills."

Repeat the final trial of mirror image exercise. Switch roles after one minute.

Briefly discuss the application of the technique of sensing and responding to what is, rather than to our concepts of events. Seek applications from the clients in their lives and in the laboratory tasks.

Task-orienting instructions (cont'd.). "Perhaps it is often appropriate during a task to respond to what is, thus without concepts and without self-instructions. However, before and after a task, there are times to analyze and to encourage and to focus your attention appropriately."

"In the laboratory tasks, you have trials within trials where the ball goes in a hole and you must start over or between each throw of the bean bag."

"What are some task-orienting self-instructions we could practice for these times--instructions that would help

our concentration?"

Explicit suggestions from clients. Choose one for a task and have subjects mentally practice the situation. (a) Say the instruction; (b) clients repeat self-instruction aloud; (c) clients repeat self-instruction in whisper; (d) clients repeat instruction internally.

Repeat exercise for the tasks for those situations where natural action breaks occur.

Homework assignment. (a) Once a day between now and the next session in a conversation or in some motor activity see the events as they are without analysis, labels or concepts--use your breathing if it helps.

(b) Once a day between now and the next session, spend ten minutes on an exercise of shifting your attention from external to internal reality. Attend externally to the sights, sounds, smells, etc., outside your body the shift after a minute or so to the sounds, pains, pressures, tastes, etc., inside your body. Attend to reality, what is happening, not to your thoughts nor images.

Thank you..

EMG Biofeedback: Trainers Manual
(by Pierre St-Jean)

Students & Trainers

In the summer of 1974, Algonquin College initiated a Biofeedback Training Program (BFT) as a module within an introductory Social Science Course. Since then, over 1,000 students (about half full-time and half Continuing Education) have completed the eight to ten hour module. These eight to ten hours or sessions are scheduled such that each student participates in no more than one session per day but at least two sessions per week, and such that each trainer is responsible for no more than two students during any given hour.

The current procedure (April 1977) is appropriate with trainers who have completed:

- 1) The EMG Training Program.
- 2) Two years of a university or community college psychology program.
- 3) A continuing in house workshop focused on BFT concepts, procedures, and equipment.

The training program may be divided into four parts. An initial one hour session where the trainer describes biofeedback training (BFT) objectives and procedures and demonstrates the operation of the equipment. This introductory session is followed by two to four sessions of Response

Shaping. Once the response has reached Plateau, the student performs Contingency Fading exercises for another two to four sessions. Fading is concurrent with and followed by a few Stimulus and Response Generalization sessions.

Introductory Session

The first session introduces the student to the equipment, the BFT process, and the objective of the training program.

Biofeedback equipment is designed to measure one of your biological sub-systems and feedback the state of that sub-system by moving a needle on a meter and turning a tone on or off.

BFT Objectives

The BFT process consists of (1) using that feedback to gradually learn control over the feedback signal, and (2) acquiring the skill to control that sub-system without the use of BFT equipment.

A standard introductory rap follows:

A stethoscope is a biofeedback machine. If you use it on yourself you can listen to increases and decreases in your heart rate. If you did this for a while, you would eventually learn to control your heart rate. The muscle feedback machine does the same thing except that it measures and feeds back the activity of your forehead muscle. We train on the forehead muscle since to relax that muscle you have to relax most of the muscles in your head and neck. When you learn to do this you will be able to get a feeling of relaxation and later on we'll work on getting that feeling without the equipment.

Intro Tips. Explain BFT before you wire up--don't try to compete for attention with the machine.

Reading one of Barbara Brown's books is a good prompt for the student who wishes to learn more about BFT.

Response Shaping

The baseline is immediately followed by an introduction to self shaping and the operation of the sensitivity knob. The student is familiarized with the idea of shaping his own response, i.e., adjusting the sensitivity setting on the equipment so that it is "just challenging to turn the tone off." It is a good idea the first few sessions to use broken record on "it is just challenging to turn the tone off" or "setting the sensitivity knob so that it is just challenging to turn the tone off." Once the baseline has been done and the student is familiar with the sensitivity setting on the equipment, the rest of the first session is straight shaping. Straight shaping consists of the student sitting, generally by himself, with the machine set so that "it is just challenging to turn the tone off."

During the second and subsequent shaping sessions, the student shapes himself while every 10 to 20 minutes, the trainer comes in and asks "how does it feel?" "does it feel different when the tone is off as opposed to when the tone is on?" "do you detect any feelings in your forehead, jaws or facial muscles?" "how do you feel now after shaping compared to when you first came in?" "do you feel more relaxed?", etc.

Generally this is an attempt to try to prompt a person to look inside for feelings that distinguish between tense and relaxed muscles and to concretize the feelings by helping the student verbalize inside perceptions. The shaping procedure will probably last two or three sessions until the student reaches plateau.

Shaping tips. The first time feedback is given, ask the student to clench his jaws, blink quickly and/or swallow to demonstrate the relationship between muscle activity and the feedback signal.

Once the student has settled into "turning the tone off" prompt the jaw relaxation as a way of decreasing frontalis activity, i.e., mouth slightly open and also prompt image of "head and face muscles melting and flowing loosely" later on in session. Invariably the student wants to know whether his plateau is higher or lower than others. Avoid between student comparisons by stressing such factors as the amount of fat in the skin, calibration of equipment, and other "external" variances in establishment of plateau levels. The only thing to "beat" is one's past performance.

Except for the introductory or "play" session, all training should be done eyes open to facilitate later generalization to everyday life situations.

From the first time the little relaxation is mentioned, the trainer should model the response whenever possible (at least twice per session).

Remember to model, MODEL, M O D E L.

Contingency Fading¹

Fading exercises are designed to help the student rely on the feedback from his own mind/body rather than the electronic feedback from the machine.

A sample rap follows:

Now that you've learned to relax with the help of the equipment, it is now time to wean yourself from the equipment. It is important that you learn how to relax by using internal feedback from facial muscles as opposed to the electronic feedback from the machine.

With Acquarius equipment, we ask the student to distinguish between levels of 20, 40, and 60 on the meter with the sensitivity setting at plateau and without feedback from the machine, i.e., the equipment is turned away from the student. As in the baseline procedure, the student is asked to lower his frontalis activity and prompted by "OK you are now at 20, bring it up to 40 and say 'now' when you think you are at 40," or, "you are now at 20, bring it up to 60 and tell me when you think you are at 60," or, "you are now at 20, bring it the way up to 100 and bring it back down to 20 and say 'now' when you think you are at 20."

After each attempt (trial) the trainer gives immediate feedback. The first feedback is "HIT" or "MISS" (Figure 5). For 40, any reading between 35 and 45 when the student indicates that they are now at 40 is scored as a hit, anything

¹We use the term "fading" rather than the more accurate attenuation since fading appears to be more communicative to the student.

| FADES | | 40 20 60 40 20 40 60 20 40 60 | | | | | | | | | | Score | | |
|---------|--------------|-------------------------------|---|----|----|---|----|----|---|---|---|-------|-----|-----|
| Date | Ses- sion | | | | | | | | | | | | | |
| 30/9/77 | #3 | H | | ✓ | | ✓ | ✓ | | | | ✓ | ✓ | | 50% |
| | M | 30 | | 80 | | | 30 | 50 | | | | | 100 | |
| 31/9/77 | #4 | H | ✓ | ✓ | | | ✓ | ✓ | ✓ | ✓ | ✓ | | | 70% |
| | M | | | 70 | 30 | | | | | | | | 85 | |
| 4/10/77 | #5 | H | ✓ | ✓ | ✓ | ✓ | ✓ | | | | ✓ | ✓ | ✓ | 80% |
| | M | | | | | | 50 | 75 | | | | | | |
| 4/10/77 | #6 | H | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | 90% |
| | M | | | | | | | | | | | | 50 | |
| | | H | | | | | | | | | | | | |
| | | M | | | | | | | | | | | | |

Figure 5
Sample Fading Record--Self Control of Muscle
Activity without Feedback

above 45 or below 35 is a miss. For 60, a hit lies between 55 and 65 and anything below 20 is scored as a hit when the target is 20.

The second feedback is a more detailed description of the trial, e.g., "You gradually went up from 20 and the meter was at 43 when you said now (or raised your finger or tapped the table), a good hit--well done (the trainer's function at this point is to reinforce hits with enthusiasm and to non-critically feedback misses).

A fade session begins with about 10 to 15 minutes of shaping practice, i.e., such that it is "just challenging to turn the tone off." Before the actual fade exercise, we give the student the opportunity to practice 20, 40, and 60 with feedback for a few minutes. This practice shouldn't last too

long since maintaining a level of 60 requires a fair amount of muscle activity and the muscles may get tired. A sample prompt follows:

Bring it up to 40 and hold it there for only a few seconds and then bring it back down to 20, but while it is at 40, look inside to see what 40 feels like, in contrast to 60 or 20 so that you get a muscle sense for 20, 40, and 60.

Once the student has done this a few times, then the machine is turned away, the tone is reduced so that it is not audible, and the fading exercise itself begins.

Each fade exercise consists of 10 trials of which 4 are targetted at 40, 3 at 60, and 3 at 20. The normal success rate on a first fade is somewhere between 4 and 6 hits. The usual pattern is a gradual increase in accuracy scores as the fading sessions progress. The usual criterion for successful termination of the fade is at least three series at 7 out of 10 hits or two series at 8 out of 10 hits.

To summarize, the fading procedure begins with 10 to 15 minutes of shaping, a few minutes of practicing 20-40-20-60-20-40 . . . with auditory and visual feedback followed by the hit or miss fade exercise.

Fading tips. Avoid straining the student by doing no more than two fades per session.

The later fading begins in training, the higher the first fade score.

In most cases, the first fade will produce relaxation levels lower than plateau. Inform the student and

congratulate him.

At the start of the first fade, some students may not be able to reach plateau without feedback. When this occurs, decrease sensitivity and allow a minute of 20-40', 20-60', 20-40' with feedback before proceeding with a fade at the new decreased sensitivity level. This inability to reach plateau without feedback is usually a sign that fading was begun too early in training.

Stimulus Generalization

Once fading is completed, the student can relax without feedback in the lab situation. Stimulus Generalization consists of using verbal prompts to integrate relaxation responses into normal life flow. (A full description of this training stage is available from P. St-Jean, Algonquin College, Ottawa, Ontario.) In the competitive stress study this training stage was omitted. Subjects were encouraged to practice control of muscle tension in their daily lives, but were not given specific training in this practice.

Cognitive Appraisal and Coping Training-- Session 2

Review and Update on Session 1

1. Answer any questions that have arisen since the last session.

2. Review rationale that the source of performance drop is psychological stress which itself is the product of our thoughts. ADD: We can have worry stress where our thoughts are taken up by concerns that we won't be able to meet the demands of the situation; or, we can have boredom stress where our thoughts focus on how little interest we have in this situation or how little challenge there is for us.

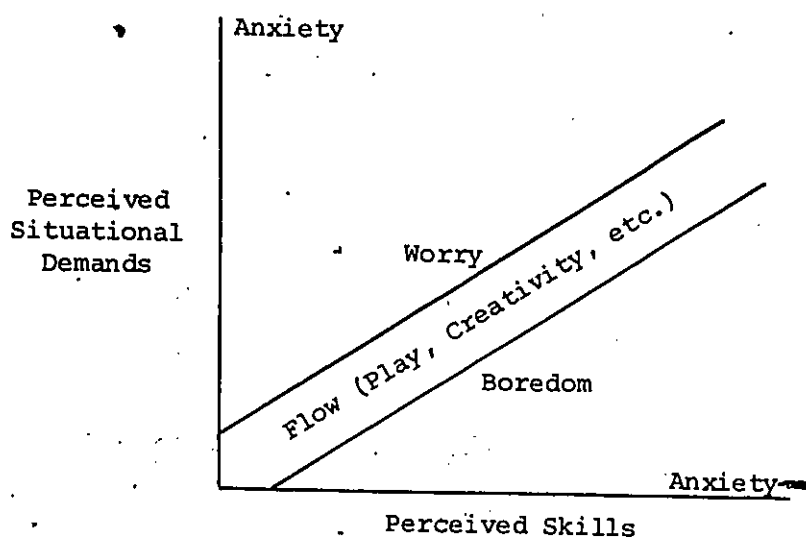
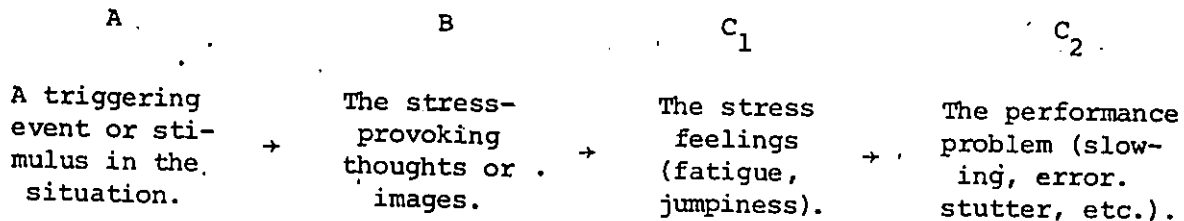


Figure 6
Cognitive Consequences of Variations in the
Difficulty/Ability Ratio

(Adapted from M. Csikszentmihalyi, Beyond boredom and anxiety.
San Francisco: Jossey-Bass Ltd., 1975, p. 49.)

Get each person to give a brief example of each type of stress! Draw out from the group how performance (score; work done; clarity of conversation; etc.) was hurt in the stress situation.

Show from one good example our Model (after Ellis, 1958).



Emphasize: when we know what is happening, our stress feelings (C_1) become a cue to change our thoughts (B).

Analysis of Stressful Competitive Situations

1. "Recall the games played in competition, the labyrinth, the bean bag toss, the catch and deposit. Recall when you came to the laboratory on the day of competition, the instructions for the competitors, waiting to perform, your own turns, waiting, posting of scores, and all that happened. Quickly list the times when you believe boredom or worry could have taken the edge off your performance."

2. Once a list is made, choose the simplest situation from each trainee's list. Have the group analyse one situation at a time. Determine:

- a) The physical sensations that the trainee calls worry or boredom. These stress sensations (C_1) will be his cues in the future.

- b) The events or stimuli in the situation that triggered his feelings. These stimuli or events (A) don't cause his feeling though it may seem that way. His feelings are provoked by his thoughts.
- c) What the trainee was thinking (B) just prior to becoming aware of tension, worry, or boredom, while he had these feelings and afterwards. What are the thoughts, pictures, or explanations he made of the events that maintained his discomfort.
- d) How his level of performance was affected by the discomfort he felt and by the thoughts he had. This is the behavioral consequence (C_2) of the competitive stress response that we want to optimize.

Where necessary, guide the trainee through the situation in imagination. Have the trainee replay that actual moment in order to recapture vividly the various aspects of the experience. Do this only after the trainees have made some response to each step of analysis for their own situation.

Training in Self-Monitoring

1. "In order to be able to interrupt our negative thoughts that provoke discomfort, we have to be able to observe our thoughts, our thinking, and imagining behavior.

Most of us carry on quite an extensive conversation with ourselves, and yet we do not really notice this dialogue. For that matter, when I talk to myself, it's not always me that is doing the talking. I might suddenly, in a situation, hear the voice of my dad telling me what I should do. What I want you to do now is to monitor, take note of, your own cognitions while you do a few activities at my suggestion. OK. Stand up and do some stretching exercises. (30 to 60 seconds.) Now walk around the room. (Another 30 seconds.) Stop. Stay where you are but close your eyes. (30 to 45 seconds.) Please take your seats and let's hear what you observed yourself thinking."

The trainees report several thoughts. Trainer distinguishes generalized impressions of what one thought from detailed accurate reporting of thought. Trainer reinforces self-monitoring that seems accurate. He can also probe for emotional and behavioral consequences of thoughts.

2. In a second exercise on self-monitoring, the trainer has the trainees imagine the following situation:

You have got word that your psychology professor wants to see you in his office. You arrive. He ushers you into a chair and says, "I'll be right back."

Now have you got that vision? Good. Imagine yourself thinking, "God! Where's he gone? What's this about? Maybe he wants to know why I haven't handed in my paper. Naw, he wouldn't call me here for anything that simple. What have I done wrong? What if he's upset about my question the other day? I don't want some scene with a prof. No waves. Gotta get through this year. What if he causes some real trouble? Oh boy!"

(After a minute or two.)

Remember how you felt during those thoughts. Perhaps that's a pretty real situation. Let's go back to the same situation but with different thoughts. I'll give you fewer thoughts this time.

"He's got an interesting library here. Hey, I've got that one. No novels. Sports Psychology, that looks good. Hey, what if I was a sport psychologist working with Team Canada? I can see myself now, helping Bobby Orr adjust to front office work. Yeah, there I am in my pearl grey three piece, clip board in hand, 'Tell me, Mistah Orr ven vas the fust time you missed your momma?'"

"I have given you a negative self-instructional set and a positive one. What specific differences in your emotional and physical responses did you notice?" Discuss the vividness of the thoughts. Contrast these sets with what they monitor in their own thoughts. Focus on their style of self-talk, pictures, sounds, the past, the future.

3. For homework, I want you to monitor your cognitions every time you have occasion to look at your watch between now and next visit.

Irrational Expectations

Present lists of the ten irrational ideas of Ellis and Harper (1977). Explain the theory that we are often not aware of the nonsense that is the foundation under our negative or stress-provoking interpretations of events. Ask the trainees to read and discuss in pairs the irrational ideas, as they might underlie their own behavior in stress. Listen in on

discussions and reinforce remarks that indicate comprehension with smiles and nods. Let the discussion develop on its own. Have a wrap-up comment after eight to ten minutes.

Coping with Stress-provoking Thought

In this closing section, you want to provide the first coping technique, cognitive reappraisal. Choose one of the simple situations from the competition that were analysed near the beginning of the session. Have everyone imagine that situation, the feelings and thoughts as described originally by the trainee. Then model out loud the self-talk that would be a realistic reappraisal of the real dangers to the trainee's goals in that situation. Get each trainee to model an alternative, yet adaptive, cognitive reappraisal. Try another situation from the analysis of competitive situations. Repeat the steps with the original trainee suggesting a model reappraisal for the group's comments and shaping.

Encourage the trainees to monitor their thoughts and to practice cognitive reappraisal whenever they experience some distressing emotion. Thank everyone for coming and remind people about the next session.

Motivation-placebo Control--Session 2

The goal of this second session is data collection, i.e., stories in response to six Thematic Apperception Test pictures.

After the stories are written, the trainer explains the test procedure to the clients.

Procedures

Rapport. Any questions regarding past session.

The T.A.T. "I want you to look at some pictures and write an imaginative story for each picture. Look at the picture for 20 seconds, then write an imaginative story that is suggested to you by that picture. You will have five minutes each time to write a story to each of the six pictures."

"To help you think about possible elements of a story in the time allowed, we give you four questions. These questions are:

- 1) What is happening? Who are the people?
- 2) What has led up to this situation? That is, what has happened in the past?
- 3) What is being thought? What is wanted? By whom?
- 4) What will happen? What will be done?"

(Get clients to write down these questions.)

"These questions are only guides for your thinking and need not be answered specifically. That is, your story to each picture should be continuous and not just specific answers to these questions."

"Do not worry about whether there are right or wrong kinds of stories to write, the most important thing is to make up vivid, imaginative stories suggested to you by the pictures. The pictures are designed to give you an idea of

what to write about, but don't be concerned about describing the pictures perfectly. Use each picture and the questions only as a guide to telling creative, dramatic stories."

"Are there any questions?"

"Here is the first picture." (Show the picture for 20 seconds, wait five minutes. Then show the second picture for 20 seconds. If clients are still writing as you near five minutes, suggest to them that they bring the story to a close.)

Exploration of T.A.T. Briefly inform clients that these pictures are similar to the Thematic Apperception Test, a method used to describe people's motivations. The leader will take the stories, score them, and bring them back to the next session for discussion. We shall be looking primarily at the achievement, affiliation, and power motives. We understand that scientists in the Federal Republic of Germany have designed T.A.T. pictures for use in analysing sports motivations.

Dreams. "Dreams are another source of information about our motives. Since the goal is improving performance through getting to know more about ourselves, we shall, over the period between now and our next session, examine one of our dreams to record details about the dream for discussion at the session." (Hand out the Dream Analysis Instruction Sheet.)

Set date and time for next session (Session #3).

APPENDIX D

SUBJECT SAMPLING AND DROPOUTS

The experimenter visited four out of six possible introductory psychology classes at the University of Ottawa. These classes were assigned by the course coordinator because they had not previously been canvassed for research subjects.

Of the 450 students who heard the request for subjects, 120 indicated a desire to participate by signing their names in a subject sign-up booklet. Among this number, 10 did not make an appointment, 11 did not show up for the appointment, and 99 arrived at their first appointment. Of these 99 subjects, one dropped out after the practice session, one did not complete his four cognitive coping training sessions, and one was excluded from the analysis at random as the 13th female in Group MC. The remaining 48 males and 48 females were assigned to treatment groups within subsamples as per Table 15.

TABLE 15
 SUBJECTS' ASSIGNMENT TO SUBSAMPLE
 TREATMENT GROUPS

| Group | Subsample | | | Total |
|------------------------------|-----------|-----------|-----------|-----------|
| | 1 | 2 | 3 | |
| Biofeedback Training | | | | |
| Males | 3 | 6 | 3 | 12 |
| Females | 3 | 4 | 5 | 12 |
| Cognitive Coping Training | | | | |
| Males | 3 | 4 | 5 | 12 |
| Females | 3 | 4 | 5 | 12 |
| Attention Training | | | | |
| Males | 4 | 4 | 4 | 12 |
| Females | 3 | 5 | 4 | 12 |
| Motivation- placebo Group | | | | |
| Males | 4 | 4 | 4 | 12 |
| Females | 4 | 5 | 3 | 12 |
| | <u>27</u> | <u>36</u> | <u>33</u> | <u>96</u> |

APPENDIX E

CROSS PRODUCT CORRELATION ADDENDUM

An Example of Representation of Interaction by
a Product of Variables in a Linear Model
(according to Porebski, 1976)

Assuming that we have final (Y-dependent variable) scores for a treatment (T) group and control (C) group, the two categories under factor A, and it is required, in addition, to study the effect of a psychometric variable X_2 , one possible way of dealing with the problem is to dichotomize X_2 and so generate B, a second factor of classification. Suppose that a random selection of individuals has led to the data in the following artificial example:

| | | Factor A | | B | |
|----------|-----|----------|----|-------|---|
| | | T | | C | |
| Factor B | | X_2 | Y | X_2 | Y |
| | (6) | (6) | 10 | (5) | 5 |
| | | (6) | 7 | (8) | 2 |
| (1) | | | 5 | (1) | 8 |
| (3) | | | 4 | (2) | 7 |

The scores on X_2 variable are shown in brackets to indicate that the classification according to factor B was done appropriately. Now the two way analysis of variance of Y scores leads to the following table:

| Source | S.S. | df | Mean square | F |
|----------------------|------|----|-------------|-------|
| Factor A | 2 | 1 | 2 | |
| Factor B | 0 | 1 | 0 | |
| Interaction A x B | 32 | 1 | 32 | 12.8* |
| Within Subclasses | 10 | 4 | 2.5 | |
| Total | 44 | 7 | | |

It should be noted that the significant interaction A x B explains 32/44 portion of S.S. of variable Y.

Exactly the same numerical values can be obtained through a linear model using the whole sample of eight cases. We can create one dummy variable (W_1) with scores +1, -1 according to whether the individual belongs to the treatment or control group, and another dummy variable (W_2) also with scores +1, -1 according to whether the individual is in the top or bottom category on variable X_2 respectively. We shall have then:

| W_1 | W_2 | W_1W_2 | Y |
|-------|-------|----------|----|
| 1 | 1 | 1 | 10 |
| 1 | 1 | 1 | 7 |
| 1 | -1 | -1 | 5 |
| 1 | -1 | -1 | 4 |
| -1 | 1 | -1 | 8 |
| -1 | 1 | -1 | 7 |
| -1 | -1 | 1 | 5 |
| -1 | -1 | 1 | 2 |

from which data the correlations squared (r^2) of each W -variable with Y can be calculated. Thus, for W_1 , $r^2 = 1/22$ and $r^2 \Sigma Y^2 = 2$; for W_2 , $r^2 = 0$ and $r^2 \Sigma Y^2 = 0$; for W_1W_2 , $r^2 = 16/22$ and $r^2 \Sigma Y^2 = 32$. The contribution of the product variable is significant and is numerically identical with that made by interaction $A \times B$ in the analysis of variance.

A linear model apart from other advantages discussed elsewhere, has a specific advantage of allowing more information to be used. The individual X_2 scores can be utilized in the product variable after they have been expressed as deviations from the mean (x_2). We have then:

| W_1 | x_2 | W_1x_2 | Y |
|-------|-------|----------|----|
| 1 | 2 | 2 | 10 |
| 1 | 2 | 2 | 7 |
| 1 | -3 | -3 | 5 |
| 1 | -1 | -1 | 4 |
| -1 | -3 | 3 | 8 |
| -1 | -2 | 2 | 7 |
| -1 | 1 | -1 | 5 |
| -1 | 4 | -4 | 2 |

and this gives r^2 of (W_1x_2) with Y equal to $25/33$ with the

corresponding value of $r^2 \sum y^2 = 100/3 = 33.3$. The result differs somewhat from the analysis of variance result for interaction (S.S. = 32), but this is due only to its greater precision.

APPENDIX F

SELECTION OR AGGREGATION OF TRIAL SCORES

The effects of training could be tested on each trial score in the final competition, on a selection of these scores, or on their total. To inform this decision, Figures 7, 8, and 9 are produced to demonstrate the change in relationship between the three trials over the four assessment sessions. These figures are graphic representations of the mean scores listed in Table 4.

Trial 1 is always the lowest performance score within an assessment session. Trials 2 and 3 remain regularly separated over time on task 1, gradually converge, and finally overlap on task 3, and are relatively identical from the individual session onwards on task 2. Trial 2 is always higher than the highest trial of the previous session. As noted earlier, a warm-up decrement often conceals the level of learning at trial 1. It now seems that trial 3 is occasionally lower than trial 2, possibly reflecting states of fatigue, diminished motivation, distractibility, and stress. Such intertrial variability corresponds with the trials effect found in the analysis of variance (Table 3). Due to consistent intertrial variability, it seems unwise to test the effects of training on each trial separately.

Selection from the trials of the best measure is similarly rejected due to the potential loss of information. Lawther (1977), citing McCraw (1955), suggests that although warm-ups could be discarded, it is wise not to throw out too much. McCraw (1955), in a study of the many ways of defining learning, concludes that total score is one of the best measures. Accordingly, total performance score within the assessment session is chosen for the test of training effects.

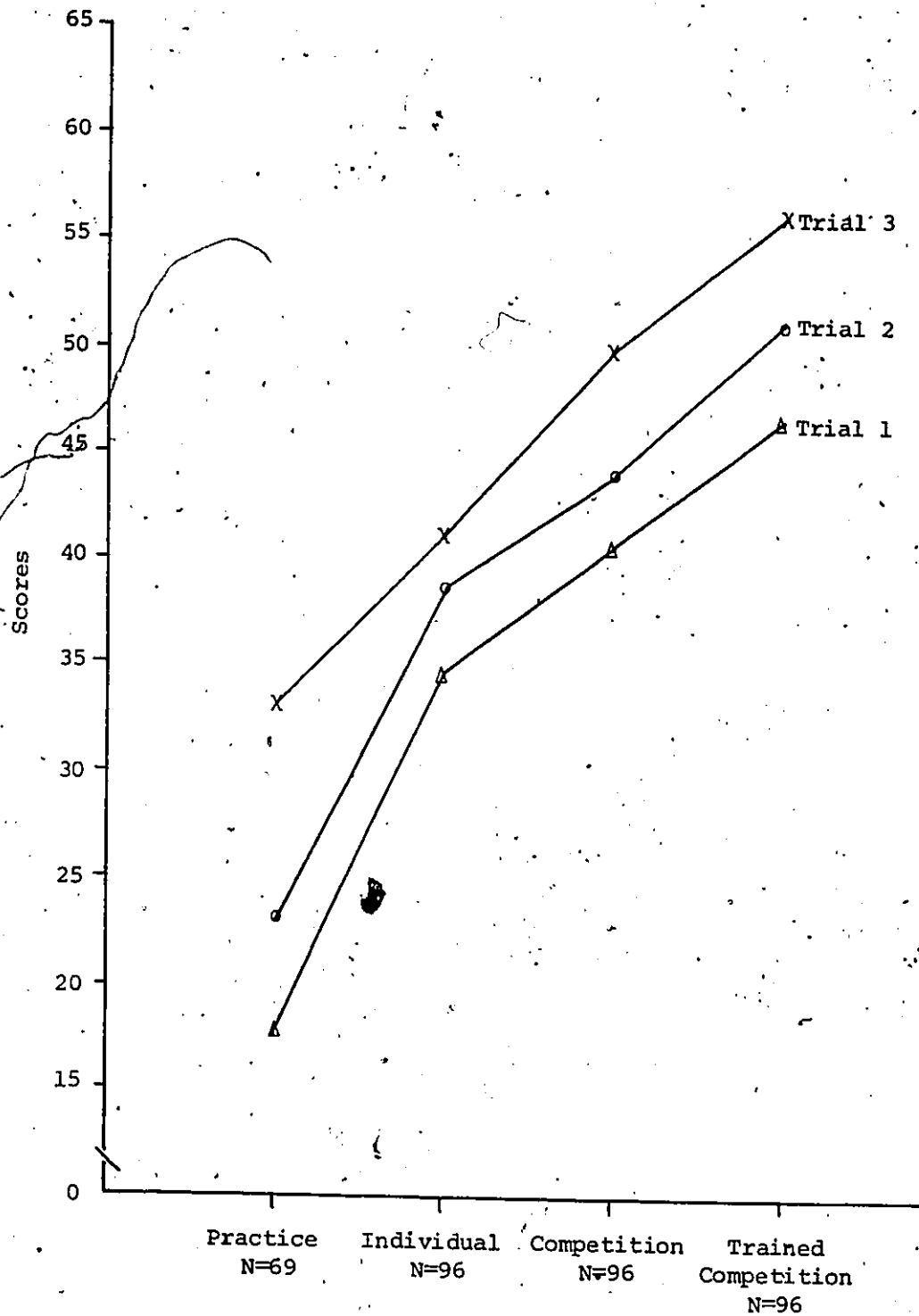


Figure 7
Relationship between the Three Trials on Task 1,
the Labyrinth, Across All Assessment Sessions

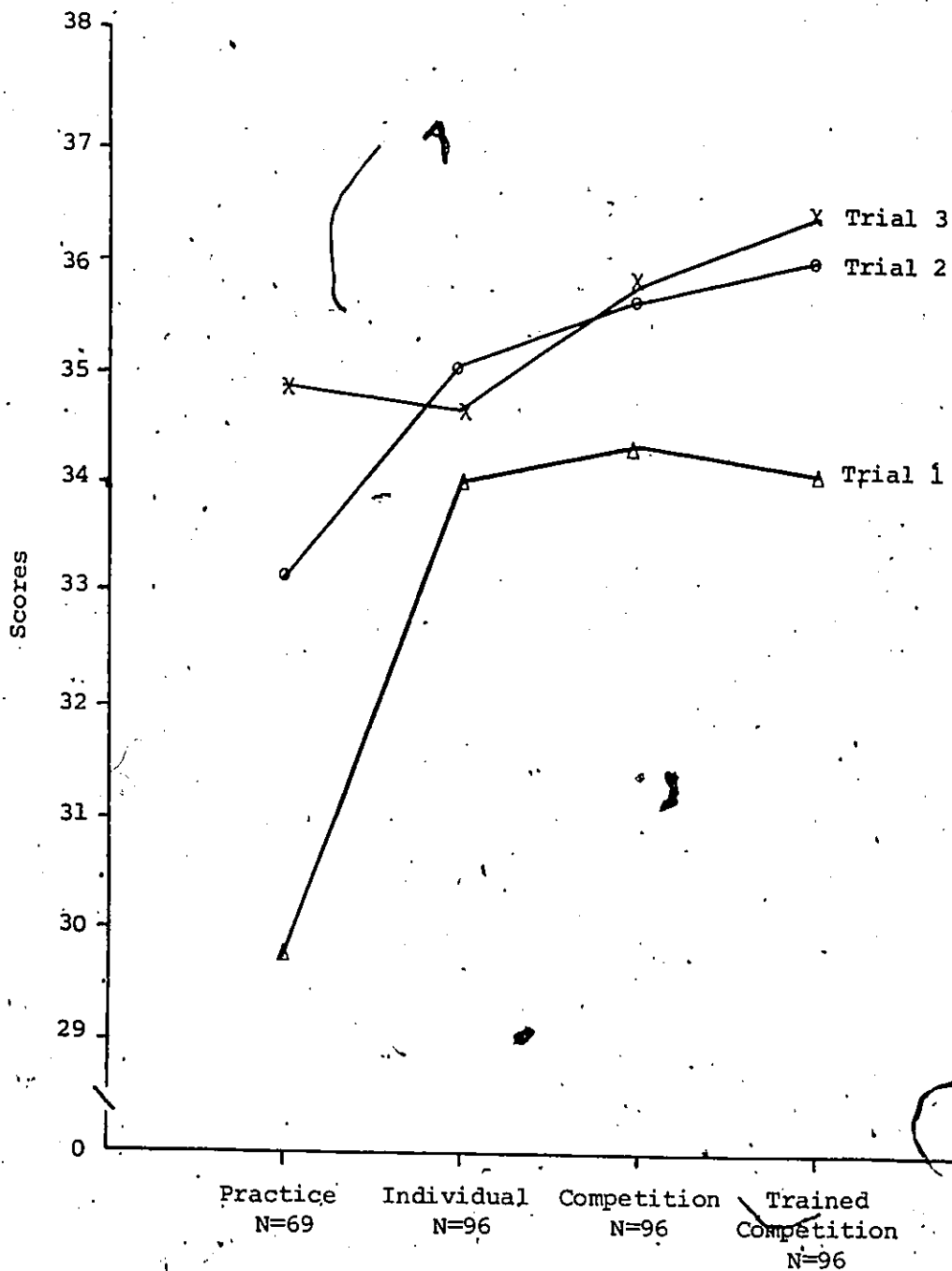


Figure 8
Relationship between the Three Trials on Task 2, the Bean Bag
Toss, Across All Assessment Sessions

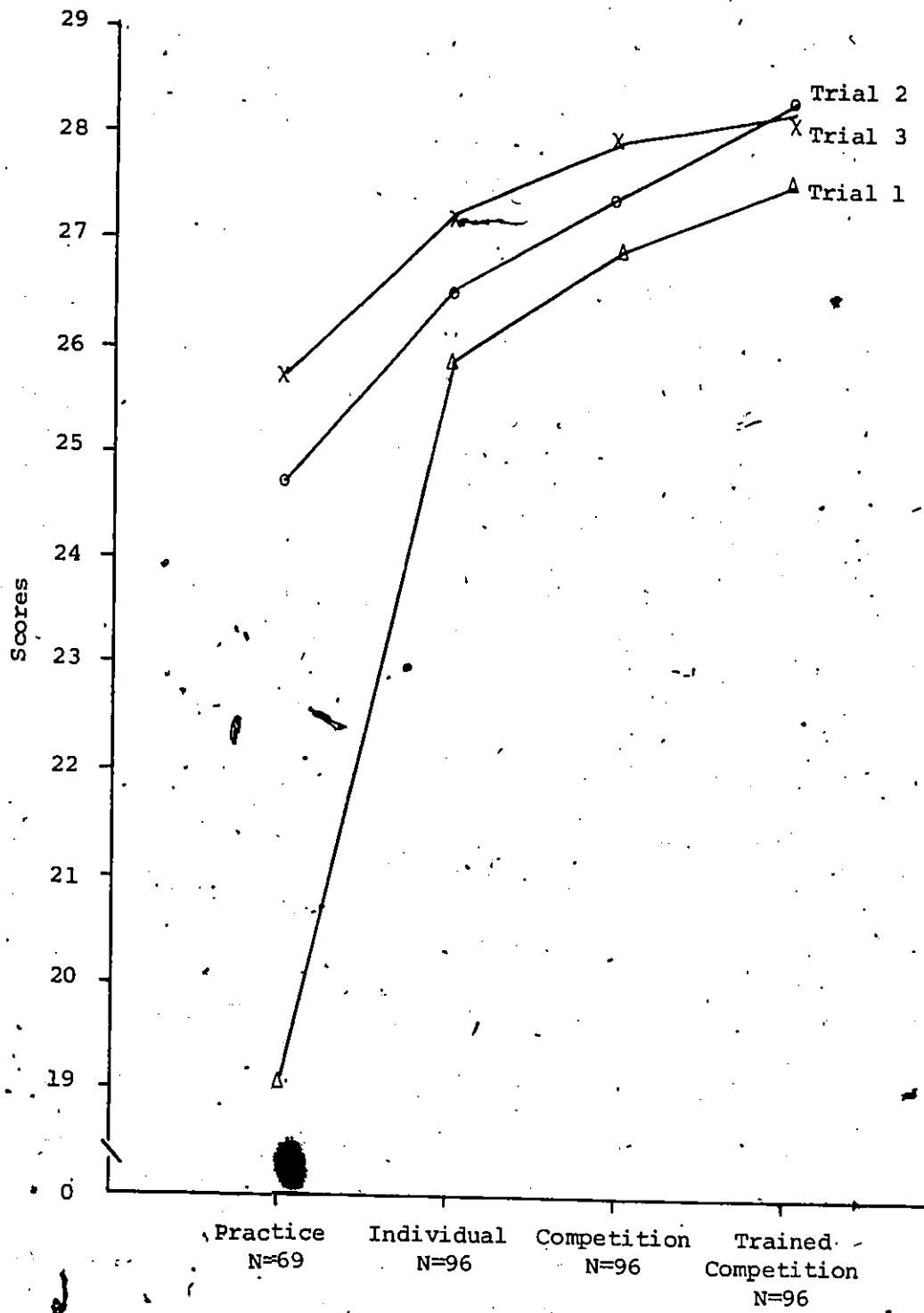


Figure 9
Relationship between the Three Trials on Task 3, the Catch and Deposit, Across All Assessment Sessions.