Ph.D. PSYCHOLOGY

Roger Charles Lyman

HEART RATE RESPONSE TO REAL AND IMAGINED STRESS

In order to investigate the assumption of the laboratory-life analogue underlying current stress research, 36 female nursing students known to suffer from audience anxiety were tested in a laboratory cognitive rehearsal condition and during the presentation of a public address. Telemetric heart rate recordings and self-ratings of anxiety indicated that laboratory responses were poor predictors of real life stress responses. As compared to the laboratory condition, the real life situation produced higher heart rate levels and greater correlations between heart rate patterns and self-ratings of anxiety. The implications of these findings for laboratory analogues of stress and for the use of fear hierarchies in reciprocal inhibition were discussed.

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A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfilment of the requirements for the degree of Doctor of Philosophy.

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INTRODUCTION

BACKGROUND

Interest in the autonomic correlates of emotional behavior has increased considerably since the pioneering work of James (1890, 1922) and Cannon (1928, 1939). James defined emotion as the perception of physiological change, postulating independent visceral response patterns for each emotion. Cannon argued that the autonomic nervous system (ANS) was restricted by anatomy to respond in a unitary and diffuse manner to any arousing stimulus. It was not until the recent development of sophisticated physiological recording equipment that the ensuing controversy could be empirically investigated.

The vast majority of research within this framework has been directed toward the autonomic correlates of emotional stress states. Specifically, attempts have been made to demonstrate that autonomic responses could be used as <u>indices</u> of such psychological states as fear, anxiety and tension. The advantages of autonomic indices as compared to behavioral or central nervous system (CNS) measures, such as E.E.G., have been described by many authors (Lazarus, 1966; Appley and Trumbull, 1967; Shapiro and Crider, in press) and can be summarized as follows:

1. Autonomic measures are independent of the subject's verbal system and conscious control. Distortions produced by the subject's defensive operations, both conscious and unconscious, are thereby eliminated.

2. Continuous recording of autonomic measures

permit the investigation of temporal trends, difficult to observe by other means. Interruptions or pauses, unavoidable in self ratings, are unnecessary.

3. *Modern data collection equipment permits* a more efficient recording of autonomic responses than behavioral or CNS measures and is at least as reliable.

In the investigation of autonomic stress responses a variety of end-organ measures and stressors have been used. Autonomic measures taken singly or in combination have included: heart and respiration rate, pupillary size, skin conductance or resistance, systolic and diastolic blood pressure, finger temperature, and blood volume. The investigation of stressors has included an even wider variety of measures. Most studies have been conducted in laboratories either with physical stimuli (electric shock: White, 1965; Hodges and Spielberger, 1966; Thackray and Pearson, 1968; auditory: Stokvis, Liem and Bolten, 1962; heat: Malmo, Shagass, Davis, Cleghorn, Graham and Goodman, 1948; Patton, 1969; cold: Lacey, Bateman and Van Lehn, 1953; Craig, 1968) or with cognitive (Malmo and Shagass, 1952; Lacey *et al.*, 1953; Schnore, 1959) and social (Jacobs and Kowalski, 1966; Nowlin, 1968; Costell and Leiderman, 1968) stimuli. Only a few studies have involved observations in field settings such as sport parachuting (Epstein and Taylor, 1967; Fenz and Epstein, 1967), battlefield situations (Berkun 1959, 1962; Weybrew, 1967), or academic examinations (Beam, 1955; Jones, Bridges and Leak, 1968).

Considering the heterogeneity of autonomic measures and stressors it is not surprising that few unequivocal results have emerged. Focusing on those studies that deal with the validity of autonomic stress indicators, the main findings can be briefly summarized: The stressors have generally produced autonomic activation but the degree of activation varies widely. Intercorrelations of autonomic measures have been low, often approaching zero (Speisman, Osborn and Lazarus, 1961; Taylor and Epstein, 1967; Lacey, 1967; Kelly, Brown and Shaffer, 1970). It has been suggested that for heart rate and skin conductance the use of varying procedures and measurements may have been responsible for the low correlations (Lazarus, Speisman and Mordkoff, 1963; Malmstrom, 1965, 1968). The literature provides little support, however, for the assumption of general or diffuse arousal.

When several autonomic measures are taken there is strong evidence that subjects respond in consistent idiosyncratic patterns to various laboratory stressors. This concept of autonomic response patterning was initially introduced by Lacey _et al_. (1953) and has received considerable experimental support (Schnore, 1959; Dykman, Ackerman, Galbrecht and Reese, 1963; Patton, 1969). There is evidence, however, that subjects do not maintain these patterns over time (Oken, Grinker, Heath, Herz, Korchin, Sabshin and Schwartz, 1962).

While self reported anxiety and autonomic indices have usually been positively correlated (Mordkoff, 1964; Fenz and Epstein, 1967; Hodges and Spielberger, 1966), there is contradictory evidence as well (Dykman _et al_., 1963).

Individual differences in the level of general anxiety, defensiveness and appraisal of the stress situation, have also been shown to affect autonomic responses (Goldstein, Jones, Clemens, Flagg and Alexander, 1965; Schacter, Williams, Rowe, Schachter and Jameson, 1965; Spielberger, Southard and Hodges, 1966; Lazarus, 1967).

These studies of autonomic stress indices have produced sufficient positive findings to encourage further investigation. Contradictory results, however, show the need for clarification of terms and improved knowledge of the specific effects different stressors have on the variety of measured autonomic responses. Attention, focused so exclusively on dependent variables, should now be turned to the effects of independent variables on autonomic responses.

THE PROBLEM OF ECOLOGICAL VALIDITY IN STRESS RESEARCH

An important issue arising from the preceding studies is the validity of generalizations from laboratory settings to real life situations. This criterion for meaningful experimentation has been labeled "ecological validity" by Brunswick (1947) and Orne (1962). In the physical sciences, the relevance of laboratory findings for practical applications is less difficult to establish than in the social sciences, where a multitude of interdependent human factors has to be considered.

The Laboratory Analogue:

Most stress research has been based on the assumption of the laboratory analogue explained by Lazarus as follows:

> What then is a laboratory analogue? First of all, it is an experiment performed under controlled conditions so that a variable, or

> several variables, can be unequivocally related to some effect being measured. But what about the term analogue? This refers to the manipulations in the experiment which parallel, or are similar to, the processes that are postulated to take place in nature. We are never really interested in the limited conditions of the experiment itself. Rather we assume that these conditions represent those in real life, and that the findings can be generalized to conditions like them in nature. If an experimenter creates stress by exposing his experimental subjects to an experience of failure by doing or saying certain things to them, he expects to generalize his results to all those situations in life that involve such failure. The laboratory experiment on stress is but a miniature of these life experiences, and most importantly one whose procedures, by analogy, are thought to correspond to or be isomorphic with the processes we postulate as taking place in nature. (Lazarus, 1964. p. 36)

The laboratory analogue has been the preferred approach in stress research because of the control the laboratory setting provides over such numerous contaminating variables as movement of subject, distractions, room temperature and the like. What presents an advantage for experimental requirements, however, is often artificial and contrived when compared to real life situations. Stressors which appear perfectly meaningful in the laboratory are often irrelevant in the natural habitat and more realistic psychological stressors are difficult to duplicate in the sterile environment of the laboratory.

Surprisingly little research evidence has been offered to support the suggestion that a laboratory stressor can evoke responses analogous to those resulting from real life stress. Contrary evidence has been reported by Berkun, Bialek, Kern and Yagi (1962) whose Ss refused to accept a danger situation presented in the laboratory as a real "threat."

> They seemed to recognize that the likelihood of danger in an experiment is very small and that, therefore, there is no reason to actually be "scared."
>
> We have termed this phenomenon "cognitive defense," because its essential element is the act of cognition: thinking, assessing probabilities, and choosing the most likely event as a basis for action. This characteristically human cognitive function, then, becomes the principal obstacle to experimental study of the human response to stress. (Berkun *et al.*, 1962. p. 2)

Apparently, the limitations of traditional "hard-wire" recording devices have prevented a meaningful systematic comparison between laboratory produced stress and the reality stress situation. There are virtually no published studies available to support the validity of the laboratory analogue in stress research. In view of the multitude of experiments on autonomic indices of stress and the importance of this field of study, it is unfortunate that the assumption of the laboratory analogue remains unvalidated.

Outside the realm of stress research several studies provide indirect evidence that laboratory analogues of human behavior may at times be misleading. Orne (1962) has shown that *Ss* will perform exceedingly boring and totally meaningless tasks when asked to do so in a psychological experiment and that they are also prepared to adjust readily to experimenter's expectations (Orne, 1959). Milgram (1963) has convincingly demonstrated the strength of obedience tendencies in *Ss* taking part in a psychological experiment. He found that *Ss* were willing to administer what they thought to be severely painful electric shocks to a fellow volunteer subject. Milgram explained these results in terms of such factors as the S's belief that he was advancing scientific knowledge and that he could trust the experimenter not to ask anything of him that he should not do.

Within the context of stress research, no direct laboratory-life comparison studies have been carried out with "hard-wire" recordings. There is evidence, however, that laboratory stressors, which vary in degree of artificiality, produce measurably different results. Jacobs and Kowalski (1966) have compared heart rate, blood pressure, and palmar resistance to a highly artificial stressor (cold pressor test) and a more realistic psychological stressor (social frustration). Significantly greater increases in heart rate and blood pressure were observed for the more realistic stressor. It is of interest to note that those studies which report consistent person-specific autonomic patterns for a variety of stressors have tended to use stressors which do not vary greatly in artificiality (Malmo and Shagass, 1952; Lacey et al., 1953; Schnore, 1959; Dykman et al., 1963; Patton, 1969). In fact Lacey, the champion of autonomic response patterning, is now placing a much stronger emphasis on situational factors ("situational stereotypes") which have been shown to produce different autonomic patterns within laboratory experiments. This emphasis is reflected in one of his more recent published statements:

> My strong preliminary impression is that the situational requirement for externalized attention is going to overwhelm idiosyncratic

> patterning. If this is true we are going to have to describe idiosyncratic patterning not over all stressor situations, which is what I thought originally, but over classes of stressor situations. (Lacey, 1967. p. 41-42) (Italics mine)

Field Studies:

Considering the lack of support for the laboratory analogue and in view of the inherent difficulties in producing real life stress in laboratories, it would appear logical to focus more directly on the study of real life stress. In terms of ecological validity, the only problem is the possibility of influencing the S's responses through the act of autonomic monitoring.

American aviation test programs have utilized autonomic measures to investigate stress responsivity in pilots engaged in difficult and dangerous flights (Roman, Ware, Adams, Warren and Kahn, 1962; Roman, 1965a, 1965b; Brown, Rogge, Meyer, Buckley and Brown, 1969). Considerable differences between responses to these stressors and the typical laboratory stressors have been noted. For example, heart rates of 120-150 B/M (rarely reached in laboratory experiments) have been maintained for long periods of time in well conditioned pilots (Roman, 1965a). Factors such as physical movement or flight acceleration have been accounted for and are, therefore, not responsible for the high heart rate levels.

Fenz and Epstein (1967) report a real life study on sport parachuting using heart rate and skin conductance as autonomic indices. This experiment is an excellent example of a well conducted field study employing hard-wire recording equipment. In the sequence of events, leading up to and following the jump, significant differences in autonomic responses between experienced and inexperienced parachutists were observed. A positive correlation between self reported anxiety and autonomic indices lends support to the relevance of this type of study.

Jones ét al. (1968) have demonstrated a substantial increase in several autonomic indices following an important oral academic examination, which confirms findings of an earlier study by Hickham, Cargill and Goldner (1948).

Unfortunately, hard-wire recording devices have seriously limited the range of field studies because of the restriction they impose on the mobility of Ss. Only very slight movements of the S are permissible before movement artifacts render the recordings unreadable. In addition, a serious problem of field studies with hard-to-conceal wire connections is the continuous awareness of monitoring imposed both on S and other participants. Only to the extent that these restrictions can be reduced with improved recording devices will field studies prove to be a serious alternative to laboratory experiments.

TELEMETRY: A METHODOLOGICAL SOLUTION

The recent introduction of telemetry in psychophysiological studies may provide a solution to the perplexing problems of field research. Telemetry may be defined as the wireless transmission of biological data from a subject to distant electronic receiving devices. The advantages of telemetry over hard-wire recording procedures include free subject mobility, concealed sensing, transmitting, and receiving devices, and the opportunity for the experimenter to remain at a distance from the subject. Several recent publications deal extensively with telemetric methodology (Caseres, 1965; Slater, 1967; MacKay, 1969a) and bibliographies are available in Geddes (1962) and Viscardi (1966).

The current telemetry literature may be divided into four main research areas: biomedicine, aerospace, ecology and stress. Primary emphasis will be placed on the stress literature as it is most relevant to the present paper.

By far, the majority of telemetric research has been carried out in a medical context. This literature has been recently reviewed by Pronko (1968) and MacKay (1969b). The research has mainly involved monitoring cardiovascular responses of patients for diagnostic or observational purposes. Telemetry has facilitated the continuous bedside monitoring of cardiac patients from a hospital miles away (Levine, Jossman, Tursky, Meister and Deangelis, 1964) and observations of myocardial infarct patients under normal strain (Gilson, Holter and Glasscock, 1964). The United States aerospace program has used telemetry to investigate stress responses during dangerous flight situations (Roman, 1965a, 1965b; Simons and Johnson, 1965) and from astronauts walking on the surface of the moon. Ecology has also made use of telemetry in tracking studies of animals in their natural habitat (Slater, 1967; Pronko, 1968; MacKay, 1969a). This method has introduced a range of application never before realized with traditional recording equipment.

Because of its unique characteristics telemetry is particularly useful in stress research. These studies, although mainly concerned with physiological stress, are important because they illustrate the wide applicability of telemetry for field studies and the problems associated with this measurement. As heart rate is, perhaps, the easiest response to measure, it has been given preference in telemetric stress studies. Continuous EKG recordings with a minimum of movement artifact have been successfully obtained in the following field situations involving extreme motor activity: free fall parachuting (Shane and Slinde, 1968; Goldberg and Foster, 1963), track and field running events (McArdle, Foglia and Patti, 1967), competitive skiing events (Hanson and Tabakin, 1964), automobile racing and normal driving in city traffic (Taggart and Gibbons, 1967; Simonson, Baker, Burns, Keiper, Schmitt and Stackhouse, 1968) and mountaineering at high altitudes (Nagasaka, Ando, Takai and Takagi, 1966).

Unfortunately, most of this research has been conducted in situations of extreme physical activity. As both movement and emotional stress have the capacity to elevate heart rate, it is difficult to separate the effects of one from the other when they occur simultaneously. Nevertheless, several important conclusions have emerged. Heart rates have often been elevated to levels previously considered unsafe or outside normal limits with no evidence of adverse effects (i.e., cross-country skiing - 200 B/M, running two miles - 206 B/M, race car driving - 205 B/M). Of even more importance, extremely high heart rates have been observed during anticipatory periods when very little movement was occurring. In some studies the anticipatory heart rate levels were higher than any rate during the actual exercise stress (Goldberg and Foster, 1963; Hanson and Tabakin, 1964). Finally, heart rates have been observed to recover in a remarkably short time after extreme physical stresses (often one to two minutes).

As psychological stress research has been more interested in autonomic indices of emotional responses, it would be desirable to select stress situations where physical activity is kept to a minimum. Although researchers have often expressed enthusiasm for the potentials of telemetry in psychological studies (Darrow, 1964; Maher, 1966; Sternbach, 1966; Pronko, 1968; Shapiro and Crider, in press), practical demonstrations have by no means kept pace with theoretical optimism. Only two studies, both unpublished and involving small numbers of subjects, have utilized telemetric field monitoring in situations where physical activity was minimal. Both studies are particularly relevant to this paper, because they have involved comparisons between laboratory and real life responses to stress.

Maher and Howe (1964) selected two <u>S</u>s, one showing marked heart rate increase to laboratory stress, and another who was unresponsive. When the heart rates of these two <u>S</u>s were monitored telemetrically during an academic examination, the previously found heart rate differences disappeared. Both <u>S</u>s maintained very high heart rates for the duration of the examination. These results were confirmed and elaborated upon in a later study by Leibner (1966). Heart rate responses of 13 <u>S</u>s were measured under three laboratory stress conditions (mental arithmetic, letter association, sudden noise) and compared to the heart rate response elicited by the stress of a final examination.

No significant correlations were found between the real life heart rate response and any of the laboratory responses, although the latter were correlated with each other.

These studies cast further doubt on the laboratory analogue and suggest the need for more extensive comparison research as well as studies of stress in real life situations.

AUDIENCE ANXIETY AS STRESS

Definitions:

For the purpose of the present investigation, stress will be defined in terms of "psychological threat" as described by Lazarus:

> .....a condition of the person....when confronted with a stimulus that he appraises as endangering important values and goals. (Lazarus, 1966. p. 28)

This definition places strong emphasis on the individual's evaluation of the harmfulness of a stimulus and on the reaction to psychological as opposed to physiological stimuli. "Real life" will be defined as a situation or activity with goals independent of the experimental aims, not designed for experimental purposes, and unaltered or only minimally affected by the experimental design and procedures. "Audience anxiety" is the particular type of real life stress which is experienced when a person confronts an audience.

Audience Anxiety in Real Life:

Dohrenwend (1961) has stated that in view of the artificiality of laboratory stress situations "what is needed on an empirical level then, is sensitivity to stress situations which though created by social and cultural factors outside the researcher's control, nevertheless provide close approximation to experimental control of meaningful conditions." (p. 294) Considering this statement and the previous definitions, audience anxiety would appear to be an ideal situation for the study of autonomic responses to real life stress. Specifically the advantages are clear: speech situations are commonly experienced, they often arouse intense anxiety, and physical movement can be kept to a minimum. Nonetheless, very little systematic investigation has been conducted with this stress situation until recently.

Beam (1955) demonstrated that stress induced by the anticipation of presenting an oral report interfered significantly with performance in serial learning. Using palmar sweat prints as the autonomic measure, it was found that the greater the autonomic increment under stress, the greater the number of trials necessary for mastery of the task.

Paul (1965, 1966) investigated heart rate and palmar sweat response to public speaking in _S_s who had undergone desensitization for audience anxiety. It was found that pairing the imagination of anxiety provoking speech situations with relaxation produced a significant reduction in autonomic responses to the actual speech.

Jones _et al_. (1968) demonstrated a significant rise in pulse rate of medical students immediately following an oral examination. The mean post-stress pulse rates were 31 beats higher than control measures taken two months later.

The only study available using telemetry for continuous monitoring of heart rate changes during a speech was conducted by Ira, Whalen and Bogdonoff (1963). These investigators showed marked heart rate increases in physicians presenting a conference speech. Unfortunately, they ignored the effects of physical activity which appeared to occur simultaneously with the highest heart rate levels.

Audience Anxiety in the Laboratory:

In contrast to the earlier definition of "real life", a condition where the S's activities and experiences are contrived to comply with experimental designs and goals, will be referred to as a "laboratory" condition. It is not unreasonable to expect that the imagination or "cognitive rehearsal" (Folkins, Lawson, Opton and Lazarus, 1968) of stressful speech experiences in Ss selected for extreme audience anxiety would, in itself, constitute laboratory stress.

The literature of behavior modification provides evidence that cognitive rehearsal of an anxiety situation constitutes stress, and that relaxation paired with cognitive rehearsal is effective in the modification of real life stress responses (Wolpe, 1958; Cooper, 1963; Eysenck and Rachman, 1965; Wolpe and Lazarus, 1966). This latter process is brought about through the application of "reciprocal inhibition" which has been defined as "the systematic pairing of anxiety evoking stimuli with a response antagonistic to anxiety, such as relaxation" (Folkins et al., 1968). Ss are required to imagine themselves in anxiety arousing situations arranged on a fear hierarchy from lowest to highest threat. Both the selection and position of items on the fear hierarchy are based on each S's subjective self-ratings of anxiety. Deep muscle relaxation is induced in order to inhibit the anxiety response as S imagines progressively more threatening events from his fear hierarchy. As he learns to cope with threatening stimuli through cognitive rehearsal combined with relaxation, the S is better prepared to tolerate these stress situations in real life. Wolpe has assumed an almost perfect transfer from anxiety reduction in imagined stress to a corresponding reduction in real stress:

> There is almost invariably a one-to-one relationship between what the patient can imagine without anxiety and what he can experience in reality without anxiety. (Wolpe, 1963. p. 1063)

The crucial assumption underlying the principle of reciprocal inhibition is that cognitive rehearsal of a threatening event constitutes psychological stress. If this were not the case, it is difficult to see how behavior modification could occur as a result of reciprocal inhibition. Support for this assumption can be found in recent studies of autonomic response to cognitive rehearsal. As compared to neutral events, the imagination of anxiety-provoking situations has been repeatedly shown to produce greater autonomic arousal by Paul (1963, 1969), Barber and Hahn (1964), Grossberg and Wilson (1967, 1968), and Craig (1968).

Additional indirect support can be found in the literature on autonomic responses to interview situations, comprehensively reviewed by Lacey (1959). These studies demonstrate that the actual experience of an anxiety-arousing situation is not essential for an autonomic response to occur, but that this reaction can be evoked by any association to these situations. An example is the work of Malmo and his collaborators, who have shown that significant increases in muscle tension are associated with the discussion of emotionally significant material (Malmo, Shagass and Davis, 1950; Shagass and Malmo, 1954).

Thus, the theoretical constructs of reciprocal inhibition, the studies of autonomic arousal evoked by cognitive rehearsal and the experiments on somatic responses to stressfull interviews provide evidence suggesting that the imagination of threatening situations can be regarded as laboratory stress.

Audience Anxiety in the Laboratory Versus Real Life:

A direct comparison between heart rate response to real and imagination-induced audience anxiety would permit an investigation of the laboratory analogue issue discussed earlier. A number of key situations could be selected from an actual speech and a subject asked to imagine himself in these exact situations. This design would offer a distinct advantage over other comparative studies previously mentioned, where highly dissimilar stressors were used.

This comparison would also have bearing on an assumption underlying the use of reciprocal inhibition in behavior modification. The imagination of progressively higher anxiety-provoking stimuli on a fear hierarchy should arouse autonomic responses less intense, but similar in pattern to those evoked in real life situations. Surprisingly, this critical assumption has not been subjected to experimental investigation, although a recent study by Craig (1968) is relevant to this issue.

Craig utilized the cold pressor test to examine autonomic responses to imagined, vicarious and directly experienced stress in a controlled laboratory setting. The results showed consistent quantitative and qualitative differences in autonomic arousal for these conditions. The direct experience condition produced greater elevation in autonomic responses and maintained them for longer periods of time than the imagined condition. These results would have been more appropriate to real life stress research, had a more natural stressor been used. The author points out:

> The extent to which the findings were specific to the use of the cold pressor test and volunteer Ss cannot be ascertained. The pattern of pain elicited at the cutaneous contact receptors, and the subsequent physiological arousal, would be expected to differ from the pattern of stress response elicited through distance receptors by socially aversive stimulation. (Craig, 1968. p. 519)

Although this study was not relevant to fear hierarchies, it nonetheless throws some doubt on the assumption that imagination produced anxiety is proportionate to real life anxiety. With the aid of telemetric equipment, autonomic fear·hierarchy responses observed in real life audience anxiety could be directly compared to responses produced by imagined stress.

OBJECTIVES OF THE PRESENT INVESTIGATION

One objective of the present study was to determine the efficacy for telemetric heart rate recordings to the measurement of audience anxiety in a situation of public speaking. Self-ratings of anxiety taken both before and after the actual speech, were used as a criterion measure and were correlated with heart rate responses in a number of speech situations. It was hypothesised that heart rate scores would correlate positively with self-ratings of anxiety.

An attempt was made to obtain a relatively "pure" index of heart rate response, unaffected by S artifacts such as movement, or procedural artifacts such as apparatus stress. In order to establish the degree of success at eliminating the effects of experimental artifacts, self-rating scales of anxiety associated with all experimental procedures were administered. It was expected that experimental artifacts could be reduced to a level where influence on the natural speech situation would be insignificant. In addition, the relationship between body movements and anxiety levels, both in terms of specific audience anxiety and general anxiety, was investigated.

A second equally important objective was to compare the real life situation to the condition of cognitive rehearsal both in terms of heart rate responses alone and the correlations between heart rate and self-ratings of anxiety. This comparison would permit the investigation of questions pertaining to the laboratory analogue, as well as the validity of the use of cognitive rehearsal as an anxiety stimulus in reciprocal inhibition. In view of the findings of Maher and

Howe (1964), Leibner (1966), and Craig (1968), it was hypothesized that the real life condition would produce significantly greater heart rate responses than the laboratory imagination condition. In addition, as fear hierarchies are based on self-ratings of anxiety in the real situation, it was predicted that the correlations between self-reported anxiety and heart rate responses would be greater in the real life situation than in the imagination condition.

METHOD

SUBJECTS AND SELECTION CRITERIA

Thirty-six female nursing students, known to suffer from audience anxiety, participated in the present study. All were enrolled in a nurses' training program at the Douglas Hospital in Montreal. They constituted a homogeneous group both in terms of age ($\bar{X}$ = 20.1, S.D. = 2.7) and educational background ($\bar{X}$ = 11.2 years, S.D. = 2.4). Each _S_ received $5.00 remuneration for taking part in the experiment.

_S_s were selected from a total female nursing group of 84 students by means of scores on an audience anxiety selection test battery. This battery was composed of items from three separate tests including:

(a) FSS - Fear Survey Schedule (Wolpe and Lange, 1964), "speaking in public" item only.

(b) S-R Inventory of Anxiousness (Endler, Hunt and Rosenstein, 1962), "Speech before a large group" subtest.

(c) PRCS - Personal Report of Confidence as a Speaker (Paul, 1965), entire test.

The latter two were included because of their extensive use by Paul (1965, 1966, 1969) and Calef and MacLean (1970) as measures of audience anxiety while the FSS item was included for its obvious relevance and ease of administration.[1]

Audience anxiety was operationally defined as a score equal to

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[1] See Appendix A-C for copies of the test forms.

or greater than the following scores on at least two of the three tests:

(a) FSS - rating of two (i.e., "a fair amount")
$\bar{X} = 3.03$, S.D. = 2.20.[1]

(b) S-R Inventory - score of 36 (Paul, 1965)
$\bar{X} = 47.92$, S.D. = 7.80.

(c) PRCS - score of 16 (Paul, 1965)
$\bar{X} = 22.4$, S.D. = 3.96.

Of the total female student population, 42 met these criteria. One of them refused to participate, and five were rejected during various phases of testing, leaving a final sample of 36 Ss.[2] General anxiety scores (FSS total) were found to be significantly higher in the S sample ($\bar{X} = 92.64$) than in the non-selected student group ($\bar{X} = 60.48$, $t = 4.60$, $p<.001$).[3]

RATING SCALES AND QUESTIONNAIRES

Three self-report rating scales were developed to meet the special needs of the present study. A speech anxiety rating scale (SAS) was administered to determine, on a seven-point scale, the amount of subjective anxiety experience in 10 key speech situations

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[1] FSS rating scored as follows; "not at all" = 0, "a little" = 1, "a fair amount" = 2, "much" = 3, "very much" = 4.

[2] S No. E-2, E-10, E-22, E-32 - rejected due to mechanical recording problems.
S No. E-36 - too anxious to present a speech.

[3] FSS general anxiety scores were obtained by multiplying the number of ratings in each category by a weighted score (i.e., "a little" = 1, "a fair amount" = 2, "much" = 3, "very much" - 4). Scores in each category were then summed for each S.

(Appendix D). Following are the 10 situations in abbreviated form:

(1) Ten minutes before the class enters.

(2) One minute before the class enters.

(3) Class enters.

(4) Introduction begins.

(5) Introduction ends.

(6) Speech begins.

(7) Speech 1/4 finished.

(8) Speech 1/2 finished.

(9) Speech 3/4 finished.

(10) Speech ends.

These were chosen to represent discrete and scorable anxiety arousing events which consistently occurred during the speeches. All subsequent speech analyses were based on these 10 situations. Space was also provided on the SAS for the S to select and rank seven of the 10 items to form a fear hierarchy for use in later analyses of the relationship between hierarchy rank and heart rate responses.

An analogous "beach anxiety" rating scale (BAS) was administered as a control measure (Appendix E). This scale was designed to establish whether any anxiety would be aroused by 10 beach situations thought to be relaxing which the subject would be asked to imagine in one session of Condition 1. This session was used as a control condition to determine whether cognitive rehearsal, itself, independent of content, could constitute an anxiety arousing situation. The 10 items, given below in abbreviated form, were carefully selected to match the SAS items on all important variables:

(1) Ten minutes before friend arrives.

(2) One minute before friend arrives.

(3) Friend arrives.

(4) Walking together toward the beach.

(5) Arrive at beach.

(6) Relaxation on beach begins.

(7) Relaxation 1/4 finished.

(8) Relaxation 1/2 finished.

(9) Relaxation 3/4 finished.

(10) Relaxation ends.

Finally, a 10-point rating scale was used to determine the S's success at imagining the required speech and beach situations (Appendix F).

Following the actual speech, a Personal Data Form (PDF) was administered to obtain information on both the S's past experiences with public speaking and her reaction to the specific situations under investigation (Appendix G).

THE STRESSORS

The nurses' training program at the Douglas Hospital seemed to present an ideal situation for a study of audience anxiety. All nursing students are required to present a 10 to 15 minute speech on a nursing topic at some time during their training period. The audience consists of fellow nursing students and instructors. Although no formal grades are given, each student is evaluated by the instructor for her performance. A 10 to 15 minute discussion period usually follows, forcing the student to be prepared for questions from students and instructors. Most students seem apprehensive of this experience, which suggested its appropriateness for a study of audience anxiety.

As all Ss were selected for audience anxiety, the "a priori" assumption was that the experience would, indeed, be stressful. On the basis of the previous definition, this situation would also clearly qualify as "real life". It was only necessary to demonstrate that the natural experience would not be substantially altered by the experimental design and procedure. The results of data from the SAS and Personal Data Form were later used to provide "a posteriori" verification of these assumptions.

The laboratory stress condition, employed the imagination of fear arousing situations encountered during speech presentations. The criteria for "laboratory" and "stress" were discussed earlier and a detailed description of this condition follows under "Procedure".

APPARATUS

The entire experiment was conducted in two rooms: a classroom and a recording room. The classroom, of 15' x 30' dimensions, contained about 30 chairs and a table at the front. To enable the experimenter to monitor events in the classroom without being physically present, a Sony closed-circuit television system was utilized. The camera was located inconspicuously in a bookcase at the rear of the room and a microphone was placed nearby. A Clarion tape recorder was positioned near the table at the front, for the presentation of instructions. An Argus slide projector and Sawyers Mirascreen were placed on the table for the imagination condition. These were removed during the actual speech condition. Finally, an Onyx omnidirectional antenna to pick up the heart rate signals was concealed behind a screen at the front of the room.

The recording room was located across the corridor and housed an Onyx FM telemetry receiver, Grass portable polygraph - Model 79, and a television monitor, all arranged in close proximity to each other. Remote control switches for the tape recorder and slide projector were located nearby. An intercom system between the classroom and recording room completed the communication network.

The Onyx telemetry system was used for all heart rate recordings. Bicom non-polarizing electrodes were connected to an Onyx miniature transmitter. These were attached to the S in positions selected to minimize movement artifact using double sided adhesive washers and "EKG Sol" electrode cream. After experimenting with several electrode placements, a modification of the midline arrangement advocated by Freiman, Tolles, Carberry, Ruegsegger, Abarquez and Ladue (1960) and Carbery, Tolles and Freiman (1960) was used. The active electrode was located on the sternum at the manubriosternal junction. This specific sternum placement has often been used where movement artifact was considered a problem (Rowley, 1959; Goldberg and Foster, 1963; Cerkez, Steware and Manning, 1965; Nagusaka, 1966). The inactive electrode was placed on the vertebral column at the level of T8, and the transmitter immediately adjacent to it.

This entire apparatus was easily concealed underneath the clothing of S, who soon lost awareness of it. A female research assistant attached the electrodes and transmitter to the S which usually took no more than five minutes.

The heart rate signal was transmitted from the sensing devices to the antennas concealed in the room. From there, it was passed by wire to the recording room where it was picked up by the telemetry receiver and fed into the Grass polygraph. Both EKG wave form and tachograph patterns were recorded to facilitate later scoring.

PROCEDURE

Condition 1 (Imagination):

Following the selection of a student, an appointment was made for one week before her actual speech was scheduled. When the S presented herself at this time, she was assigned to one of two counterbalanced conditions. On an alternating basis, half the Ss were exposed first to the speech imagination condition (Condition 1S), while the other half were assigned first to the control condition of imagining relaxing beach situations (Condition 1C).

Session 1. A transmitter and two electrodes were attached and S was led into the classroom where she was first required to complete the appropriate rating scale (SAS with fear hierarchy rankings, or BAS) for her assigned condition. From this point on, the experimental procedure was remotely controlled and the following taped instructions were presented:[1]

> In the first part of this experiment we would like you to remain seated and relax for about 12 minutes. This is to give us a chance to adjust our recording devices and to allow you to get completely comfortable in these surroundings. At the end of the 12 minute period, my voice will begin again to give you further instructions.....
>
> 12 MINUTE RESTING PERIOD
>
> .....In this experiment you will be viewing a number of slides. Your task is basically very easy. You simply look at each slide and try very hard to imagine yourself in that situation. Some situations will perhaps be easier to imagine than others, but you must try very hard to mentally put yourself into the situations described.
>
> A new slide will appear automatically every minute. Although you may find it difficult at first, you should try to sustain your imagination throughout this one minute period.
>
> People differ in their ability to imagine a scene vividly and some situations are easier to imagine than others. Therefore, it is important for us to know how successful you are at imagining each slide. At the end of each one minute slide presentation, the projector will change to the next slide. At this point, we would like you to rate, on a 10-point scale, your success at imagining the previous slide.
>
> Here are some trial slides to give you practice in the procedure. There will be three practice slides, followed by the test slides.

The projector was then activated by remote control and the slide

---

[1]The instructions given here are a shortened version of the original taped instructions - see Appendix H for complete instructions.

presentation proceeded according to the instructions given.

Session 2. One day later, at the same hour, S was required to repeat the entire procedure but with the alternate slide condition and appropriate rating scale. A S viewing speech slides in Session 1 would thus be presented with the control slides in Session 2 and vice versa.

Condition 2 (Speech to Class):

One week later, S was asked to present herself 30 minutes before the speech was to begin. Electrodes were again attached and S was led into the classroom where the following taped instructions were presented (see Appendix I for complete instructions):

> Please relax and make yourself comfortable. In the first part of this session we would like you to remain seated for about 12 minutes. This is to give us a chance to adjust our recording devices and to allow you to get completely comfortable in these surroundings. At the end of the 12-minute period, my voice will begin again to give you further instructions.......
>
> 12 MINUTE RESTING PERIOD
>
> .....Please rest assured that we have taken great care to minimize our interference with your presentation in class today. We would like the class to be carried out in a completely normal and natural manner.
>
> Due to the difficulties of this type of recording, we must impose two very small restrictions. First, please avoid any sudden, jerky movements, as they could dislodge the electrodes. Secondly, remain seated behind the table at all times until after the class has left the room. You may speak to anyone after the class but remain seated while doing so.
>
> The class will be entering in a few minutes.

> You may wish to review your notes before they arrive. Good luck on the speech. This recording will shut off automatically.

The audience then entered and S was left to present her speech. She was monitored continuously from the time of entrance to the conclusion of the discussion. The experimenter recorded all significant events on the polygraph paper, giving special attention to the 10 previously rated items. Following the completion of the speech and discussion, the electrodes were removed and S was asked to complete another SAS form (with fear hierarchy ranking) and a Personal Data Form.

MOVEMENT SCORING

During all phases of Conditions 1 and 2, a research assistant was observing the television monitor to record all spontaneous movements of S with the following scoring system:

Head movement	1
Arm movement (except hand or fingers only)	11
Leg movements (except feet only)	111
Gross body movements	1111

These categories were designed to include all those types of movement in the present situation which might have an effect on heart rate. Movements of any type tended to be very infrequent and no problems were encountered in applying the scoring system. These movement scores were later used in an effort to correct the heart rate recordings for movement effects.

RESULTS

RATING SCALES

Self-ratings of subjectively felt anxiety, obtained both in anticipation of the speech and immediately following it, are presented in Figure 1 (see also Appendix J). In all cases speech ratings were not only consistently higher than control ratings, but also showed overall high anxiety levels. In addition, a marked curvilinear pattern of self-rated anxiety emerged. The ratings tended to rise steeply to a point immediately preceeding the beginning of the speech and to decline rapidly thereafter.

The two speech ratings were found to be highly intercorrelated (Spearman's rho = .97) although a significant decrease in post-speech ratings as compared to pre-speech was observed ($t = 4.20$, $p<.01$). Control ratings were consistently low, as expected, fluctuating slightly above the zero point.

Ratings from the Personal Data Form also yielded data on the Ss' subjective response to the speech situation. The final PDF ratings of speech anxiety yielded a mean score of 3.54, which when compared to the mean of 4.94 for pre-speech ratings, was found to be significantly lower at the .01 level ($t = 3.13$). Means and Standard Deviations for ratings of anxiety due to apparatus stress (i.e., electrodes, closed circuit television) are given in Table 1. A seven-point rating scale identical to that in Figure 1 was used.

All ratings of anxiety associated with the specific experimental

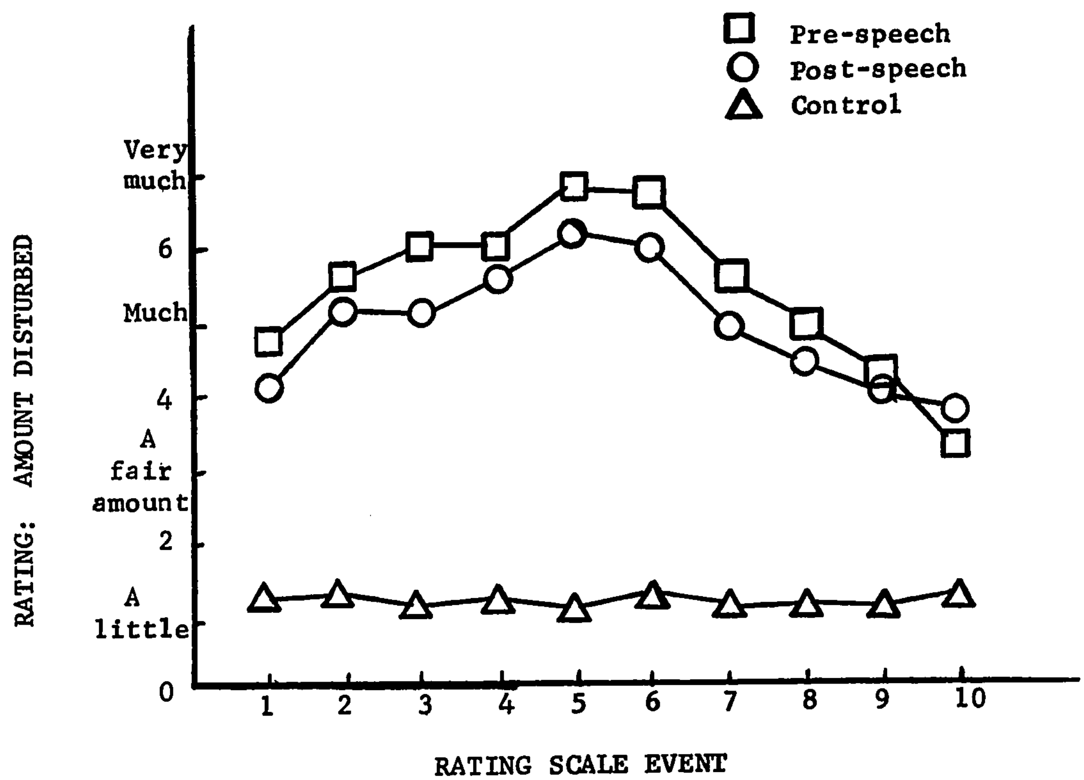

Figure 1. Mean self ratings of disturbance due to speech and control events (N = 36).

TABLE 1

MEAN SCORES ON PDF RATINGS RELATED TO APPARATUS STRESS

RATING	MEAN	S.D.
1. Overall disturbance due to special requirements of experiment.	1.42	1.57
2. Specific ratings of amount disturbed due to:		
(a) electrodes	1.08	1.75
(b) microphone	1.25	1.43
(c) closed circuit T.V.	2.11	1.90
(d) tape recorded instructions and R.P.	1.54	1.42

requirements were consistently lower than ratings of speech anxiety.

HEART RATE: UNCORRECTED SCORES

Listed below, in abbreviated form, are the specific segments (hereafter referred to as Events) of the continuous Condition 1 and 2 heart rate recordings which were selected for statistical comparisons. Details of time samples used and methods of heart rate scoring are given in Appendix K.

Pre-Test Events

Tape recorded introduction
Resting period
Tape recorded instructions

Trial slide No. 1[1]
Trial slide No. 2
Trial slide No. 3

Test Events

Speech:

1. 10 min. before class enters.
2. 1 min. before class enters.
3. Class enters
4. Introduction begins.
5. Introduction ends.
6. Speech begins.
7. 1/4 finished.
8. 1/2 finished.
9. 3/4 finished.
10. Speech ends.

Control:

1. 10 min. before friend arrives.
2. 1 min. before friend arrives.
3. Friend arrives.
4. Walk to beach.
5. Arrive at beach.
6. Relaxation on beach begins.
7. Relaxation 1/4 finished.
8. Relaxation 1/2 finished.
9. Relaxation 3/4 finished.
10. Relaxation ends.

Mean beat-per-minute scores are presented in Figure 2. A two-way analysis of variance for repeated measures yielded significant F scores

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[1]Three trial slides not appropriate for Condition 2, and therefore, not included in the analysis of variance between the three conditions.

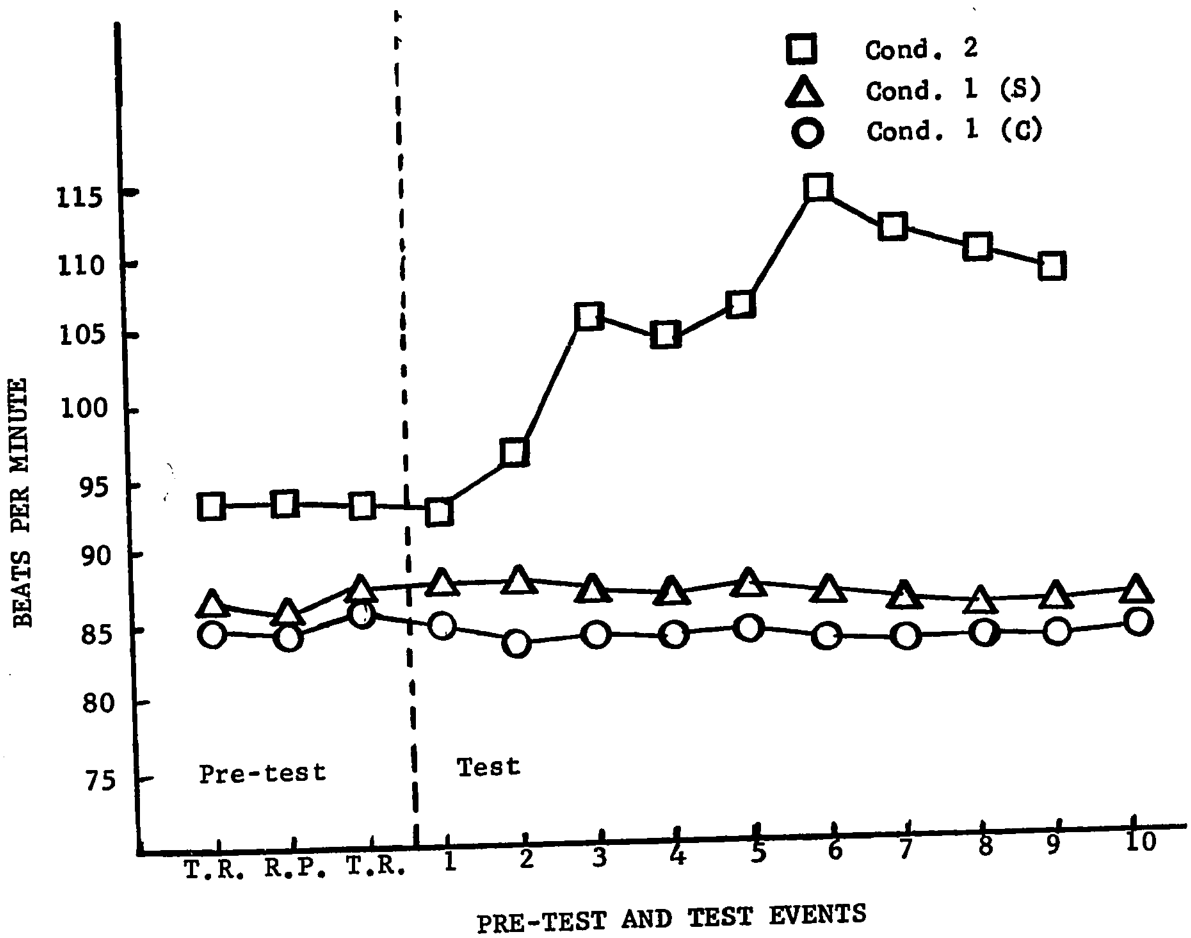

Figure 2. Mean uncorrected heart rate response in three conditions to 13 pre-test and test events (N = 36).

at the .001 level for Conditions ($F = 58.5$), Events ($F = 27.5$) and the interaction between Conditions and Events ($F = 36.3$). Detailed scores of this analysis can be found in Appendix L.

Individual t-tests were then calculated to determine the significance of specific differences. Condition 2 was found to be significantly different from the two imagination conditions by calculating a single t-test on the smallest difference between these groups (Event E-1, $T = 2.35$, $p<.05$). All further comparisons were therefore directed at the pre-test and test events of the two imagination conditions (Appendix M). No significant differences were found between the two conditions for any of the pre-test events, including the three trial slides. A pre-test combination score consisting of the mean of all pre-test events also failed to reveal a significant difference ($t = 0.97$). However, for a combination test event score made up of the mean of events 1-10 in both conditions, a significant difference at the .05 level was found ($t = 2.35$).

Finally Spearman rank order correlations were calculated on all combinations of the three sets of heart rate scores. Condition 2 was found to correlate negatively with Condition 1S (rho = -.678, $p<.05$) and with Condition 1C (rho = -.591, $p<.05$). A non-significant correlation of .407 was obtained between Condition 1C and 1S.

HEART RATE: CORRECTED SCORES

An attempt was made to correct the previously reported heart rate values for two possible biasing factors: movement effects and speaking effects. Following is a description of the correction factor developed for this purpose and the results of the analyses of corrected data.

Movement Effects:

In an effort to determine the effects of the three types[1] of observed spontaneous body movements on heart rate, a series of three studies was carried out. Studies 1 and 2 were concerned with the beat-to-beat tachograph changes in 5-second intervals associated with single isolated body movements. All movements, meeting rigid criteria, based on detailed inspection of the records, were selected from the resting periods of Conditions 1C and 1S (Appendix N). Briefly explained, in order to be included as a body, leg, or arm movement, it must have been isolated within a 75" time period, with no other movements occurring 10" prior to and 60" following the scorable event. No more than one of a type of movement was used for each S. On the basis of these criteria, 12 body, 23 leg, and 35 arm movements were selected. Results of this analysis are presented in Figure 3 (see also Appendix O).

Study 2 employed the same type of analysis, but with less stringent criteria. Results of Study 1 suggested that most of the movement effects dissipate much earlier than had been originally thought. The resulting changes in movement selection criteria are outlined in

[1]Inspection of the heart rate records revealed that head movements had no effect on heart rate and were, thereby eliminated from the following analyses.

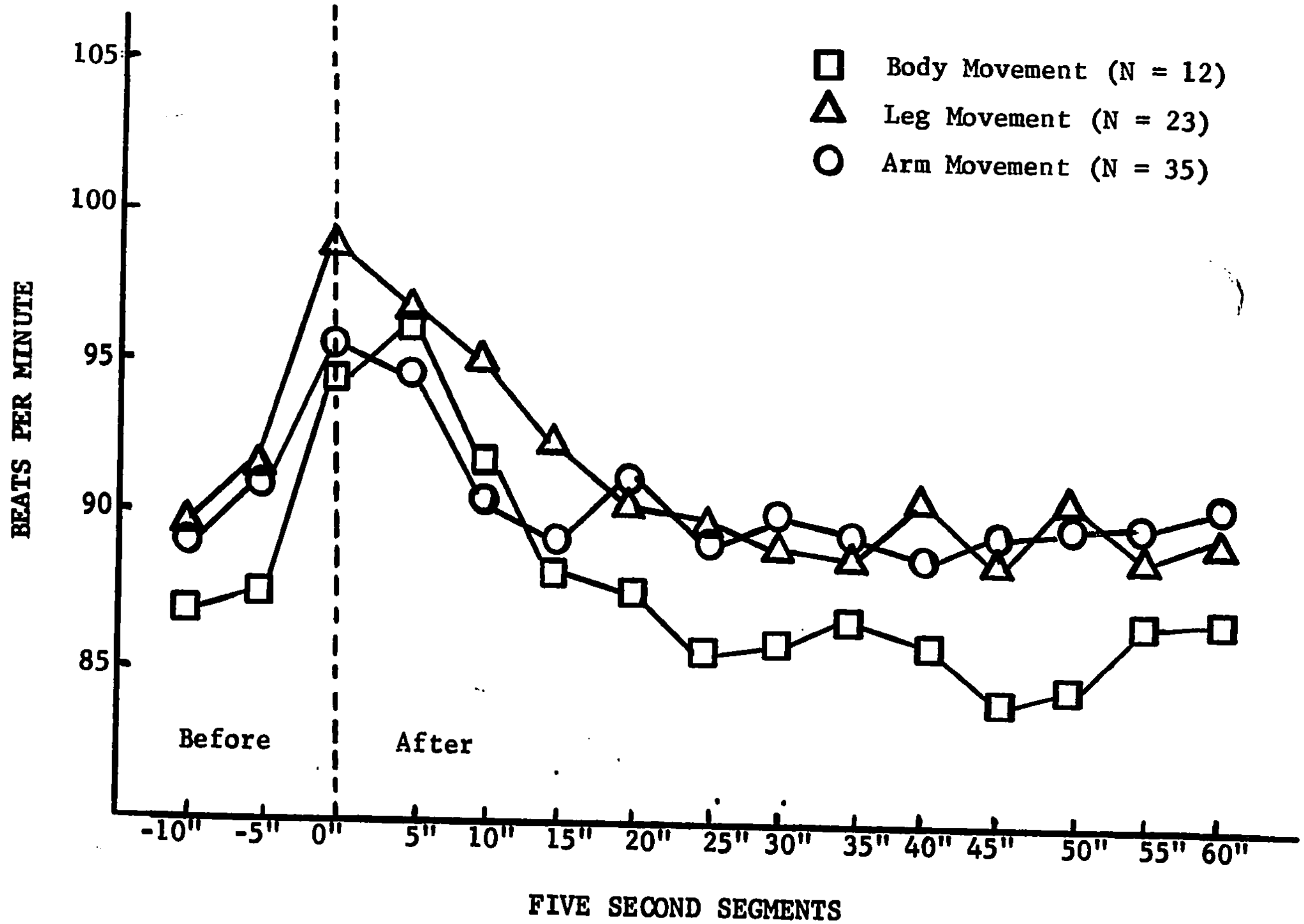

Figure 3. The effect of body, leg and arm movements on heart rate over a 75" period.

Appendix P, but basically involved shortening the post movement time span from 60 seconds to 25 seconds. With these criteria, a greater number of movements could be included, increasing the sample size to 20 for body, 28 for leg, and 38 for arm movements. Results of this analysis are presented in Figure 4 (see also Appendix O).

Study 3 utilized the information gained from Studies 1 and 2 to develop a general correction factor for beat-per-minute scores. Rather than calculating movement effects on heart rate in 5-second intervals, the effects were calculated over a 1 minute portion of the record. The resting periods of all conditions were searched for minute segments which included one of the three types of movement under study, and which were either preceeded or followed by a movement-free minute. Detailed selection criteria are given in Appendix Q. On the basis of these criteria, 22 body, 23 leg, and 39 arm movements were located. The increase in heart rate associated with these movements are given in Table 2.

With the knowledge that the types of movements observed in the speech situation did in fact result in statistically significant heart rate increases, frequencies of these movements were tabulated and are presented in Figure 5 (see also Appendices R, S, and T).[1] One-way analyses of variance calculated for each of the three movement types revealed that only in the case of arm movements was there

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[1]Test Event E-3 (class entering) was not scored for movement in Condition 2 because students entering the classroom obstructed the experimenter's view of S. For this reason, Event E-3 has been deleted from all movement and corrected heart rate analyses.

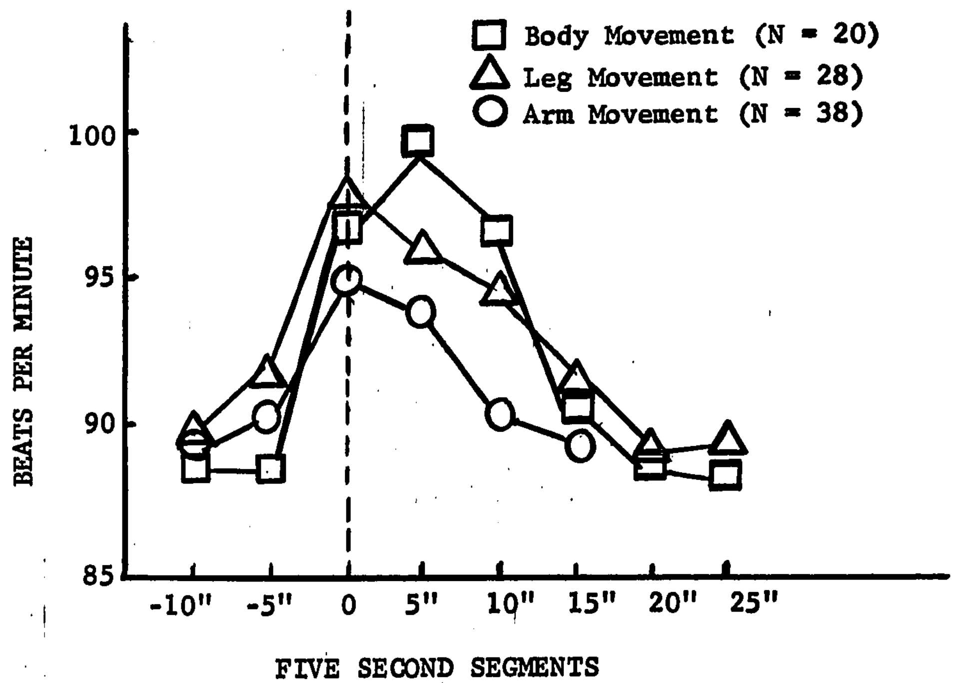

Figure 4. The effect of arm, leg and body movements on heart rate over a 40" period.

TABLE 2

HEART RATE INCREASE IN MOVEMENT MINUTE (MM) COMPARED TO MOVEMENT-FREE MINUTE (MFM)

	MEAN HEART RATE					
MOVEMENT	N	MFM	MM	DIFFERENCE	t	p
Body	22	85.68	88.23	2.55	3.24	< .01
Leg	23	85.69	87.16	1.47	2.14	< .05
Arm	39	86.02	87.34	1.32	4.00	<.001

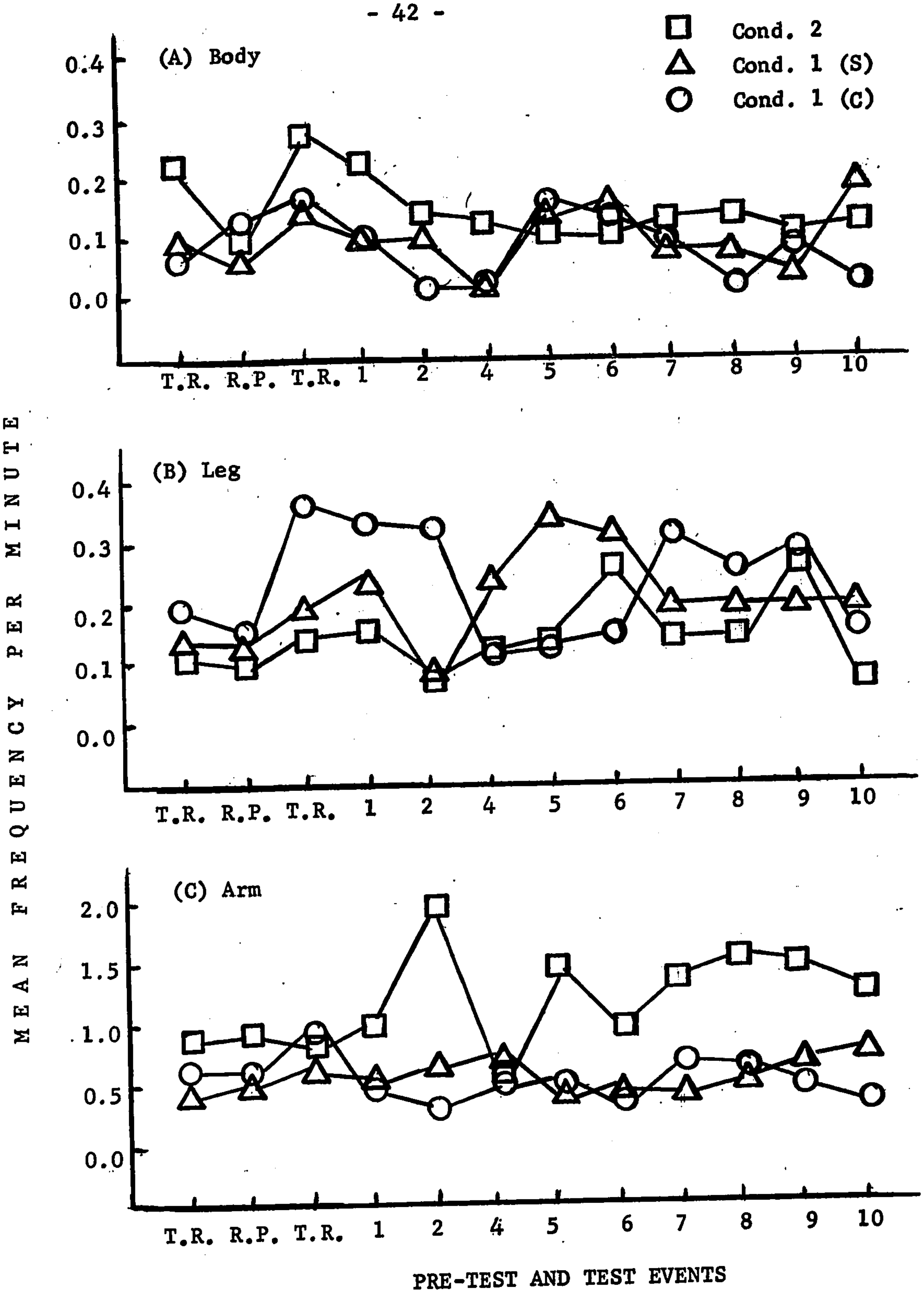

Figure 5. Mean frequency of body, leg, and arm movements in three conditions to 12 pre-test and test events (N = 36).

a significant difference between conditions ($F = 20.7$, $p < .001$). T-tests demonstrated a greater frequency of arm movements in Condition 2 than in Condition 1S ($t = 4.51$, $p < .001$) or Condition 1C ($t = 5.34$, $p < .001$).

Correction Factor I. A correction factor for this bias in arm movements was introduced by multiplying the constant 1.32 (mean heart rate increase due to an arm movement) with the mean frequency of arm movements in each event of the 2 conditions. This value was then subtracted from the raw heart rate scores in each event to render a corrected score for arm movement on each S.

Speaking Effects:

It should be noted that beginning with event E-6 (Speech begins) S was actually speaking in Condition 2, but continued cognitive rehearsal in Condition 1. This introduced a possible bias in the data as the act of speaking aloud has been shown to elevate heart rate response (Johnson and Campos, 1967). A brief study was carried out to determine whether the present speech requirement, in itself, was capable of producing heart rate acceleration. Fifteen Ss were asked to read aloud from a neutral magazine article for a 10-minute period. Heart rate values for the equivalent of test events E-6 through E-10 (Speech begins - Speech ends) were obtained and compared to the beat-per-minute values in a resting period immediately preceeding the reading. It was found that speaking produced mean rounded heart rate elevations of 11 beats-per-minute in the first minute which leveled off to an average of 7 beats-per-minute through the end of speaking (Appendix U).

Correction Factor II. The mean beat-per-minute increases obtained in this analysis were then subtracted from the Condition 2 E-6 through E-10 responses of each S in a manner similar to correction factor I. Appendix V shows the final correction scores (combination of 1st and 2nd correction factors) which were subtracted from the raw scores of each S.

Corrected Heart Rate:

Mean corrected beat-per-minute scores are presented in Figure 6. A two-way analysis of variance yielded significant F scores at the .001 level for conditions ($F = 28.3$), Events ($F = 9.2$), and the interaction between Conditions and Events ($F = 16.0$). Detailed scores are given in Appendix W.

Individual t-tests were calculated in a manner similar to that reported earlier for uncorrected scores and the results obtained were consistent with these findings (Appendix M). Condition 2 was found to be significantly different from all events of Condition 1 (Event E-1, $t = 2.27$, $p<.05$), and test score differences were significant between the two imagination conditions, while pre-test scores were all non-significant.

Spearman rank order correlations were also similar to those of uncorrected scores. Negative but non-significant correlations were obtained between Condition 2 and Condition 1S (rho = -.237) and Condition 1C (rho = -.204) while Condition 1S and 1C were again positively intercorrelated (rho = .709, $p<.05$).

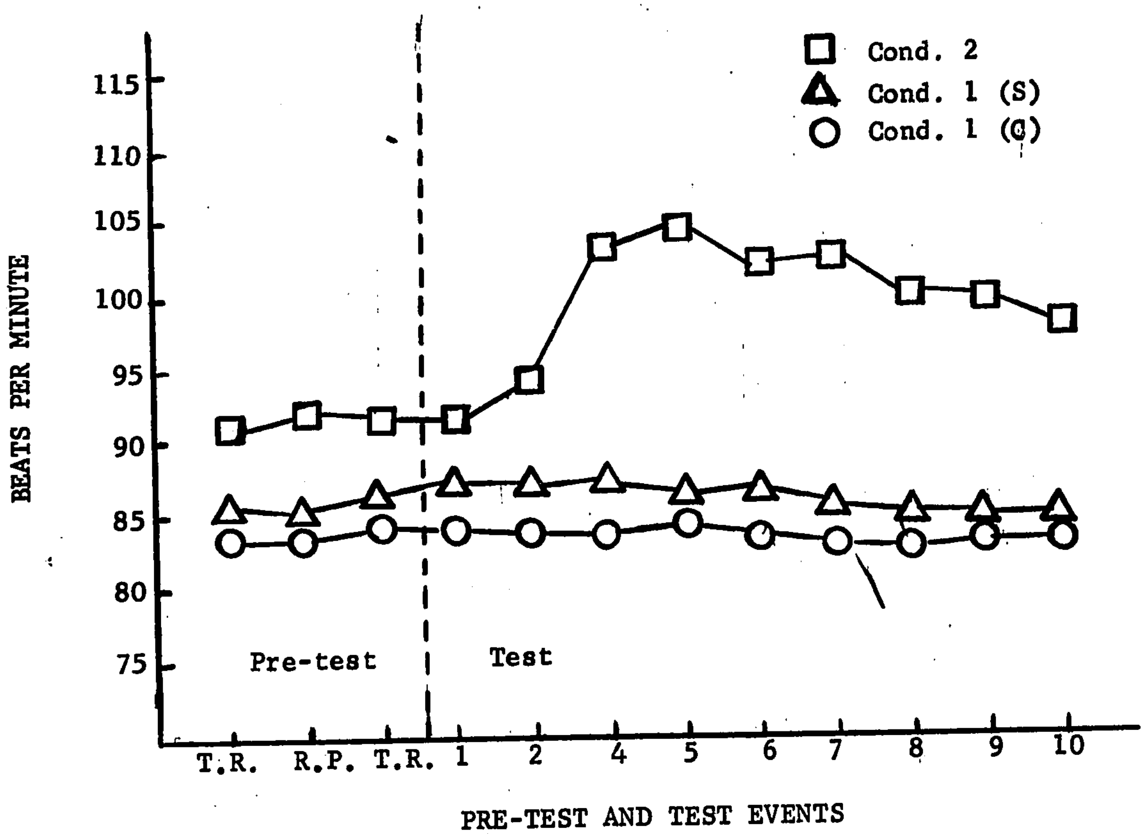

Figure 6. Mean corrected heart rate response in three conditions to 12 pre-test and test events (N = 36).

HEART RATE AND RATING SCALE INTER-CORRELATIONS

Pearson rank order correlations were calculated on the mean scores for all combinations of rating scale responses and heart rate responses. The only significant correlations found were between the corrected Condition 2 heart rate values and both rating scales. The results of this analysis are given in Table 3.

Rank order correlations were then calculated for the fear hierarchy analysis. Fear hierarchy rank was correlated with heart rate response in Condition 1S and Condition 2 using both uncorrected and corrected heart rate scores. The correlation was found to be .858 ($p<.05$) for both corrected and uncorrected heart rate scores in Condition 2, while for Condition 1S, correlations of .670 for uncorrected scores and -.053 for corrected scores were obtained, both of which were non-significant. These results are shown in Figure 7 (see also Appendix X).

OTHER CORRELATIONAL ANALYSES

Two final correlational analyses were carried out and the results presented below. The first was concerned with the relationship between anxiety and number of body movements. A Pearson Product-moment correlation of -.130 was obtained between audience anxiety (mean of PDF pre- and post-anxiety ratings) and the number of total movements in the two conditions. To further investigate this somewhat surprising finding, S's anxiety scores were divided into three groups (low, medium, and high) on the basis of PDF ratings. The mean number of movements associated with these groups was 977,

TABLE 3

SPEARMAN RANK ORDER CORRELATIONS BETWEEN HEART RATE AND RATING SCALE RESPONSES

CONDITION	SELF RATING: PRE-SPEECH RATING (rho)	SELF RATING: POST-SPEECH RATING (rho)
C-1 Control		
H.R. uncorrected	.076	.025
H.R. corrected	.196	.134
C-1 Speech		
H.R. uncorrected	.390	.350
H.R. corrected	.421	.360
C-2 Speech		
H.R. uncorrected	.030	-.081
H.R. corrected	.684*	.713*

* $p<.05$, $N = 9$

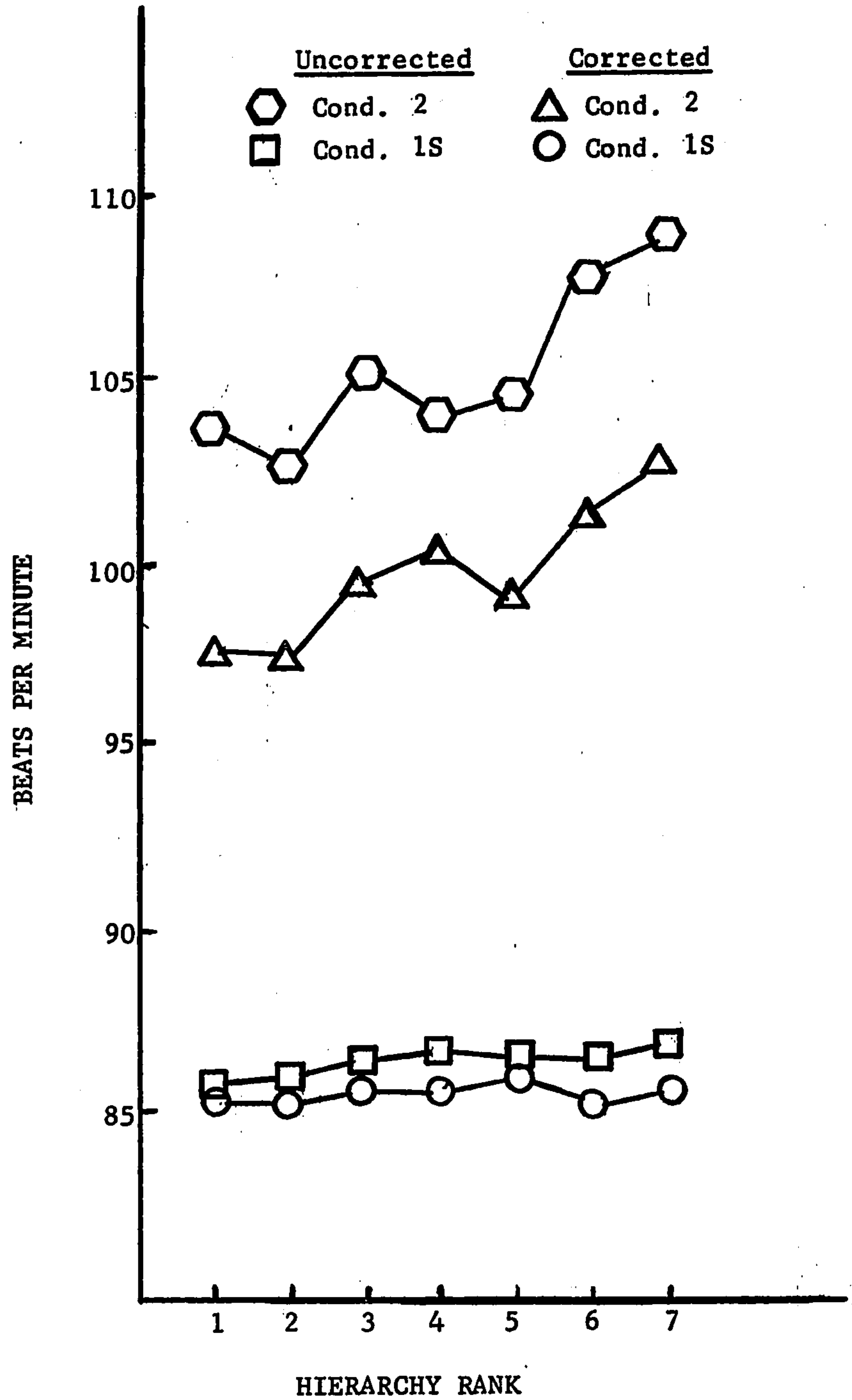

Figure 7. Mean heart rate response in Condition 1S and Condition 2 to self rated fear hierarchy events (N = 36).

673, and 906 respectively, indicating that although highly anxious Ss move more frequently than medium anxious Ss, both are surpassed in number of total movements by the low anxious group. None of these differences, however, proved significant. Finally, a Pearson Product-Moment Correlation was calculated on general anxiety scores (FSS totals) compared to frequency of movements. Again, a non-significant negative correlation was obtained (rho = -.029).

The final correlational study was an analysis of the relationship between ability to imagine a scene vividly and both heart rate response to the scene and self-ratings of anxiety associated with the scene. Mean ratings on the Imagination Success Scale are presented in Figure 8 (see also Appendix Y).

No significant difference was found between ability to imagine the speech and control situations (t = .618). The Condition 1S scores failed to correlate significantly with uncorrected Condition 1S heart rate scores (rho = .049), corrected Condition 1S heart rate scores (rho = -.029) or the pre-speech rating scale scores (rho = -.230).

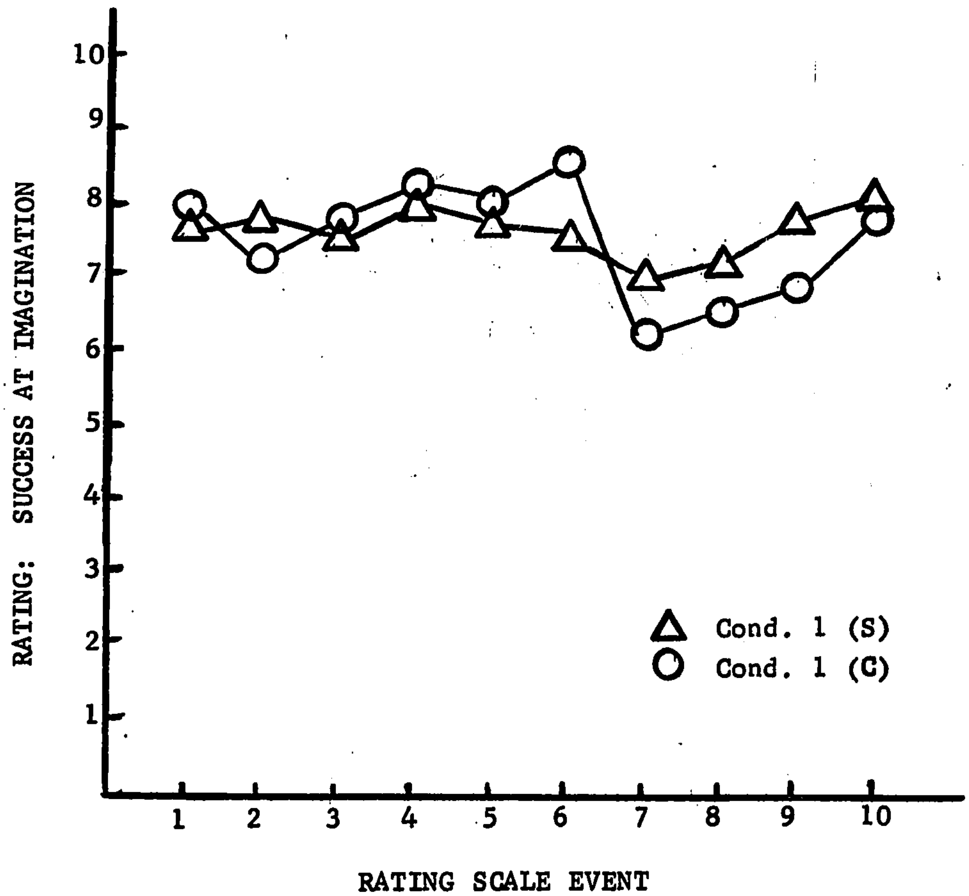

Figure 8. Mean scores on imagination success rating scale for Condition 1C and Condition 1S (N = 36).

DISCUSSION

The intriguing finding of the present study is that real life stress by comparison to laboratory stress produced not only a different magnitude, but also a different pattern of heart rate response. The pattern produced by the laboratory condition would have proved of little value in predicting real life response patterns, and, in some instances, would have been very misleading. Heart rate response to imagined speech situations had much more in common with the imagination of non-stressful (control) events than with the real life situation of public speaking. For example, while non-significant negative correlations were obtained between heart rate response in the laboratory and the real life condition, a comparison between the laboratory and control condition yielded a significant positive correlation.

These findings, in combination with other studies which have reported similar results (Maher and Howe, 1964; Leibner, 1966), throw serious doubt on the "laboratory analogue", which provides the basis for most of the research on autonomic response to stress. Because of the importance of these implications, a closer examination of the specific responses to the two conditions appears worthwhile.

In the real speech condition corrected heart rate scores correlated significantly with self-ratings of anxiety, taken both before and immediately following the speech. Significant correlations were also obtained between subjectively established hierarchy rank and both uncorrected and corrected heart rate scores. These results are all the more striking when one considers the large "intra" and "inter" individual differences always associated with heart rate response (Benjamin, 1963; Viscardi, 1966; Lacey, 1967) and the very high correlation coefficients needed to obtain significance when rank order techniques are used with small samples.

It is interesting to compare these results with the only other study which has presented data on heart rate and self-rated anxiety in time sequences throughout a real life stress experience (Epstein and Fenz, 1962). Using sport parachuting as a stressor, these authors obtained a positive correlation between these two variables in novice parachutists, and reported heart rate curves very similar to those of the present study. Although only these two studies have investigated the relationship between heart rate and self-rated anxiety in a real life stress situation, the results obtained lend strong support to the use of heart rate as an index of stress. Due to the limited data presently available, however, further investigation is needed before firm conclusions can be drawn. It may be, for example, that the magnitude and patterning of heart rate response is not restricted to <u>Ss</u> with high levels of audience anxiety, but may represent a <u>general</u> reaction pattern to speech making. The positive correlation reported for self-ratings and heart rate response could, therefore, be an artifact of the specific sample selected. This interpretation could be tested by including a sample with different self-ratings (i.e., non-anxious) in future research designs.

This hypothesis appears less likely when the individual patterns of Ss' responses observed in the present study are considered. Figure 9 illustrates the heart rate responses of two Ss whose self-rating patterns differed not only from the overall mean scores but also from each other. Further investigations using group data are necessary to permit generalized conclusions on this issue.

The laboratory imagination condition, in contrast to the real life situation, yielded no significant correlations between heart rate response and either self-ratings of anxiety or fear hierarchy rank. This failure to correlate was primarily due to the fact that the imagination of speech situations, while producing heart rate levels significantly higher than the control situation, did not yield a curvilinear pattern of arousal comparable to the one produced by self-ratings of anxiety. Heart rate, in other words, was ineffective in differentiating between the different levels of stress indicated by self-rated anxiety.

As the two experimental conditions were analogous to the commonly used reciprocal inhibition techniques of desensitization "in fantasy" and "in vivo", the failure to confirm the "laboratory-life" analogue also has implications for the use of these approaches in behavior modification. It challenges the untested assumption underlying reciprocal inhibition that autonomic arousal produced by the imagination of fear hierarchy items is directly proportional to the stress response evoked by the actual experience of these hierarchy events (Wolpe, 1963). This assumption is clearly not supported by the present findings. Although heart rate response increased progressively in the real speech

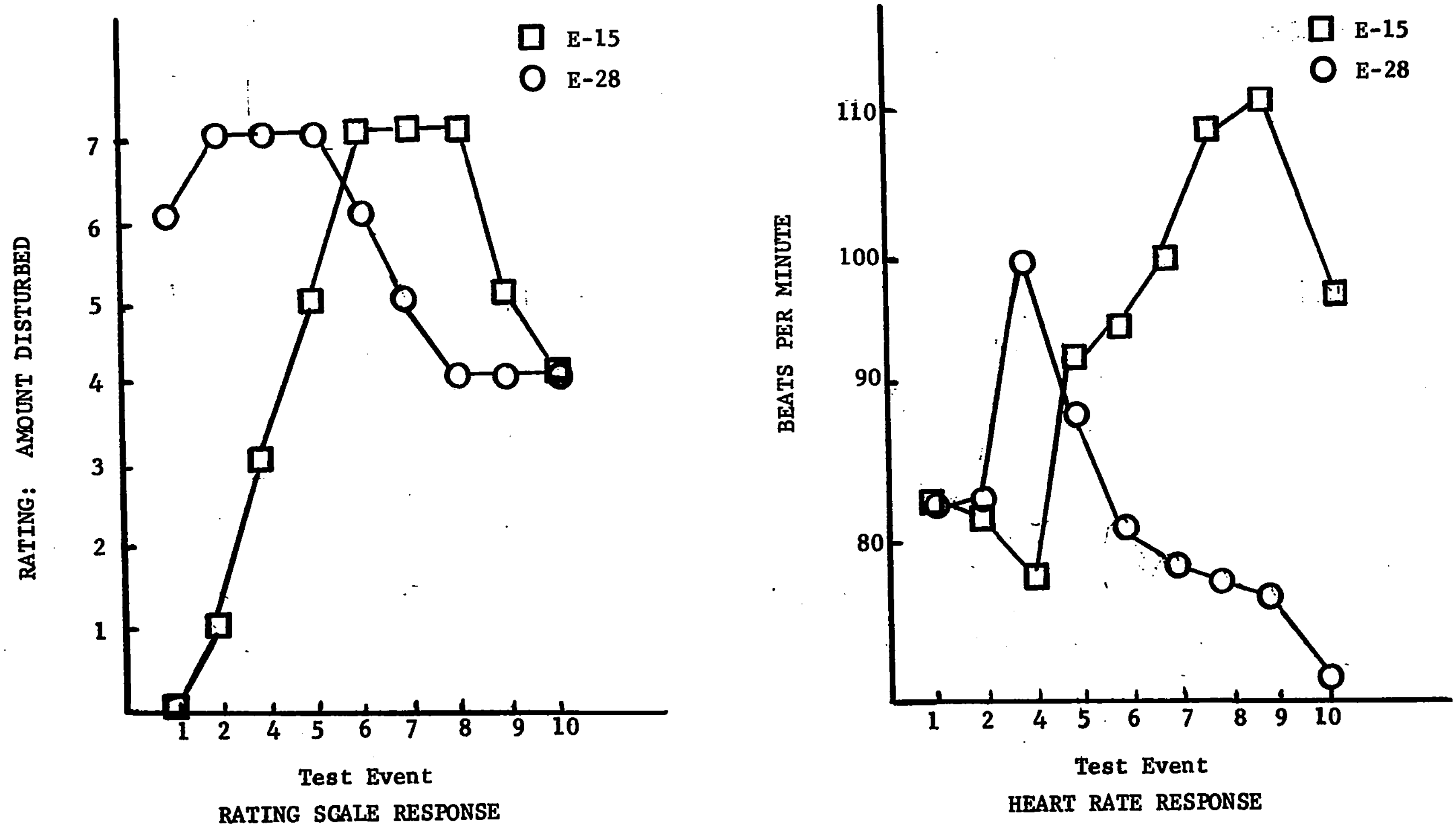

Figure 9. Rating scale and heart rate response for $\underline{S}$s varying widely in rating scale responses.

condition, there was no corresponding rise in heart rate associated with cognitive rehearsal.

The fact that significant correlations were found only for real speech situations and heart rate scores, provides a possible explanation for the recent observation that reciprocal inhibition is more effective when carried out "in vivo" (Barlow, Leitenberg, Agras and Winze, 1969). Wherever practical considerations permit, reciprocal inhibition in real life settings, then, appears to be the method of choice.

In view of the well established effectiveness of reciprocal inhibition by cognitive rehearsal, the absence of a positive correlation between heart rate and fear hierarchy rank is somewhat disconcerting. It provides a possible explanation, however, for the finding that progress in coping with real life situations often lags far behind progress in the imagination of fear hierarchy items. This phenomenon, termed the "transfer gap", has recently been demonstrated by Cooke (1966), Agras (1967), and Barlow _et al_. (1969). If a hierarchical order of autonomic arousal to the imagination of fear hierarchy items does not exist, a "transfer gap" is not surprising.

As the present study deviated somewhat from the normal pattern utilized in behavior modification in that the choice of hierarchy items was restricted, the results cannot be considered conclusive. Caution is particularly warranted in view of the contradictory findings reported by Cowan and Poser (in press), who obtained correlations between hierarchy rank and level of GSR activity during the imagination of fear hierarchy items. Significant overall positive correlations were found in both patient and normal groups, although marked individual differences were observed (.17 - .96). As, with the exception of these two studies, no other systematic evidence is available on the relationship between hierarchy rank and autonomic response, further research is needed to clarify this issue.

A possible alternative explanation for the discrepancy in heart rate response between the laboratory and real life conditions was subjected to further investigation. The differences found in heart rate between Condition 1 (S and C) and Condition 2 could possibly have been due to varied pre-test heart rate levels. For example, although Condition 1 (S and C) produced no significant pre-test differences (see Figures 2 and 6), there was, nonetheless, a consistent tendency for the pre-test heart rate scores of Conditions 1S to be slightly elevated above the Condition 1C scores. It was hypothesized that Ss may have deduced the nature of the impending test condition from the rating scale they were asked to complete prior to the test. Thus, a S asked to complete the speech rating scale rather than the control rating scale might have experienced greater anticipatory anxiety. To investigate this possibility, heart rate was measured during a three-minute period immediately following the attachment of electrodes, but before administration of the rating scale and pre-test events. This investigation during a "pre-resting period" was carried out on 13 Ss with the results shown in Table 4.

It was concluded that the initial heart rate levels for the two

TABLE 4

MEAN HEART RATE RESPONSE TO THE PRE-RESTING PERIOD

IN CONDITION 1S and 1C

(N = 13)

HEART RATE SCORING METHOD	CONDITION 1S	CONDITION 1C	t	p
Uncorrected scores	90.78	91.23	0.19	N.S.
Corrected scores	90.00	90.00	0.00	N.S.

Condition 1 situations were equal, although the administration of the rating scale apparently had a non-significant but consistent effect on the pre-test heart rate levels. The fact that the heart rate measure was sensitive enough to pick up these subtle changes in autonomic response was surprising in itself, and illustrates the suitability of heart rate recordings for stress research.

In view of the anticipatory anxiety effect seen in the 2 imagination conditions, the highly significant difference in pre-test scores between Conditions 1 and 2 appears to be the direct result of anticipating the presentation of a speech in Condition 2. This difference in "resting period" heart rates between conditions illustrates the difficulty of using pre-experimental resting periods as an index of basal response (Malmo, 1957).

Finally, the use of a single autonomic measure in the present study deserves explanation. As low inter-correlations between autonomic measures have often been found, many authors have stressed the importance of employing multiple measures in stress research (Davis and Buchwald, 1957; Wenger, 1957; Schnore, 1959; Patton, 1969; Elliot, Bankart and Light, 1970). The use of a single measure in the present study, therefore, precludes generalizations to other autonomic functions or to "autonomic response" in general.

The present level of technological development in the field of autonomic measurement makes it advisable to limit telemetric recordings to a single measure in order to preserve the advantages of this technique in recording autonomic responses in the natural setting. To date, multiple telemetric measures have either led to the use of cumbersome and bulky devices (Goldberg and Foster, 1963; Bergey, Sipple, Hamilton and Squires, 1968; Reichenbach and Leutschaft, 1968) or have imposed serious movement restrictions on S (Pessar, Krobath and Yanover, 1962; Levine et al., 1964; Viscardi, 1966; Brouha and Krobarth, 1967). Shafer (1967) has described a promising technique for measuring multiple autonomic functions without attached sensors. This technique which employs changes in magnetic fields as indicants of autonomic response is, however, still in the developmental stage. Until methods are established which permit multiple recordings while retaining the advantages of telemetry, the conservative approach of using only single measures appears advisable.

Although multi-channel telemetric monitoring does not as yet appear practical, there is evidence that when only one function is monitored, heart rate is the measure of choice. The recording of autonomic responses in real life situations has been described by Ax, Andreski, Courter, DiGiovanni, Herman, Lucas and Orrick (1964) as, at best, the "detection of a signal immersed in noise" (p. 229). Artifacts originating from environmental, instrumental, or extraneous physiological signals, greatly complicate the discrimination of signal from noise. Of all autonomic functions, heart rate appears to be the most stable under adverse recording conditions, and, therefore, best suited for real life studies. A number of measures which are highly appropriate to laboratory studies because of their sensitivity to emotional responses (i.e., GSR) usually fail to produce interpretable results in more realistic settings, where the artifact problem is greatly increased.

Regarding the implications of the present study for future research, the reported findings encourage the further use of public speaking in real life stress research. There is every indication that telemetry and public speaking represent an effective combination of dependent and independent variables. The high levels of anxiety and limited movement associated with public speaking, facilitate the application of telemetry, which, through the use of concealed recording devices, largely preserves the natural characteristics of the setting.

It is of interest to note that on the basis of Personal Data Form ratings, the microphone and closed-circuit television aroused more anxiety than the telemetric recording devices attached to S. Ss commonly reported that they completely lost awareness of the heart rate transmitter very early in the speech. It was also noted that the mean rating of overall disturbance due to the combined experimental requirements was only 1.42, which was considerably below the speech anxiety ratings.

The analysis of bodily movement frequencies and the effects on heart rate further supported the use of telemetry in future studies of audience anxiety. Movements were found to occur infrequently and posed no particular problems in the scoring phases of the analysis. Mean heart rate increases associated with movement during a one-minute period, were remarkably small, although statistically significant. Only in the case of arm movements, probably due to gestures during the speech, was there any difference in frequency of movements between conditions.

Future studies of autonomic response to public speaking should incorporate several groups which differ in patterns of self-rated audience anxiety. In this way, the question of the relationship between heart rate and self-rated anxiety could be explored in a more comprehensive manner. For example, a study of experienced versus inexperienced speakers would be useful to determine whether heart rate and rating scale responses, similar to those reported by Epstein and Fenz (1962), would be generated.

More extensive work in the analysis of movement effects on heart rate in public speaking or any other real life stress situation is also suggested. A more sophisticated classification system and an analysis of the effects of multiple movements, occuring in close proximity to each other, would be a good point of departure. It is important to establish whether movement effects accumulate in an additive manner or follow some other discernible pattern.

Much more attention should be given to individual differences in stress response. An investigation of individual coping styles, personality factors, and physiological reaction patterns, which might ultimately increase the correlation between autonomic response and self-rated anxiety, would be important. For example, Weinstein, Averill, Opton and Lazarus (1968) have shown that "repressors" tend to indicate less anxiety in self-ratings than their autonomic responses, while "sensitizers" react in the opposite manner.

The present results strongly suggest the need for further laboratory-life comparison studies. Although telemetry has provided the means for studies of autonomic response in real life stress, the practical application of this method has only just begun. The data reported here along with those available from a few similar studies lead one to conclude that the concept of the "laboratory analogue" in stress research is in need of further exploration.

SUMMARY

Current knowledge of autonomic response to stress is predominantly derived from laboratory experiments with the assumption that one can readily apply these findings to real life situations. The few studies which have investigated the laboratory-life relationship have provided little support for the laboratory analogue.

The present study investigated heart rate response, self-ratings of anxiety, and the correlation between the two in 36 female nursing students, known to suffer from audience anxiety. Heart rate recordings were obtained with the use of radio-telemetric equipment. In the laboratory condition, _Ss_ were asked to imagine themselves in stressful public speaking situations. The real life stress situation consisted of _Ss_ presenting a speech to an audience of nursing students and supervisors. The hypothesis that the second condition would produce higher heart rate levels and a greater correlation between heart rate pattern and self-ratings of anxiety, was confirmed. The implications of these results for laboratory analogues of stress and for the use of fear hierarchies in reciprocal inhibition were discussed.

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APPENDIX A

FEAR SURVEY SCHEDULE

The items in this questionnaire refer to things and experiences that may cause fear or other unpleasant feelings. Please place a tick in the column that describes how much you are disturbed by each of these items.

	Not at all	A little	A fair amount	Much	Very much	Does not Apply
1. Noise of vacuum cleaners						
2. Open wounds						
3. Being alone						
4. Being in a strange place						
5. Loud voices						
6. Dead people						
7. Speaking in public						
8. Crossing streets						
9. People who seem insane						
10. Falling						
11. Motor cars						
12. Being teased						
13. Dentists						
14. Thunder						
15. Sirens						
16. Failure						
17. Entering a room where other people are already seated						
18. High places on land						
19. People with deformities						

	Not at all	A little	A fair amount	Much	Very much	Does not Apply
20. Worms						
21. Imaginary creatures						
22. Receiving injections						
23. Strangers						
24. Bats						
25. Journeys: (a) train						
(b) bus						
(c) car						
26. Feeling angry						
27. People in authority						
28. Flying insects						
29. Seeing other people injected						
30. Sudden noises						
31. Dull weather						
32. Crowds						
33. Large open spaces						
34. Cats						
35. One person bullying another						
36. Tough looking people						
37. Birds						
38. Sight of deep water						
39. Being watched working						
40. Dead animals						
41. Weapons						
42. Dirt						
43. Crawling insects						

	Not at all	A little	A fair amount	Much	Very much	Does not Apply
44. Sight of fighting						
45. Ugly people						
46. Fire						
47. Sick people						
48. Dogs						
49. Being criticized						
50. Strange shapes						
51. Being in an elevator						
52. Witnessing surgical operation						
53. Angry people						
54. Mice						
55. Blood: (a) human						
(b) animal						
56. Parting from friends						
57. Enclosed places						
58. Prospect of a surgical operation						
59. Feeling rejected by others						
60. Airplane						
61. Medical odours						
62. Feeling disapproved of						
63. Harmless snakes						
64. Cemeteries						
65. Being ignored						
66. Darkness						
67. Premature heart (missing a beat)						

	Not at all	A little	A fair amount	Much	Very much	Does not Apply
68. (a) Nude men						
(b) Nude women						
69. Lightning						
70. Doctors						
71. Making mistakes						
72. Looking foolish						

APPENDIX B

INVENTORY OF ATTITUDES TOWARD SPECIFIC SITUATIONS

NAME: ______________________ DATE: __________

AGE: __________

SEX: __________

Instructions

This inventory represents a means of studying peoples' reactions to and attitudes towards various types of situations. On the following page is a situation which most people have experienced personally or vicariously through stories, etc. For this situation certain common types of personal reactions and feelings are listed. Indicate by encircling one of the five points shown on the following scales, the degree to which you would show these reactions and feelings in the situation indicated.

Here is an example:

You are about to go on a roller coaster.

Heart beats faster	1 Not at all	2	3	4	5 Much faster

If your heart beats much faster in this situation you would circle alternative 5 on the scale; if your heart beats somewhat faster, you would circle alternative 2, 3, or 4 depending on how much faster; if in this situation your heart does not beat faster at all, you would circle alternative 1 on the scale.

If you have no questions, please turn to the items on the following page.

Circle one of the five alternative degrees of reaction or attitude for each of the following 14 items.

Situation: <u>YOU ARE GETTING UP TO GIVE A SPEECH BEFORE A LARGE GROUP.</u>

1. Heart beats faster.
   Not at all 1 2 3 4 5 Much faster

2. Get an "uneasy feeling".
   None 1 2 3 4 5 Very strongly

3. Emotions disrupt action.
   Not at all 1 2 3 4 5 Very disruptive

4. Feel exhilarated and thrilled.
   Very much 1 2 3 4 5 Not at all

5. Want to avoid situation.
   Not at all 1 2 3 4 5 Very much

6. Perspire.
   Not at all 1 2 3 4 5 Perspire much

7. Need to urinate frequently.
   Not at all 1 2 3 4 5 Very frequently

8. Enjoy the challenge.
   Enjoy much 1 2 3 4 5 Not at all

9. Mouth gets dry.
   Not at all 1 2 3 4 5 Very dry

10. Become immobilized.
    Not at all 1 2 3 4 5 Completely

11. Get full feeling in stomach.
    None 1 2 3 4 5 Very full

12. Seek experiences like this.
    Very much 1 2 3 4 5 Not at all

13. Have loose bowels.
    None 1 2 3 4 5 Very much

14. Experiences nausea.
    Not at all 1 2 3 4 5 Much nausea

APPENDIX C

PRCS

This instrument is composed of 30 items regarding your feelings of confidence as a speaker. After each question there is a "true" and a "false".

Try to decide whether "true" or "false" most represents your feelings associated with your most recent speech, then put a circle around the "true" or "false". Remember that this information is completely confidential and will not be made known to your instructor. Work quickly and don't spend much time on any one question. We want your first impression on this questionnaire. Now go ahead, work quickly and remember to answer every question.

1.	I look forward to an opportunity to speak in public.	T	F
2.	My hands tremble when I try to handle objects on the platform.	T	F
3.	I am in constant fear of forgetting my speech.	T	F
4.	Audiences seem friendly when I address them.	T	F
5.	While preparing a speech I am in a constant state of anxiety.	T	F
6.	At the conclusion of a speech I feel that I have had a pleasant experience.	T	F
7.	I dislike to use my body and voice expressively.	T	F
8.	My thoughts become confused and jumbled when I speak before an audience.	T	F
9.	I have no fear of facing an audience.	T	F
10.	Although I am nervous just before getting up I soon forget my fears and enjoy the experience.	T	F
11.	I face the prospect of making a speech with complete confidence.	T	F
12.	I feel that I am in complete possession of myself while speaking.	T	F
13.	I prefer to have notes on the platform in case I forget my speech.	T	F
14.	I like to observe the reactions of my audience to my speech.	T	F

15.	Although I talk fluently with friends I am at a loss for words on the platform.	T	F
16.	I feel relaxed and comfortable while speaking.	T	F
17.	Although I do not enjoy speaking in public I do not particularly dread it.	T	F
18.	I always avoid speaking in public if possible.	T	F
19.	The faces of my audience are blurred when I look at them.	T	F
20.	I feel disgusted with myself after trying to address a group of people.	T	F
21.	I enjoy preparing a talk.	T	F
22.	My mind is clear when I face an audience.	T	F
23.	I am fairly fluent.	T	F
24.	I perspire and tremble just before getting up to speak.	T	F
25.	My posture feels strained and unnatural.	T	F
26.	I am fearful and tense all the while I am speaking before a group of people.	T	F
27.	I find the prospect of speaking mildly pleasant.	T	F
28.	It is difficult for me to calmly search my mind for the right words to express my thoughts.	T	F
29.	I am terrified at the thought of speaking before a group of people.	T	F
30.	I have a feeling of alertness in facing an audience.	T	F

APPENDIX D

SPEECH ANXIETY RATING SCALE (SAS)

NAME ______________________ OTHER ______________________

DATE ______________________ ______________________

The items in this questionnaire refer to things and experiences that might cause you fear or other unpleasant feelings when giving a speech to a group of nursing students. Please circle the number that best describes how much you would be disturbed by each of these items.

RANK	SITUATION	RATING, AMOUNT DISTURBED							
		0 NOT AT ALL	1 A LITTLE	2	3 A FAIR AMOUNT	4	5 MUCH	6	7 VERY MUCH
1.	You are sitting alone in the classroom trying to relax about 10 minutes before the audience arrives.	0	1	2	3	4	5	6	7
2.	You are sitting alone in the classroom reviewing your notes about one minute before the class arrives.	0	1	2	3	4	5	6	7
3.	The door to the classroom opens and your audience of students and instructors enters.	0	1	2	3	4	5	6	7
4.	The class is seated and your nursing instructor begins to introduce you as the speaker for today.	0	1	2	3	4	5	6	7

RANK	SITUATION	0 NOT AT ALL	1 A LITTLE	2	3 A FAIR AMOUNT	4	5 MUCH	6	7 VERY MUCH
					RATING, AMOUNT DISTURBED				
	5. Your nursing instructor ends her introduction and looks directly at you to begin.	0	1	2	3	4	5	6	7
	6. You get your notes in order and begin your speech.	0	1	2	3	4	5	6	7
	7. Your speech is 1/4 finished.	0	1	2	3	4	5	6	7
	8. Your speech is 1/2 finished.	0	1	2	3	4	5	6	7
	9. Your speech is 3/4 finished.	0	1	2	3	4	5	6	7
	10. Your speech ends and a discussion period begins.	0	1	2	3	4	5	6	7

APPENDIX E

BEACH ANXIETY RATING SCALE (BAS)

NAME ______________________________ OTHER ______________________

DATE ______________________________ ______________________

The items in this rating scale refer to things and experiences that you might find relaxing when suntanning on the beach with a girl-friend on a warm day. If, however, you find that any item causes you fear or other unpleasant feelings, please circle the number that best describes how much you are disturbed by each of these items.

		RATING, AMOUNT DISTURBED							
		0	1	2	3	4	5	6	7
RANK	SITUATION	NOT AT ALL	A LITTLE		A FAIR AMOUNT		MUCH		VERY MUCH
1.	You are relaxing in a beachside cottage, about 10 minutes before going out to the beach.	0	1	2	3	4	5	6	7
2.	You are sitting inside the cottage about 1 minute before you go out to the beach.	0	1	2	3	4	5	6	7
3.	A girlfriend arrives at your cottage to join you in your walk to the beach.	0	1	2	3	4	5	6	7
4.	You and your girlfriend leave the cottage and walk in the direction of the beach.	0	1	2	3	4	5	6	7

RANK	SITUATION	0 NOT AT ALL	1 A LITTLE	2	3 A FAIR AMOUNT	4	5 MUCH	6	7 VERY MUCH
		RATING, AMOUNT DISTURBED							
5.	You arrive at the beach and find a warm spot to put your blanket down.	0	1	2	3	4	5	6	7
6.	You lie down and relax as the warm sun is beating down.	0	1	2	3	4	5	6	7
7.	Your suntanning is 1/4 finished.	0	1	2	3	4	5	6	7
8.	Your suntanning is 1/2 finished.	0	1	2	3	4	5	6	7
9.	Your suntanning is 3/4 finished.	0	1	2	3	4	5	6	7
10.	Your suntanning is finished and you pick up your blanket.	0	1	2	3	4	5	6	7

APPENDIX F

IMAGINATION SUCCESS SCALE

NAME ______________________ COND. I or II

DATE ______________________ S or B

HOUR ______________________

SUBJECT NO. ________________

SLIDE NO.	SCORE 1 - 10
T-1	
T-2	
T-3	
E-1	
E-2	
E-3	
E-4	
E-5	
E-6	
E-7	
E-8	
E-9	
E-10	

APPENDIX G

PERSONAL DATA FORM

NAME: ______________________

DATE: ______________________

AGE: ______________________

MARITAL STATUS: ______________

Before this presentation, approximately how many speeches have you given in front of an audience? Circle one.

None 1 2 3 4 5 6 7 8 9 10 More than 10

Briefly describe the requirements for these speeches. Describe the audience.

About how disturbed were you when you learned about the 15 minute speech requirement which was part of your training program? Circle one.

0	1	2	3	4	5	6	7
Not at all	a little		a fair amount		much		very much

Now that your speech is finished, how disturbing did you actually find it overall? Circle one.

0	1	2	3	4	5	6	7
Not at all	a little		a fair amount		much		very much

Compared to other speeches you have given, how disturbing did you find this one? Circle one.

0	1	2	3	4	5	6	7
Much less disturbing			about the same				Much more disturbing

How would you rate the quality of your speech, compared to others you have heard in the class? Circle one.

1	2	3	4	5	6	7
Much poorer than average			about average			Much better than average

To what extent did the special apparatus required by this experiment (i.e., electrodes, microphone, closed circuit T.V.) make your speech more difficult? Circle one.

OVERALL RATING

0	1	2	3	4	5	6	7
No effect	a little		a fair amount		much		very much

SPECIFIC RATINGS

Recording electrodes

0	1	2	3	4	5	6	7
No effect	a little		a fair amount		much		very much

Microphone

0	1	2	3	4	5	6	7
No effect	a little		a fair amount		much		very much

Closed-circuit T.V.

0	1	2	3	4	5	6	7
No effect	a little		a fair amount		much		very much

To what extent were you disturbed by the following?

Tape recorded instructions and resting period prior to speech.

0	1	2	3	4	5	6	7
Not at all	a little		a fair amount		much		very much

Sitting at the front of the room for the entire hour.

0	1	2	3	4	5	6	7
Not at all	a little		a fair amount		much		very much

Having class held in Nurses Residence classroom rather than teaching department.

0	1	2	3	4	5	6	7
Not at all	a little		a fair amount		much		very much

About how much were you disturbed concerning your speech in the following time periods just before the presentation?

One week before.

0	1	2	3	4	5	6	7
Not at all	a little		a fair amount		much		very much

One day before.

0	1	2	3	4	5	6	7
Not at all	a little		a fair amount		much		very much

Morning before the speech.

0	1	2	3	4	5	6	7
Not at all	a little		a fair amount		much		very much

You arrive at the classroom a half hour before the speech.

0	1	2	3	4	5	6	7
Not at all	a little		a fair amount		much		very much

If you smoke, approximately how many cigarettes/day? ________

Compared to other people you know, how would you rate your overall physical fitness? Circle one.

1	2	3	4	5	6	7
Much poorer than average			average			Much better than average

How would you evaluate the usefulness to you personally of this class compared to others in your training program? Describe briefly.

What do you feel was the purpose of this experiment?

APPENDIX H

TAPE RECORDED INSTRUCTIONS FOR CONDITION 1

Please relax and make yourself comfortable. Remain facing the screen directly in front of you.

You may rest assured that you will not be given any electric shock or any other painful stimulus at any time in this experiment. Nor will we ask you to do anything that might embarrass you in any way.

Your experimenter is sitting in a room across the corridor, but is able to see and hear you through the use of closed circuit television. You will see a television camera, if you look toward the rear of the room. A microphone is located on the table in front of you.

All the instructions for this experiment will be given to you in this tape recording. We hope you will excuse the impersonal nature of tape recorders and television cameras. We have found that the presence of the experimenter as he gives directions or records information can have a marked effect on experimental results. For example, unintentional changes in instructions as the experimenter gives them--time after time--can influence results. For this reason it was important for us to turn to automated procedures.

In the first part of this experiment we would like you to remain seated and relax for about 12 minutes. This is to give us a chance to adjust our recording devices and to allow you to get completely comfortable in these surroundings. At the end of the 12 minute period, my voice will begin again to give you further instructions.....

12 MINUTE RESTING PERIOD

....In this experiment you will be viewing a number of slides. Your task is basically very easy. You simply look at each slide and try very hard to imagine yourself in that situation. Some situations will perhaps be easier to imagine than others, but you must try very hard to mentally put yourself into the situation described.

A new slide will appear automatically every minute. Although you may find it difficult at first, you should try to sustain your imagination throughout this one minute period.

People differ in their ability to imagine a scene vividly and some situations are easier to imagine than others. Therefore, it is important for us to know how successful you are at imagining each slide. At the end of each one minute slide presentation, the projector will change to the next slide. At this point, we would like you to rate, on a 10-point scale, your success at imagining the previous slide.

For example, when a slide appears on the screen, you try very hard to imagine yourself in that situation.

At the end of the one minute imagination period, just as the next slide appears, you would say out loud "nine" or "ten" if your imagination was extremely vivid; or you might say "one" or "two" if you had almost no luck at all imagining the scene. You might say "five" or six" if your success at imagining fell somewhere in between.

You should feel free to use any number on the one to 10-point scale that best indicates your success. The microphone will enable your experimenter to hear and record the score.

Remember, you will be attempting to imagine situations presented on slides as vividly as possible. At the end of each one minute imagination period you will rate your success at imagining the slide on a 10-point scale.

These instructions should cover any questions you might have. However, you may speak into the microphone to the experimenter now, if you have any further questions.....

PAUSE FOR QUESTIONS

Here are some trial slides to give you practice in the procedure. There will be three practice slides, followed by the test slides.

This is the end of the tape recording. The recorder will shut off automatically.

APPENDIX I

TAPE RECORDED INSTRUCTIONS FOR CONDITION 2

Please relax and make yourself comfortable. In the first part of this session we would like you to remain seated for about 12 minutes. This is to give us a chance to adjust our recording devices and to allow you to get completely comfortable in these surroundings. At the end of the 12 minute period, my voice will begin again to give you further instructions.....

12 MINUTE RESTING PERIOD

Please rest assured that we have taken great care to minimize our interference with your presentation in class today. We would like the class to be carried out in a completely normal and natural manner.

For this reason, the experimenter will not be present in the classroom at any time today. He will be observing by closed circuit television. The only persons in the room will be your fellow nursing students and at least one nursing supervisor.

As a further precaution, we have attempted to conceal the recording electrodes as much as possible. Remember that although you may feel conspicuous with the electrodes attached, your audience will not even notice them.

Because you have already had experience with closed circuit television and recording electrodes, we hope you will be able to completely disregard them and give full attention to your speech.

Due to the difficulties of this type of recording, we must impose two very small restrictions. First, please avoid any sudden, jerky movements, as they could dislodge the electrodes. Secondly, remain seated behind the table at all times until after the class has left the room. You may speak to anyone after the class but remain seated while doing so.

These instructions should cover any questions you might have. However, you may speak into the microphone now if you have any further questions.......

PAUSE FOR QUESTIONS

The class will be entering in a few minutes. You may wish to review your notes before they arrive. Good luck on the speech. This recording will shut off automatically.

APPENDIX J

MEAN RATING SCALE SCORES

(N = 36)

TEST EVENT	RATING SCALE BAS *	SAS ** (PRE)	SAS (POST)
1	0.3	3.7	3.1
2	0.4	4.6	4.2
3	0.2	5.0	4.1
4	0.2	4.9	4.6
5	0.1	5.8	5.2
6	0.2	5.6	5.0
7	0.1	4.5	3.9
8	0.1	3.9	3.4
9	0.2	3.2	3.1
10	0.3	2.3	2.7

* BAS : Beach Anxiety Rating Scale
** SAS : Speech Anxiety Rating Scale

APPENDIX K

TIME INTERVAL AND METHOD USED FOR CALCULATING ALL HEART RATE SCORES IN THE 2 CONDITIONS

EVENT	SCORING INTERVAL C-1 (min.)	SCORING INTERVAL C-2 (min.)	SCORING METHOD C-1	SCORING METHOD C-2
T.R. introduction	1.6	0.5	All beats counted and averaged for B/M score.	Same as C-1
Resting period	12.0	12.0	Means of highest and lowest tach. heart rate for each minute averaged for final mean.	Same as C-1
T.R. instructions	3.1	2.0	All beats counted and averaged for B/M score.	Same as C-1
T-1	1	N.A.*	All beats counted = B/M	N.A.
T-2	1	N.A.	Same as above	N.A.
T-3	1	N.A.	Same as above	N.A.
E-1	1	1	All beats counted = B/M	B/M counted in 1 min. segment exactly 10 min. before class enters.
E-2	1	1	Same as above	Same as above except for 1 min. before class enters.
E-3	1	1	Same as above	B/M counted in first min. as class enters.
E-4	1	$\bar{X}$=15.8" Variable	Same as above	Beats counted in first 1/2 of intro. prorated for B/M score.
E-5	1	$\bar{X}$=15.8" Variable	Same as above	Same as above for second 1/2 of intro.

EVENT	SCORING INTERVAL C-1 (min.)	C-2 (min.)	SCORING METHOD C-1	C-2
E-6	1	1	Same as above	B/M counted in first min. of speech.
E-7	1	1	Same as above	Total speech divided into 4 quarters - B/M counted in 30" segment on both sides of 1/4 mark.
E-8	1	1	Same as above	Same as above at 1/2 mark.
E-9	1	1	Same as above	Same as above at 3/4 mark.
E-10	1	1	Same as above	B/M counted in final min. of speech.

* Not appropriate

APPENDIX L

MEAN UNCORRECTED HEART RATE SCORES

(N = 36)

EVENT	CONDITION 1C	CONDITION 1S	CONDITION 2
	CONDITION		
T.R. introduction	84.7	86.1	92.9
Resting period	84.4	85.4	93.3
T.R. instructions	85.4	86.8	92.9
T-1	84.4	86.1	-
T-2	83.8	84.7	-
T-3	83.8	85.3	-
E-1	84.3	87.3	92.7
E-2	83.5	87.3	96.6
E-3	83.8	86.8	105.2
E-4	83.9	86.7	103.6
E-5	84.1	86.1	105.9
E-6	83.4	86.7	114.0
E-7	83.6	86.0	111.4
E-8	83.4	85.6	109.4
E-9	83.0	85.7	108.6
E-10	84.0	85.9	106.5

ANALYSIS OF VARIANCE FOR UNCORRECTED HEART RATE SCORES

(N = 36)

Source of Variance	Sum of Squares	Degrees of Freedom	Variance Estimate	F	p
Total	417,198.9	1403			
Subjects	207,543.5	35			
Conditions	96,531.5	2	48,265.8	58.5	<.001
Events	8,473.2	12	706.1	27.5	<.001
Conds. x events	18,363.5	24	765.1	36.3	<.001
Error conds.	57,724.6	70	824.6		
Error events	10,799.5	420	25.7		
Error C x E	17,763.1	840	21.1		

APPENDIX M

INDIVIDUAL t-TEST RESULTS FOR PRE-TEST AND TEST EVENT UNCORRECTED HEART RATE SCORES IN CONDITION 1C AND CONDITION 1S

	MEAN SCORES			
EVENT	CONDITION 1C	CONDITION 1S	t	p
T.R. introduction	84.8	86.2	0.99	N.S.
Resting period	84.5	85.4	0.75	N.S.
T.R. instructions	85.4	87.1	1.10	N.S.
T-1	84.4	86.1	1.10	N.S.
T-2	83.8	84.7	0.52	N.S.
T-3	83.8	85.3	0.94	N.S.
Combination Pre-test event score	84.5	85.8	0.97	N.S.
Combination Test event score (items 1-10)	84.0	86.7	2.05	<.05*

*2-tailed test

INDIVIDUAL t-TEST RESULTS FOR PRE-TEST AND TEST EVENT CORRECTED HEART RATE SCORES IN CONDITION 1C AND CONDITION 1S

	MEAN SCORES			
EVENT	CONDITION 1C	CONDITION 1S	t	p
T.R. introduction	83.9	85.3	0.99	N.S.
Resting period	83.6	84.8	0.93	N.S.
T.R. instructions	84.3	86.1	1.17	N.S.
T-1	84.1	85.6	0.84	N.S.
T-2	83.4	84.3	0.65	N.S.
T-3	83.1	84.6	0.91	N.S.
Combination Pre-test event score	83.5	85.0	1.07	N.S.
Combination Test event score (items 1-10)	83.0	86.1	2.27	<.05*

* 2-tailed test

APPENDIX N

MOVEMENT SELECTION CRITERIA FOR STUDY 1

1. Each movement must be selected from the resting period of Condition 1 (S or C). The final sample should include an equal number from Condition 1S and Condition 1C. No more than 1 of each movement type can be selected from each S. Where more than 1 occur per subject, movements will be selected so as to equalize the distribution between conditions.

2. The tachograph recording must be readable (i.e., no more than 10% artifact).

3. The scoring interval must consist of 10" before the movement and 60" following. This scoring interval must be free of any other arm, leg or body movement, and including coughs, sighs, etc.

4. Immediately preceeding the scoring interval, the following criteria should be observed:
   (a) no arm movement within 10"
   (b) no leg movement within 30"
   (c) no body movement within 30"
   (d) no coughs, sighs, etc. within 30"
   (e) tape recorded instructions must end before 10" prior to scoring interval

5. Following the scoring interval, none of (a) - (d) above must occur within 5".

NUMBER OF MOVEMENTS SELECTED FROM CONDITION 1C AND CONDITION 1S IN STUDY 1

MOVEMENT	N	CONDITION 1C	CONDITION 1S
Arm	35	18	17
Leg	23	12	11
Body	12	7	5

APPENDIX O

MEAN HEART RATE FOR MOVEMENTS MEETING CRITERIA FOR STUDY 1

TIME INTERVAL	MOVEMENT ARM (N = 35)	LEG (N = 23)	BODY (N = 12)
-10"	89.3	89.7	86.8
- 5"	90.9	91.5	87.1
0"	95.7	98.9	94.5
5"	94.5	96.2	96.2
10"	90.5	95.1	91.9
15"	89.2	92.2	87.8
20"	91.0	90.2	87.3
25"	89.1	89.5	85.3
30"	90.0	88.7	85.5
35"	89.4	88.6	86.4
40"	88.7	90.4	85.7
45"	89.3	88.5	83.8
50"	89.5	90.4	84.3
55"	89.2	88.8	86.5
60"	90.2	89.2	86.7

MEAN HEART RATE FOR MOVEMENTS MEETING CRITERIA FOR STUDY 2

TIME INTERVAL	MOVEMENT ARM (N = 38)	LEG (N = 28)	BODY (N = 20)
-10"	89.1	89.6	88.9
- 5"	90.4	91.9	88.5
0"	95.2	97.5	96.7
5"	94.0	95.8	99.8
10"	90.4	94.2	96.6
15"	89.2	91.0	90.5
20"	-	88.6	88.5
25"	-	89.3	88.7

APPENDIX P

MOVEMENT SELECTION CRITERIA FOR STUDY 2

1. Each movement must be selected from the resting period of Condition 1 (S or C). The final sample should include an equal number from Condition 1S and Condition 1C. No more than 1 of each movement type can be selected from each S. Where more than 1 occur per subject, movements will be selected so as to equalize the distribution between conditions.

2. The tachograph recording must be readable (i.e., no more than 10% artifact).

3. The scoring interval must consist of 10" before the movement and 25" following (15" for arm movements). This scoring interval must be free of any other arm, leg, or body movement, and including coughs, sighs, etc.

4. Immediately preceeding the scoring interval, the following criteria should be observed:
   (a) no arm movement within 10"
   (b) no leg movement within 20"
   (c) no body movement within 20"
   (d) no coughs, sighs, etc. within 10"
   (e) tape recorded instructions must end before 10" prior to scoring interval

5. Following the scoring interval, none of (a) - (d) above must occur within 5".

NUMBER OF MOVEMENTS SELECTED FROM CONDITION 1C AND CONDITION 1S IN STUDY 2

MOVEMENT	N	CONDITION 1C	CONDITION 1S
Arm	38	19	19
Leg	28	14	14
Body	20	10	10

APPENDIX Q

MOVEMENT SELECTION CRITERIA FOR STUDY 3

1. Each movement must be selected from the resting period of Condition 1 or 2 with an approximately equal distribution.

2. The scoring interval must consist of a 1-minute segment containing an arm, leg or body movement. In addition, a movement-free-minute (MFM) must either precede or follow this movement minute (MM). Approximately 1/2 of the MM's selected should be preceded by the MFM and 1/2 followed by the MFM.

3. Only the movement under study must occur within the MM. MM may be selected such that this movement may occur anywhere between 5" of the beginning of the minute and 15" of the end.

NUMBER OF MOVEMENTS SELECTED FROM CONDITIONS 1 AND 2, AND NUMBER OF MOVEMENTS PRECEDED OR FOLLOWED BY THE MOVEMENT-FREE-MINUTE (MFM)

MOVEMENT	N	CONDITION 1C	CONDITION 1S	CONDITION 2*	MFM (PRE)	MFM (POST)
Arm	39	17	18	4	20	19
Leg	23	11	11	1	11	12
Body	22	9	6	7	11	11

* Movements were selected from the Condition 2 resting period for this study in order to increase the sample sizes, especially for body movements. Although the addition of these movements seriously distorted the desired equal distribution of scores among conditions, a detailed inspection of these data failed to indicate that any significant biasing effect had been introduced.

APPENDIX R

MEAN FREQUENCY PER MINUTE OF BODY MOVEMENTS

IN EACH CONDITION (N = 36)

EVENT	CONDITION		
	CONDITION 1C	CONDITION 1S	CONDITION 2
T.R. introduction	.06	.08	.21
Resting period	.11	.07	.08
T.R. instructions	.15	.14	.27
T-1	.08	.17	-
T-2	.03	.11	-
T-3	.14	.08	-
E-1	.08	.08	.22
E-2	.00	.08	.14
E-3	.00	.11	-
E-4	.00	.00	.11
E-5	.11	.11	.11
E-6	.11	.14	.08
E-7	.06	.06	.11
E-8	.00	.06	.11
E-9	.06	.03	.06
E-10	.00	.17	.11

ANALYSIS OF VARIANCE FOR BODY MOVEMENT FREQUENCIES

(N = 36)

Source of Variance	Sum of Squares	Degrees of Freedom	Estimate of Variance	F	p
Total	851.8	107			
Subjects	621.8	35			
Treatments	3.1	2	1.6	0.50	N.S.
Error	226.9	70	3.2		

APPENDIX S

MEAN FREQUENCY PER MINUTE OF LEG MOVEMENTS IN EACH CONDITION (N = 36)

EVENT	CONDITION 1C	CONDITION 1S	CONDITION 2
	CONDITION		
T.R. introduction	.18	.13	.11
Resting period	.14	.12	.10
T.R. instructions	.36	.18	.13
T-1	.14	.14	-
T-2	.33	.14	-
T-3	.22	.19	-
E-1	.33	.22	.14
E-2	.31	.06	.06
E-3	.22	.19	-
E-4	.11	.22	.11
E-5	.11	.33	.11
E-6	.14	.31	.27
E-7	.31	.19	.14
E-8	.25	.19	.14
E-9	.28	.19	.27
E-10	.17	.19	.08

ANALYSIS OF VARIANCE FOR LEG MOVEMENT FREQUENCIES (N = 36)

Source of Variance	Sum of Squares	Degrees of Freedom	Estimate of Variance	F	P
Total	1,701.0	107			
Subjects	1,047.7	35			
Treatments	37.9	2	19.0	2.16	N.S.
Error	615.4	70	8.8		

APPENDIX T

MEAN FREQUENCY PER MINUTE OF ARM MOVEMENTS

IN EACH CONDITION (N = 36)

EVENT	CONDITION 1C	CONDITION 1S	CONDITION 2
T.R. introduction	.63	.50	.88
Resting period	.60	.54	.91
T.R. instructions	.81	.68	.78
T-1	.22	.36	-
T-2	.28	.31	-
T-3	.50	.50	-
E-1	.50	.53	.96
E-2	.31	.62	1.95
E-3	.42	.47	-
E-4	.53	.62	.64
E-5	.44	.39	1.45
E-6	.42	.47	.91
E-7	.68	.44	1.34
E-8	.59	.53	1.56
E-9	.44	.61	1.45
E-10	.28	.72	1.24

ANALYSIS OF VARIANCE FOR ARM MOVEMENT FREQUENCIES

(N = 36)

Source of Variance	Sum of Squares	Degrees of Freedom	Estimate of Variance	F	p
Total	12,807.2	107			
Subjects	6,107.9	35			
Treatments	2,488.6	2	1,244.3	20.7	<.001
Error	4,210.7	70	60.2		

APPENDIX U

HEART RATE INCREASES ASSOCIATED

WITH READING ALOUD IN 15 Ss

		TIME SAMPLE				
Subject Number	Resting Period	1st min.	1/4 finished (2 min.)	1/2 finished (4 min.)	3/4 finished (6 min.)	End of Speaking (8 min.)
1	93.6	105.6	104.5	97.6	99.3	93.0
2	82.5	89.3	90.5	83.3	88.5	85.9
3	81.5	102.0	89.0	83.5	80.5	85.0
4	96.6	102.3	101.3	103.0	102.6	105.3
5	92.6	102.6	102.3	96.3	99.6	95.0
6	90.0	104.0	98.3	94.6	95.3	96.0
7	73.7	86.9	84.5	82.0	81.5	80.0
8	77.2	101.6	84.5	85.5	87.9	88.9
9	72.7	91.6	84.8	86.5	88.5	90.0
10	98.3	108.3	99.6	98.0	99.6	98.6
11	83.0	83.5	84.3	85.9	86.5	86.0
12	85.9	90.0	84.0	81.8	82.5	84.3
13	64.6	81.0	84.5	81.2	86.3	88.0
14	90.0	101.3	98.0	96.6	100.3	101.3
15	91.3	95.3	94.3	89.3	95.3	96.3
$\bar{X}$	84.9	96.3	92.3	89.7	91.6	91.6

APPENDIX V

COMBINED ARM AND SPEECH EFFECT CORRECTION VALUES

EVENT	CONDITION CONDITION 1C	 CONDITION 1S	 CONDITION 2
T.R. introduction	0.8	0.7	1.2
Resting period	0.8	0.7	1.2
T.R. instructions	1.1	0.9	1.0
T-1	0.3	0.5	-
T-2	0.4	0.4	-
T-3	0.7	0.7	-
E-1	0.7	0.7	1.3
E-2	0.4	0.8	2.6
E-3	-	-	-
E-4	0.7	0.8	0.9
E-5	0.6	0.5	1.9
E-6	0.6	0.6	12.2 (Speech=11)
E-7	0.9	0.6	8.8 (Speech= 7)
E-8	0.8	0.7	9.1 (Speech= 7)
E-9	0.6	0.8	8.9 (Speech= 7)
E-10	0.6	0.9	8.6 (Speech= 7)

APPENDIX W

MEAN CORRECTED HEART RATE SCORES

(N = 36)

EVENT	CONDITION 1C	CONDITION 1S	CONDITION 2
T.R. introduction	83.9	85.3	91.8
Resting period	83.6	84.8	92.2
T.R. instructions	84.3	86.1	91.9
T-1	84.1	85.6	-
T-2	83.4	84.3	-
T-3	83.1	84.6	-
E-1	83.6	86.6	91.4
E-2	83.4	86.5	94.0
E-3	-	-	-
E-4	83.2	86.0	103.3
E-5	83.5	85.6	104.2
E-6	82.8	86.1	101.7
E-7	82.7	85.4	102.1
E-8	82.6	84.9	100.6
E-9	82.4	84.9	99.6
E-10	83.4	85.0	97.9

ANALYSIS OF VARIANCE OF CORRECTED HEART RATE SCORES

(N = 36)

Source of Variance	Sum of Squares	Degrees of Freedom	Variance Estimate	F	p
Total	340,321.3	1295			
Subjects	190,260.0	35			
Conditions	50,348.5	2	25,174.3	28.3	<.001
Events	2,747.0	11	249.7	9.2	<.001
Conds. x events	7,247.0	22	329.4	16.0	<.001
Error conds.	62,325.3	70	890.4		
Error events	10,521.6	385	27.3		
Error C x E	15,871.9	770	20.6		

APPENDIX X

MEAN HEART RATE RESPONSE ASSOCIATED WITH IMAGINING AND EXPERIENCING 7 RANKED FEAR HIERARCHY SITUATIONS

(N = 36)

HIERARCHY RANK	UNCORRECTED HEART RATE SCORES		CORRECTED HEART RATE SCORES	
	CONDITION 1S	CONDITION 2	CONDITION 1S	CONDITION 2
1	85.7	103.6	85.6	97.6
2	86.0	102.5	85.4	97.0
3	86.5	104.9	85.9	99.3
4	86.9	103.9	85.4	100.1
5	86.4	104.2	86.1	98.9
6	86.5	107.7	85.2	101.0
7	86.8	108.8	85.6	102.7

APPENDIX Y

MEAN IMAGINATION SUCCESS SCALE SCORES

(N = 36)

TEST EVENT	CONDITION	
	CONDITION 1C	CONDITION 1S
E-1	7.9	7.8
E-2	7.3	7.9
E-3	7.8	7.6
E-4	8.2	8.0
E-5	8.0	7.9
E-6	8.7	7.6
E-7	6.3	7.0
E-8	6.6	7.2
E-9	6.9	7.9
E-10	7.9	8.0