PSYCHOPHYSIOLOGICAL CORRELATES OF SELF-ESTEEM

By

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To friends among the shade
who selflessly gave so much for the uncaring.
And who demanded fairness for others
at great personal jeopardy,
and whom I and we can never repay.
Especially Phinny and Ed.

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This dissertation is of course a beginning and not simply an end. But it is the epitaph of a very long and fruitful life goal. This has been an arduous search for insight into personality, a first step on a little marked trail. Although I have found that the search has often been lonely as one moves tree by tree, the forests are replete with those who will take a moment from their own pursuits. To all those who paused and shared their time and their ideas with me I express my appreciation.

But certainly there were those who paused longer, and then journeyed a ways with me. Their ideas, support, and encouragement were invaluable and very special for me.

Don Avila contributed the basic question I have so diligently researched. He first authored a grant proposal that succinctly stated the problems concerning research on self-esteem and how this research has failed to satisfactorily address many of the empirical requirements of the modern scientific community. Further, he became a special friend, and my friends contribute the real joy and meaning in this life's too quick journey.

Barry Guinaugh is a rock whose unerring judgement has served me well. Although we sometimes disagreed, time has

amply demonstrated the wisdom of his advice. I reminisce often about the year we did our weekly behavior therapy group at the local mental health center. It was successful because he made it so.

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Amidst the insanity and chaos of one's journey through time and despite and because of one's indispensable family of friends, one must every once in a while take time to say the hell with it all. This is my life, my journey, and I'm going to get on with it in my own good time.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Abstract of Dissertation Presented to the Graduate Council of the University of Florida in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

PSYCHOPHYSIOLOGICAL CORRELATES
OF SELF-ESTEEM

By

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The purpose of this study was to look for relationships between self-esteem and physiology. Self-theory has not made the contributions to education and counseling that it is capable of making because self-constructs have not been operationalized well enough to be adequate predictors of behavior.

Seventy subjects (29 male, 41 female) were tested singly. Right forebrain electrical activity (EEG), systolic blood pressure (SBP), heart rate, respiration rate, and perspiration rate were measured simultaneously while the subjects were mentally imaging well being and depression and undergoing machine induced stress.

Self-esteem as measured by the Tennessee Self-Concept Scale was significantly related to the EEG and SBP, but not to the other physiological indices. The EEG was positively related to self-esteem during the well being state and negatively correlated during stress. The SBP was negatively related to self-esteem during both depression and stress.

Replication of the findings was accomplished by having selected subjects also mentally image guilt and listen to statements about death (instruction induced stress). Significant self-esteem correlations with the EEG and SBP ranged between .20 and .50.

High and low self-esteem groups were compared using analyses of variance (ANOVA) and the low self-esteem group had higher EEG during stress and suffered higher SBP during both depression and stress. These differences probably exacerbated and did mask expected differences due to the aging process (ANOVA--subject population included 53 younger and 17 age sixty and older adults).

After the debriefing, casual SBP was not related to self-esteem for the younger age group but was strongly related (.71) for the older age group. Casual diastolic blood pressure was related to self-esteem for all seventy subjects. These results and the ANOVAs suggest that self-esteem is related to the developmental process and accounts for at least half of the variance due to aging.

The age related findings spoke to the meaningfulness of the relationship between self-esteem and physiology and suggested practical as well as theoretical significance. These were addressed and a theoretical model for construction of a more adequate self-concept instrument was suggested.

CHAPTER I
INTRODUCTION

Purpose of the Study

The purpose of this study was to determine whether physiological correlates exist for self-esteem and, if so, to determine if those with a measured state of high or low self-esteem also significantly differ in measured physiology. For instance, people with low self-esteem may suffer higher blood pressure than those with high self-esteem.

Since large numbers of subjects may produce significant relationships that have little or no practical effect, simultaneous investigation was accomplished comparing younger adults and older adults. This comparison was intended to demonstrate practical or "real-world" strength or weakness. In other words, if physiological effects due to one's self-esteem are very meaningful, physiological differences expected between younger and older groups due to the aging processes should be masked or exacerbated by the physiological differences due to one's self-esteem state. For instance, younger people with low self-esteem may not have blood pressure that is significantly different from older people, and people with high self-esteem will have lower blood pressure than other groups, especially during depression and stress. Further, if this is so, the physiology of older people (e.g., blood pressure) should be related to self-esteem because older people have usually had a lifetime of having higher or lower self-esteem.

Statement of the Problem

An individual's self-esteem, a major factor in self-concept or self-image, is considered the single most important determinant of human behavior by many authorities (Combs, Richards, and Richards, 1976; Hamachek, 1978). Self-esteem influences every aspect of personal behavior, but especially such characteristics as mental health, levels of aspiration, learning, and delinquency (Combs, Avila, and Purkey, 1978). In education, self-esteem may be the most important single factor in the success or failure of teaching and learning (Howsam, Corrigan, Denemark, and Nash, 1976).

For many persons in the helping professions the solution to many of our personal and social problems lies in a better understanding of the self. However, self-theory and the research based on it have not been as fruitful as they must be in order to gain more widespread acceptance and implementation. Avila (1980) said there are three major problems which have kept self-theory from making the significant contributions of which it is capable:

1. Theoretical Constructs. The constructs and terms the position employs are too abstract. They are not anchored directly to empirical measurement (operationalized) and the theory does not always generate highly reliable prediction.

2. Instrumentation. The instruments used to investigate the basic research concerns of the theory are inadequate. Further, these instruments (mainly self-report, inference from a paper and pencil task, and observational report) are not sensitive enough for every reliable prediction of real-world behavior.

> 3. Application. Because of the poorly defined constructs and inadequate instrumentation, research of self-theory implementation in the classroom has generated mixed results or, worse, unwarranted conclusions that have not been substantiated upon replication. (p. 2)

Avila (1980) then said these weaknesses may appear to be so serious as to suggest that self-theory should be abandoned. The understanding of self-esteem, a key and integral component of the theory, however, is so critical according to Avila, that few individuals can be found who are willing to propose such a course. Even Kenneth W. Spence, one of the most ardent behaviorists and a rigorous experimental psychologist, has defended self-theory:

> That this field approach to the problems of psychology has been fruitful and valuable is amply supported by the experimental contributions it has made. . . . Furthermore, the phenomenological approach has its advantages, particularly in the complex field of social behavior of the human adult. (Spence, 1963, p. 170)

Ruth Wylie (1974a), probably the severest critic of the theory, has added that even though the process of giving the position a sounder scientific basis is going to involve many long and arduous tasks, "I believe these tasks can be accomplished and that their probable contribution to the science of personality is worth the strenuous effort required" (p. 316).

Thus there seemed to be two major reasons for the present state of affairs in self-theory. The first has to do with the position from which the theory approaches the study of the human being.

Self-theory focuses on the internal aspects of the individual, being concerned with what goes on inside the organism. Constructs based on internal conditions which have not yet been open to direct observation are extremely difficult to translate into manipulable and controllable components. In order to render such constructs open to manipulation they must be tied to some type of operational procedures and translated into intervening variables in much the same way that behaviorists in psychology have done with considerable success for more easily observable phenomena.

The second reason is related to the first. Because the basic constructs have had an inadequate empirical base, and then have not been sufficiently accessible to experimental manipulation, satisfactory tools of measurement could not be developed.

Avila (1980) says this current dilemma for self-theory can be resolved with a technological and procedural model which can operationalize the position's constructs and that these are available but have not yet been investigated. He says adequate physiological bases have not been demonstrated, but must be there, given that the theory has real-world viability. Further, technological advances in the measurement of physiology now make sophisticated comparisons more easily accomplished.

Recent years have witnessed a tremendous increase in interest and research in psychophysiological processes and

their relationship to observable behavior. Studies along these lines have proliferated (Benson, 1975; Schwartz and Beatty, 1977) and a whole new discipline based on psychophysiological measurement, biofeedback theory, has emerged. Most of this research, however, has been clinical and applied in nature and its tenets are probably premature since the results so far produced are often contradictory. The main purpose of most of these kinds of research has been to discover the consequences of clinical treatment. Very little basic research has been done and researchers in the area are confronting the same problems faced by self-theorists relating to poorly defined constructs.

Of importance to the present dissertation is that psychophysiology has produced a technology which lends itself well to looking at internal aspects of the individual and then to the operationalization of self-theory constructs. By employing this technology it now seems possible that self-theorists will be able to find the empirical basis that is needed for the adequate development of the theory and its constructs such as self-concept and self-esteem. Then it will be possible to construct more accurate instrumentation.

The psychophysiological model and psychophysiological techniques lend themselves well to the problems related to a holistic theory beginning with and concentrating on internal variables. Self-theory is concerned with the nature of a subject's subjective experience, the internal processes

occurring and how these influence behavior. Gale (1973) states that this is precisely what the psychophysiological model allows one to study:

> Three different aspects of the person may be studied concurrently, along with a common time scale: performance or behavior, verbal report or subjective experience, and physiological state. The capacity to study events in three universes at once is the hallmark of the psychophysiologist. His job is to construct units and scales of measurement which enable him to make sense of what is occurring concomitantly in all three universes: (i) physiology, or what is going on in the nervous system (e.g., as measured by variation in heart rate, electrodermal activity, respiration, muscle activity and the EEG), (ii) what the subject is observed to be doing (reaction time, learning, social behavior, activity level, and so on) and (iii) subjective report of experience (what is thought, felt or imagined). (Gale, 1973, p. 215)

For this researcher the psychophysiological model gives a highly practical frame of reference for the study of self-theory and biomonitoring equipment provides exactly the kinds of tools the self-theorist needs in order to develop (1) an empirical basis for the constructs of the theory, (2) instruments that are sensitive enough to measure changes in these operationally defined constructs, and consequently, (3) strategies for achieving the goals of the theory. Lazarus (1977) sees the same potential when he states:

> In the biofeedback laboratory or clinic, the person is given information about the activities of his visceral systems and asked to regulate these. How he/she does this, what works and what does not work, the limits of the effects in magnitude of control, over time--all such information is capable of contributing something of immeasurable value to our knowledge. Research using biofeedback procedures could help us discover much more

> than we now know about the psychological mechanisms of self-regulation, particularly the intrapsychic ones. (p. 85)

Lazarus goes on to point out the feasibility and the necessity of the kind of research conceived in the present dissertation:

> If the problem is approached only in a parochial way, or as merely a gimmick limited to the biofeedback laboratory, then we are likely to advance little in spite of the evident potential. Biofeedback research will go much farther and rapidly become an integral part of psychology if it is seen and approached within the larger context in which it belongs. (Lazarus, 1977, p. 85)

Thus the technology of psychophysiology is available to investigate whether physiological correlates exist for self-theory constructs. If self-theory constructs can be grounded in physiology then the theory will become more predictive of human behavior. Preliminary research looking for relationships between self-esteem and human physiology is then a giant first step towards solving self-theory construct operationalization problems.

Description of the Study

A self-theory construct, self-esteem, delineated by a paper and pencil task that is currently accepted as the most reliable and valid instrument, was utilized to rank order seventy subjects by self-esteem. Division of this order into high, middle, and low self-esteem groups permitted between group comparisons by measured physiology.

Concurrent differences in physiology were produced by having the subjects mentally image separate psychological events, such as well being and depression. Behaviorally produced stress was also physiologically measured.

With these measurements, correlations between self-esteem and physiology (such as blood pressure and electro-encephalogram) while the subjects were in differing psychological states (well being, depression, and stress) was calculated. Further, the measured physiology was averaged for each self-esteem group and comparisons were made between high and low self-esteem groups during the different psychological states. These calculations showed correlations or lack thereof between self-esteem and physiology during different psychological states. They also showed self-esteem group differences or lack of differences during separate psychological states (e.g., high self-esteem subjects having higher or lower relative brain activity during well being or stress than do low self-esteem subjects).

Finally, younger and older age groups were delineated. This grouping allowed comparisons between age groups to determine physiological similarities and differences (such as the younger age group having blood pressure as high as the older age group during the experiment). This last grouping then made possible inferences concerning the "real-world" meaningfulness of the effects of self-esteem on physiology. In order to make the age group comparisons, the subject population, relative to the general population,

had a disproportionate number of persons over the age of sixty. (One-quarter of the subject population was in the older group.)

After the experiment was over, blood pressure was taken by the conventional method and the results were given to the subjects as a "reward" for "having been such a good subject." These data, collected after the experiment, were utilized to verify expected a priori differences between the age groups. In other words, if the older group's mean blood pressure was higher than the younger group's mean after they all thought the experiment was over, the inference can be made that the older group had higher normal blood pressure.

CHAPTER II
REVIEW OF LITERATURE

Human emotions, including personality variables such as "ego," have long been thought to be major factors in some physical disorders (Cannon, 1928). Researchers over the decades have investigated physiological correlates of many emotions (Sternbach, 1966). Further, the journal Psychophysiology is fully accepted by the American Psychological Association, an event attesting to the present day sophistication of the field.

Investigation in psychophysiology has often entailed simultaneous dependent measures of one or more emotions. The present design used both simultaneous measurement and delayed measurement and is most easily understood when the psychophysiological measures (e.g., blood pressure) are presented singly to the reader. Further, investigation of particular psychological states has taken place over decades and strict chronological reporting is hard to follow if the reader is led from one state to another and back to the first again. For these reasons strict adherence to chronological reporting in this review was not done.

First, a brief overview of psychophysiological history is presented. Then, additional historical and current

literature related to this design's independent variables (experimentally induced states of consciousness: well being, depression, and stress) are presented. Some redundant presentation is then unavoidable but was held to a minimum. Next, literature related to the dependent variables (physiological measures) is presented. Again, some redundancy, primarily attributable to simultaneous measurement, was unavoidable. Finally, self-esteem literature followed by pertinent gerontological literature is included.

Historical Review of the Psychophysiological Literature

Cacioppo and Petty, writing in the May, 1981, issue of the American Psychologist, said that "the earliest writings to address the relationships between psychological and physiological phenomena are probably those of the ancient Greeks (e.g., about 500 B.C. in Plato's Theatetus; cf. McGuigan, 1978, Chap. 2; Mesulum & Perry, 1972)" (p. 441). But empirical research is relatively recent, begun about 100 years ago--Cacioppo and Petty reference Angel and Thompson, 1899, and Sechenov, 1878-1947, for early reviews. The May, 1981, American Psychologist also contains a brief history of the field of psychophysiology, a definition of the field delineating boundaries between it and other fields in psychology, and an excellent discussion of the methods and applications of the field to psychological research.

Sir William Osler wrote in 1897 about the relationship of stress to arterial degeneration. He said he believes psychological variables influence physiology: "In the worry and strain of modern life arterial degeneration is not only very common, but develops often at a relatively young age. For this I believe that the high pressure at which men live and the habit of working the machine to its maximum capacity are responsible rather than excesses in eating or drinking" (p. 153-154).

However, it was not for another generation that procedures acceptable to today's scientific community began to be implemented. Baselines, the physiological measurements taken prior to an intervention, were taken and experimental manipulation such as learning and dreaming states were accomplished. These mental states resulted in increases in physiological responding over the baselines. This procedure was detailed by Cacioppo and Petty (1981), who cited Clites (1936), Freeman (1930), and Golla (1921). Cacioppo and Petty then wrote about the 1950s, "As a result, several elaborate theories regarding task performance and arousal (in one of its many forms) were developed" (p. 441). They cited Duffy (1957), Lindsley (1952), and Malmo (1957).

Returning to the 1930s, the Menningers hypothesized in 1936 that repressed, aggressive tendencies lead to heart disease. Mittelmann and Wolff (1939) showed that emotional conversation lowered hand temperature in those with Raynaud's disease (cold hands).

The 1940s saw Dunbar (1943) describe coronary patients as hard driving, goal oriented people who are "workaholics" (in today's vernacular). At about the same time Bettelheim (1943) observed a different kind of interplay between psychological state (seemingly acute instead of chronic) and physiology. He described the "Muselmäner" (walking corpses) in Nazi concentration camps who, "because of their extreme sense of hopelessness, developed symptoms of apathy and withdrawal that many times resulted in death due to no known organic cause" (p. 417). Richter (1957) and Seligman (1975), researching "learned helplessness," also documented instances of sudden, unexplained death in animals that had no control over a stressful environment.

Returning to the literature on coronary prone individuals, Kemple (1945) said such individuals manifest "a persistent pattern of aggressiveness and drive to dominate. . . . They are usually very ambitious and strive compulsively to achieve goals incorporating power and prestige" (p. 87).

Probably the first research to directly observe changes in internal physiology that were produced by manipulating psychological states was done by Wolf and Wolff in 1947. They observed a subject with a gastric fistula (an opening in the stomach wall through which they could observe the stomach lining). They reported that stomach movement, gastric secretion, and dilation of blood vessels increased during anger and decreased during fear. Two emotional states

(anger and fear) seemed to elicit the only kinds of patterns found. Although a great variety of emotions were manipulated, all others seemed to elicit more or less of the same two general patterns.

However, seemingly confounding research was being published about the same time. Shaffer (1947) interviewed World War II combat pilots and found that most (80%) were easily irritated or angry while experiencing fear. This suggests that the physiologically different emotions found by Wolf and Wolff are involved in mutual "feedback loops" where one emotion affects another which in turn affects the former and a cycle was continued.

Further evidence supporting Wolf and Wolff was found by Ax in 1953. Ax connected subjects to a polygraph under the pretext of recording their physiological responses while the subjects were relaxing. During the recording session, he provoked his subjects to intense anger by having the polygraph operator rudely insult them and to intense fear by leading them to believe that the polygraph was short-circuited and might electrocute them. Ax said respiration rate and perspiration increased more during fear and blood pressure increased more during anger. However, these findings showed quantitative differences in the same direction and, although they certainly imply psychophysiological differences for different emotional states (or at least that different instructions produce different results), this may not turn out to be Ax's most important contribution. Perhaps his most

important finding is one not often reported in the literature of psychophysiology although all report Ax's finding that anger and fear are psychophysiologically different emotions. Ax "found greater between-subject than within-subject variance in physiological reactions which suggests that people may have distinctive modes of responding physiologically" (Cacioppo and Petty, 1981, p. 443).

Lacey and Lacey showed in 1958 (as reported by Cacioppo and Petty, 1981) that

> there are multiple psychologically important factors that influence the various physiological responses at each moment in time. Two principles identified by the Laceys are individual response stereotypy and stimulus response stereotypy. Individual response stereotypy refers to the tendency for the same individual to display the same profile of physiological responses regardless of the situation or stimulus, whereas stimulus response stereotypy refers to the tendency for a situation or stimulus to elicit a common pattern or profile of responses from people in general. (p. 443)

Graham (1955) reported that significant forearm temperature decreases occurred during states of anger, stress, and depression. Graham, Stern, and Winokur (1958) found that hypnotically suggesting an attitude associated with hives resulted in raising hand temperature and that suggesting Raynaud's disease decreased hand temperature.

Friedman and Rosenman (1960), after several years of study of occupational "risk factors," found that coronary artery disease was seven times more prevalent in a personality structure they had labeled "Type A" than in those they had labeled "Type B." Extensive interviews were used to

differentiate who was Type A, or coronary disease prone, and who was Type B.

Friedman and Rosenman tried to identify Type A and Type B by using a polygraph, which measured respiration, body movements, and hand clenching, while subjects listened to tape recordings designed to elicit Type A behavior. This technique often misclassified more coronary patients as Type B rather than Type A. However, newer techniques such as voice analysis appear to be quite promising for assessing the A/B behavior dimension (Schucker and Jacobs, 1977).

T.G. Burish (1981), writing in the Encyclopedia of Clinical Assessment (Volume 1), said the crucial link between Type A behavior and coronary heart disease may be the development of damaging psychophysioendrocrinological conditions. He cited studies showing significantly greater beta-lipoprotein concentrations, faster blood-clotting times, greater heart-rate variability, higher serum cholesterol and serum lipid levels, increased epinephrine and norepinephrine levels, and autopsy findings revealing more atherosclerosis and coronary occlusion in Type A individuals than Type B individuals. These studies seem overwhelmingly conclusive.

Burish (1981) further said that there are two psychological assumptions involved in the above conclusions. The first is that stress can lead to damaging physioendocrinological consequences and the second is that Type A individuals live under increased stress because of their Type A behavior (for instance, "workaholicism"). Burish then quoted Glass (1977) who hypothesized a definitive link

between Type A behavior and learned helplessness, a depressive reaction.

The 1960s saw a marked increase in the level of sophistication of psychophysiological studies. Stern et al. (1961) identified a "startle effect" in psychophysiological measurement that can confound data.

Schachter and Singer (1962) showed that there is an interaction between physiological arousal and emotionally toned cognitions. Nisbett and Schachter (1966) demonstrated that genuine emotions can sometimes be suppressed when people are given alternative explanations for their arousal. In other words, how one perceives the emotional situation will affect that emotion.

"Real" arousal is not necessary according to Valins (1966), only the self-perception that one is aroused. Emotional disorders such as shyness, stuttering, and even impotence are characterized by a "feedback" cycle according to Davison and Valins (1972). Self-perception then is an important variable, in addition to perception of the emotional situation.

Lang et al. (1973) showed that there are reliable differences between the autonomic patterns shown in fear, anger, the startle response, hunger, and pain. They said that differences among the more subtle emotions have not been demonstrated consistently. They also found further evidence that Ax (1953) was correct in reporting consistency of responding within individuals. Lang et al. (1973) said

some people respond with an all-out autonomic arousal to every emotion-producing situation, others seem to respond very little in any situation, and still others respond greatly to some kinds of situations and only slightly in others. Scientific classifications simply substantiate what people have known for centuries--that there are definite emotional types of individuals. Perhaps if a consistent kind of responding can be delineated for groups of people, then a "personality label" can be ascertained (or invented) and highly accurate prediction of emotion will be possible for people within a particular group.

Some of the more subtle responses Lang was referring to in 1973 have since been identified. "Significant differences in hormone responses to such stress-producing factors as physical exertion, fasting, and exposure to intense heat and cold have been found" (Mason, 1975, p. 413; Mason et al., 1976). Certainly there should be even more subtle specific hormone patterns that will eventually be found for specific emotions (Lazarus et al., 1980). Dienstbier (1979) said that "the more important role will eventually be assigned to physiological patterns as a means of identifying specific emotional states and differentiating them from nonemotional stimuli" (p. 10).

Well being, depression, and stress were the specific emotional states investigated by many researchers. However, none investigated self-esteem and emotional states.

Independent Variables

Well Being

Clynes (1974) showed links between imagined emotional states and simple observable behavior. During an imagined state of love subjects pushed a key down slowly and away from themselves. While imaging anger the subjects pushed they key down straight and fast. A no emotional control task gave an intermediate response: The key was pushed straight down slowly. The physiological responses to love and anger were consistent across cultures.

Light (1981) reported that young, healthy males who are very reactive people during stress are indistinguishable physiologically (heart rate and blood pressure) from the less reactive persons when relaxed and feeling good (well being).

Relaxation and well being seem to be states primarily produced by the parasympathetic nervous system (PNS) according to Krech et al. (1974). The neurotransmitter is acetylcholine in the PNS as it is in the somatic system. These function as part of the autonomic nervous system (ANS).

The PNS slows the system (e.g., heart rate) down while the sympathetic nervous system (SNS) speeds it up. Surprisingly, both can produce feelings of well being. The SNS activates both the adrenal medulla and the adrenal cortex while the SNS itself is activated in the brain by norepinephrine. The adrenal medulla produces epinephrine

and norepinephrine which "speed" the physiological system up. Many people experience well being, but usually not relaxation, when the adrenal medulla is stimulated. Additionally, norepinephrine has been implicated in mania, a well being state (Krech et al., 1974).

Further, well being can be produced by the SNS when the anterior pituitary hormone (adrenocorticotropic hormone or ACTH) stimulates the adrenal cortex to produce adrenal steroids. Although many people experience well being, many experience irritability and others no effect when given ACTH or adrenal steroids (Krech et al., 1974).

Well being then, a psychological state, can be produced by either the PNS or the SNS but is usually associated with the PNS, while the SNS is associated with the stress response. Other neurotransmitters can produce well being (serotonin and the enkephalins) but their activating hormones or psychological events are not yet known (Kretch et al., 1974).

Levenson and Ditto (1981) investigated sixteen kinds of instructions to individuals to elicit heart rate (HR) changes. Only two were significantly related to performance. "Make yourself feel relaxed" ($r = -.29$ with HR) and "Think about something peaceful" ($r = -.30$) produced heart rate decreases.

Levinson and Ditto (1981) also found that personality variables (locus of control, state and trait anxiety) were

not related to the ability to control heart rate increase or decrease.

Cacioppo and Petty (1981) said that in 1976 Swartz, Fair, Salt, Mandel, and Klerman replicated Darwin's suggestion that distinctive facial expressions are linked to different emotions. "Nondepressed subjects displayed patterns similar to those produced by the depressed subjects, but the pattern accompanying pleasant imagery was accentuated and the pattern accompanying unpleasant imagery attenuated in normal subjects" (p. 443).

Depression

The literature on depression is voluminous. One of the best historical reviews is presented by Fabry (1981) in the Encyclopedia of Clinical Assessment, Volume II.

Directly relating to the present study, Fabry (1981) said that Bibring in his 1953 study of depression examined the relationship between anger or hostility and depression. Bibring showed that when anger is turned inward or remains unexpressed, it retards behavior. When it is turned outward, it is manifested through agitated behavior. Fabry (1981) says Beck (1961) proposed that a negative view of the self, the world, and the future, along with self-blame and criticism is the primary element in depression. As previously referenced, Seligman in 1975 said that depression results from "learned helplessness": The organism "gives

up" when confronted with an uncontrollable environment (hopelessness).

Depression is also endocrinologically related. Reduced levels of norepinephrine (a neurotransmitter) often characterize depression and drugs that deplete norepinephrine produce depression (Schildkraut and Kety, 1967; Schildkraut and Freyhan, 1972). Dienstbier (1979) found the inducation of anger stimulated production of norepinephrine and counteracted depression.

Schuyler (1974) said that "normal depressive reactions become neurotic when the person shifts his attention from the significant other to the self" (p. 36). Fabry (1981) calls this reactive (situational) depression and labels more chronic depression as endogenous depression. Cammer (1972), writing about chronic depression, said "This type of depression has also been associated with postpartum depression, aging, toxification, infectious diseases, glandular disorders, severe injuries, surgery or changes in body structure" (p. 14). "However, it has been most closely related to involutional melancholia at menopause" or aging, according to Fabry (p. 591). He said, "In general the involutional is characterized by a rigid, perfectionistic life style" (p. 21).

Cacioppo and Petty (1981) found that nondepressed subjects displayed facial electromyographical (EMG) activity that was similar to prior EMG that they had displayed while they were imaging a pleasant experience when they were

thinking of their typical day. Moreover, depressed subjects showed their "depressive facial EMG" when they were asked to image their typical day. Schwartz et al. (1978) found that those most likely to improve clinically had resting facial EMG levels higher than those who showed little clinical improvement. Perhaps this implies those most likely to show clinical improvement are in an "anger" phase and have not yet reached an extreme learned helplessness (apathetic) phase.

Krech et al. (1974) said that epinephrine (SNS) secretion increases when people are angry at themselves in a stressful situation. However, when people are angry at others or the situation they seem to have an increase in norepinephrine (also SNS). Thus anger, as a psychological state, may itself be as complex as depression.

Stress

Those suffering from chronic stress have been described in the historical literature as having "state anxiety" (Marinelli, 1981). Spielberger (1975) described state anxiety as "subjective, consciously perceived feelings of tension, apprehension, and nervousness accompanied by or associated with activation of the autonomic nervous system" (p. 137). Marinelli (1981) said state anxiety is expected to fluctuate in intensity over time.

Marinelli (1981) in his historical review of anxiety in the Encyclopedia of Clinical Assessment said:

> Freud (1926, 1936) led anxiety into the twentieth century by giving it a central position in his theory of personality. Freud's focus was on anxiety as a global motivational force rather than on the experience of anxiety. In building his theory, Freud depended primarily on hypothetico-deductive reasoning based on clinical observation. Learning-oriented theorists (Hull, 1921, 1943, 1952; Mowrer, 1939, 1950) made the first significant movements in using experimental methods for the theoretical study of anxiety. Important postulates in their conceptions are that (1) anxiety is, to a large extent, learned behavior; (2) it motivates trial-and-error behavior; and (3) its reduction reinforces the learning of new habits. These points are considered the touchstone of the drive conceptions of anxiety proposed by Dollard and Miller (1950) and Spence (1956, 1960). (p. 560)

Hilgard et al. (1979) listed the effect of stress on the sympathetic nervous system (SNS), a part of the autonomic nervous system (ANS):

1 Blood pressure and heart rate increase.

2 Respiration becomes more rapid.

3 The pupils of the eyes dilate.

4 Perspiration increases, while secretion of saliva and mucus decreases.

5 Blood-sugar level increases to provide more energy.

6 The blood is able to clot more quickly in case of wounds.

7 Motility of the gastrointestinal tract decreases; blood is diverted from the stomach and intestines and sent to the brain and skeletal muscles.

8 The hairs on the skin become erect, causing "goose pimples." (p. 330)

Interestingly, anger (also SNS stimulating) was almost the same as stress except for Hilgard's number seven: anger increased gastro-intestinal activity (Wolf and Wolff, 1947; Dienstbier, 1979).

Gersten et al. (1974) showed where both positive and negative change produced symptoms of anxiety but only negatively weighted change correlated with their stress symptoms. Gersten et al. (1974) then imply a self-perception variable related to the physiological changes that they found.

Cronbach and Snow (1977) said that self-esteem is simply the other side of the coin with anxiety. They posited a single morale factor, "constructive motivation." Corno et al. (1981) said "there might be more value in characterizing students along this single dimension than in attempting to predict outcomes from any one self-appraisal variable independently. Of course, this is best addressed by an analysis (e.g., factoring)" (p. 54).

If Cronbach and Snow (1977) and Corno et al. (1981) are correct, stress will be related to self-esteem and depression will not be related to self-esteem.

Dependent Variables

Right Forebrain Electrical Activity

Gale (1973), in "The Psychophysiology of Individual Differences: Studies of Extroversion and the EEG," said

there have been more than a dozen studies looking at such a relationship and they have yielded three classes of outcomes. "Extroverts have been shown to be less aroused than introverts, more aroused than introverts, or equally aroused" (p. 215). He used this as an example of how psychophysiological studies can be poorly executed because the environment or the instructions are not adequately controlled. He said "Some sort of task, to which the subject must give attention, is essential if the experiment is not to measure speed of sleep onset rather than resting EEG" (Electroencephalogram) (p. 224).

Campbell et al. (1981) in their "Neuroanatomical and Physiological Foundations of Extroversion" also presented a fairly comprehensive review of extroversion and the EEG. They said, "A possible explanation for the contradictory reports is that the late "N1-P2" components of the evoked potential are influenced by uncontrolled non-sensory factors such as attention and motivation" (p. 264). (The N1-P2 are standard electrode implacements and are located at the higher centers.) Campbell et al. (1981) showed that "effects found at higher levels of the brain are probably not due to parallel changes in the periphery or the brainstem" (p. 263). They found no differences for lower brain level EEG among the introverted, ambiverted, or extroverted. However, their strict adherence to accepted EEG experimental principles was instructive.

Stanley (1982) implied that there would be a functional decrease in brain activity in the frontal cortex of extremely depressed people (inferred from his suicide autopsy studies where he found people who had committed suicide had fewer neuroreceptors than those who had not committed suicide).

Systematic habituation effects were discussed by Rösler (1981) in his "Event Related Brain Potentials in a Stimulus-Discrimination Learning Paradigm" in the journal Psychophysiology. He manipulated different stages of learning and found functionally distinct processes of attentional set. He also described four different procedures and explained when to use each when using the EEG in experimental studies. Another excellent article about the EEG and research is "The Analysis of Brain Waves" (Brazier, 1962). An in-depth discussion of the EEG, electrode implacement, and application of computer technology for the analysis of the EEG was presented.

Heart Rate

Attention to non-threatening external stimuli produced heart rate deceleration and hypotension according to Lacey et al. (1963). Attention to internal stimuli increased heart rate and blood pressure. Breathing rate and skin conductance were not affected. Lacey and Lacey (1970) showed the same phenomena using heart rate variability, a complex procedure differentiating within the heart wave.

Subjects "who are above average in heart rate during coping tasks show consistently higher heart rates and systolic pressures during other stresses as well, but are indistinguishable from less reactive persons when relaxed," according to Light (1981, p. 217). In her procedure for heart rate during relaxing, she recorded the lowest HR elicited. Light also found that those

> with hypertensive parents had significantly higher heart rates than subjects with normotensive parents during both relaxation and the avoidance task: however, the two groups were most clearly differentiated at the onset of the avoidance task when the group with hypertensive parents averaged 15 beats per minute higher than the comparison group. (p. 221)

Schell and Lusche (1981) reported heart rate differences between Type A and B individuals at rest. They also found a generally higher SNS "tone" among the Type A subjects (for blood pressure or other measures taken simultaneously) during their experimental manipulations.

Van Egeren et al. (1978) investigated whether verbally harassed subjects would experience a heart rate increase. He noted that heart rate increased with their report of anger.

Appel et al. (1981) investigated between group heart rate differences for both high and low blood pressure people subjected to anger. There were no heart rate differences for anger in the experiment. In fact, heart rate decreased although blood pressure increased.

Personality traits (locus of control, state anxiety, and trait anxiety) were tested by Levenson and Ditto (1981) for predictability of controlling heart rate and nothing significant was found.

Schandry (1981) tested groups of good and poor heart rate perceivers and found that the good perceivers had significantly higher scores on a test of state anxiety. He then showed that "accurate autonomic awareness is coupled to emotional experience and especially anxiety" (p. 475). They further said, "it seems that higher self-reported anxiety is due to better perception of physiological processes rather than to actual level of autonomic arousal" (p. 479). Schandry (1981) then seemed to imply a "feedback loop" between psychology and physiology.

Respiration Rate

Willer (1980) found a progressive increase in respiration rate and heart rate as a function of repetition of stress in time. These kinds of increases were noted in study after study and have been reported earlier in this review (Hilgard, 1979, and others).

In each of the studies in the review of the literature presented in previous sections in which respiration rate was one of the simultaneously recorded variables, respiration rate was not associated with any significant differences for any variable (e.g., Stern et al., 1961).

However, respiration rate affects heart rate and generally heart rate increases as breathing rate increases. Breathing rate then must be monitored to insure heart rate data collection is accurate. An excellent article discussing the effect of breathing rate on heart rate variability was presented by Mulder and Mulder (1981). Respiration rate implications and new technology in psychophysiology were discussed.

Perspiration Rate

A high degree of arousal, assessed from a number of behavioral indexes such as crying and movement, was found highly correlated with the galvanic skin response for sixty neonates, human two to five day old babies (Weller and Bell, 1965).

Schell and Lusche (1981) found significantly higher skin conductance for those with Type A personality during all of the treatments in their research. They had four conditions: (1) resting, (2) reaction time, (3) anagram task with difficulty varied successively from easy to difficult and a loud unpleasant noise sounded at failure, and (4) a timed math task with verbal harassment. However, changes in skin conductance did not differ between Type A and Type B personality subjects for any of the tasks.

Schandry (1981), as reported previously in this study, found that good heart beat perceivers had higher state

anxiety. He also found that skin conductance level did not change. He speculated this "may be a consequence of the rather rapid changes between rest and perception phases; possibly this tonic measure was not sufficiently responsive to rapid changes, so that the mean values remained unchanged" (p. 477).

Fenz and Epstein (1967) reported that both novice and experienced parachutists have a similar increase in galvanic skin response (GSR) as the time for jumping approached. However, experienced jumpers reported different timing for emotional arousal (just after the jump) while novice jumpers reported an earlier arousal (just before the jump). They speculated that "perhaps the experienced jumpers had learned to inhibit the subjective response of fear in response to the first signs of physiological arousal" (p. 34).

Hastrup (1979) reviewed literature concerning the relationship of vigilance tasks to extroversion/introversion and labile subjects, defined as those who have a high frequency of spontaneous electrodermal fluctuation and who do not quickly habituate. She said many investigators have found a relationship between introversion and electrodermal lability. She found that introversion was not related to electrodermal lability but that it was related to a higher initial level of performance.

Electrodermal responding to aversive stimuli differed between depressed and non-depressed persons according to many researchers (Gatchel, 1981). Further, many investigators

have found that clinical depression is associated with decreased electrodermal responding (Gatchel, 1981).

Blood Pressure

Lacey and Lacey (1970) found that attention to external stimuli had a decreasing effect on blood pressure (BP) and that attention to internal stimuli had a hypertensive effect.

Type A personality people generally had higher blood pressure than Type B (Schell and Lusche, 1981). They also found that a high time pressure task produced greater increases in blood pressure for Type A personality subjects than for Type B subjects.

Light in 1981 showed that males who have higher than average heart rate during coping tasks also have consistently higher systolic blood pressure during other stressful tasks. However, these subjects were indistinguishable from the other subjects when they were relaxing. She found large increases for systolic BP but only small increases in diastolic BP during the stressful tasks. Systolic BP was consistently more reactive than diastolic BP.

During the course of her complex experiment Light found her various measures did not yield a consistent picture and suggested other factors may also be involved. She also said "that both higher casual systolic blood pressure and high heart rate reactivity to stress are associated with an increased incidence of parental hypertension, but high heart

rate reactivity shows a stronger relationship. The incidence of parental hypertension is roughly twice as great among parents of subjects with mildly elevated casual blood pressures, but it is almost five times as great among the parents of high as compared with low heart rate reactors" (1981, p. 222).

Van Egeren et al. (1978) found that verbally harassed subjects had higher systolic BP while solving anagrams. After the task, blood pressure reduced back to normal at a slower rate when there was uncertainty of consequences compared with those who were told what to expect next.

An excellent article giving blood pressure statistics in the national population by age, sex, and other relevant variables was presented in Hypertension in Adults (1981). The summary was particularly instructive as was Appendix III (Sources of Variation in Blood Pressure Measurements).

Between Groups Factors

Self-Esteem

Social learning and cognitive variables influence the development of the self-concept according to Combs and Snygg (1959). "One of the most critical aspects of the self-concept is self-esteem" (Mischel, 1976, p. 4). "Self-esteem refers to the individual's personal judgement of his own worth," according to Coopersmith (1967, p. 8).

Terman and Oden (1959), in their historic longitudinal study of the gifted, found that the mortality rate of the least successful was twice that of the most successful.

The above statements, when taken as a whole, imply that low self-esteem may lead to earlier death and, by further inference, to deleterious physiological variables prior to death.

Additionally the loss of self-esteem can be acute, rather than chronic as Terman's study of the life span infers. Burns (1980) said that some people "are likely to respond to the perception of failure or inadequacy with a precipitous loss in self-esteem that can trigger episodes of severe depression and anxiety" (p. 25).

Bandura (1982) postulated a theory of self-efficacy. He said this theory must specify when perceived inefficacy will give rise to anxiety and depression.

Combs and Snygg (1959) talked about the adequate person and about anxiety and depression. Bandura (1982), although he would disagree, tested some of Combs and Snygg's principles when Bandura showed "the higher the level of self-efficacy, the higher the performance accomplishments and the lower the emotional arousal" (p. 122). Bandura also said that perceived self-efficacy helps to account for the level of physiological stress reactions, resignation to failure experiences, and achievement strivings, among others.

The "dirty words" studies (McConnell, 1980) showed emotional arousal (SNS: blood pressure and heart rate

increases) even when the words were presented at very high speeds and were supposedly unintelligible (subjects said they did not know what they saw). Perception of the world is done through a filter/amplifier--a feedback loop--the self (Bedinger, Bedinger, and Purkey, 1983). McConnell (1980) said there "seems to be fairly good evidence that something like perceptual defense or vigilance does occur" (p. 273). People seem to not always be aware at a cognitive level of their SNS arousal or the external stimuli that produced that arousal.

Aging

As people age, there is an increase in individual specificity (Garwood and Engel, 1981). This means that as people grow older there is an increase in the tendency to respond to stimuli with a consistent response hierarchy. Physiological measures in the Garwood and Engel (1981) study were heart rate, blood pressure, perspiration, breathing, and digital blood flow.

Weg (1975) chronicled age related physiological changes in her chapter "Changing physiology of aging, normal and pathological" in the text Aging. She mentioned those effects generally known such as decreases in brain electrical activity, heart rate, breathing rate, and perspiration rate and increases in blood pressure. She also said reaction to stress decreases with age at SNS stimulation because there

are concomitant changes in hormone levels such as adrenaline, noradrenaline, and corticords and thus changes in the activity of the organs affected.

Although reaction to stress decreases, depression may increase according to many researchers (Breslan and Haug, 1983). Gaitz (1977) proposed that depression is the inevitable consequence of the aging process. However, Bultena (1978), in his ten year study, rebutted depression as an inevitable consequence when he showed that those with younger self-images correlated high with favorable self-evaluations and that they were as happy as older people as they had been as younger people.

Wortman and Loftus (1981) further refute inevitable depression by reporting that they found the aged either extremely happy or extremely unhappy. Their findings also seem to concur with the decrease in women's suicide with aging ("Vital Statistics of the United States," Mortality, Volume II, 1979). This is so because if depression is an inevitable consequence of aging one would not be expected to find extremely happy older people or decreases in suicide rates. However this is a very complex phenomenon since many older people are extremely depressed and there has been an increase in suicide rate for aging men (Mortality, Volume II, 1979).

Perhaps one of the most important findings for the aged was that active coping strategies increase physiological arousal but were associated with lower psychological perception

of anxiety and stress (Miller et al., 1970). This latter infers that older people who remain active may suffer less anxiety and stress, and with further inference, less depression.

Palmore (1982) in the Duke twenty-five year longitudinal study found that several variables were instrumental in predicting longevity. For men, health self-rating, work satisfaction, and performance intelligence were the strongest predictors. Predictors for women were health satisfaction, past enjoyment of intercourse, and physical function rating. Each of these is somewhat measured by the Tennessee Self-Concept Scale. Why then has aging consistently not been related to self-esteem as stated by Wylie (1974b) in her compendium of self-theory research?

Breslan and Haug (1983) presented a model that seems to describe the path that some elderly take to clinical depression. Their model also may predict the answer to the above question. Their model involves an interplay between developmental changes, special age-related vulnerabilities, and the consequences of depression. This model explained how many elderly people remain happy while others suffer clinical depression. It then also suggests an explanation for the consistent lack of correlations between aging and self-esteem as reported by Wylie (1974b) because an interaction between aging and depression will mask any relationship between aging and self-esteem if depression is related to self-esteem.

This means then, if there are such relationships, healthy older individuals are likely to enjoy high self-esteem and less healthy older people will have less self-esteem.

Pilot Studies

Many procedures reported in the articles in the above review of the literature were investigated in the pilot studies. The pilot studies also served as a training vehicle for the researcher.

Thirty subjects took part in the pilot studies. One hundred undergraduates were screened using a short-form self-concept instrument and ten students from each of the high and the low extremes took part in additional research. Five graduate students and five older adults also underwent the trial procedures. Initial pilot studies might be better characterized as single subject designs. The latter pilot studies looked at between group differences.

Many of the subjects were tested two or more times: five of the subjects twice the same day, five of the subjects twice in one week, and five of the subjects every month for three months. Reliability of physiological responding by psychological treatment was generally high for all subjects ($r = .60$ to $.90$, $p < .01$). Test-retest reliability of the instruments was very high ($r = .85$ to $.95$, $p < .01$).

The criteria for selection of physiological indices included accuracy, reliability, and the history of the measurement in the professional journals. Five were selected: right forebrain electrical activity measured by the electroencephalograph, heart rate, respiration rate, perspiration rate, and systolic blood pressure. The perspiration rate was measured independently of the other four and both systolic and diastolic blood pressure were measured at the end of the debriefing at least ten minutes after the formal data collection was completed. These data were taken after the subjects thought the experiment was over. The pilot studies showed that if the data were collected as a "reward" for "being such a good subject," the subjects were most likely to exhibit their "real-world" personality.

Five psychological variables were selected as treatments based on the subjects' subjective ability to follow instructions, the ability of the physiological measurements to discriminate between treatments, and the meaningfulness to self-theory suggested by the literature review.

The five psychological variables selected were mentally imaging well being while relaxing, mentally imaging depression, machine-produced stress (the subjects in the pilot studies reported stress when the blood pressure cuff was first inflated), mentally imaging guilt, and instruction-produced stress (listening to statements about death). The first three (well being, depression, and the stress at the first blood pressure cuff inflation) produced the most

reliable results and were used in the primary factorial designs of the study. The last two, guilt and the "instruction stress" that was produced when the subjects listened to statements about death, were used to successfully replicate the seemingly significant relationships that were found between the primary physiological indices and self-esteem in the latter pilot studies.

CHAPTER III
METHODOLOGY

The underlying assumption of the present research was that one's self-esteem, a psychological state, is directly related to one's internal physiology. That is, for instance, a low state of self-esteem will be deleterious to one's physiology and will disproportionately magnify the negative relationship during periods of depression and stress. Further, this adverse relationship, if very meaningful, will exacerbate or mask the aging process itself.

Experimental treatments (psychological events such as depression) were produced and measured by dependent variables (physiological indices such as blood pressure). Physiological indices were then correlated with self-esteem for each psychological event to see if a relationship was present.

Subjects were next divided into groups by self-esteem so that treatment by self-esteem interactions could be assessed, and later into younger and older age groups in order to assess the practical as well as the theoretical implications of the research. Practical implications were gained in two ways. One way was to take the younger and older age groups and simply look at the "real-world" data

like that which had been produced in the pilot studies when the subjects' blood pressure was given as a "reward" for "being such a good subject." The other was to assume that if self-esteem is a meaningful construct, self-esteem effects will produce predictable confounding (e.g., masking) when comparing the younger and older age groups. For instance, the older age group should have higher blood pressure. But if there are more younger people and their blood pressure (BP) increases at a greater rate (this predictable phenomenon is explained in the next four paragraphs below), there should be no BP differences between the younger and older age groups even though the older age group normally has higher casual blood pressure.

The factorial design of the present study precluded an investigation of the interaction between younger and older age groups by self-esteem because few older people were expected in the two extreme self-esteem (se) groups (high and low se). Design cells with extremely small numbers are not at all reliable. Some masking and exacerbating effects were predictable, though, because aging characteristics are highly reliable and directional. The five physiological variables selected in the present design either increase or decrease with age. That is, for instance, blood pressure increases and brain electrical activity decreases with age.

This would mean then that an older age group, already suffering from adverse increases in a physiological variable such as blood pressure, will have an average BP that

will no longer exceed a younger age group mean when the younger group suffers disproportionately higher blood pressure during experimental treatments (assuming more younger people than older people suffer disproportionately higher blood pressure). This is so in the present experiment because, with very small numbers of older people expected in the high and low se groups, any effect for se will be borne mostly within the younger group. Stated in another way, if there is a disproportionate significant increase in blood pressure for those with low self-esteem and the low self-esteem group is composed mainly of younger people, the overall younger group mean will increase enough to mask an a priori difference between age groups if the effect for se is very meaningful.

Therefore, there will be no statistical difference between the younger and older age group means as measured by a directionally increasing variable, blood pressure, during psychological events that also increase that measure, such as depression and stress.

However, should there be a priori differences between the two groups of younger and older people in the other (negative) direction (e.g., brain electrical activity decreases with age), the differences would be magnified. This is so because the younger group, if low self-esteem people's average output is disproportionately increased by depression or stress, will have their already higher output exacerbated.

Four dependent measures that decrease with age were selected from the many variables that were pilot tested: right forebrain electrical activity, heart rate, respiration rate, and perspiration rate.

Hypotheses and Corollaries

The above assumptions and inferences generated the following hypotheses and their corollaries:

$H_{1.0}$: Right forebrain electrical activity will be negatively related to self-esteem.

$C_{1.1}$: People with low self-esteem will have relatively higher right forebrain electrical activity than those with high self-esteem during states of depression and stress.

$C_{1.2}$: Older people will have lower right forebrain electrical activity than younger people during states of depression and stress (exacerbated EEG decrease).

$H_{2.0}$: Heart rate will be negatively related to self-esteem.

$C_{2.1}$: People with low self-esteem will have a higher relative heart rate than those with high self-esteem during states of depression and stress.

$C_{2.2}$: Older people will have a lower heart rate than younger people during states of depression and stress (exacerbated HR decrease).

$H_{3.0}$: Respiration rate will be negatively related to self-esteem.

$C_{3.1}$: People with low self-esteem will have a relatively higher respiration rate than those with high self-esteem during states of depression and stress.

$C_{3.2}$: Older people will have a lower respiration rate than younger people during states of depression and stress (exacerbated RR decrease).

$H_{4.0}$: Perspiration rate will be negatively related to self-esteem.

$C_{4.1}$: People with low self-esteem will have a relatively higher perspiration rate than those with high self-esteem during states of depression and stress.

$C_{4.2}$: Older people will have a lower perspiration rate than younger people during states of depression and stress (exacerbated GSR decrease).

$H_{5.0}$: Blood pressure will be negatively related to self-esteem.

$C_{5.1}$: People with low self-esteem will have higher relative blood pressure than those with high self-esteem during states of depression and stress.

$C_{5.2}$: There will be no blood pressure differences between younger people and older people during states of depression and stress (masking effect).

Subjects

Fifty-five volunteer Caucasian adults were recruited from the Unitersity of Florida and Lake City Community College. Of the 55, two subjects were older adults. Additionally, fifteen volunteer Caucasian older adults were recruited through the Gainesville, Florida, Older Americans' Council (total N = 70).

The age range of the younger age group (N = 53) was 15-59 years and the older age group (N = 17) was

60-79 years. Older people were then one-fourth of the total sample.

Thirty-five of the subjects were in the upper-lower socio-economic status (SES) group. Twenty-one were lower-middle SES and fourteen were upper-middle. Ten subjects had previously undergone psychological therapy. The subjects' SES and/or previous therapy history were thought to be possible confounding variables but they were not. This is shown in Appendix I where statistical analyses of demographic variables are presented. It shows that the subject population was not statistically different from the general population except that their average age was higher since the research design called for comparison of a younger and an older age group.

Two subjects were eliminated from the results, one Black person because enough Black volunteers were not forthcoming and one Caucasian because she refused to complete the Tennessee Self-Concept Scale after data collection on the physiograph.

Subjects were not asked to participate if they were more than plus or minus one standard deviation from the weight norm for their height or if they had taken any drugs within twenty-four hours of data collection. Only healthy, normotensive subjects were recruited.

Apparatus

Three separate apparati were used of which two, a NARCO Bio-Systems Phsyiograph and a Lafayette Student Galvanometer, were used simultaneously. The physiograph consisted of the following systems:

PMP-4B Physiograph with five second and event marker and four Channel Amplifiers, Type 7070

Programmed Electro-Sphygmomanometer, PE-300 with occluding cuff Transducer Coupler, Type 7173

Hi-Gain Coupler, Type 7171 (2 each)

Impedance Pneumograph Coupler, Type 7212

A Standard K-085 cuff blood pressure measurement apparatus was used independently in time from the other two (used at exit interview instead of during formal data collection).

Instrumentation

The Tennessee Self-Concept Scale was used to measure self-esteem and the Hollingshead Two-factor Socio-economic Status Scale was utilized to measure socio-economic status (SES).

Procedure

The subjects were requested to read and sign two informed consent forms (Appendix II) and retain one since they were considered to be at risk by the University of Florida Human Subjects Committee. (Any research involving human subjects, where their physiology is being monitored by electrodes attached to equipment with potentially harmful amounts of electrical current anywhere in the system, constitutes an "at risk" condition. See Appendix III). Subjects next completed a medical history and SES questionnaire (Appendix IV).

Laboratory Setting

The laboratory consisted of a desk area facing a wall where subjects completed the above mentioned forms. The other side of the room was a blank wall, virtually stimulus free, and the physiograph apparatus stood in the center of the room behind a reclining chair.

Subjects were seated in the reclining chair. They faced the blank wall and the physiograph equipment was behind them. The physiograph operator (the researcher) stood behind the physiograph but in a position to closely observe the subjects and to record observations on the chart paper as it moved across the machine.

Electrodes were implaced by a same sex graduate student. Three were placed in the sternum area (care was taken to

insure all electrode implacement was identical for all subjects) for recording of heart rate (ECG) and respiration rate. Two finger electrodes were placed on the first two fingers of the right hand for recording the perspiration response. Subjects were asked to report if there was any pulse throbbing in the finger tips and, if so, electrodes were loosened. Subjects' comfort was stressed throughout data collection. Two electrodes were placed under a headband one-half inch above the right eye to measure right forebrain electrical activity (EEG). The blood pressure (BP) cuff was affixed to the left upper arm and the physiograph turned on.

Standard time constants for human subjects for the ECG (3.2) and EEG (0.3) were used. Respiration rate settings varied by subject to insure that both normal and stressful breathing rates were measured. Directions from the Narco Physiograph Manual (1980) were scrupulously followed for each measure.

Instructions

After ascertaining that heart rate, respiration rate, perspiration rate (GSR), and electroencephalograph were being monitored and recorded correctly while subjects were relaxing (see Appendix V), the researcher stated in a carefully practiced delivery, "I'm going to turn the blood pressure cuff on now. Let me know if you experience any discomfort."

This statement was found to remove a "startle response." The initial BP cuff inflation often produced such an effect in the pilot studies. The not too subtle implication that discomfort was expected was then timed with the BP cuff inflation, beginning at cuff inflation and ending at fifty millimeters of Mercury (mm Hg) pressure. The cuff continued to 150 mm Hg, well below the 180 to 200 mm Hg typically delivered by a nurse or medical doctor and then deflated at the same rate. The machine repeatedly inflated the BP cuff twice per minute and BP was recorded twice each inflation (four times per minute).

Subjects were again requested to relax so that the physiological indices would return to the baseline for the recording of the well being state (see Appendix V). Data were then collected while subjects imaged depression (see Appendix V) for at least two minutes. Again, a practiced delivery was accomplished during the mentally imaging states. Appendix V operationalizes imaging states.

Next, as an intervening task, twelve statements from the Tennessee Self-Concept Scale and eight additional self-concept statements were read while the subjects relaxed and listened. Fifty-three of the subjects selected randomly were then asked to mentally image guilt (Appendix V). Twenty-two subjects were also requested to listen to statements about death (mentally imaging a stressful event, Appendix V). All subjects imaged well being again as their last task on the physiograph.

After completing data collection, the researcher removed the electrodes and BP cuff and requested the subject take the Tennessee Self-Concept Scale. Identification of high and low self-esteem groups was not done until all raw data had been evaluated and recorded.

After finishing the paper and pencil task the subjects were given an exit interview and their blood pressure was taken by the traditional method. This was offered as a "reward" for "being such a good subject." This is also, of course, additional data that may be more "real-world" than the "laboratory" data that had just been collected. The "laboratory" data were probably slightly confounded by "anticipation" while the "exit" data were less likely to be so influenced. "A priori" blood pressure was inferred from this "real-world" resting blood pressure (the older age group was expected to have higher a priori blood pressure).

General Design Used in the Present Experiment

The above procedure resulted in five 3 x 3 factorial designs each with an N of 70 (self-esteem group by treatment for each dependent measure). The additional 53 subjects in the "guilt" condition and the 22 in the "image stress" condition created an unequal-cell 3 x 2 (self-esteem group by treatment) for each of the five measures. This gave the added ability to statistically compare two mentally unpleasant images (depression and guilt) and two stressful

events (one machine-produced at the first BP cuff inflation and the other instruction-produced while listening to statements about death). This gave test-retest reliability.

Figure 1 is a conceptual integration of these designs. Figure 1 shows each psychological state was reflected separately by the different physiological variables. These were further divided into self-esteem groups. For instance, 70 subjects imaged well being as measured by the electroencephalogram and 19 of these were in the low self-esteem group.

Figure 2 is the design used for looking at age group differences. Younger and older age group means were analyzed in a 2 x 3 (age group by psychological treatment) factorial for each dependent measure (physiological variable). They were further analyzed for replication of significant findings in a 2 x 2 factorial for the physiological variables found significant for age group by psychological treatment in the prior 2 x 3 factorial.

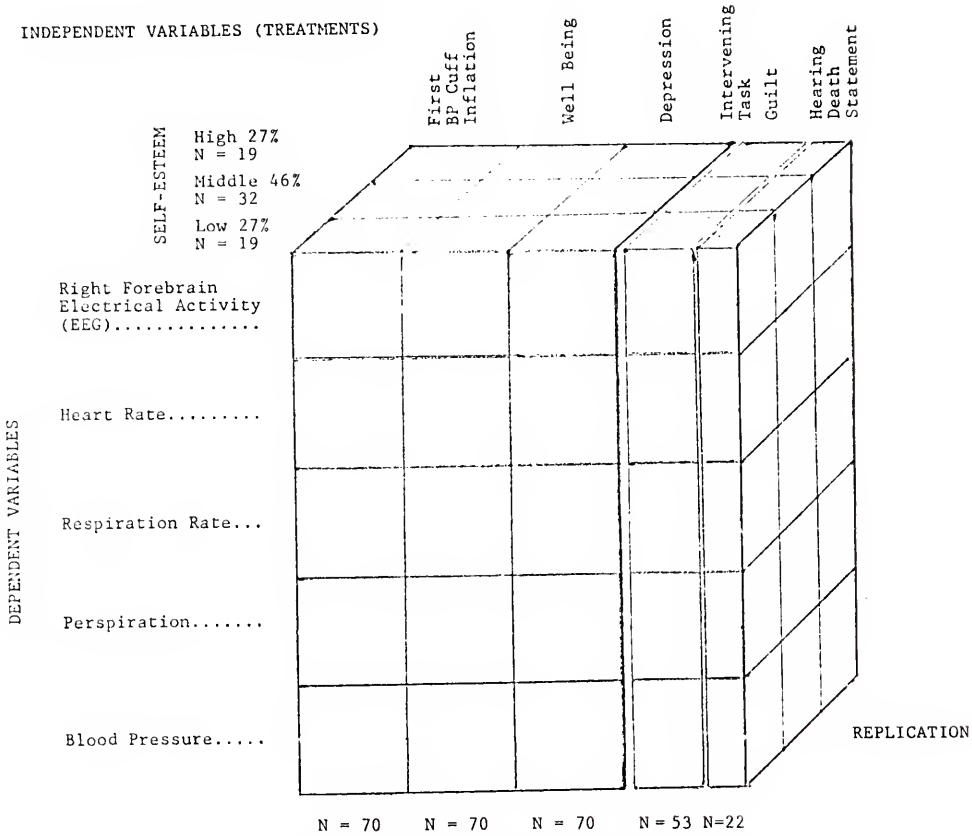


Figure 1. General design used in the present experiment.

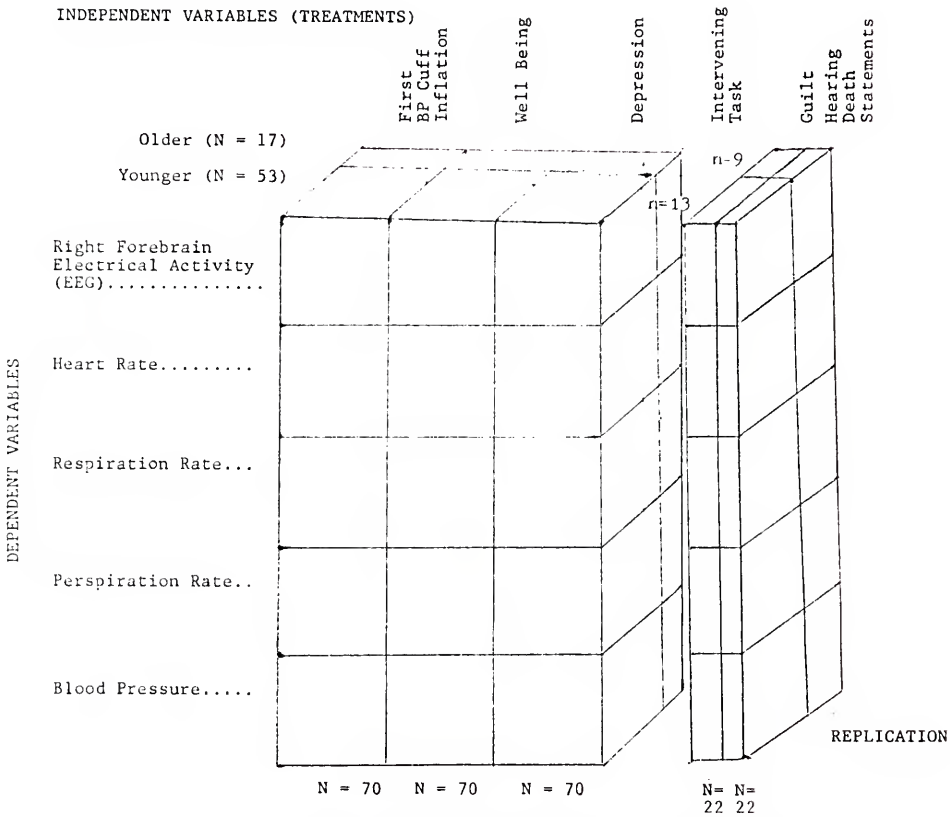


Figure 2. Design used to investigate differences between younger and older age groups.

CHAPTER IV
RESULTS

Subjects selected for the experiment did not differ significantly from the general population except in expected design-determined directions. This was so because there were more people over age 60 in the sample than in the general population so that a comparison between a younger group and an aged group would be possible (e.g., this older group had average higher systolic blood pressure at exit) (see Appendix VI).

Demographic Results

There were no significant relationships between age and self-esteem as measured by the Tennessee Self-Concept Scale (TSCS) ($r = .08$, $p < .05$). When the subjects were divided into three groups by self-esteem (high self-esteem was defined as those in the sample who scored in the upper 27% on the TSCS; the middle self-esteem group was the center 46%; and the low self-esteem group was the bottom 27%), the middle group age mean was significantly higher ($F(2,69) = 3.19$, $p < .05$) than the other two groups. This difference was of course predicted since a higher percentage of subjects over age 60 in the middle group was expected. Of the 17 subjects in the over 60 age group, three fell in the highest

27%, four in the lowest 27%, and ten in the middle group, which elevated the middle group age mean.

The high self-esteem group age mean was 35.5 years ($N = 19$, $\sigma = 14.9$), the middle self-esteem group age mean was 45.6 years ($N = 32$, $\sigma = 18.8$), and the low self-esteem group age mean was 34.0 years ($N = 19$, $\sigma = 18.1$).

Post hoc analysis using the Duncan procedure ($DF = 67$, $MS = 326.64$, $p < .05$) confirmed that the age of the middle se group was significantly different from both the high and low se groups while the high and low groups were not significantly different from each other for age. Thus any differences found for measured states of high and low self-esteem are more meaningful for self-esteem comparisons with the middle group removed because the middle group physiology was influenced by the larger percentage of aged people within that group. However, graphic results which include the middle group do demonstrate age comparisons because the middle group has a disproportionate share of older people.

Given that the demography of the subject sample was not identical to the overall national population, there were still no significant relationships between self-esteem and the demographic variables measured: age, sex, socio-economic status, and whether or not the subject had had psychological therapy (see Appendix I).

Further, there were no significant demographic differences within the groups of measured states of high and low self-esteem (see Appendix I).

Results of analyses of psychophysiological measures (dependent variables) follow and are again organized into sections in the following order:

Electroencephalogram
Heart rate
Breathing rate
Galvanic skin response
Blood pressure

Results within each of these sections are reported in the following order: first, the correlations between the dependent measures (e.g., blood pressure) and self-esteem; second, any differences between measured states of self-esteem; and third, any differences between younger and older age groups.

Right Forebrain Electrical Activity

Electroencephalogram (results of analyses of psychophysiological relationship between self-esteem and right forebrain electrical activity as measured by physiograph (electroencephalogram) during experimental treatments)

Analysis of variance of right forebrain activity (EEG) showed that mentally imaging well being, imaging depression, and the mental event taking place at the first BP cuff inflation (stressful event) by the physiograph were significantly different from each other ($F(2,134) = 41.17$, $p < .001$). Further, the interaction between self-esteem and the treatments was significant ($F(4,134) = 4.80$, $p = .001$) (see Table 1).

TABLE 1
SUMMARY OF ANALYSIS OF VARIANCE PERFORMED ON RIGHT FOREBRAIN ELECTRICAL ACTIVITY MEASURED BY PHYSIOGRAPH (ELECTROENCEPHALOGRAPH)

SOURCE	DEGREES OF FREEDOM	MEAN SQUARE	F	PROBABILITY
Subjects	1	493.77	1072.88	.001
Self-esteem group	2	3.34	7.27	.001
Error	67	0.46		
Treatment	2	8.64	41.17	.001
imaging well-being				
imaging depression				
first BP cuff inflation				
Self-esteem groups x treatment	4	1.00	4.80	.001
Error	134	0.21		

TREATMENT	low se	σ	middle se	σ	high se	σ
Well being	1.10	0.3	1.12	0.3	1.36	0.5
Depression	1.94	0.7	1.28	0.4	1.63	0.4
First BP cuff inflation	2.26	0.6	1.65	0.4	1.84	0.7

$H_{1.0}$: Right forebrain electrical activity will be negatively related to self-esteem.

Right forebrain activity measured by an electroencephalograph (EEG) was positively correlated with self-esteem ($r = .31$, $p < .01$) while subjects were imaging well being (relaxing). However, imaging depression showed no relationship ($r = .09$, $p > .05$) with the TSCS. The mental event at the first BP cuff inflation (stressful event) was negatively correlated with the score on the TSCS ($r = -.26$, $p < .05$).

This result was replicated when twenty-two subjects who listened to statements about death (also a stressful event) had a negative correlation ($r = -.41$, $p < .05$) between their EEG and self-esteem.

The finding of no relationship between the EEG and depression was not replicated. Fifty-three subjects who mentally imaged guilt (a mentally unpleasant event similar to depression) were found to have their EEG and self-esteem related ($r = -.41$, $p < .05$).

$C_{1.1}$: People with low self-esteem will have relatively higher right forebrain electrical activity than those with high self-esteem during states of depression and stress.

During the well being state the self-esteem group means were not significantly different from each other (Kruskal-Wallis chi-square = 1.72, DF 2, $p > .05$). Therefore, while the subjects were relaxing, their right forebrain activity tended to be positively related to their score on the TSCS, but not enough to show statistical differences between the high and low self-esteem groups.

The Kruskal-Wallis chi-square non-parametric statistic was significant (chi-square = 9.67, DF = 2, $p < .01$) for the self-esteem groups when the subjects were mentally imaging depression. The middle self-esteem group with the disproportionate number of older people had a significantly lower EEG (1.28, $\sigma = 0.4$) while imaging depression (Wilcoxon *t*-test approximation 0.43, $p < .05$). High (1.63, $\sigma = 0.4$) and low (1.94, $\sigma = 0.7$) self-esteem groups showed no differences.

The Kruskal-Wallis test indicated a reliable difference for the self-esteem groups (chi-square = 7.67, DF = 2, $p < .05$) at the first BP cuff inflation stressful event (see Figure 3).

$C_{1.2}$: Older people will have lower right forebrain electrical activity than younger people during states of depression and stress (exacerbated EEG decrease).

Older subjects did not differ from younger subjects when mentally imaging well being or when mentally imaging depression. However, the event at the first BP cuff inflation showed significant differences between older and younger people (Wilcoxon *t*-test approximation 0.68, $p < .05$).

The older subjects' mean EEG at the first BP cuff inflation (stressful event) was 1.58 ($\sigma = 0.6$, N = 17), and was significantly lower than the younger group mean EEG of 1.96 ($\sigma = 0.6$, N = 53). Aging differences were exacerbated during stress.

An attempt to replicate this finding with a small sample of 22 subjects during a different stressful psychological

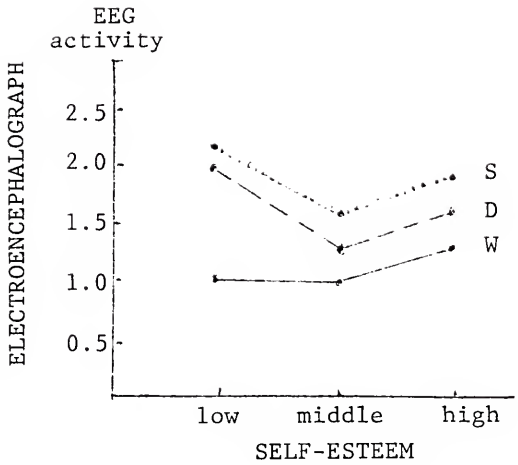


Figure 3. Right forebrain electrical activity during experimental treatments and its relationship to self-esteem. (Note: Middle group had disproportionate number of older subjects and age was negatively associated with EEG activity, resulting in depressed middle group means.)

..... First BP cuff inflation (stressful event) (S)
----- Imaging depression (D)
——— Imaging well being (W)

event (listening to statements about death) was not successful but was suggestive that a larger N would be significant (Wilcoxon t-test approximation 0.13, $p = 0.07$).
When listening to statements about death (reported as stressful by 91% of the subjects), the older age group mean EEG was 1.33 ($\sigma = 0.3$, $N = 9$), and the younger group mean was 1.85 ($\sigma = 0.3$, $N = 13$). Thus older subjects most probably displayed lower EEG output again and this subtractive effect exacerbated differences since the treatments disproportionately added electrical output to the younger group mean.

Heart Rate

Electrocardiogram (results of analyses of psychophysiological relationship between self-esteem and heart rate measured by physiograph during experimental treatments)

Heart rate in beats per minute varied significantly between treatments ($F(2,134) = 27,05$, $p < .001$) (see Table 2). The Duncan statistic ($DF = 134$, $MS = 18.03$, $p < .05$) showed the three treatments were different from each other.

$H_{2.0}$: Heart rate will be negatively related to self-esteem.

There were no significant relationships between self-esteem and the experimental treatments when measured by heart rate (HR) in beats per minute. The Tennessee Self-Concept Scale (TSCS) by HR while imaging well being was $r = .01$ ($p > .05$), the TSCS by HR for depression was $r = -.07$ ($p > .05$), and the TSCS by HR at the first BP cuff inflation was $r = -.02$ ($p > .05$).

TABLE 2
SUMMARY OF ANALYSIS OF VARIANCE PERFORMED ON HEART RATE
MEASURED BY PHYSIOGRAPH

SOURCE	DEGREES OF FREEDOM	MEAN SQUARE	F	PROBABILITY
Subjects	1	1029762.70	2485.14	0.001
Self-esteem groups	2	111.52	0.27	0.76
Error	67	414.36		
Treatment	2	487.93	27.05	0.001
imaging well being				
imaging depression				
first BP cuff inflation				
Self-esteem groups x treatment	4	12.36	0.69	0.60
Error	134	18.03		

TREATMENT MEANS	low se	σ	middle se	σ	high se	σ
Well being	67.4	9.4	70.8	11.5	69.6	12.4
Depression	74.5	12.2	75.4	12.7	74.2	13.9
First BP cuff inflation	71.2	11.7	74.0	12.4	71.8	13.2

$C_{2.1}$: People with low self-esteem will have a higher relative heart rate than those with high self-esteem during states of depression and stress.

During the three treatments there were no differences between the self-esteem groups ($F < 1$, $p > .05$).

$C_{2.2}$: Older people will have a lower heart rate than younger people during states of depression and stress (exacerbated HR decrease).

There were no significant differences between the younger and older age groups during the experimental treatments with heart rate as the dependent variable either. Thus well being ($F < 1$, $p > .05$), depression ($F = 2.19$, $p > .05$), and the event at the first BP cuff inflation ($F < 1$, $p > .05$) provided no heart rate differential between younger and older age groups. Exacerbated HR decrease was not found. However, any differences found for age would not be relevant for this research since HR was consistently found not related to self-esteem.

Respiration Rate

Respiration rate (results of analyses of psychophysiological relationship between self-esteem and respiration rate measured by physiograph during experimental treatments

Respiration rate in breaths per minute varied significantly ($F(2,134) = 4.52$, $p < .01$) between treatments (see Table 3).

$H_{3.0}$: Respiration rate will be negatively related to self-esteem.

Correlations between self-esteem and the two mental imaging conditions (well being and depression) were not

TABLE 3
SUMMARY OF ANALYSIS OF VARIANCE PERFORMED ON RESPIRATION RATE MEASURED BY PHYSIOGRAPH

SOURCE	DEGREES OF FREEDOM	MEAN SQUARE	F	PROBABILITY
Subjects	1	45794.32	815.51	0.001
Self-esteem group	2	114.55	2.04	0.13
Error	67	56.15		
Treatment imaging well being imaging depression first BP cuff inflation	2	45.10	4.52	0.01
Self-esteem groups x treatment	4	10.77	1.08	0.36
Error	134	9.97		

TREATMENT MEANS	low se	σ	middle se	σ	high se	σ
Well being	13.3	4.4	14.4	5.8	15.7	3.6
Depression	15.0	3.9	16.3	6.8	17.0	3.2
First BP cuff inflation	12.6	4.6	16.1	4.4	16.2	5.2

significant (respectively .08 and .06, $p > .05$), but the relationship between the TSCS and respiration rate at the first BP cuff inflation was significant ($r = .26$, $p < .02$). However the TSCS by another psychologically similar (stressful) event (hearing statements about death) was not related ($r = -.11$, $p > .05$).

$C_{3.1}$: People with low self-esteem will have a relatively higher respiration rate than those with high self-esteem during states of depression and stress.

There were no differences between self-esteem groups ($F(2,67) = 2.04$, $p > .05$) during the three experimental treatments. Interestingly, all nine means were directional from low se to high se.

$C_{3.2}$: Older people will have a lower respiration rate (RR) than younger people during states of depression and stress (exacerbated RR decrease).

There were no significant differences between the younger and older age groups while mentally imaging well being and depression with respiration rate as the dependent variable ($F < 1$, $p > .05$ for both).

However the older age group took significantly ($F(1,68) = 5.07$, $p < .05$) more breaths per minute at the physiograph's first BP cuff inflation (stressful event).

The younger age group's mean respiration rate was 14.5 ($\sigma = 5.0$, $N = 53$) breaths per minute, and the older was 17.4 ($\sigma = 3.9$, $N = 17$).

An attempt to replicate this finding during a different stressful event (listening to statements about death) was again not successful ($F < 1$, $p > .05$).

Respiration rates between age groups were not exacerbated during states of depression and stress as predicted. However, the expected a priori difference that older age groups have a lower respiration rate was also not found.

Perspiration Rate

Perspiration rate (results of analyses of psychophysiological relationship between self-esteem and perspiration measured by galvanic skin response meter independently of the physiograph, but during experimental treatments)

The experimental treatments were significantly different from each other when measured by the GSR ($F(2,134) = 53.28$, $p < .001$) (see Table 4).

$H_{4.0}$: Perspiration rate will be negatively related to self-esteem.

There were no significant correlations between self-esteem and the three experimental treatments as measured by the galvanic skin response (GSR). The TSCS and well being were thus not related: $r = .06$ ($p > .05$). The TSCS and depression $r = .09$ ($p > .05$) and the TSCS and the mental event at the first BP cuff inflation $r = .18$ ($p > .05$).

$C_{4.1}$: People with low self-esteem will have a relatively higher perspiration rate than those with high self-esteem during states of depression and stress.

There were no differences between the self-esteem groups ($F(2,67) = 1.58$, $p > .05$) during the experimental treatments.

$C_{4.2}$: Older people will have a lower perspiration rate than younger people during states of depression and stress (exacerbated GSR decrease).

TABLE 4

SUMMARY OF ANALYSIS OF VARIANCE PERFORMED ON PERSPIRATION RATE MEASURED BY GALVANIC SKIN RESPONSE METER INDEPENDENTLY OF THE PHYSIOGRAPH, BUT DURING EXPERIMENTAL TREATMENTS

SOURCE	DEGREES OF FREEDOM	MEAN SQUARE	F	PROBABILITY
Subjects	1	46706.29	114.85	0.001
Self-esteem groups	2	642.64	1.58	0.21
Error	67	406.67		
Treatment imaging well being imaging depression first BP cuff inflation	2	11689.78	53.28	0.001
Self-esteem groups x treatment	4	313.43	1.43	0.22
Error	134	219.39		

TREATMENT MEANS	low se	σ	middle se	σ	high se	σ
Well being	2.68	6.5	7.59	14.0	4.73	12.1
Depression	7.05	11.9	13.50	19.0	11.57	13.9
First BP cuff inflation	25.26	23.5	28.00	21.5	37.89	17.1

While mentally imaging well being there were no differences between the younger and older age groups ($F < 1$, $p > .05$). However, while imaging depression and at the first BP cuff inflation, the older subjects had significantly lower GSR. Both findings were significant during replication with psychologically similar events (guilt and stress) but any GSR differences for age are not relevant to the present dissertation because the GSR was consistently found not related to self-esteem. Findings of an exacerbated GSR decrease were not then possible with the present design.

Blood Pressure

Systolic blood pressure (results of analyses of psychophysiological relationship between self-esteem and systolic blood pressure measured by physiograph during experimental treatments)

Systolic blood pressure (SBP) was recorded on the physiograph chart while the subjects were mentally imaging well being, mentally imaging depression, and when the blood pressure cuff was first machine inflated (first BP cuff inflation).

These three treatments (imaging well being, imaging depression, and the first BP cuff inflation) were significantly ($F(2,134) = 74.79$, $p < .01$) different from each other (see Table 5). Further, the se groups by treatment interaction was significant ($F(4,134) = 3.76$, $p < .01$).

TABLE 5
SUMMARY OF ANALYSIS OF VARIANCE PERFORMED ON SYSTOLIC BLOOD PRESSURE MEASURED BY PHYSIOGRAPH

SOURCE	DEGREES OF FREEDOM	MEAN SQUARE	F	PROBABILITY
Subjects	1	1114.00	590.26	0.01
Self-esteem groups	2	3.88	2.06	0.13
Error	67	1.88		
Treatment imaging well being imaging depression first BP cuff inflation	2	22.81	74.79	0.01
Self-esteem groups x treatment	4	1.14	3.76	0.01
Error	134	0.30		

TREATMENT MEANS	low se	σ	middle se	σ	high se	σ
Well being	2.96	1.0	3.02	0.8	2.99	0.8
Depression	1.95	0.9	2.27	0.8	2.66	0.9
First BP cuff inflation	1.33	0.7	2.05	0.9	2.09	0.9

$H_{5.0}$: Blood pressure will be negatively related to self-esteem.

The relationship between well being and self-esteem (measured by the TSCS) was not significant ($r = .07$, $p > .05$). However, the correlations between the TSCS and mentally imaging depression and the mental event at the first BP cuff inflation were statistically significant ($r = -.22$, $p = .05$ and $r = -.27$, $p = .02$, respectively).

Replication of the finding for depression was accomplished by having fifty-three subjects mentally image guilt (also a mentally unpleasant event). The SBP was related to the TSCS ($r = -.38$, $p < .05$).

Further replication of the finding for stress (first BP cuff inflation) was suggestive that a larger number of subjects would be related. Twenty-two subjects listened to statements about death (also a stressful event) and their SBP was related to their self-esteem ($r = -.39$, $p = .06$).

$C_{5.1}$: People with low self-esteem will have higher relative blood pressure than those with high self-esteem during states of depression and stress.

Systolic blood pressure (measured in centimeters on the physiograph chart) while mentally imaging well-being (relaxing with pleasnt thoughts) was remarkably constant between self-esteem (se) groups: The high se was 2.99 cm ($\sigma = .88$, $N = 19$), the middle se was 3.02 cm ($\sigma = .87$, $N = 32$), and the low se was 2.96 cm ($\sigma = 1.08$, $N = 19$).

While resting comfortably the average systolic blood pressure of all subjects was 3.00 cm and no self-esteem

group mean deviated from the subject mean by more than .04 cm. Thus the "baseline" (relaxing) blood pressure for all three groups was virtually identical.

When imaging depression the low self-esteem group's systolic blood pressure went up significantly (Duncan, DF = 134, MS = 0.30, $p < .05$) more than the high self-esteem group (low se group mean increased 1.01 cm, high se increased 0.33 cm). The middle se group mean increased 0.75 cm and was significantly different from the other two (see Figure 4).

The systolic blood pressure that was first machine recorded (first BP cuff inflation) was also significantly higher for those with low self-esteem compared to the high self-esteem group (low se increased 1.63 cm, high se increased .98 cm). The middle group mean increased 0.97 cm and was also significantly different from the low self-esteem group, but not from the high self-esteem group. This first BP cuff inflation was almost universally reported as a stressful event (98%).

$C_{5.2}$: There will be no blood pressure differences between a younger group and an older age group during states of depression and stress (masking effect).

There were no significant differences between the younger and older age groups during the experimental treatments with systolic blood pressure as the dependent variable. Thus imaging well being ($F < 1$, $p > .05$), imaging dpression ($F = 2.63$, $p > .05$), and the event at the first BP cuff inflation ($F = 2.73$, $p > .05$), showed no systolic blood

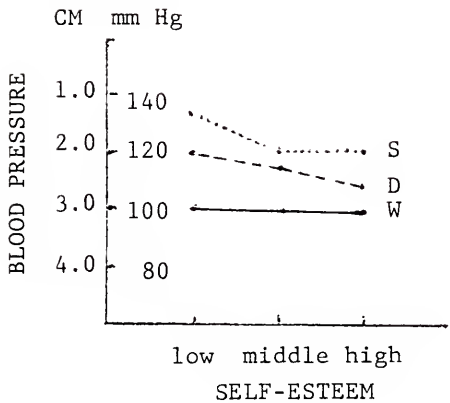


Figure 4. Systolic blood pressure during experimental treatments and its relationship to self-esteem. (Note: Middle se group has disproportionate number of older subjects.)

..... First BP cuff inflation (stressful event) (S)
----- Depression (D)
——— Well being (W)

Physiograph chart centimeters (CM) drawn to scale.

pressure differences between age groups. Thus the significant differences between high and low self-esteem, which raised the overall younger group mean, masked a priori blood pressure differences due to aging.

Blood Pressure at Exit

Blood pressure at exit (results of analyses of psychophysiological relationship between self-esteem and blood pressure measured independently of the physiograph and experimental treatments as a reward after subjects had successfully completed all tasks)

Systolic blood pressure at exit was not significantly correlated with the Tennessee Self-Concept Scale ($r = -.17$, $p > .05$), but diastolic was ($r = -.33$, $p < .01$).

Subjects were again grouped by their score on the Tennessee Self-Concept Scale (TSCS) into high (upper 27%), middle (46%), and low (lower 27%) self-esteem groups.

The exit systolic and diastolic blood pressures were analyzed using the analysis of variance procedure and Duncan's post hoc statistic (see Tables 6 and 7). Subjects in the high self-esteem group had significantly lower blood pressure than did those in the low self-esteem group for both systolic ($F(2,67) = 4.15$, $p < .02$) and diastolic ($F(2,67) = 5.50$, $p < .01$) blood pressure (see Figure 5).

The Duncan procedure confirmed that the high self-esteem group had significantly lower systolic blood pressure than did the low self-esteem group (DF = 67, MS = 167.17, $p < .05$).

TABLE 6
SUMMARY OF ANALYSIS OF VARIANCE PERFORMED ON SYSTOLIC BLOOD PRESSURE MEASURED SEPARATELY FROM PHYSIOGRAPH AND SEPARATELY FROM EXPERIMENTAL TREATMENTS

SOURCE	DEGREES OF FREEDOM	MEAN SQUARE	F	PROBABILITY
Self-esteem group	2	693.77	4.15	0.02
Error	67	167.17		

SYSTOLIC BLOOD PRESSURE IN MILLIMETERS OF MERCURY (mm Hg)	MEAN	SD
High self-esteem group	111.0	8.8
Middle self-esteem group	121.5	13.6
Low self-esteem group	120.1	13.9

TABLE 7
SUMMARY OF ANALYSIS OF VARIANCE PERFORMED ON DIASTOLIC BLOOD PRESSURE MEASURED SEPARATELY FROM PHYSIOGRAPH AND SEPARATELY FROM EXPERIMENTAL TREATMENTS

SOURCE	DEGREES OF FREEDOM	MEAN SQUARE	F	PROBABILITY
Self-esteem group	2	323.69	5.50	0.01
Error	67	58.84		

DIASTOLIC BLOOD PRESSURE IN MILLIMETERS OF MERCURY (mm Hg)	MEAN	SD
High self-esteem group	68.7	6.0
Middle self-esteem group	74.0	7.2
Low self-esteem group	76.8	9.0

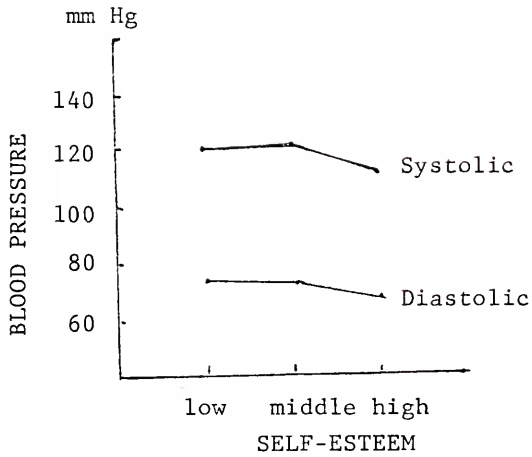


Figure 5. Systolic and diastolic blood pressure measured at exit and their relationship to self-esteem. (Note: Middle self-esteem group had disproportionate number of older subjects, and mean blood pressure for this group was elevated due to the aging process.)

The middle group systolic blood pressure was not different from the lower self-esteem group but was higher than the high self-esteem group. (Note: Middle group has disproportionate number of older subjects; Duncan, DF = 67, MS = 167.17, $p < .05$.)

The Duncan procedure also confirmed that the high self-esteem group had significantly lower diastolic blood pressure than the low self-esteem group (DF = 67, MS = 58.84, $p < .05$).

The middle self-esteem group diastolic blood pressure was not different from the lower self-esteem group but was higher than the high self-esteem group. (Note: Middle group has disproportionate number of older subjects; Duncan, DF = 67, MS = 58.84, $p < .05$.)

Systolic blood pressure was not significantly related to self-esteem for the younger age group ($r = -.11$, $p > .05$). However the 17 older subjects' SBP was highly related to their self-esteem ($r = -.70$, $p < .01$).

The younger age group mean blood pressure was significantly different from the older group for systolic ($F(1,68) = 14.37$, $p < .001$) blood pressure (see Appendix VI). The younger group systolic BP was 115.1 mm Hg ($N = 53$, $\sigma = 12.0$) and the older age group mean was 128.1 mm Hg ($N = 17$, $\sigma = 13.4$). This exit difference confirmed an a priori difference between age groups. This difference was found masked by the effect of self-esteem during the experimental treatments.

There was no significant difference (Appendix VII) between the younger and older age group means for diastolic BP ($F < 1$, $p > .05$). The younger group mean was 73.6 mm Hg ($N = 53$, $\sigma = 8.1$) and the older group mean was 72.5 mm Hg ($N = 17$, $\sigma = 7.8$). Diastolic BP is much less reactive than systolic BP and remained high for the low se group composed mainly of younger people, even after more than one-half hour after machine data collection. Since there were significant differences between age groups at that time for systolic BP it is very reasonable to infer that, given enough time, there would be differences between age groups for diastolic blood pressure. Again, between group differences were masked by the effect due to self-esteem.

Reliability and Validity

After completing the experimental treatments, selected subjects were given additional treatment(s) that were seemingly psychologically comparable to the original experimental treatments, a test-retest reliability.

Fifty-three of the seventy subjects were requested to mentally image guilt (a universally self-reported unpleasant image, as was imaging depression) and their psychophysiological measurements were compared with those these same subjects had displayed while they were imaging depression. Blood pressure, heart rate, and respiration rate were significantly correlated between similar unpleasant experimental treatments

(.71, .88, and .77, respectively; $p < .0001$). The electroencephalograph (EEG) and galvanic skin response (GSR) were not correlated with their corresponding treatment ($p > .05$) (see Table 8).

Twenty-two subjects were read statements about death (reported as stressful by 91% of the subjects) and the psychophysiological measurements were correlated with the respective responses that took place at the first BP cuff inflation (also reported as stressful).

Three of the physiological responses were significantly correlated with their corresponding (stressful) experimental treatment responses: blood pressure at .57, $p < .01$; heart rate at .60, $p < .01$; and GSR at .68, $p < .001$. Two were suggestive that an N larger than twenty-two would be statistically significant: respiration rate at .36, $p = .09$; and EEG at .37, $p = .08$ (see Table 8).

Further, correlations between the psychophysiological measurements and the TSCS from the two additional samples were compared to their respective psychologically similar event correlations with the expectation that the measures that had previously been found to be related to self-esteem would again be related.

For the fifty-three subjects who additionally imaged guilt, the blood pressure and right forebrain electrical activity (EEG) were again related to self-esteem: $r = -.38$, $p < .01$ and $r = -.34$, $p < .01$, respectively. However, the

TABLE 8
PSYCHOPHYSIOLOGICAL MEASUREMENTS AND THEIR RELATIONSHIP BETWEEN MENTALLY IMAGING DEPRESSION AND GUILT (UNPLEASANT EVENTS), AND BETWEEN FIRST BP CUFF INFLATION AND HEARING DEATH STATEMENTS (STRESSFUL EVENTS)

	CORRELATION BETWEEN IMAGING DEPRESSION AND IMAGING GUILT	CORRELATION BETWEEN FIRST BP CUFF INFLATION AND HEARING DEATH STATEMENTS
	N = 53	N = 22
Right forebrain electrical activity	.17	.37 (p = .08)
Heart rate	.88*	.60***
Respiration rate	.77*	.36 (p = .09)
Galvanic skin response	.15	.68**
Blood pressure	.71*	.57***

*p < .0001

**p < .001

***p < .01

EEG for mentally imaging depression had not been significantly correlated with self-esteem but the well being state was significantly related (see Table 9).

Heart rate, respiration rate, and galvanic skin response were again not significantly correlated ($p > .05$). Thus the five physiological measurements continued to act in approximately the same manner as they had done earlier.

Further, for the twenty-two subjects who were read statements about death, the psychophysiological responses were similar to their corresponding experimental treatment. Right forebrain activity was significantly correlated ($r = -.41$, $p < .05$) and blood pressure was suggestive that a larger sample would be statistically significant ($r = -.39$, $p = .06$). The other three measures were not significant ($p > .05$). Thus, the physiological responses had continued to act in approximately the same manner as they had in the original similar treatment (stressful event).

Tables 3 through 7 show significant differences for each of the five psychophysiological measurements and their concurrent experimental treatment. Imaging well being, imaging depression, and the mental event at the first BP cuff inflation (stressful event) were shown to be significantly different from each other physiologically in five relatively independent ways (predictive validity).

In summary, the experimental treatments (independent variables) were significantly different psychological events

TABLE 9
SUMMARY OF CORRELATION RESULTS: RELATIONSHIP BETWEEN SELF-ESTEEM (TSCS SCORE) AND PSYCHOPHYSIOLOGICAL MEASUREMENT (DEPENDENT VARIABLES) BY TREATMENTS (INDEPENDENT VARIABLES) INCLUDING PSYCHOLOGICALLY SIMILAR MENTAL EVENTS (REPLICATION)

Correlations of Tennessee Self-Concept Scale Score by:	WELL BEING	DEPRESSION (UNPLEASANT EVENT)	GUILT (UNPLEASANT EVENT)	FIRST BP CUFF INFLATION (STRESSFUL EVENT)	HEARING DEATH STATEMENTS (STRESSFUL EVENT)
	N = 70	N = 70	N = 53	N = 70	N = 22
Electroencephalogram	.31*	.09	-.34*	=.26**	-.41**
Heart Rate	.01	-.07	-.21	-.02	-.08
Respiration Rate	.08	.06	.11	.26**	-.11
Galvanic Skin Response	.06	.09	-.11	.18	.03
Systolic Blood Pressure	.07	-.22**	-.38*	-.27**	-.39 (p = .06)
Systolic Blood Pressure at Exit	-.17				
Diastolic Blood Pressure at Exit	-.33*				
Systolic Blood Pressure at Exit:					
Older Age Group	-.70*				
Younger Age Group	-.11				

*p < .01; **p < .05

for each physiological measure and the measured physiology (dependent variables) acted in a moderately reliable manner during psychologically similar treatments.

CHAPTER V
DISCUSSION

This study demonstrated that, for the subject population in this experiment, self-esteem was significantly related to physiological indices (electroencephalogram and blood pressure). During stressful events the effect seemed strong enough to exacerbate and did in fact mask a priori differences between younger and older age groups, a priori differences due to the aging process itself. Further, older subjects' systolic blood pressure was highly related to self-esteem even though they thought the experiment was over. This robustness suggests that the effect of self-esteem states on physiological indices has practical as well as theoretical implications.

Dependent Variables

Electroencephalogram

Results of the analyses of the electroencephalogram (EEG) show that the EEG for right forebrain activity was directly related to self-esteem, especially during stressful events. During depression there was no relationship. However, mentally imaging well being while relaxing was related, as was guilt.

The most surprising finding in the present experiment was that, when subjects were relaxing, right forebrain electrical activity was positively correlated with self-esteem. One possible explanation is the obvious, that those who have high self-esteem have more electrical activity because they engage in more active situational coping most of the time.

Another possible explanation is that, since different self-esteem acts like different filters, the high and low self-esteem groups understood different things from the same instructions. For instance, the high self-esteem group may have heard a challenging task when the well being instructions were read, while the low self-esteem group heard a chance to escape the testing situation at the same instructions to relax and feel good.

Neither of the above two psychological explanations are eliminated by a third explanation that is more physiologically based. During mentally imaging well being, people with low self-esteem, assuming they have suffered more psychological depression in the past, display less frontal activity than people with high self-esteem. This was suggested from Cacioppo and Petty (1981) who found that facial electromyograph displayed during mental imagery of the subjects' typical day was negatively related to the subjects' prior history of depression; and to Stanley et al. (1982) who showed depressed people are also likely to have lowered frontal activity because they have fewer frontal cortex imipramine binding sites.

The most probable explanation for a relationship between self-esteem and EEG is a mix of all three psychological variables. High and low self-esteem groups often differ in coping strategies, hear different instructions, and have differing depression levels.

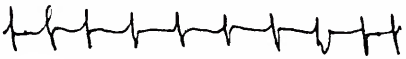
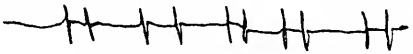
Between group results showed the low self-esteem group had significantly more right forebrain activity than the high self-esteem group at the machine produced stressful event (first blood pressure cuff inflation). This was replicated when a sample of the low self-esteem subjects again had more EEG activity when they were listening to statements about death. Further they had significantly more EEG activity while mentally imaging guilt (this also implies mentally imaging guilt and depression may be very different events: Guilt produced significantly more brain activity than did depression).

Higher EEG activity for younger subjects appeared to be exacerbated by the effect of self-esteem during the machine produced stress. Again, this suggests that the effect of self-esteem states on right forebrain activity has practical as well as theoretical implications.

Electrocardiogram

The statistical analysis used in the experiment showed that heart rate was not related to self-esteem. This lack of relationship could be a type II error (not finding an

effect that is present) because the experimental manipulations were not successful in producing large enough changes in heart rate to produce significance.

Heart rate was the most consistent intrasubject variable (imaging well being correlated .87 and .92, $p < .01$, with depression and stress, respectively). However, two confounding variables were observed during data collection. Respiration rate affected heart rate as expected. But unexpectedly, many subjects showed a "between beat" variability that is not reflected in the "beats per minute" statistic. For instance, one subject's heart rate looked like the following normal ECG:  . During the machine produced stress at the first blood pressure cuff inflation, this changed to:  . These dramatically different (normal and arythmatic) beats are not different in beats per minute.

Computer assisted technology ("on line" equipment) is recommended for subsequent research to quantify interbeat subleties as well as intrabeat variability for investigation involving personality variables and heart rate.

Respiration Rate

Respiration rate was not related to self-esteem in the present study. Again, type II error is suspected.

During data collection several different "breathing styles" were observed. Respiration is sympathetic <u>and</u>

central nervous system activated: It is automatic but one can also breathe virtually any time one chooses. Simply counting data per minute was again not an adequate description of the data. Some subjects breathe in quickly and let the air out slowly, others breathe in slowly and out quickly. Still others maintain a consistent breathing rate but change from shallow to deep breathing during stress. Rapid, shallow breathing under stress as reported in the literature review was not observed in this study. This reaction was seen in the pilot studies immediately after the "startle response" and low self-esteem subjects, in particular, exhibited this "breathing style." (A "startle response" that was sometimes observed when the blood pressure cuff was machine inflated without specific and timely comment by the operator was seen as too dangerous to use with older subjects.) Again, more sophisticated analyses (computer assisted) looking at larger numbers of subjects may show a significant relationship between self-esteem and respiration rate.

Perspiration Rate

Perspiration rates were not significantly related to self-esteem in the present experiment. Some younger subjects had extremely high perspiration rates (the literature review showed this may be genetic). These high perspiration rate subjects, named "labiles," whose high rate is genetic,

will mask any effect due to self-esteem, especially among younger people.

Blood Pressure

Systolic blood pressure was found negatively related to self-esteem during periods of depression and stress during the experiment. After the experiment and debriefing (when blood pressure was taken at exit), casual systolic blood pressure was no longer correlated with self-esteem for the subject population. However, casual diastolic was negatively related (diastolic is less reactive than systolic).

The casual systolic blood pressure at exit showed significant differences between the younger and older age groups and confirmed expected differences between age groups due to the aging process (see Appendix VI). However, this "a priori" difference was masked during the experimental manipulations due to the effect of self-esteem.

Subjects with low self-esteem had suffered disproportionately higher systolic blood pressure, blood pressure high enough to mask measured a priori differences between younger and older people. This speaks to the meaningfulness of the relationship between self-esteem and blood pressure.

The older age group's casual systolic blood pressure at exit was strongly related to self-esteem. This suggests self-

esteem plays an important part in the aging process itself.

Limitations of the Present Study

The subject population was not random, but all indications are that it was representative. The sample had approximately the same distribution on the Tennessee Self-Concept Scale as the norm group (see Appendix I). Further, the subjects' measured physiological characteristics generally coincided with that expected from the literature review.

The Tennessee Self-Concept Scale itself was a major limitation of the present study. It has the drawback of not being operationally "grounded," a limitation mentioned in the "Statement of the Problem" section of this study as being so serious as to call into question its validity. A subjective analysis of the content of the TSCS shows that more than one-half of the test items seem to reflect "guilt" ("I ought to go to church more" and "I should trust my family more" are examples that seemingly reflect guilt).

The present study showed differing physiological indices for well being, depression, guilt, and stress. The weight of the physiological evidence presented in this study implies that the TSCS is a good beginning but is not measuring a self-esteem construct robust enough for optimal real-world prediction.

Correlations in this study of .20 to .70 predict about five to fifty percent of the variance. Although this is meaningful (i.e., enough to mask some effects of the aging process) this researcher expects future similar instruments to reflect much greater predictability, on the order of correlations around .85 to .90 and higher. Future instruments should entail a "match-up" (iteration) between physiology and factor analysis for subscales, each subscale correlating with self-esteem, but having little or no correlation between subscales.

Iteration will involve culling items that seemingly reflect self-esteem but are not correlated with physiological indices and further culling dependent measures (physiological indices) that are not strongly correlated with self-esteem until an item pool is constructed that has validity and is grounded in physiology.

The largest obstacle to the creation of such an instrument was also an obstacle in the present study. Equipment to measure the physiology itself has limitations such as inaccuracy and expense. However such obstacles are surmountable, albeit not easily.

Certainly the limited number of subjects was a problem in the present study. This limited the number of variables that could be tested (e.g., self-esteem by age groups could not be calculated because of the small numbers of older people in the high and low self-esteem groups). However the "cup is half full" side of this issue is that effects

found with small numbers of subjects are most often robust.

Suggestions for Additional Research

Additional research empirically grounding self-esteem to physiology is warranted to operationalize theoretical constructs. Subscales concerned with the physiology of stress, depression, and guilt can be correlated with items from many of the currently available self-concept tests. Subscales with labels such as real-self and ideal self and other such labels already acceptable to many in the scientific community can be used to label the physiologically grounded constructs.

Self-esteem research looking at Type A personality for shared physiological and psychological problems should be productive. Low self-esteem and Type A people often seem to share perfectionistic (guilt?) and stressful traits. What are their similarities and differences and what does this imply for self-theory? Can the "essence" of the Type A personality (with self-esteem and genetics factored out) become itself a subscale of a more comprehensive and predictive personality test?

Further research is also warranted to investigate whether those with low self-esteem will improve physiologically with rising self-esteem, as seems likely. "Real-world" investigation may soon be possible using advanced technology

(i.e., the Holter monitor records twenty-four hours of the electrocardiogram while the client goes about his everyday routine).

Additional research investigating the role of self-esteem in the aging process is recommended. This study strongly suggests that having low self-esteem, which produces concurrently elevated stress and depression levels, is a key factor in the aging process. The low self-esteem person seems to "practice" deleterious psychophysiology over his lifetime and accelerates the aging process.

Implications for Education

This study demonstrated that self-esteem is a meaningful construct with practical implications. Self-esteem was shown to be reflected in one's physiological characteristics in several ways. Which one "causes" the other is of little import to the teacher or clinician (e.g., a student with low self-esteem can learn relaxation, an adaptive coping strategy that reduces high blood pressure which in turn may help raise the student's self-esteem).

However, the subtle interplay between cause and effect involving a "feedback loop," as described in the example above, is the stuff of self-theory. Untangling these nuances will enable construction of adequate scales for self-report instruments for the teacher and school psychologist. Thus armed the teacher can guide the student into the most

productive area for enhancement of the self. In addition, the teacher or counselor can make accurate prediction about students' "real-world" behavior and can then guide them into more productive learning situations and enhanced mental health.

Implications for Theory

Many theorists have constructed self-concept tests and/or posited a multiplex entity which is instrumental for mental health (e.g., Coopersmith, 1967; Fitts, 1972; and Hurlock, 1974).

Coopersmith (1967) tests self-constructs primarily along dimensions of confidence and anxiety. Fitts (1972), the author of the Tennessee Self-Concept Scale, tests thirteen subscales and totals selected scores for an overall "Positive," or self-esteem score. Fitts' scales further cluster (using item analyses) to make what he labels empirical scales: defensive positive, general maladjustment, psychosis, personality disorder, neurosis, personality integration, number of deviant signs scores, number of integrative signs, and self-actualization scores.

Fitts' (1972) self-esteem score includes what he calls identify, self-satisfaction, and behavior. He adds these scores to others for physical self, moral-ethical self, personal self, family self, and social self to get what he calls the Positive Score, a measure of self-esteem.

Hurlock (1974) seems to find a balance between Coopersmith and Fitts. She posits four roles: the basic self, the ideal self, the transitory self, and the social self.

Recently published results from longitudinal studies of longevity and life satisfaction suggest that the above theorists are on the right track. However, they may not be directly measuring the predictors found in the longitudinal studies. Palmore (1982), in his 25-year longitudinal study, found that the strongest independent predictors of longevity for men were health self-rating, work satisfaction, and performance intelligence. For women the best predictors were health satisfaction, past enjoyment of intercourse, and physical function rating. His predictors constituted a difference in longevity of 16 years for men and 23 years for women. Interestingly, "usefulness" was a minor predictor for men and not significant for women.

"Self-perceived health," "not being neglected by friends," and "not riding in a car with a friend or neighbor as usual form of transportation" were significant predictors of life satisfaction for the elderly in a three-year longitudinal study (Baur and Okun, 1983).

Since the present study found that self-esteem accounts for as much as 50% of the effects in the aging process, future self-esteem instruments must reconcile the differences between findings in the longitudinal studies and current theory. (In fact, because of the imperfect reliability and validity of the Tennessee Self-Concept Scale, the

correlations found in the present study are undoubtedly conservative and the effect on aging due to self-perception is probably higher than 50%.)

Correlational investigations are always going to have certain kinds of problems with reliability and prediction. Inference is often made from behavior and self-report, but error-free inference, and hence prediction, may never be possible. Moreover, this researcher, given the human condition, certainly neither desires nor expects complete prediction. However, the technology is now present to improve prediction to a point where it can have meaningful positive future consequences for personality. For instance, in the longitudinal study above, "not riding in a car with a friend or neighbor as usual form of transportation" infers that "dependency on others" may be a predictor. Other research reported earlier in this study saying that "elderly men have a high rate of suicide" is additional inference that dependency may be a significant factor in self-esteem. "Past enjoyment of intercourse" suggests that longevity for women is related to the marriage relationship and thus the marriage relationship becomes a factor in self-esteem. Using inference in the above ways to produce an item pool and then grounding the items in physiology should enhance prediction of longevity, success, and other "real-world" behavior.

Construction of a self-concept instrument grounded in physiology would then make use of inferences from longitudinal studies, possibly items from the Coopersmith instrument and

the Tennessee Self-Concept Scale, and items generated by a theoretical model combining the above with Hurlock's (1974) model and the results of the present study (see Figure 6).

The model suggested in Figure 6 deletes Hurlock's "transitory self" in favor of a more developmental approach. A theoretical essay suggesting this approach to the study of successful aging was presented by Ryff (1982) and her argument seems compelling. She addresses issues of operational definitions, selective sampling, and stage theory.

The theoretical model for construction of a self-concept instrument grounded in physiology is necessarily incomplete at this point in time. More longitudinal data are needed. Further, additional research using the model itself will generate a more predictive model grounded in physiology. The projected model should have subscales that are not related to each other, assuming factor analyses, but they should be related to the overall construct of self-concept. Then the educator and the counselor will have a tool that will enable successful and meaningful prediction.

Conclusion

"Self-esteem" can be operationalized using phsyiological variables such as right forebrain electrical activity and systolic blood pressure. This then may lead to operationalization of more global constructs such as the self-concept.

SUBSCALES (factor analysis)	COGNITION (self-talk)	EMOTION (feelings)	PHYSIOLOGICAL INDICES	SELF-CONCEPT	BEHAVIOR
?Basic Self	?confidence Type A/B uselessness regard in/dependence in/external efficacy .....?				
Ideal Self	?identification values expectations .....?	stress depression ..... guilt ..... well being ....?	EEG blood pressure ..... speech senses eye blink body move- ments .....?	generalized self genetics environment filter feedback loop development	performance addiction longevity aggressive- ness incarcera- tion success suicide .....?
Social Self	?in/extrovert marital relations family others .....?				
Physical Self?	?perceived health strength .....? health satisfac- tion .....?				

Figure 6. Theoretical model for construction of a self-concept instrument grounded in physiology.

The findings in this study that depression, guilt, and well being states, in addition to stress, are related to self-esteem show that Cronbach and Snow (1977) and Corno et al. (1981), who were quoted in the literature review of this study, are in error when they characterized anxiety and self-esteem along a single dimension. This is so because the physiological effects found in this study show differing psychophysiology depending on the psychological event and the physiological variable and their relationships to self-esteem. This study demonstrates that self-esteem is an important, complex multidimensional concept grounded in one's physiology.

The most important novel contribution, among the many significant results reported in this study, is that self-esteem is highly involved in the aging process itself. This speaks to the importance of longitudinal studies and personality research, particularly self-esteem investigation.

APPENDIX I
SUBJECTS

TSCS Norm Group Mean = 347.0;
σ = 30.0.

Study Subject Mean = 347.5;
σ = 30.4.

SUBJECTS BY AGE GROUPS

Age	N = 70
15-59	N = 53
60-78	N = 17

SUBJECTS BY SEX

Sex	N = 70
Male	N = 29
Female	N = 41

There were no significant sex differences between the younger and older age groups (nonparametric Wilcoxon *t*-test approximation of 0.62 or $p > .05$).

SEX BY SELF-ESTEEM

There was no significant correlation between the sex of the subjects and self-esteem ($r = .17$, $p > .05$).

SUBJECTS BY SOCIO-ECONOMIC STATUS (SES)

SES	N = 70
Upper lower	N = 35
Lower middle	N = 21
Upper middle	N = 14

There were no significant SES differences between the younger and older age groups (Wilcoxon *t*-test approximation of 0.13 or $p > .05$).

There were no subjects in the sample (N = 70) from the lower or the upper classifications of SES.

SES BY SELF-ESTEEM

There was no significant correlation between SES and self-esteem ($r = 0.02$, $p > .05$).

SUBJECTS BY SES AND SEX

SES	SEX	N = 70
Upper lower	male	N = 13
	female	N = 22
Lower middle	male	N = 9
	female	N = 12
Upper middle	male	N = 7
	female	N = 7

SES BY SEX

Sex was approximately equally distributed within each socio-economic group. The non-parametric Wilcoxon 2-sample test gave a *t*-test approximation significance of 0.45, or $p > .05$. Thus statistically, there was no significant difference between the number of men and women in each socio-economic group.

THERAPY BY SELF-ESTEEM

There was no significant correlation between self-esteem and psychological therapy ($r = -.06$, $p > .05$). Further,

those who had therapy (N = 10) were approximately equally distributed among the self-esteem groups. The non-parametric Kruskal-Wallis test of chi-square approximation gave a chi-square of 1.61, $p > .05$, median one-way analysis. Thus statistically, there were not a significant number of those who had undergone therapy in any one self-esteem group.

APPENDIX II
INFORMED CONSENT

You will be requested to sit down in an easy chair and relax while we monitor some of your body's physiology.

With your help, three electrodes for an electrocardiogram and two for an encephalogram will be taped down by a researcher of your own sex.

Your help will also be requested in placing the blood pressure cuff on your left arm and the finger perspiration monitor on two fingers of your right hand.

After recording your responses while you relax for a couple of minutes we will read some statements from the self-concept forms you completed earlier. We want to see how your body physiology changes. We do not anticipate any discomfort or risk for you and will report your blood pressure to you when we turn the physiograph off.

Please feel free to ask any questions now or at any time they arise, whether the physiograph is on or not.

You are, of course, free to withdraw this consent at any time and discontinue without prejudice.

No monetary compensation will be awarded.

I understand if I am physically injured during this experiment, and if the experimenter is at fault, that I may seek appropriate compensation and may contact the Insurance Coordinator for information about compensation at 107 Tigert Hall, University of Florida, telephone number 392-1325. I understand that no other form of compensation is available.

I have read and I understand the procedure described above. I agree to participate in the procedure and I have received a copy of this description.

_____
Subject

_____
Relationship if other than subject

_____
Witness

George Michael Bedinger, 1403 Norman Hall, U.F.
Principal investigator's name and address

APPENDIX III
UNIVERSITY OF FLORIDA HUMAN SUBJECTS COMMITTEE APPROVAL

UNIVERSITY OF FLORIDA
INSTITUTIONAL REVIEW BOARD
114 PSYCHOLOGY BUILDING
GAINESVILLE, FL 32611
(904) - 392 - 0433

May 1, 1981

TO: Mr. George Michael Bedinger
1403 NRN

FROM: C. Michael Levy, Chair
University of Florida Institutional
Review Board

SUBJECT: Approval of University of Florida Institutional
Review Board Project # 81-73
"Physiological Correlates of Self-Esteem"

Your request for approval for a research project involving human subjects, referenced above, is approved as recommended by the University of Florida Institutional Review Board. The Board has concluded that subjects are placed at risk in the approved research. It is essential that you obtain written, witnessed informed consent (including the insurance statement) from each participant. You are reminded that a change in protocol in this project must be approved by re-submission of the project to the Board for approval.

If the project has not been completed by April 28, 1982, please telephone our office (2-0433) and request instructions for obtaining a renewal of this approval.

By a copy of this memorandum, your department Chair is reminded that she or he is responsible for being informed about the status of all projects involving human subjects in your department, and for reviewing the protocol of such projects as often as necessary to insure that each project is being conducted in the manner approved by this memorandum.

CML/her

cc:	Dr. Donald Avila		1403 NRN
	Dr. R. R. Sherman		314 NRN
	Dr. D. C. Smith		140 NRN
	Dr. F. M. Wahl	(unfunded)	237 GRI

APPENDIX IV
MEDICAL HISTORY AND SES QUESTIONNAIRE

CONFIDENTIAL

Do you have any important medical history that may affect your recordings, such as epilepsy, high blood pressure, cardiac disease, or emphysema? Are you in counseling now in either individual or group therapy? When did you start? Have you completed counseling and, if so, when?

(Please use back if necessary)

Have you taken any drugs or other medication today?

What is your occupation?

What is your education?

What is your father's occupation?

Do you have any questions?

Thank you.

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34

35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50

(All information will be kept confidential)

APPENDIX V
INSTRUCTIONS TO SUBJECTS FOR MENTALLY IMAGING TREATMENT CONDITIONS

WELL BEING

Initial instructions:

"I would like for you now to mentally image feeling good. Please relax as much as possible and think of taking a trip to a place that you really like.

Go someplace like the beach or to the mountains. Go with someone or by yourself. I want you to really enjoy where you are while you are relaxing. Try to really experience where you are. For instance if you go to the beach I want you to smell the salt air and feel the ocean breeze. Feel the hot sun on your skin. Relaxing and enjoying. . . . If you go to the mountains I want you to feel the cool mountain air, hear the wind in the trees. Relaxing and enjoying. Feeling so good. . . ."

During data collection:

As blood pressure cuff inflates: "relaxing and enjoying. . ."; after deflation: "feeling so good. . . ."

DEPRESSION

Initial instructions:

"I would like for you now to mentally image feeling bad. Please think of something bad that has happened to you in

the past. Something like not having enough money or a close loved one lying in a casket. Try to really experience where you are. For instance if you think of being out of money try to recall the feeling you had when you saw the bills and wondered what you were going to do. Feeling so bad. . . . If you think of a lost loved one I want you to see the casket closing. . . . You'll never see this loved one again. Feeling so bad. . . ."

During data collection:
As blood pressure cuff inflates: "what am I going to do? . . ." after deflation: "feeling so bad. . . ."

GUILT

Initial instructions:

"I would like for you now to mentally image feeling guilty. Please think of something you did in the past that you really wish you had not done. Or think of a time when you said something to someone that you later wished you had not said. Try to really relive the guilty feelings and say things to yourself like 'I really wish I hadn't done that' or 'I wish I could take back what I said.'"

During data collection:
As blood pressure cuff inflates: "I really wish I hadn't done that. . . ."; after deflation: "I really wish I could do that over. . . ."

STRESS (instruction induced)

Initial instructions:

"I'm now going to read you five statements about death. I want you to think of yourself as I read them."

During data collection:

As blood pressure cuff inflates: "I am not at all afraid to die. . . ."; after deflation: "I am not at all afraid to die. . . ."

APPENDIX VI
RESULTS OF ANALYSIS OF VARIANCE PERFORMED ON SYSTOLIC BLOOD PRESSURE MEASURED SEPARATELY FROM PHYSIOGRAPH AND ITS RELATIONSHIP BETWEEN YOUNGER AND OLDER AGE GROUPS

RESULTS OF ANALYSIS OF VARIANCE PERFORMED ON SYSTOLIC BLOOD PRESSURE MEASURED SEPARATELY FROM PHYSIOGRAPH AND ITS RELATIONSHIP BETWEEN YOUNGER AND OLDER AGE GROUPS

SOURCE	DEGREES OF FREEDOM	MEAN SQUARE	F	PROBABILITY
Age groups	1	2196.49	14.37	0.001
Error	68	152.82		

AGE GROUP	AGE	MEAN	σ	N = 70
Younger	15-59	115.1 mm Hg	11.8	N = 53
Older	60-78	128.1 mm Hg	13.0	N = 17

Systolic blood pressure is significantly different between age groups. (Millimeters of mercury is abbreviated mm Hg.)

APPENDIX VII

RESULTS OF ANALYSIS OF VARIANCE PERFORMED ON DIASTOLIC BLOOD PRESSURE MEASURED SEPARATELY FROM PHYSIOGRAPH AND ITS RELATIONSHIP BETWEEN YOUNGER AND OLDER AGE GROUPS

RESULTS OF ANALYSIS OF VARIANCE PERFORMED ON DIASTOLIC BLOOD PRESSURE MEASURED SEPARATELY FROM PHYSIOGRAPH AND ITS RELATIONSHIP BETWEEN YOUNGER AND OLDER AGE GROUPS

SOURCE	DEGREES OF FREEDOM	MEAN SQUARE	F	PROBABILITY
Age groups	1	15.91	0.24	0.62
Error	68	67.27		

AGE GROUP	AGE	MEAN	σ	N = 70
Younger	15-59	73.6 mm Hg	8.1	N = 53
Older	60-78	72.5 mm Hg	7.8	N = 17

Diastolic blood pressure was not significantly different between age groups. (Millimeters of mercury is abbreviated mm Hg.)

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BIOGRAPHICAL SKETCH

George Michael Bedinger was born May 8, 1939, in Charleston, WV. He graduated from Stonewall Jackson High School in Charleston and began college at Hampden-Sydney College, VA, in 1957.

After two years he transferred to Marshall University where he continued a concentration in chemistry and zoology and a major in psychology. For the four summers between sessions he was employed in the chemical laboratories of Union Carbide Corporation.

In early 1962 he was ordered to active duty in the U.S. Army and served five years. Upon returning from Vietnam he resigned his commission to continue his formal education.

Bedinger graduated from the University of Charleston in 1968 with a B.A. in psychology. He graduated from the University of South Florida in 1974 with an M.A. in political science and a community college teaching certificate.

He taught for six years at Tampa College where he also served at various times in the following capacities: chairman of the social sciences department, dean of the St. Petersburg campus, and assistant dean of the college.

He was an adjunct instructor at Hillsborough Community College and is currently an adjunct instructor at Lake

City Community College and Central Florida Community College in addition to employment at the University of Florida (UF).

While at UF in his doctoral program in educational psychology, Bedinger was employed as a graduate teaching assistant and also earned a Certificate in Gerontology. At UF he also presented a poster session (as second author) in the Experimental Psychology division of the American Psychological Association.

Bedinger's current employment at UF is in the Division of Continuing Education where he has rewritten (first author) and instructs a high school psychology course (workbook format) which is implemented in many Florida high schools. He also is presently serving on the State of Florida Life Skills Task Force (Division of Community Colleges and Department of Corrections) and has authored articles in their publications.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Donald L. Avila, Chairman
Professor, Foundations of Education

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This dissertation was submitted to the Graduate Faculty of the Department of Foundations of Education in the College of Education and to the Graduate Council, and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

August 1983

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