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HEART RATE RESPONSES TO AFFECTIVE AND NONAFFECTIVE VISUAL STIMULI BY AGGRESSIVE AND NONAGGRESSIVE MENTALLY RETARDED ADULTS AND NONHANDICAPPED ADULTS

A Dissertation

Presented in Partial Fulfillment of the Requirements for the Degree Doctor Philosophy in the Graduate School of The Ohio State University

By

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* * * * *

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Background

In our continued efforts to provide effective services to mentally retarded persons, we are often confronted with the repeatedly violent, acting-out client. Such individuals present a chronic risk to both themselves and others, and are many times relegated to institutional care. Recent surveys in this community (Schumacher, 1977; DeRienzo, 1978) have identified large numbers of institutionalized developmentally delayed individuals who continually display destructive-aggressive behaviors involving physical injury and damage to institutional property. Macy (1970) reports that a 1972 survey at the Orient State Institute identified 400 residents as aggressive or destructive. Similarly, Bunck (1977) reports that in 1976 at the Columbus State Institute, the aggressive residents were responsible for 280 episodes in which intervention by police was required; from 20 to 40 personal injuries to staff members each month, 2500 window replacements, 2
to 3 toilets and/or sinks torn from fixtures each month, about $40,000 worth of furniture damaged and an average of 6 episodes per day requiring the use of a seclusion room. Aggressive behavior represents one of the most formidable barriers to effective programming and deinstitutionalization in that clients may receive treatment aimed more at reducing levels of maladaptive behaviors than at producing the appropriate levels of adaptive skills.

Understanding the nature of aggressive behavior in these "problem" clients may be important in achieving the ultimate goals of normalization and deinstitutionalization. Beyond the moral and legal dilemmas presented by aggressive clients, questions arise as to why these behaviors take place, or, in essence, through what kinds of processes aggressive behaviors in mentally retarded individuals are mediated. A considerable amount of attention has been directed toward the theoretical analysis of aggression, with certain authors preferring a drive reduction theory approach emphasizing reactions to frustration (Dollard, Miller, Mowrer, Doob, and Sears, 1939), the effects of modeling and imitation (Bandura, 1965), or the building of aberrant reward and punishment relationships (Patterson, Littman and Bricker, 1967), while others prefer a psychoemotional orientation in which aggression results from innate self-preservative
(Lorenz, 1966) or self-destructive (Freud, 1919) impulses. Still others rely heavily upon neurobehavioral explanations (Mark and Ervin, 1970; Gellhorn, 1968; Moyer, 1976) in which the organ systems of the body respond to and act upon the environment, yet in which the neural and neurochromonal substrates of aggression are of primary emphasis.

Within the practical realm of trying to control the aggressive-destructive behavior of retarded clients, behaviors are generally analyzed in terms of antecedent and consequent stimuli, response topography, frequency, intensity and duration, but entirely on an overt behavioral level. Little attention has to this point been directed at identifying the covert or internal aspects of emotional behavior in mentally retarded individuals; that is, physiologically, what goes on inside a client's body when the environmental conditions seem to elicit an emotional display, and additionally, when conditions call for the inhibition of an emotional display.

In a recent review of the literature, Griggs and Dawson (1978) indicate that measures of covert "behavior," in terms of autonomic nervous system activity, provide clues to the organism's level of arousal, or preparedness to deal with the environment, and, in the case of measures
of cardiovascular activity, may also indicate whether the organism is taking in or avoiding information. Experiments by Lacey (1978) and Karrer (1975) have shown that the heart both responds to environmental stimuli and plays a behaviorally mediating role in ongoing behavior through complex, reciprocal effects upon the central nervous system (CNS). Certain aspects of cardiovascular function such as fluctuations in blood pressure, heart rate variability, tachycardia (heart rate speeding) and bradycardia (heart rate slowing) have been utilized in defining neural and somatic responses to stimuli, and in quantifying relative behavioral and physiological arousal. The behavior of the heart can provide a valuable indice of the state of the organism - its level of preparedness to interact with the environment, and its responses to stimulation.

Both physical preparedness and the ability to attend to and extract information from the environment are highly adaptive behaviors, the mechanisms of which are provided by the central nervous system, and the effects of which may be reflected in cardiovascular functioning. Developmentally delayed individuals manifest both intellectual and adaptive behavior deficits (Grossman, 1977), aberrations which in some cases are due to CNS pathology, but which in most cases are associated with
functional deficits in information processing, attention and memory (Zigler, 1966; Zeaman and House, 1963; Robinson and Robinson, 1976). The question arises as to the possible value of a psychophysiological index such as heart rate in determining or quantifying deficits like those mentioned above; and in identifying individuals who frequently display aggressive-destructive behavior.

**Problem**

Sokolov (1963) contends that the orienting response, a configuration of physiological responses to novel stimuli, is weaker or less vivid in mentally retarded individuals than in the non-retarded of similar age. Similarly, Luria (1963) proposes that the orienting response habituates, or diminishes, less rapidly in retarded subjects. Other investigators (Karrer, 1975) have shown consistent differences among retarded individuals (e.g., Downs Syndrome differed from persons whose retardation was diagnosed as cultural-familial). Differences have also been noted between retarded and nonretarded subjects in physiological responses to stimuli.

The purpose of this investigation is to examine one aspect of physiological process, heart rate, in aggressive and nonaggressive mentally retarded adults and in non-handicapped adults to determine whether the heart rate responses of aggressive retarded individuals differ from
those of nonaggressive retarded and nonhandicapped subjects. If differences are found, the implications for diagnosis and rehabilitation will be discussed, and suggestions offered for future research.

Hypotheses

In light of the theoretical propositions of Sokolov (1963) and Luria (1963) indicating that orienting responses and habituation to stimuli in the retarded may differ from those in non-handicapped individuals, one would expect that the presentation of various affectively loaded visual stimuli would evoke different response patterns in such groups of subjects. This study will examine the following hypotheses:

1. There will be no difference between the subject groups in the distribution of mean heart rates across all conditions.
2. There will be no differences between the subject groups in the distribution of mean heart rates during baseline, affective stimulus, and neutral stimulus conditions.
3. There will be no differences between the subject groups in the direction and/or magnitude of heart rate changes to affective, neutral, and combined affective and neutral stimulus conditions.
4. There will be no differences between the subject groups in the amount of heart rate variability across baseline, affective, neutral and combined conditions.
5. There will be no differences between the subject groups in mean habituation to stimulus presentation.
Relevance

Society's inability to deal effectively with violent, maladaptive individuals results in both the continued presence of inter-human aggression and in the existence of institutions such as prisons and mental health and mental retardation facilities. Although the comparison between correctional and mental health facilities may be invalid in some respects, both types of institutions serve the purpose of housing and secluding individuals who are deviant, and whom society cannot effectively deal with at this time. In the case of aggressive developmentally delayed individuals current methods and tactics for remediation of socially unacceptable agonistic behavior are comparable to those which are employed for violent criminals and the end result is much the same: more or less permanent incarceration. If we are to develop effective remediative services for those retarded persons who are chronically aggressive, it may prove facilitative to understand the characteristics of and the reasons for their behavior, such as understanding individual styles of response, patterns of arousal, and inhibitory or self-control deficits.

Data gathered here may also serve to aid in the formulation of individualized program plans, by identifying patterns of stimuli which affect the individual more
than others, potentially indicating which information is being attended to, which is ignored, and which stimuli are of importance to the individual, whether in preference or aversion. In sum, an index of physio-behavioral functioning could aid in the theoretical analysis of aggression in the developmentally delayed, and in the formulation of effective individualized habilitation plans based on aspects of both overt and covert behavior.
This chapter presents a review of literature pertinent to this dissertation, dealing first with theories of aggression and focusing on behavioral and physiological arousal. It continues with an examination of the psychophysiology of the cardiovascular system, its neural substrates and functional properties. Finally, a review of relevant mental retardation literature is presented, including studies of aggressive behavior and cardiovascular psychophiology.

Theories of Aggression

Contemporary theories of aggressive behavior generally emphasize one or the other of three different lines of thought in accounting for the development of agonistic behavior. These include explanations in terms of

1) either biologically or instinctually based explanations,
2) in terms of patterns of reaction to frustration, or
3) in terms of socially mediated learning. A fourth and newer approach which is based on physio-behavioral relationships can be added to the above, and here will be
presented in hopes of integrating certain previously divergent data and concepts.

Aggression has been defined by Buss (1961) as "a response that delivers noxious stimuli to another organism". The definition provides two essential criteria for an aggressive act in 1) the delivery of noxious stimuli, and 2) an interpersonal context. Other workers have added to the definition of aggression the notion of "intent" (Moyer, 1973) in order to further discriminate between acts which cause pain or damage yet are accidental, and those which are intended. Yet other researchers utilize the concept of instrumentally in defining aggression (Patterson and Cobb, 1973; Bandura, 1973). As an example, Bandura points out that a limited definition, which is restricted to intentional aggression, may imply that aggression serves only the purpose of inflicting injury, whether intended or not. Bandura proposes that much of agonistic behavior stems from an individual's desire to obtain extraneous rewards rather than from the intent to cause suffering. Feshbach and Feshbach (1971) however have warned that the preferred definition of aggression depends upon both the theoretical orientation(s) of the user and the demands of the research. For purposes of this investigation, aggression will be defined as behaviors that result in personal injury and/or the destruction of property (Bandura, 1973).
Biological-Instinctual Theories

The biological-instinctual position utilizes strict, operational definitions the least, a point which has led to a great deal of criticism (Montagu, 1976; Berkowitz, 1969), yet which has also allowed for intriguing and often productive theorizing. Proponents of such a position contend that man is innately aggressive and that violence is an intrinsic component of human behavior, whether it is viewed as a consequence of natural selection (Lorenz, 1966) or merely as an integral part of personality development (Freud, 1919). The classic writings of McDougall (1909) proposed that aggression was an instinct...

"an inherited or innate psycho-physical disposition which determines its possessors to perceive, and to pay attention to, objects of a certain class, to experience an emotional excitement of a particular quality upon perceiving such an object and to act in regard to it in a particular manner, or, at least, to experience an impulse to such action (p. 25)."

The instinct of aggression for McDougall, represented one aspect of the human personality (which curiously enough was lacking "in the constitutions of the females of some species") and which provided the substrate for certain types of motivation and emotion.

Freud (1919) initially hypothesized two groups of instincts, the sexual and the ego instincts, to be the
dynamic or driving forces behind human development. Following World War I however, Freud, in reaction to his unsatisfactory explanations of sadistic and masochistic behaviors, refashioned his theory by proposing a labidinal or life-enhancing instinct (Eros) and a death instinct (Thanatos). Aggressive behavior was the result of a conflict between the two theoretically biological processes, one life preservative and the other death seeking. In the healthy individual, Eros did not allow the death instinct to be turned inward or become focused upon the individual; thus, the power inherent in the death instinct was directed outward toward the destruction of others, and manifested as aggressive behavior. Freud considered aggression to be a necessary component of normal development and the product of innate motivational and emotional processes.

Within the realm of biological-instinctual theories are Lorenz (1966) especially, and Ardrey (1966), Storr (1968) and Morris (1968) who speak in terms of the adaptive functions of "normal" aggressiveness. Berkowitz (1969) in reviewing the most recent publications of the above authors points out that:

"All four voice essentially the same message: Much of human behavior generally, and human aggression in particular, must be traced in large part to man's animal nature. A spontaneously engendered drive impells (sic) us to aggression, even to the destruction of other persons (p. 286)."
Lorenz (1966) believes that human aggression is an adaptive instinct, released upon the presentation of specific survival-related cues, and warns that...

"Knowledge of the fact that the aggressive drive is the true, primarily species-preserving, instinct enables us to recognize its full danger; it is the spontaneity of the instinct that makes it so dangerous. (p.49-50)

The aggressive instinct is for Lorenz much the same as McDougall had earlier conceived in that aggressive behavior is innate and cue dependent, but Lorenz tends to base his theory on the functional, survival-related aspects of aggression as one component of successful adaptation, noting that man appears to be the only earth bound species that aggresses purely for the sake of aggressing, without the immediate necessity of survival-related conditions.

In a general sense, to propose that man is innately aggressive allows for great freedom in theorizing, as it neglects or takes for granted human abilities which may be learned. Berkowitz (1969) argues that the Lorenzians have continually failed to recognize that "constitutionally governed impulsive responses can be modified by learning", that the ethological literature takes a "simplistic" view of aggression, and that the repeated use of "excessively free-wheeling" analogies misrepresents the data available.
Drive Models and the Frustration-Aggression Hypothesis

Perhaps one of the more provocative reports published in the field of aggression was that of Dollard, Miller, Mowrer, Doob and Sears (1939), which proposed that aggressive behavior presupposes the existence of frustration, and conversely, that the presence of frustration is followed by some form of aggression. Miller (1948) submits that the frustration-aggression hypothesis:

"...is intended to suggest to the student of human nature that when he sees aggression he should turn a suspicious eye on possibilities that the organism or group is confronted with frustration; and that when he views interference with individual or group habits, he should be on the lookout for, among other things, aggression. (p. 337)

It should be noted that the 1948 version of the frustration-aggression hypothesis is stated quite a bit more loosely than that of 1939, likely due to the fact that research failed to support the hypothesis as originally stated.

The frustration-aggression hypothesis implies that frustration results from interfering with ongoing, purposeful activity, thereby preventing drive reduction; a person tries to overcome an obstacle blocking goal attainment such that the aim of frustration-induced aggression is the removal of obstacles to the goal. However, as Berkowitz (1969) points out in his review
of research related to the frustration-aggression hypothesis, a) frustration does not universally result in aggression, and b) aggression aimed at goal attainment does not necessarily result in drive reduction. Although in its original form, the frustration-aggression hypothesis was not supported, it did instigate a great deal of research (Bandura and Walters, 1963; Berkowitz, 1969a, 1969b; Burnstein and Worcel, 1962; Buss, 1963; Kaufman, 1970; Rosenzweig, 1941; Sears, Maccoby and Levin, 1967 to cite a number of examples).

The frustration-aggression hypothesis has been heavily criticized in that its terms, both 'frustration' and 'aggression', are not objectively defined and raise more questions than were actually answered (Feshback, 1970; Kaufman, 1970). One criticism of the hypothesis is its seeming failure to include other apparent antecedents to aggression such as pain. Pain has been shown to elicit within and across-species fighting in many animals (Ulrich and Azrin, 1962; Ulrich, Wolff and Azrin, 1964; Ulrich, 1966). Berkowitz (1965, 1966, 1969a) has proposed a pain-frustration-aggression hypothesis to explain aggressive reactions to aversive stimuli. Berkowitz has investigated the properties of frustrative non-reward, finding that both pain and frustration belong to the same class of aversive stimuli and thus produce aggression for the same reasons.
**Social Learning Theory**

Contemporary learning theory states that aggressive behavior is largely generated and maintained through a process of learning in an interpersonal or social context. Feshbach (1970) states that:

"...All theoretical models of aggression assume that aggressive behavior is, to some degree, acquired. The disagreements among theorists lie in the importance ascribed to learning as a determinant of aggression and in the kinds of aggressive behavior that are assumed to be influenced by past learning." (p. 173)

Stimulus-response models have been used to conceptualize human aggression primarily through the reinforcing qualities or instrumentality of aggressive acts (Bandura, Ross and Ross, 1961; Buss, 1961); or, through the characteristics of the stimuli or conditions leading to aggressive behavior (Berkowitz, 1962, 1964, 1965; Patterson, Littman and Bricker, 1967; Patterson and Cobb, 1973). Learning theories generally attribute the existence of aggression to patterns of behavior which are acquired, maintained and modified in response to rewarding and punishing contingencies presented by the environment, whether generated by parents, peers, or any number of social or economic factors.

Bandura (1963, 1973) and Feshbach (1970) propose that aggressive behaviors are learned early in life through a socially mediated process of modeling and imitation.
Bandura and Huston (1961) and Bandura, Ross and Ross (1961) have shown that a model's incidental aggressive responses effect subsequent aggressive behaviors in children. When children observed a model who was either rewarded or punished as a result of aggressive behavior, more imitative aggressive acts were seen in children who observed the rewarded model, than in those who had observed either a non-rewarded or a punished model (Bandura, 1965). Walters (1966) argues that human models (11) "serve as cues which indicate that a particular kind of behavior is permissible or non-permissible in a given social context" and that "seeing a model rewarded leads the observer to anticipate that he, too, will be rewarded if he acts similarly to the model." For the Bandura group, the cause of aggressive behavior is the social reward-punishment array, while the major mechanism for building and maintaining aggression is observational learning.

An imitation or modeling approach has proven useful in explaining the effects of televised violence on children's behavior. Bandura (1969) points out that observational learning can occur through stimulus contiguity; reinforcement is not necessary, thus a child could learn specific aggressive acts merely by watching them take place on TV. Although studies have shown that
prosocial behavior may be acquired through the observa-
tion of models, Hoffman (1970) suggests that modeling is
not very effective in producing inhibitory behavior such
as resistance to temptation and nonaggression. Friedrich
and Stein (1973) exposed groups of children to equal
amounts of either aggressive, prosocial or neutral tele-
vision, and found that aggressive programs produced
effects on aggressive behavior and self-regulation. The
authors report that...

"One of the most clear-cut findings in
this study was a sharp decline in tolerance
of delay by children who saw the aggressive
programs. They also declined some in rule
obedience. Both of these findings suggest
that the aggressive programs led to reduced
willingness on the part of the children to
exert self-control or to tolerate minor
frustrations." (p. 204)

Thus, it appears that the social environment, even when
passively presented in the form of visual media, may
influence the development of aggressive behaviors.

Also in the learning theory orientation, Patterson,
et al., (1967, 1973) base their research on the belief
that aggressive behaviors are functions of both discrimi-
inated eliciting stimuli and reinforcing consequences. The
"social environment" provides the organism with mixtures
of positive and negative reinforcement which act to
shape and maintain patterns of aggression behavior.
Positive reinforcement may establish objects in the
environment as discriminative stimuli through their association with positive consequences after attack, and research has shown (Patterson, et al., 1967, 1970) that even the victim's pain cries may be positively rewarding to an aggressor and thus increase the probability of future attack. Patterson and Cobb (1973) also propose that aggressive behaviors may also be established through a process of negative reinforcement...

"Negative reinforcement occurs in social interaction when one or more members introduces an aversive stimulus. The appropriate behavior of the 'victim' terminates the presentation of the aversive stimulus. The 'aggressor' presents the aversive stimulus repeatedly, until the appropriate response is produced." (p. 156-157)

Patterson, perhaps more than Bandura, is concerned with discrete stimulus-response-consequence relationships in explaining aggressive behavior, yet the two theories have several points in common, above and beyond the fact that both groups use the term 'social learning theory' to describe their position. Both emphasize that aggression is 1) learned through contingencies established within the social environment, and 2) that it may be controlled by the appropriate changes in child rearing practices, cultural traditions and parental examples (Gilula and Daniels, 1971).
Neuro-Behavioral Models

It is apparent that each of the above theories of aggression offers a particular level or type of explanation, portions of which researchers will find more or less useful depending upon the needs and goals of their work. The theories do, however, draw oftentimes sharp distinctions between what is considered learned and what is innate, the end product of which is a theory that lacks a good deal of explanatory power. An interactionist position based on physio-behavioral relationships would seem to provide an apt model for the integration of constitution and learning, of anatomical form and functional significance. Such a model could be extremely useful in the area of developmental disability, where problems of learning and maladaptive behavior often stem from a combination of physiological and social-environmental factors.

Physiological models of aggression have tended to be encompassed within general theories of the neural substrates of emotion. The classic Peripheral Origin Theory of emotion proposed by James (1884) and Lange (1885) provides an early attempt at explaining complex behavior in terms of an interaction between the environment and the body. Grossman (1973) explained that:

"According to this theory environmental stimuli impinge upon distance receptors and elicit activity in the sensory areas of the cortex. This reflex produces excitation in
somatic as well as autonomic motor pathways and consequent changes in muscle tension, blood pressure, sweat secretion, and the like. This, in turn, stimulates interoceptors and initiates impulses that return to cortical receiving areas that monitor autonomic and skeletal motor functions. This gives rise to the perceptions that add the emotional quality to the original perception of the environmental stimulus." (p. 274).

The James-Lange theory predicts that an environmental stimulus should produce a physiological reaction and give rise to an emotion. Although later research such as that of Cannon (1927) pointed out that the peripheral origin theory of emotion could not fully account for complex emotional experiences, the model provided an early attempt at explanations based on brain-behavior interactions.

Cannon (1927) proposed an "emergency" theory of emotion, implicating both the autonomic nervous system and neurohormonal agents in emotional behavior. Cannon's theory held that emotional stimuli activated the sympathetic branch of the autonomic nervous system and caused the release of epinephrine and norepinephrine from the adrenal medulla, which in turn, prepared the body for rapid, survival-related actions, including fight, flight, and/or defense.

Before proceeding further with neuro-behavioral models, a brief look at the relationships between behavioral and
physiological arousal and the functions of the autonomic nervous system is necessary. The nervous system consists of both somatic and autonomic components, the former being primarily responsible for the reception of sensory information and the mediation of bodily movement while the latter serves to regulate homeostasis functions. The autonomic nervous system (ANS) is subdivided into two branches, the sympathetic and the parasympathetic, which act in a balanced, reciprocal manner to control the viscera and mediate homeostasis and the expression of emotion. This interactive balance of systems was early proposed by Cannon (1927), the sympathetic branch serving the function of mobilizing the body for the rapid expenditure of energy as in fight and flight, and the parasympathetic branch producing vegetative or energy restoring effects. Such balance is explained by Hubbard (1975):

"It will be noted that, where an organ is Innervated by the sympathetic and parasympathetic division, it will be excited by one and inhibited by the other. For instance, while our hearts are normally under a degree of vagal slowing, when we are excited, the vagal depression is removed and a sympathetic acceleration takes place." (p. 38)

In general, sympathetic stimulation results in pupillary dilation, a dry mouth (inhibition of salivary secretion), stoppage of gut contraction, an increased heart rate and blood pressure, constriction of the peripheral vasculature, dilation of the vessels in the head, and erection of hairs.
The parasympathetic division usually has the effect of inhibiting or dampening the above reactions, such that the end product, behaviorally and physiologically, of ANS activity is the sum of sympathetic and parasympathetic excitation.

Lindsley (1951), Hess and Ackert (1955), Morgan (1957), Stellar (1960) and Malmo (1962) have all proposed theories of motivations and emotion emphasizing the importance of various central nervous system centers such as the recticular formation, thalamus, and hypothalamus, in both behavioral and physiological arousal and in concomitant activities such as aggression, fear, hunger, thirst and so on. The point is that both the overt behavioral and the covert physiological components of any one act are highly interrelated, such that contemporary theorists and researchers have found it necessary to utilize the relationships between the environment, the brain and the body to explain complex human behavior.

Returning specifically to aggressive behavior, Moyer (1976) has proposed a model based on central nervous system mechanisms and processes which mediate behavior. Moyer explains that:

The first premise of this model indicates that there are in the brains of animal and many innately organized neural systems which, when active in the presence of particular complexes of stimuli, result in a tendency for the organism to behave destructively toward those stimulus complexes. (p. 164)
Moyer emphasizes that, especially in man, these organized neural systems which mediate aggression are influenced by experience and learning, although the mechanism(s) by which such influence takes place is not stated. Brain-behavior systems exist at all levels of the central nervous system and include such functions as sensory input, output to motor neurons, sensory-motor feedback, reciprocally active facilitory and inhibitory centers, as well as neural interaction with endocrine, cardiovascular and other organ systems. Moyer feels that aggression is a product of neurophysiological substrates reacting to either internal or external (environmental) stimulation, and summarized his theory by stating:

> The model that best fits the available data is an interactive one. Feeling states and the correlated behaviors are most frequently a result of an interaction between the activity (or reactivity) of complex neural systems in the brain and the individual's cognitive reactions to external events. There is always some interaction involved but in any particular situation either the internal or the external conditions may have a predominant influence. (1976, p. 280)

Cardiovascular Psychophysiology

The cardiovascular system includes the heart, blood vessels and the blood they contain and serves to distribute oxygen and nutrients and to remove metabolic wastes from the body. Heart rate, outflow, and vascular pressure are automatically regulated through both the
sympathetic and parasympathetic branches of the autonomic nervous system, with cardiac innervation at the sinoatrial node producing atrial contraction, and at the atrioventricular node producing ventricular contraction. The CNS in turn, receives afferent feedback about the timing, force, volume and pressure of each heartbeat through sensitive receptors contained within the walls of the aortic arch and the carotid sinus. This information is transmitted via the vagus nerve to the nucleus tractus solitarius located in the lower brainstem. Here, the central portions of the ANS are closely intermingled with cardiac and respiratory centers, and with the somatic centers of the brain stem and spinal cord (Hurst, 1978). Thus, neuro-cardiac interactions are circular, or in the form of a number of feedback loops, allowing for an action in one system to produce an effect in the other, and vice versa.

It has long been known that the heart will respond to various environmental events with changes in rate and volume of outflow. Lynn (1966) indicates that there are the following three primary types of cardiac reactions to stimuli: 1) the orienting reaction in which the heart rate slows, serving to prepare the organism to deal with a novel stimulus; 2) the adaptive reaction in which the heart rate changes to accommodate environmental demands, serving the purpose of preserving homeostasis equilibrium,
Moyer emphasizes that, especially in man, these organized neural systems which mediate aggression are influenced by experience and learning, although the mechanism(s) by which such influence takes place is not stated. Brain-behavior systems exist at all levels of the central nervous system and include such functions as sensory input, output to motor neurons, sensory-motor feedback, reciprocally active facilitory and inhibitory centers, as well as neural interaction with endocrine, cardiovascular and other organ systems. Moyer feels that aggression is a product of neurophysiological substrates reacting to either internal or external (environmental) stimulation, and summarized his theory by stating:

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**Cardiovascular Psychophysiology**

The cardiovascular system includes the heart, blood vessels and the blood they contain and serves to distribute oxygen and nutrients and to remove metabolic wastes from the body. Heart rate, outflow, and vascular pressure are automatically regulated through both the
and 3) the defensive reaction in which the heart rate speeds, serving to mobilize the organism for efficient action in response to intense stimuli. All of the above reactions have a special significance in terms of the readiness of the individual to act, and his attention to the information provided by the stimulus.

The concept of the orienting response or orienting reflex (OR) was originally proposed by Pavlov (1927) and restated by Sokolov (1960) as a mechanism for maximizing the input of information by alerting the organism, increasing receptor sensitivity, and acting as a filter for irrelevant information. The OR is initiated presumably when incoming information differs significantly from neuronal models already stored in cortical tissue. Defensive reactions (DR) on the other hand physically prepare the organism for the rapid expenditure of energy, in sympathetic-like fashion. Researchers who utilize the OR-DR model hold that the OR is associated with heart rate deceleration, while the DR consists of heart rate acceleration.

Lacey and Lacey, realizing the existence of feedback loops between the brain and the heart, hypothesize that changes in heart rate and blood pressure affect the activity of the nervous system, in terms of cortical excitability. Lacey's group (Lacey, 1959; Lacey and Lacey, 1970, 1978; Lacey, Kagan, Lacey, and Moss, 1963) proposes that cardiac deceleration and blood pressure decreases
are detected by specialized cells in the aortic arch and carotid sinus, which in turn, send afferents to the brainstem. The afferents from these specialized cells hypothetically have an inhibitory effect upon higher neural systems, such that when the heart slows, fewer inhibitory impulses reach the brain, allowing for increased cortical activity, and therefore increased sensory sensitivity and cortical preparedness. Lacey and Lacey (1978) have supported this notion by showing that the heart slows in the foreperiod of a reaction time task and that following the presentation of novel stimuli, the heart first slows and then speeds, which suggests that cardiac deceleration is associated with focused attention or with the rapid uptake of information, as in the period following a novel stimulus. It is important to point out that Lacey and Sokolov disagree about what cardiac activities characterize physiological arousal. Sokolov holds that the defensive reaction consisting of heart rate acceleration represents the cardiac component of autonomic arousal, while Lacey contends that the cardiac response is paradoxical, in that initially a marked deceleration is observed, followed by the usual cardiac acceleration. However, the differences between the two theories may lie more in the level of data analysis used than in any logical inconformity, as both theories concur on the general effects of cardiac speeding and slowing.
Obrist and colleagues (Obrist, Gaebelein, Shanks, Langer and Botticelli, 1976; Obrist, Black, Brener and DiCara, 1974) do not believe that the direct neural-cardiac reciprocity has the effect which the above authors propose, and question the validity of using cardiac activity as a measure of behavioral or psychological events. Obrist, et al., (1976) states that:

...we feel that there is some question as to whether cardiovascular processes will provide us with useful information about behavioral events. (p. 339)

and,

...The basic question here concerns whether heart rate provides any more predictable information as to the behavioral outcome of manipulating attentional states as does an assessment of stimulus parameters. (p. 340)

The Obrist group believes that the cardiac effects seen in sustained attention paradigms such as the reaction time task are due as much to CNS mediated somatic (muscular) and metabolic processes as they are to the direct neural-cardiac loop proposed by the Laceys. As such, Obrist, et al., caution researchers to take great care in arriving at conclusions about behavioral states based on heart rate data.

The hypotheses of Sokolov and the Laceys have led to the use of several working assumptions in the current literature. These are 1) that cardiac deceleration is associated with information uptake, attention and
heightened cortical activity, 2) cardiac acceleration is associated with forced or motivated inattention and higher levels of cortical inhibition, and 3) cardiac acceleration is associated with autonomic and somatic arousal. The remainder of this chapter will examine the use of heart rate as an index of behavioral state, including attention, information processing and arousal in relation to the mentally retarded in general and the aggressive mentally retarded in particular.

Aggression, Mental Retardation and Cardiovascular Psychophysiology

Mental retardation is defined as subaverage general intellectual functioning concurrent with deficits in adaptive behavior occurring during the developmental period (Grossman, 1977). Mentally retarded individuals comprise about 3% of our population (Zigler, 1978) and may exhibit a range of symptoms in the areas of physical, social, vocational, emotional and intellectual deficit. Robinson and Robinson (1976) state that mental retardation should not be conceptualized as a unitary syndrome but rather as "a symptom which can stem from a wide variety of disorders." Robinson and Robinson further propose that:

It must be clear, therefore, that no single theoretical model will suffice to 'explain' retardation. Although some workers search for a general model, representing retardation as, for example, a simple slowing of development or a set of specific deficits, their searches are not likely to be fruitful. We cannot, however, expect to find pervasive
traits or dimensions common to all retardates but not to normal children, other than their relative deficit in general mental ability and its direct consequences. (p. 620)

Mental retardation is often evidenced through delays or aberrations in learning, memory, and/or attention (Zigler, 1966; Zeaman and House, 1968), physical abnormalities, and deficits in adaptive skills such as socialization and independent functioning (Leland and Smith, 1971).

Those mentally retarded individuals who are more severely impaired or who cannot function in a community setting because of emotional instability, acute medical needs, or repeated legal offenses are often relegated to the care of specialized institutional facilities. Robinson and Robinson (1976) indicate that about 1% of the population of mildly retarded individuals is institutionalized, with proportions increasing radically as the extent of impairment increases. One survey (Schumacher, 1977) pointed out that a significant portion, about 15%, of the residents of a local institution were chronically aggressive; that is, the residents displayed at least one major violent incident per month for a period of at least five consecutive months. Interestingly, Eyman and Call (1977), in a cross sectional study of maladaptive behaviors in the institution and community, reported that "The greater the severity of retardation, the more likely that a behavior problem was present."
Goldfarb (1943) and Kaufman (1967) have shown that institutional settings may have adverse effects upon the behavior and development of the individual, and Talkington and Hall (1969) suggest that "group living impositions of an institutional setting may contribute to aggressive patterns of retarded subjects." Aggression in the retarded has been investigated in light of the frustrating effects of diets (Talkington and Riley, 1971) and communication deficits (Talkington and Hall, 1969; Talkington, Hall and Altman, 1971), the results of which partially support an explanation of aggression on the basis of the frustration-aggression hypothesis. Aggression has also been studied with respect to territoriality among institutionalized clients (Paluck and Esser, 1971), defense of territory being considered a primitive means of social organization and environmental adaptation. Taking another approach, Cleland, McGavern and Case (1976) have examined aggressive behavior in relation to the day of the week, finding more outbursts on Monday than Thursday, an effect which they attributed to "reduced activity, absence of daily routine and scheduled events, and fewer personnel on Sunday."

Cleland et al., hypothesize that similar results would be found on days following holidays for many of the same reasons.
Talkington and Altman (1972) have proposed a modeling or imitative mechanism for the development of aggressive behavior in the retarded. These authors, in light of Zigler's (1966) findings that retarded persons depend heavily upon environmental cues for appropriate responses, suggest that noxious behaviors may be learned through the modeling of such behavior after its performance by an influential or authoritarian figure such as a highly regarded peer or any number of ward personnel. The case for a modeling explanation of aggression is not conclusive however, especially concerning more severely impaired individuals (Talkington and Altman, 1973), and a more widespread approach to the problem is generally advocated.

Realizing that approximately 75% of retarded individuals show no "hard" signs of brain damage (Zigler, 1978), it is reasonable to believe that much of their aggressive behavior is learned, whether through imitation of instrumental aggressive acts or as an acquired pattern of coping reactions brought about by the frustrations of deficits or maladaptive environments. Such aggressive acts may be the result of several factors, including 1) the learning of inappropriate responses to stimuli, 2) the misinterpretation of stimuli, and/or 3) the inability to inhibit inappropriate responses in the presence of certain stimuli.
In recent years, research has generated psychophysiological techniques which may be able to provide insight into the above processes by examining the covert correlates of learning and attention in the retarded. In fact, it is widely assumed that physiological response patterns, such as the orienting and defensive reflexes described earlier, are related to arousal, information intake, learning, and possibly intelligence (Kimmel and Deboskey, 1978). For example, Powazek and Johnson (1973) state that "Retarded individuals are thought to possess inadequate or weak orienting reflexes, which theoretically are correlated with attentional deficits and poor learning." However, caution is necessary, because a review of American investigations by Heal and Johnson (1970) reports that the evidence for a difference between retarded and non-retarded subjects in psychophysiological responding is inconsistent and confusing, with some studies demonstrating superior orienting reflexes in retarded subjects, and some demonstrating superior orienting reflexes in non-retarded subjects.

Attention and Information Processing

Populations which are often clinically described as having problems in attention, such as the mentally retarded and hyperactive and learning disabled children, typically exhibit slower and/or more variable performance on reaction time tasks, in which sustained attention is demanded
The reaction time (RT) task usually involves the presentation of a warning signal followed by a reaction signal. The subject is instructed to respond, by pressing a button, as quickly as possible to the reaction signal. Results from several studies (Lacey and Lacey, 1970; Obrist, Webb and Sutterer, 1969; Chase, Graham and Graham, 1968) indicate that in normal adults, fast RT responding is consistently accompanied by significant heart rate decelerations during the period between the warning stimulus and the reaction stimulus, with the deceleration reaching its peak at the second of the reaction stimulus. Further, developmental studies show that age is significantly and inversely related to both RT and the degree of heart rate deceleration (Shrouf, 1971).

Krupski (1975) compared the heart rate reactions of 12 normal and 12 retarded adult males during a reaction time task, utilizing 4, 7, and 13 second intervals between warning and reaction signals. Results revealed that the retarded subjects had significantly slower RT scores in all three conditions, and the retarded subjects manifested significantly smaller and more variable heart rate decelerations than did the normal subjects. Krupski, however, is reluctant to state that the differences in heart rate reactions are due to deficit attention in retarded individuals. Rather, she attributes the effect to a lack
of covert timing activity on the part of the retarded individuals.

Johnson (1971) concurs with Krupski in believing that differences between retarded and non-retarded subjects on components of the orienting reflex may result from cognitive rather than attentional deficits. Johnson suggests that simple stimuli, which contain little information to be incorporated into an internal model, would be unlikely to elicit differential orienting reflexes in retarded and non-retarded subjects. As stimuli become more complex, or laden with more information, retarded subjects should show deficit responses. A study by Powazek and Johnson (1973) presented both simple novel stimuli and "signal" stimuli, made meaningful through reinforcement, to 32 mildly retarded and 32 normal subjects. There were no reliable differences between the groups in heart rate reactions to the simple stimulus, but to the signal stimulus, retarded subjects demonstrated heart rate acceleration while the non-retarded subjects demonstrated slight heart rate deceleration. Powazek and Johnson assume that the failure of the retarded subjects to orient to the complex stimulus supports the possibility of an information processing rather than attentional deficit.

Taken as a whole, studies of heart rate reactions in the mentally retarded have generated only a moderate
amount of support for the use of psychophysiological measures as indexes of attention and cognitive activity (Elliott and Johnson, 1971). Yet such measures show promise as diagnostic tools. For example, Bradley-Johnson and Travers (1979), using a 65 db, 350 CPS (cycles per second) (approximately the level of normal conversation), monitored the heart rates of five healthy infants and five infants which had experienced some prenatal condition associated with later developing mental retardation. The potentially non-retarded babies demonstrated a reliable heart rate deceleration immediately following the tone, whereas the at-risk babies manifested no significant change in heart rate. In short, the healthy infants showed the typical orienting response while the traumatized babies did not.

Heart Rate Responses in Affective Situations

Cannon (1927) early proposed that autonomically mediated physiological states are correlated with behavioral states. Thus, when a person is startled by a novel event, hurt by a painful event, or aroused by an emotional event, the internal and external states may be synchronous and causally related. Grossman (1973) states that:

Many early investigators reported that autonomic measures such as changes in the skin resistance could be used to identify specific emotional reactions - a liar could be found out because his breathing changed just before telling a lie. (p. 276)
Further investigation revealed that these changes were not as clear and straightforward as some early workers believed. Sokolov (1963), for instance believed that psychophysiological reactions such as orienting and defensive responses reflected the general level of arousal or activation moreso than a specific emotion of one sort or another. Grossman (1973) points out that "Stimuli that have special meaning may elicit intense and immediate reactions even though they are not very intense, sudden or novel, but one cannot tell whether the emotional experience is pleasant or unpleasant." Still, the use of a psychophysiological index may provide insight into the internal or covert accompaniments of certain behavioral states. As Grossman contends:

There is still hope that each emotion might, after all, be related to a particular pattern of physiological responses. Some respond differently to stimuli that elicit fear than to stimuli that evoke anger and aggression. Others appear to differentiate between positive and negative affect. Still others respond in qualitatively similar ways to all emotion-inducing stimuli but give larger responses to some. We have not yet come up with the magic combination of measures that permits certain identification of specific emotional experiences but have not entirely given up hope. (p. 277)

The potential usefulness of psychophysiological indices of emotional and motivational states has brought about a good deal of research, the majority of which utilizes Sokolov's concepts of the orienting and defensive responses. For example, phobics exhibit heightened
activity in the sympathetic branch of the autonomic nervous system when exposed to a particular feared situation (Klorman, 1974). Hare (1973) showed pictures of spiders to groups of subjects either high or low in fear of spiders, and found that high-fear subjects demonstrated heart rate acceleration characteristics of a defensive response, while low-fear subjects manifested the orienting response of cardiac slowing. Klorman, Weissberg and Wiesenfeld, 1977) have replicated the above, finding lawful relationships between individualized aversions and cardiac responses. Fredrikson and Ohman (1979) attempted to demonstrate psychophysiological differences between groups of subjects conditioned to fear-relevant (snakes and spiders) and fear-irrelevant (flowers and mushrooms) visual stimuli. Mild shocks were paired with all stimuli over an 8-trial acquisition period, after which each stimulus was presented 20 times without shock. No differential heart rate reaction was exhibited to shocked and non-shocked cues and there was no effect of fear-relevance. The authors suggest that this result may be due to the relatively few pairings of stimulus and shock, and that a larger acquisition period could produce the classical heart rate phobic reaction.

Using a different stimulus parameter, Gang and Teft (1975) investigated the effects of an affective noise, in this case the sound of a dentist's drill, on the heart
rate responses of 38 female subjects. Subjects were assigned to groups on the basis of their past experience, familiarity with dental noise, and measures of hostility, depression and anxiety. Results showed that the heart rate reactions varied directly with the subject's familiarity and subjective experience with the stimulus. Subjects who had less experience with and who had rated the stimulus as more unpleasant showed greater heart rate accelerations.

Mangelsdorff and Zuckerman (1975) utilized massacre scenes to investigate the effects of "set" on heart rate responses. Groups of Army ROTC trainees and non-ROTC students were shown pictures of auto accidents and massacre scenes labeled either "Viet Cong massacre of civilians" or "American massacre of civilians". The majority of subjects showed a deceleratory cardiac response to the auto accident scene and the "Viet Cong" massacre scene, but manifested cardiac acceleration, indicative of a defensive response or sensory rejection, to the "American" massacre scene. Also, ROTC cadets gave significantly less heart rate deceleration to the Viet Cong label than did non-ROTC students.

The two latter-mentioned studies point out the impact of background variables such as experience and attitudinal set on psychophysiological measures. Realistically, heart rate reactions to different stimuli are dependent upon number of variables including the information content,
modality of presentation, subjective experiences of the individual, as well as the novelty or intensity of the stimulus.

A number of attempts have been made to differentiate normal from pathological subjects on the basis of autonomic responsiveness. Dengerink and Bertilson (1975), utilizing a modified Buss aggression procedure, in which subjects are allowed to shock a counterpart, showed that both heart rate changes and skin conductance could reliably differentiate between psychopathic and non-psychopathic inmate groups. In explaining these results, the authors propose that "under the right conditions, psychopaths might prove to be more proficient than other persons at 'tuning out' disturbing stimulation, and that this process would be associated with cardiac acceleration and small electrodermal responses" (p. 684).

The utility of psychophysiological measures in differentiating between normal and mentally retarded individuals is at this point unsure, perhaps because standard psychometric tools and adaptive behavior scales seem to be able to perform this discrimination quite readily in most cases. Elliott and Johnson (1971) found no differences between normal and retarded subjects in blood volume responses to both a relevant and an irrelevant stimulus, while along similar lines, Powazek and Johnson (1973) found reliable differences in the heart rate
component of the orienting reflex in response to a reinforced auditory stimulus.

A few studies have indicated that measures such as heart rate may be useful as adjunctive diagnostic and interpretive tools. For example, Clausen, Lindsley and Sersen (1975) found that within a heterogeneous group of 115 institutionalized retarded subjects, the magnitude of deceleratory cardiac responses in a reaction time task positively correlated with both age and IQ. Also, Johnson (1975) was able to discriminate between EMR, TMR, LD and normal subjects on the basis of heart rate changes in response to a loud (90dB) auditory stimulus.

It is apparent in reviewing the literature that the physiological reactions of mentally retarded subjects to affect-laden stimuli lacks documentation. Relationships between behavioral traits such as aggressivity and emotionality, the accompanying physiological patterns, and the practical questions of identifying and dealing with mental deficiency are in need of investigation, if for no other reasons than those stated by Eyman and Call (1977):

Chronic problems of self-violence, violence to others, and damaging property represent the types of behavior that will surely persist as obstacles to community placement for large numbers of retarded individuals. (p. 143).
This chapter delineates the method through which the data presented in this dissertation were gathered. Subjects, consisting of either aggressive or nonaggressive mentally retarded adults and non-retarded adults, were shown a series of affectively loaded and affectively neutral pictures. Affective and nonaffective stimuli were presented in random order and each was preceded by a black, non-stimulus condition. Heart rate, in beats per minute, was monitored continuously throughout the stimulus presentation. Data consisted of heart rate level, heart rate change, and heart rate variability, which were analyzed in terms of both group and individual differences.

Design

The heart rates of samples of non-handicapped (NH), aggressive retarded (AR) and nonaggressive retarded (NAR) subjects were compared in an attempt to discover differences in autonomic responsiveness to three visual stimulus conditions. Stimulus conditions consisted of a baseline period, in which no picture was presented, an affective condition,
in which emotionally loaded pictures were shown, and a neutral condition, in which pictures with relatively neutral content were shown. Figure 1 presents a schematic illustration of the stimulus sequence. Affective and neutral stimuli were randomly ordered throughout the stimulus presentation, and each was preceded by a baseline period. All subjects received the same sequence of stimuli. Heart rate was monitored continuously throughout the stimulus presentation.

Subjects

The subjects consisted of 40 mildly to severely retarded residents of the Columbus State Institute, and one group of 20 nonhandicapped adults. Twenty of the retarded subjects had been identified as nonaggressive residents, while the other group of 20 consisted of individuals who displayed chronic aggressive and maladaptive behaviors. Chronological ages ranged from 18 to 40 years for the aggressive retarded sample, and from 21 to 56 years for the nonaggressive sample. IQ's for the aggressive group ranged from 22 to 69, while for the nonaggressive group, IQ's ranged from 23 to 69. No IQ information is provided for the handicapped group. The nonhandicapped group was made up of 13 institutional staff and 7 students from the Hershell B. Nisonger Center for Developmental Disabilities at The Ohio State University.
Figure 1: Schematic of stimulus sequence.
A: Baseline - no picture.
B: Affective.
C: Neutral.
Chronological ages for the nonhandicapped group ranged from 21 to 39 years.

A pool of retarded subjects was solicited by sending an explanatory letter and referral form (Appendix A) to all unit directors, requesting them to nominate their most and their least aggressive residents for treatment through the institution's biofeedback project. The 60 names thus obtained constituted the population pools of aggressive and nonaggressive subjects. The names of residents nominated as being aggressive were then screened in terms of the following criteria:

a) A history of overt violent acts as reported through the institution's daily medical incident reports, with a frequency of at least one major citation (requiring seclusion or medical treatment) per month.

b) A history of overt, violent acts as reported through interviews with ward staff, with a frequency of at least one citation per month.

and/or

c) A history of overt violent acts as documented in the client's ward chart, requiring the use of special behavioral intervention strategies directed at reducing or reshaping aggressive/maladaptive behaviors.

Two of the three above criteria had to be met before a resident was accepted as aggressive.

Subjects in all groups were required to be at least 18 years of age and to display no major visual or auditory handicap. Three aggressive individuals were excluded from the population a priori because of frequent severe seizure
activity. Twenty aggressive and 20 nonaggressive retarded subjects were then randomly drawn from the lists provided by the unit directors. A list of 10 alternates in each group was also kept, in the event that one or more subjects refused to participate. Six aggressive individuals and two nonaggressive individuals refused to participate in the experiment, and were replaced by subjects randomly drawn from the alternate list.

**Apparatus**

Heart rate (HR) was monitored via a Cyborg BL907 cardiotachometer. This instrument utilizes an acoustic electrode mounted in a velcro wrist cuff and provides an LED (light emitting diode) of continuous average heart rate; a beat-to-beat heart rate averaged for each two beats. To obscure natural sounds that could not be controlled in the testing room, white noise at approximately 70 dB was presented via a Panasonic tape recorder placed about 5 feet from the subject. A ½-inch format portable reel-to-reel videotape recorder and camera (Panasonic) were used to record data from the cardiotachometer. A digital stopwatch (Radio Shack) was used for timing stimulus intervals. The videotape camera was positioned facing the cardiotachometer and stopwatch such that HR and temporal measures could be simultaneously recorded.
A comfortable arm chair and foot stool, which allowed the subject to partially recline, was positioned such that the subject faced the projection screen. A thin wooden partitain separated the subject from the cardiotachometer and experimenter. Visual stimuli were presented through 35 mm. slides projected onto a 4' x 4' viewing screen by a Kodak carousel projector. The slides consisted of a) a set of 20 completely black slides which allowed no light to be projected onto the screen, b) a set of 10 affective slides depicting scenes of violence, gore, and interpersonal aggression, and c) a set of ten neutral slides made up of non-violent scenes. The stimulus slides consisted of both real and staged scenes, and were produced by the experimenter. (See Appendix B for a description of the slides). Non-stimulus slides used for the baseline conditions were manufactured by filling 35 mm. slide frames with black construction paper.

Procedure

Retarded subjects were visited in their residence halls by the experimenter, at which time each potential subject was explained the procedure and asked to give written permission to participate. Subjects were escorted to a light-attenuated 10' by 18' room in the institution's administration building. All subjects were tested under similar lighting conditions. An attempt was made to maintain room temperature at 72 degrees F., however, because of
wide fluctuations in ambient temperature, room temperatures did vary. Subjects were asked if they were comfortable (e.g., Is the room too hot or too cold? Are you comfortable at this temperature?) and every effort was made to provide a stable, temperate situation for the subject.

Subjects were asked to be seated, with both feet either on the floor or on the cushioned foot stool, and look toward the viewing screen which was placed directly ahead at a distance of about 8 feet. The following narrative was used to explain the procedure and establish rapport with the subject:

Hello (Subject), my name is Kevin. I'm glad you could come to visit with me today. I'd like to show you some pictures. It will be a lot like going to the movies or watching TV, but you will have to sit very still and watch this big screen here (demonstrate). Why don't you have a seat in this big comfortable chair and we'll get started.

The slide projector and white noise apparatus were then turned on, and the HR sensor was placed around the subject's left wrist.

I'm going to turn on some sound here so that we can keep other noises out of the room. I'd also like to have you wear this. (Experimenter shows wrist cuff to subject and demonstrates on self). This little button in here acts just like your ears... it listens for your heart beat. See how it works on me? Now, let's see how it looks on you....There, is that comfortable? Now sit very, very still. I'm going to turn out the lights so we can see the pictures.
If necessary to calm the subject:

If you are very good and sit as still as you can, we'll go have a soda or some coffee after we're done. OK? Here we go.

The room lights were extinguished with the exception of a small, dim lamp (containing a 40 Watt bulb) placed a few feet behind and to the right of the subject's back. Three or four minutes were allowed for acclimation, during which time the experimenter repeated instructions to lie back, relax, and remain very still and watch for the pictures. The recording instruments were then activated and the stimulus sequence was started. Slides were changed manually at intervals of ten seconds via a remote control apparatus. Following the presentation of the final stimulus slide, the measurement and recording equipment was turned off, the room lights were turned back on, and the heart rate electrode was removed. The subject was then asked if he/she liked the pictures, and was offered the opportunity to ask questions about the procedure and the study as a whole and to look at the instrumentation if desired.

Data Analysis

Heart rate data and temporal measures were recorded from the cardiotachometer on videotape and transcribed by the investigator onto data sheets (Appendix C) following the departure of the subject. The videotaped product allowed for heart rate and time to be synchronously recorded, such that a beats-per-minute reading in 'real
time' units, was available for any given second during the stimulus sequence. One heart rate datum was recorded and transcribed for each second following the onset of the initial baseline condition. Thus, each 10-second interval produced 10 chronologically sequenced HR measures.

Dependent Variables

The data, recorded and transcribed as mentioned above, were analyzed in terms of the following:

Heart Rate Level (HRL): Mean absolute heart rate in beats per minute for any given interval, condition or combination of conditions. For any one stimulus interval, HRL is calculated by summing the ten data units and dividing by ten.

Variability 1 (V1): The standard deviations of the ten data units within a stimulus interval.

Variability 2 (V2): The absolute number of times the heart rate level changed within a given interval. For example, the data 72, 72, 72, 73, 73, 75, 73, 73, 73, 73 would produce a V2 of three.

Heart Rate Change 1 (C1): The difference in beats per minute, between the mean HRL of a baseline interval are used. C1 provides a measure of cardiac acceleration or deceleration in response to a particular condition. If C1 is positive in value, the heart has accelerated relative to baseline levels, and if C1 is negative in value, the heart has slowed relative to baseline levels.

Heart Rate Change 2 (C2): The difference in beats per minute, between the mean HRL of the final 3 seconds of a stimulus condition. C2 provides much the same information as does C1 in that it is a measure of changes in HR in response to stimulus onset. C2 however, may be more sensitive to changes of short duration, taking place immediately following stimulus onset.
Habituation: Habituation is the diminishing of an autonomic response after repeated presentations of a stimulus. The 20 baseline-stimulus pairings in the stimulus sequence will be divided into four blocks of ten. Habituation will be measured as decreases in response magnitude across these four blocks of trials.

Reliability

The reliability of both the cardiotachometer and the method of data recording were tested in two small pilot studies. Test-retest reliability was assessed by measuring the resting heart rates of a small group of subjects ($N=3$) for a period of 30 seconds, and then retesting (again for 30 seconds) approximately 1 hour later. Data (in beats per minute) for trial 1 and trial 2 were: $S1 - 89.5, 88.9$. $S2 - 89.7, 88.5$. $S3 - 76.1, 78.6$. Results show a good deal of consistency in the heart rate measurements across an hour's time.

Interrater reliability was assessed by videotaping 50 seconds of heart rate data for a small group of subjects ($N=5$). This data was then independently transcribed from videotape to data sheets, one datum for each second, by the investigator and a fellow student. Reliability was analyzed in terms of percent of agreement in the transcriptions of the two raters. Percent agreement (agreements/agreements + disagreements) was calculated for each of the 5 subjects and the results were: $S1 - 96\%$; $S2 - 88\%$; $S3 - 91\%$; $S4 - 86\%$; $S5 - 94\%$. It may be seen that agreement was generally high. The method of data transcription
was extremely reliable because the transcriber could, at any point in time stop the videotape playback of the data, and recheck his transcription.
CHAPTER IV

RESULTS

This chapter presents a description and analysis of the data gathered in this investigation. Data for three samples of subjects, including aggressive and nonaggressive mentally retarded adults, and nonhandicapped adults will be analyzed for between and within group differences in heart rate level, heart rate variability, heart rate change, and habituation. Sex differences on the above measures will also be examined. Dependent variables consist of two measures of absolute heart rate level (HRL10 and HRL3), two measures of variability (V1 and V2) and two measures of relative change in heart rate in response to stimulus presentation (C1 and C2).

Subject Characteristics

Subjects consisted of 20 aggressive mentally retarded adults, 20 nonaggressive retarded adults, and 20 nonhandicapped adults. Table 1 presents means, ranges and standard deviations of chronological age for the three groups. IQ information is presented for the two retarded
TABLE 1

Means, Ranges and Standard Deviations of Chronological Age and IQ for the Subject Groups. Data for Male, Female, and Male + Female Subjects is Provided

<table>
<thead>
<tr>
<th></th>
<th>Aggressive Retarded</th>
<th>Nonaggressive Retarded</th>
<th>Nonhandicapped</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MALE</td>
<td>FEMALE</td>
<td>BOTH</td>
</tr>
<tr>
<td>AGE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>10</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>Mean</td>
<td>28.3</td>
<td>28.2</td>
<td>28.3</td>
</tr>
<tr>
<td>SD</td>
<td>6.8</td>
<td>5.6</td>
<td>6.1</td>
</tr>
<tr>
<td>IQ</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>10</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>Mean</td>
<td>51.8</td>
<td>45.6</td>
<td>48.7</td>
</tr>
<tr>
<td>Range</td>
<td>22-69</td>
<td>26-65</td>
<td>22-69</td>
</tr>
<tr>
<td>SD</td>
<td>12.5</td>
<td>11.9</td>
<td>12.3</td>
</tr>
</tbody>
</table>
groups. Data is broken down for male, female and male+female subjects in each group. Table 2 presents the results of the one-way analysis of variance for differences in the chronological ages between groups. It may be seen that there were no significant differences in the distributions of chronological ages between groups. It may be seen that there were no significant differences in the distributions of chronological ages between the three groups. Further analyses were performed to determine differences in chronological age between the male subjects in the three groups, and between the female subjects in the groups, the results of which are presented in Table 2A. It may be seen that there were no statistically significant differences when the chronological ages of the male subjects were compared, nor did the age distributions differ when the female subjects in the three groups were compared.

Separate analyses were performed to determine differences in chronological age between male and female subjects within each of the three groups. There were no significant differences in the chronological ages of male and female subjects within the aggressive retarded group \((t = 0.18, df 18)\), the nonaggressive retarded group \((t = 1.46, df 18)\), or the nonhandicapped group \((t = 0.04, df 18)\). The aggressive and nonaggressive retarded subjects did not differ significantly in IQ \((t = 0.18, df 38)\) nor
### TABLE 2
**Values Of F For A One-Way Analysis Of Variance For Differences In Chronological Age Between The Subject Groups**

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>SUM of SQUARES</th>
<th>df</th>
<th>MEAN SQUARE</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>29.20</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between</td>
<td>69.10</td>
<td>2</td>
<td>34.55</td>
<td>0.78</td>
<td>0.20</td>
</tr>
<tr>
<td>Within</td>
<td>2510.50</td>
<td>57</td>
<td>44.04</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### TABLE 2A
**Values Of F For One-Way Analysis of Variance for Differences in Chronological Age Between Male and Female Subjects**

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>SUM of SQUARES</th>
<th>df</th>
<th>MEAN SQUARE</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>28.03</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>6.32</td>
<td>2</td>
<td>3.16</td>
<td>0.11</td>
<td>0.20</td>
</tr>
<tr>
<td>Within</td>
<td>808.70</td>
<td>27</td>
<td>29.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>30.37</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>142.96</td>
<td>2</td>
<td>71.48</td>
<td>1.25</td>
<td>0.20</td>
</tr>
<tr>
<td>Within</td>
<td>1540.00</td>
<td>27</td>
<td>57.04</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
was there a significant difference in IQ between the male and female subjects in the aggressive group ($t = 1.07$, df 18) or the nonaggressive group ($t = 1.13$, df 18).

**Frequency of Aggressive Incidents**

The 20 retarded adults in the aggressive group were selected to participate in this study solely because of their aggressiveness. The nonaggressive retarded subjects were chosen because they did not chronically act out. The frequency of major aggressive incidents over a period of three consecutive months for both aggressive and nonaggressive subjects is presented in Table 3, and illustrated graphically in Figure 2. The data presented in Table 3 were drawn from the institution's daily medical incident reports and reflect only major incidents requiring medical or police intervention.

**TABLE 3**

Frequency of Major Aggressive Incidents Over a Period of Three Consecutive Months by Aggressive and Nonaggressive Retarded Subjects

<table>
<thead>
<tr>
<th>Month</th>
<th>December</th>
<th>January</th>
<th>February</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggressive retarded</td>
<td>20</td>
<td>18</td>
<td>20</td>
</tr>
<tr>
<td>Nonaggressive retarded</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>
Figure 2: Frequency histogram of the number of reported aggressive incidents during a three month period for aggressive subjects (AR, N = 20) and nonaggressive subjects (NAR, N = 20).
It will be noted that the aggressive group averaged about 20 incidents per month, while the nonaggressive group averaged fewer than two incidents per month.

**Distribution of Scores**

Table 4 presents means, ranges and standard deviations of scores on each of the six dependent variables for each of the three groups of subjects. Data are presented by stimulus condition: baseline, affective picture condition, neutral picture condition. The data of Table 4 represent the means for each group of subjects as a whole; that is, for each of the six dependent measures, data for the 20 subjects in each group were averaged, such that one score, representative of the entire group, could be obtained.

Data for HRL 10, HRL3, V1 and V2 showed relatively normal, unimodal distributions for all three subject groups and in each of the three stimulus conditions. Cl and C2 however, were not normally distributed, as the data reported in Table 4 would indicate; change scores ranged widely across groups and across conditions with several subjects in each group exhibiting scores near the extremes of the distributions. However, an F-maximum test for homogeniety of variance (Bruning and Kintz, 1968) indicate that the variances of the change scores for the three subject groups did not differ significantly either for Cl (Fmax = 1.47, df 2,19, NS) or for C2 (Fmax = 1.77, df 2,19, NS).
TABLE 4

Means, Ranges and Standard Deviations of Scores on All Dependent Variables for Each Subject Group and Each Stimulus Condition. Scores Presented Here Represent the Mean Response Per Trial for a Given Subject Group

<table>
<thead>
<tr>
<th>Variable</th>
<th>Condition</th>
<th>Aggressive Retarded</th>
<th>Nonaggressive Retarded</th>
<th>Nonhandicapped</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Range</td>
</tr>
<tr>
<td>HRL10</td>
<td>Baseline</td>
<td>76.9</td>
<td>7.8</td>
<td>61.1-94.0</td>
</tr>
<tr>
<td></td>
<td>Affective</td>
<td>76.9</td>
<td>8.0</td>
<td>60.6-94.1</td>
</tr>
<tr>
<td></td>
<td>Neutral</td>
<td>76.8</td>
<td>7.7</td>
<td>61.3-94.2</td>
</tr>
<tr>
<td>HRL3</td>
<td>Baseline</td>
<td>76.9</td>
<td>7.8</td>
<td>61.3-94.0</td>
</tr>
<tr>
<td></td>
<td>Affective</td>
<td>76.9</td>
<td>8.0</td>
<td>62.9-94.1</td>
</tr>
<tr>
<td></td>
<td>Neutral</td>
<td>76.9</td>
<td>7.6</td>
<td>60.4-94.1</td>
</tr>
<tr>
<td>C1</td>
<td>Baseline</td>
<td>0.09</td>
<td>0.19</td>
<td>-0.37 to 0.39</td>
</tr>
<tr>
<td></td>
<td>Affective</td>
<td>0.01</td>
<td>0.53</td>
<td>-1.12 to 1.12</td>
</tr>
<tr>
<td></td>
<td>Neutral</td>
<td>-0.02</td>
<td>0.48</td>
<td>-1.56 to 0.76</td>
</tr>
<tr>
<td>C2</td>
<td>Affective</td>
<td>0.07</td>
<td>0.35</td>
<td>-0.88 to 0.46</td>
</tr>
<tr>
<td></td>
<td>Neutral</td>
<td>-0.06</td>
<td>0.36</td>
<td>-1.16 to 0.39</td>
</tr>
<tr>
<td>V1</td>
<td>Baseline</td>
<td>0.66</td>
<td>0.35</td>
<td>-0.28 to 1.40</td>
</tr>
<tr>
<td></td>
<td>Affective</td>
<td>0.63</td>
<td>0.39</td>
<td>-0.17 to 1.45</td>
</tr>
<tr>
<td></td>
<td>Neutral</td>
<td>0.64</td>
<td>0.32</td>
<td>-0.23 to 1.37</td>
</tr>
<tr>
<td>V2</td>
<td>Baseline</td>
<td>2.1</td>
<td>1.1</td>
<td>-0.8 to -4.7</td>
</tr>
<tr>
<td></td>
<td>Affective</td>
<td>2.1</td>
<td>1.2</td>
<td>-0.8 to -4.2</td>
</tr>
<tr>
<td></td>
<td>Neutral</td>
<td>2.1</td>
<td>1.0</td>
<td>-0.8 to -4.0</td>
</tr>
</tbody>
</table>
Relationship Between the Dependent Variables

Data for each group of subjects will be examined in terms of six dependent variables (see pg. 50 for a description of each): two measures of absolute heart rate (HRL10 and HRL3), two measures of relative change in heart rate in response to the presentation of a stimulus (C1 and C2), and two measures of heart rate variability (V1 and V2). Table 5 presents linear correlation coefficients\(^a\) for associations between the six dependent variables. Separate analyses\(^a\) are presented for each of the subject groups.

It may be seen that for all subject groups, HRL10 and HRL3 correlated perfectly, and V1 correlated highly with V2. Thus, even though the data in these pairs were derived in slightly different fashions, the results show redundancy. The variables C1 and C2 show a moderate positive association for all three groups of subjects, although the inter-relationship is not as strong as in the previously mentioned pairs of variables. C2, which is calculated on the basis of a shorter set of intervals, may be more sensitive than C1 to immediate, short-lasting changes in heart rate occurring at the time of stimulus onset.

An examination of the associations between dependent variables yields some interesting differences between the

\(^a\)Coefficients were calculated on a Challenger IP microprocessor through a program found in: Poole, L. and Borchers, M. Some Common Basic Programs. Berkeley, Calif: Osborne and Associates, 1978.
TABLE 5

Linear Correlation Coefficients for Associations Between Dependent Variables Presented for Each of the Three Groups of Subjects

<table>
<thead>
<tr>
<th></th>
<th>HRL10</th>
<th>HRL3</th>
<th>C1</th>
<th>C2</th>
<th>V1</th>
<th>V2</th>
</tr>
</thead>
<tbody>
<tr>
<td>HRL10</td>
<td>1.0</td>
<td>.22</td>
<td>.13</td>
<td>-.44</td>
<td>-.45</td>
<td></td>
</tr>
<tr>
<td>HRL3</td>
<td>.09</td>
<td>.12</td>
<td>-.22</td>
<td>-.44</td>
<td>-.44</td>
<td></td>
</tr>
<tr>
<td>C1</td>
<td>.49</td>
<td>-.44</td>
<td>-.45</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C2</td>
<td>-.65</td>
<td>-.56</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V1</td>
<td>.94</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Aggressive

<table>
<thead>
<tr>
<th></th>
<th>HRL10</th>
<th>HRL3</th>
<th>C1</th>
<th>C2</th>
<th>V1</th>
<th>V2</th>
</tr>
</thead>
<tbody>
<tr>
<td>HRL10</td>
<td>1.0</td>
<td>.11</td>
<td>.13</td>
<td>.29</td>
<td>.30</td>
<td></td>
</tr>
<tr>
<td>HRL3</td>
<td>.15</td>
<td>.12</td>
<td>.16</td>
<td>.35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C1</td>
<td>.58</td>
<td>.03</td>
<td>.13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C2</td>
<td>-.05</td>
<td>.01</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V1</td>
<td>.82</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Retarded

<table>
<thead>
<tr>
<th></th>
<th>HRL10</th>
<th>HRL3</th>
<th>C1</th>
<th>C2</th>
<th>V1</th>
<th>V2</th>
</tr>
</thead>
<tbody>
<tr>
<td>HRL10</td>
<td>.99</td>
<td>.41</td>
<td>.44</td>
<td>-.11</td>
<td>.09</td>
<td></td>
</tr>
<tr>
<td>HRL3</td>
<td>.38</td>
<td>.45</td>
<td>-.12</td>
<td>.08</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C1</td>
<td>.50</td>
<td>.36</td>
<td>.36</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C2</td>
<td>.20</td>
<td>.32</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V1</td>
<td></td>
<td>.84</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Nonhandicapped
groups. For the aggressive retarded group, variability (VI and V2) showed an inverse relationship with both heart rate level and heart rate change. That is, individuals who exhibited higher heart rates and cardiac acceleration in response to stimuli also exhibited less variability in heart rate. Conversely, those who showed lower heart rates and cardiac deceleration exhibited greater variability. Such a relationship was not evident in the responses of either the nonaggressive retarded group or of the nonhandicapped subjects.

For the nonhandicapped group, correlations between heart rate variability and heart rate change suggest that the opposite relationship prevailed: greater cardiac acceleration was associated with increased variability. Associations between heart rate level and heart rate change were positive but small for all three groups of subjects. The nonhandicapped subjects evidenced a moderate positive relationship between heart rate level and heart rate change: higher heart rate level was associated with cardiac acceleration.

Heart Rate Level (HRL10 and HRL3)

Table 4 (pg. 61) presents the mean heart rate levels per trial for the three subject groups in each stimulus condition. A pair of 3 x 3 (groups x conditions) analyses of variance were performed to determine whether HRL10 and HRL3 mean scores differed for any of the three conditions:
baseline, affective picture stimulus, or neutral picture stimulus. The results are shown in Table 6.

**Differences between subject groups:** As noted in Table 6, differences between subject groups were highly significant for both MRL10 and MRL3, with the non-aggressive group displaying the highest mean heart rate levels, the nonhandicapped group the lowest, and the aggressive group manifesting levels between these two extremes. Figures 3 and 4 present illustrations of HRL10 and HRL3 respectively, for the three subject groups across stimulus conditions.

Duncan's Multiple Range Test (Duncan, 1966) was used to determine the significance with which the three subject groups differed from each other. Duncan's test was chosen here because, for small ranges \(k=2, k=3\), it proves to be as conservative as do other post hoc tests such as Newman-Keuls or Tikey (Winer, 1962). Table 7 presents values of \(q\) for differences between the subject groups. It will be noted that the nonhandicapped and the nonaggressive retarded groups differed significantly from one another on both heart rate level measures, while the differences between the aggressive retarded and nonhandicapped groups did not reach significance. Mean heart rate level differences between the two groups of retarded subjects also failed to reach significance.

**Differences Within Groups:** The results of analyses of variance performed on HRL10 and HRL3 indicate that there
TABLE 6

Values of F of 3 x 3 (Group X Condition) Analyses of Variance for Heart Rate Level Data

<table>
<thead>
<tr>
<th>Source</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
<td>1967.13</td>
<td>2</td>
<td>983.57</td>
<td>10.14</td>
<td>0.0001</td>
</tr>
<tr>
<td>Condition</td>
<td>3.51</td>
<td>2</td>
<td>1.76</td>
<td>0.02</td>
<td>0.98</td>
</tr>
<tr>
<td>Group X</td>
<td>2.19</td>
<td>4</td>
<td>0.55</td>
<td>0.01</td>
<td>0.99</td>
</tr>
<tr>
<td>Condition</td>
<td>2.19</td>
<td>4</td>
<td>0.55</td>
<td>0.01</td>
<td>0.99</td>
</tr>
<tr>
<td>Error</td>
<td>16578.79</td>
<td>171</td>
<td>96.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td>1925.22</td>
<td>2</td>
<td>962.61</td>
<td>9.96</td>
<td>0.0001</td>
</tr>
<tr>
<td>Condition</td>
<td>4.82</td>
<td>2</td>
<td>2.41</td>
<td>0.02</td>
<td>0.97</td>
</tr>
<tr>
<td>Group X</td>
<td>4.47</td>
<td>4</td>
<td>1.12</td>
<td>0.07</td>
<td>0.99</td>
</tr>
<tr>
<td>Condition</td>
<td>4.47</td>
<td>4</td>
<td>1.12</td>
<td>0.07</td>
<td>0.99</td>
</tr>
<tr>
<td>Error</td>
<td>16521.36</td>
<td>171</td>
<td>96.62</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 3: Comparison of mean heart rates in beats per minute for the subject groups across stimulus conditions. Based on HRL1C.
Figure 4: Comparison of mean heart rates in beats per minute for the subject groups across the three stimulus conditions. AR = aggressive retarded, NAR = nonaggressive retarded, NH = nonhandicapped.
TABLE 7

Values of q Using Duncan's Multiple Range Test for The Significance of Heart Rate Level Differences Between Aggressive Retarded (AR), Nonaggressive Retarded (NAR), and Nonhandicapped (NH) Subjects Groups

<table>
<thead>
<tr>
<th></th>
<th>AR</th>
<th>NAR</th>
<th>NH</th>
</tr>
</thead>
<tbody>
<tr>
<td>HRL10</td>
<td>AR</td>
<td>--</td>
<td>3.2</td>
</tr>
<tr>
<td></td>
<td>NAR</td>
<td>--</td>
<td>9.1*</td>
</tr>
<tr>
<td>HRL3</td>
<td>AR</td>
<td>--</td>
<td>3.1</td>
</tr>
<tr>
<td></td>
<td>NAR</td>
<td>--</td>
<td>7.9*</td>
</tr>
</tbody>
</table>

* p 0.05, k=2, df 171, $R_{.95} = 6.16$

k=3, df 171, $R_{.95} = 6.49$

were no significant differences attributable to stimulus condition (refer to Table 6), nor was there a significant interaction between group and condition. The mean heart rate levels for nonaggressive retarded and nonhandicapped subjects were slightly higher in the affective stimulus condition than in either neutral or baseline conditions, but again these differences were not statistically reliable.

Heart Rate Variability (V1 and V2)

Table 4 (pg. 61) provides mean variability scores for the three subject groups in each stimulus condition. A pair of 3 x 3 analyses of variance were performed to determine the significance of differences between the subject groups and across stimulus conditions, the results of which are presented in Table 8.
<table>
<thead>
<tr>
<th>Source</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
<td>0.479</td>
<td>2</td>
<td>0.239</td>
<td>3.15</td>
<td>0.05</td>
</tr>
<tr>
<td>Condition</td>
<td>0.045</td>
<td>2</td>
<td>0.022</td>
<td>0.30</td>
<td>0.74</td>
</tr>
<tr>
<td>Group X</td>
<td>0.097</td>
<td>4</td>
<td>0.024</td>
<td>0.032</td>
<td>0.87</td>
</tr>
<tr>
<td>Condition</td>
<td>0.097</td>
<td>4</td>
<td>0.024</td>
<td>0.032</td>
<td>0.87</td>
</tr>
<tr>
<td>Error</td>
<td>12.99</td>
<td>171</td>
<td>0.076</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
<td>0.87</td>
<td>2</td>
<td>0.87</td>
<td>1.01</td>
<td>0.36</td>
</tr>
<tr>
<td>Condition</td>
<td>0.07</td>
<td>2</td>
<td>0.07</td>
<td>0.08</td>
<td>0.92</td>
</tr>
<tr>
<td>Group X</td>
<td>0.09</td>
<td>4</td>
<td>0.09</td>
<td>0.10</td>
<td>0.98</td>
</tr>
<tr>
<td>Condition</td>
<td>0.09</td>
<td>4</td>
<td>0.09</td>
<td>0.10</td>
<td>0.98</td>
</tr>
<tr>
<td>Error</td>
<td>171</td>
<td>171</td>
<td>0.86</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Differences between subject groups: The variability data are similar to the data of heart rate level in that the nonaggressive group displayed the highest mean variability per trial, the nonhandicapped group the lowest, with the aggressive group again between the two extremes. As may be seen from Table 8, differences between the groups were statistically significant on the variable VI. There was no significant difference between the groups on V2. Figures 5 and 6 present illustrations of heart rate variability scores for the subject groups in each stimulus condition.

Table 9 presents the results of Duncan's Multiple Range Test for the significance of differences between the VI scores of each subject group. It may be seen that none of the three groups differed significantly from each other, although the differences between the nonaggressive and nonhandicapped groups approached significance. Again, for small ranges, Duncan's Test is rather conservative, and the possibility of making a Type II error, in this case asserting that there is no difference between groups when one actually exists, is greater than that for the inverse error (Winer, 1962).

Differences within subject groups: Figures 5 and 6 suggest certain differences in heart rate variability within groups, with the nonaggressive retarded group showing increases in variability during the neutral
Figure 5: Mean V1 per trial plotted for the subject groups across conditions. AR = aggressive retarded, NAR = nonaggressive retarded, NH = nonhandicapped.

Figure 6: Mean V2 per trial plotted for the subject groups across conditions. AR = aggressive retarded, NAR = nonaggressive retarded, NH = nonhandicapped.
TABLE 9

Values of q Using Duncan’s Multiple Range Test for Significance of Differences on VI Between Aggressive Retarded (AR), Nonaggressive Retarded (NAR), and Nonhandicapped (NH) Subject Groups

<table>
<thead>
<tr>
<th></th>
<th>AR</th>
<th>NAR</th>
<th>NH</th>
</tr>
</thead>
<tbody>
<tr>
<td>VI</td>
<td>AR</td>
<td>--</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td>NAR</td>
<td>--</td>
<td></td>
</tr>
</tbody>
</table>

k = 2, df 171, R.95 = 0.17
k = 3, df 171, R.95 = 0.18

stimulus condition. An analysis of variance, however (refer to Table 8), points out no significant main effect due to stimulus condition, and no significant interaction between stimulus condition and subject group. When scores for the nonaggressive retarded group in baseline, affective and neutral stimulus conditions were examined, significant differences were found on VI between baseline and neutral conditions (t = 2.98, df 28, p 0.05), and between affective and neutral conditions (t = 2.17, df 18, p 0.05). Differences in variability between baseline and affective conditions did not reach significance (t = 0.81, df 18). When analyzed in a similar manner, differences between conditions for both the aggressive retarded and nonhandicapped groups did not reach statistical significance.
Heart Rate Change (C1 and C2)

Table 4 (pg. 61) presents the mean heart rate change per trial for the three subject groups in each stimulus condition. A pair of 3 x 3 (groups x conditions) analyses of variance were computed to determine whether differences in C1 and C2 mean scores were significant in any of the stimulus conditions. Table 10 presents the results of these analyses. As the score variances were large for all of the groups and the heart rate changes per trial for a given group were small. It is not surprising that the analyses of variance showed no significant difference between the means of the groups or between the means for the three conditions.

Figures 7 and 8 present illustrations of C1 and C2 respectively. These figures are meant to illustrate both the quantity and the quality of the heart rate changes in question, with cardiac acceleration taking positive values, and cardiac deceleration taking negative values. For the variable C1, the aggressive retarded subjects showed cardiac acceleration in the baseline and affective conditions while displaying cardiac deceleration in the neutral stimulus condition. The nonaggressive retarded and nonhandicapped groups on the other hand, decelerated in the baseline condition, and accelerated in the affective and neutral conditions. The pattern of heart rate change based on C2 was much the same as for C1, with all groups accelerating in the affective condition. In the neutral
### TABLE 10

Values of F of 3 x 3 (Group x Condition) Analyses of Variance for Heart Rate Change Data

<table>
<thead>
<tr>
<th>Source</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
<td>0.062</td>
<td>2</td>
<td>0.031</td>
<td>0.95</td>
<td>0.39</td>
</tr>
<tr>
<td>Condition</td>
<td>0.188</td>
<td>2</td>
<td>0.059</td>
<td>1.82</td>
<td>0.17</td>
</tr>
<tr>
<td>Group X</td>
<td>0.165</td>
<td>4</td>
<td>0.041</td>
<td>1.27</td>
<td>0.28</td>
</tr>
<tr>
<td>Condition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error</td>
<td>5.560</td>
<td>171</td>
<td>0.032</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td>0.094</td>
<td>2</td>
<td>0.047</td>
<td>0.32</td>
<td>0.73</td>
</tr>
<tr>
<td>Condition</td>
<td>0.355</td>
<td>2</td>
<td>0.177</td>
<td>1.20</td>
<td>0.30</td>
</tr>
<tr>
<td>Group X</td>
<td>0.509</td>
<td>4</td>
<td>0.127</td>
<td>0.86</td>
<td>0.49</td>
</tr>
<tr>
<td>Condition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error</td>
<td>25.22</td>
<td>171</td>
<td>0.147</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 7: Mean heart rate change per trial for subject groups and stimulus conditions. Based on C1. Positive values indicate cardiac acceleration. AR = aggressive retarded, NAR = nonaggressive retarded, NH = nonhandicapped.
Figure 8: Mean heart rate change per trial for the subject groups and stimulus conditions. Based on C2. Positive values indicate cardiac acceleration. AR = aggressive retarded. NAR = nonaggressive retarded. NH = nonhandicapped.
condition, the aggressive retarded group responded with deceleration, and the nonhandicapped group with acceleration. The nonaggressive group showed a weak trend toward deceleration on C2 where it had accelerated on C1.

The analysis of heart rate change data in terms of group mean scores allows for an examination of potential overall group effects, however, a good deal of information is lost, especially the individual qualitative aspects of the heart rate change, e.g., acceleration or deceleration in response to stimuli. A further breakdown of the heart rate change data into classes based on the directionality of the change itself is warranted. To accomplish this, subjects in each group were classified as "accelerators" or "decelerators" based on their mean heart rate change score (on C2) for the affective and neutral stimulus conditions. C2 is used in this analysis because it provides data representative of the subject's immediate responses to the visual stimuli, and may be more indicative of phasic, short-lasting responses to individual stimuli than would C1. Lacey and Lacey (1974) have utilized the distinction between "accelerators" and "decelerators" to explain why certain subjects respond with cardiac acceleration in situations which usually elicit deceleration, believing that such patterns are manifestations of the individual's own response style.
TABLE 11

Number of "Accelerators" and "Decelerators" and Mean Heart Rate Change for Each Subject Group in Both Affective and Neutral Stimulus Conditions. This Data is Based on the Variable C2

<table>
<thead>
<tr>
<th></th>
<th>Aggressive Retarded</th>
<th>Nonaggressive Retarded</th>
<th>Nonhandicapped</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Affective</td>
<td>Neutral</td>
<td>Affective</td>
<td>Neutral</td>
</tr>
<tr>
<td><strong>Accelerators</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>14</td>
<td>9</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>Mean</td>
<td>0.23</td>
<td>0.19</td>
<td>0.16</td>
<td>0.17</td>
</tr>
<tr>
<td><strong>Decelerators</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>6</td>
<td>11</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Mean</td>
<td>0.31</td>
<td>0.26</td>
<td>0.22</td>
<td>0.22</td>
</tr>
</tbody>
</table>
Figure 9: Histogram of mean heart rate change for "accelerators" and "decelerators" in each group. AR = aggressive retarded, NAR = nonaggressive retarded, NH = nonhandicapped.
Table 11 presents the number and the mean heart rate changes of "accelerators" and "decelerators" for each group. Data for both the affective and the neutral stimulus conditions are compared. Figure 9 illustrates the data of Table 11, and suggests that those subjects who decelerated in response to the visual stimuli (either affective or neutral) generally produced a response of somewhat greater magnitude that did those subjects who accelerated. This relationship did not hold true for the nonhandicapped group's responses in the affective stimulus condition, in which the mean response of the "accelerators" was slightly greater than that of the "decelerators."

The numbers of subjects who either accelerated or decelerated did not differ significantly for the aggressive retarded group (Chi square = 2.56, df 1), the nonaggressive retarded group (Chi square = 0.40, df 1), or the nonhandicapped group (Chi square = 0.44, df 1).

Table 12 presents the results of a 3 x 2 x 2 (groups x conditions x direction of change) analysis of variance performed on the data listed in Table 11. There was no significant difference in heart rate change between the three subject groups, and there was no significant interaction between group and stimulus condition and group and direction of heart rate change. Thus, the groups did not differ in the magnitudes of their accelerations and decelerations, nor did these heart rate changes differ
across stimulus conditions. There was also no difference between the magnitudes of responses exhibited by "accelerators" and "decelerators," although this effect approached significance \( p > 0.14 \). There was no significant interaction between stimulus condition and direction of change, e.g., the responses made by "accelerators" and "decelerators" did not differ with respect to the stimulus condition. Finally, there was no significant interaction between subject group, stimulus condition and the direction of heart rate change.

As another way of analyzing the heart rate change scores, individual patterns of response to stimuli were examined. Subjects were divided into "accelerators", "decelerators" or "mixed" classes on the basis of their heart rate responses to affective and neutral stimulus conditions (again the variable C2 was used). Subjects who displayed cardiac acceleration to both types of stimuli were classified as "accelerators," while subjects who displayed cardiac deceleration to both stimuli were classified as "decelerators." Those who accelerated on one type of stimulus and decelerated on the other were classified as "mixed."

Figure 10 presents a histogram of the number of subjects within each group classified as described above. It will be noted that in both groups of retarded subjects,
<table>
<thead>
<tr>
<th>Source</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>f</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
<td>10.74</td>
<td>2</td>
<td>5.37</td>
<td>1.22</td>
<td>0.30</td>
</tr>
<tr>
<td>Condition</td>
<td>0.54</td>
<td>1</td>
<td>0.54</td>
<td>0.12</td>
<td>0.73</td>
</tr>
<tr>
<td>Direction</td>
<td>10.01</td>
<td>1</td>
<td>10.01</td>
<td>2.27</td>
<td>0.14</td>
</tr>
<tr>
<td>Group x Condition</td>
<td>3.25</td>
<td>2</td>
<td>1.63</td>
<td>0.37</td>
<td>0.69</td>
</tr>
<tr>
<td>Group x Direction</td>
<td>5.95</td>
<td>2</td>
<td>2.98</td>
<td>0.67</td>
<td>0.51</td>
</tr>
<tr>
<td>Condition x Direction</td>
<td>0.09</td>
<td>1</td>
<td>0.09</td>
<td>0.02</td>
<td>0.89</td>
</tr>
<tr>
<td>Group x Condition x Direction</td>
<td>2.27</td>
<td>2</td>
<td>1.13</td>
<td>0.26</td>
<td>0.77</td>
</tr>
<tr>
<td>Error</td>
<td>467.79</td>
<td>106</td>
<td>4.41</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 10: A comparison of the frequency of "accelerators", "decelerators" and "mixed" subjects in each group.
AR = aggressive retarded. NAR = nonaggressive retarded. NH = nonhandicapped.
10 out of 20 displayed the "mixed" pattern, while the remaining subjects in each group consistently responded with either acceleration or deceleration. In the non-handicapped group, only 3 of 20 subjects manifested the "mixed" pattern, while the majority (12) displayed cardiac acceleration to both types of stimuli. When considered as a whole, there was no significant difference between the aggressive and nonaggressive retarded groups (Chi square = 0.22, df 2). Differences between the nonhandicapped group and both retarded groups approached significance (Chi square = 5.59, df 2, p = 0.10 for nonhandicapped compared to aggressive retarded, Chi squared = 5.88, df 2, p = 0.10 for nonhandicapped compared to nonaggressive retarded) but did not reach the 0.05 level.

Further analysis of this data in terms of the consistency of responses yields some interesting results. Subjects who manifested consistent cardiac acceleration or deceleration in response to stimulus presentation were combined into a class which may be described as "consistent" responders, while subjects who displayed the "mixed" pattern were classified as "inconsistent." It may be seen from Figure 10 that the retarded subject groups contained equal numbers of "consistent" and "inconsistent" responders, while in the nonhandicapped group, only three of 20 subjects displayed an inconsistent response pattern.
These differences between retarded and nonhandicapped subjects were statistically significant (Chi square = 6.134, df 2, p < 0.05).

**Habituation**

This section is concerned with habituation, or changes in the characteristics of a response, in this instance heart rate level and variability, with repeated presentation of a stimulus. The data for each subject were divided into four sequential blocks of ten trials each; the individual response data within a block were averaged to provide mean scores for that trial block. These means were then averaged to provide an overall mean representative of each group. Table 13 provides the means and standard deviations of each of the three subject groups on the variables HRL10 and V2, for four sequential blocks of trials. Change scores (C1 and C2) are not utilized because habituation of heart rate change is dependent upon the elicitation of a consistent orienting or defensive response, and no such patterns were evident in this study. Figures 11 and 12 illustrate the data presented in Table 13.

Figure 11 presents mean heart rate levels (HRL10) across trial blocks for the subject groups. It can be noted that the nonaggressive retarded group shows a gradual decrease in heart rate level across trial blocks,
TABLE 13

Means and Standard Deviations of Scores on HRL10 and V2 for the Subject Groups Across Trials. Trials are Blocked in Four Sets of Ten.
AR - Aggressive Retarded; NAR - Nonaggressive Retarded;
NH - Nonhandicapped

<table>
<thead>
<tr>
<th>Trial Block</th>
<th>NRL10</th>
<th>V2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AR</td>
<td>NAR</td>
</tr>
<tr>
<td>1</td>
<td>76.5</td>
<td>80.9</td>
</tr>
<tr>
<td>2</td>
<td>76.8</td>
<td>80.4</td>
</tr>
<tr>
<td>3</td>
<td>76.9</td>
<td>79.5</td>
</tr>
<tr>
<td>4</td>
<td>76.7</td>
<td>79.0</td>
</tr>
</tbody>
</table>
Figure 11: Habituation: Changes in heart rate level for the three subject groups across four blocks of ten trials. AR = aggressive retarded, NAR = nonaggressive retarded, NH = nonhandicapped.
Figure 12: Habituation: Changes in level of variability for the three subject groups across four blocks of ten trials. AR = aggressive retarded. NAR = nonaggressive retarded. NH = nonhandicapped.
while the other two groups exhibit no change or a slight increase across trials. Figure 12 plots the variable V2 across trials for the three subject groups. On V2, the nonhandicapped subjects show a definite decline in variability, and the aggressive retarded group manifests a sharp decrease in the last two blocks of trials. The nonaggressive retarded group shows an erratic pattern, with no clear trend toward increases or decreases in variability.

Table 14 presents the results of 3 x 4 (groups x trial blocks) repeated measures analyses of variance for HRL10 and V2. The "group" terms in these analyses are not as meaningful as are those of prior analyses because averaging across subjects and then across trials greatly reduces the variance within a group, such that already existing differences are magnified. The effects of "trial" and the interaction between subject group and trial block will be examined. Table 14 points out a highly significant trial effect and group by trial block interaction for HRL10. Figure 11 (pg. 88) shows a steady decline in heart rate for the nonaggressive retarded group, while the aggressive group increased slightly, and the nonhandicapped group remained approximately the same. Table 15 presents values of q using Duncan's Multiple Range Test to determine, from each subject group, which trial blocks differ significantly.
### TABLE 14

Values of F for 3 x 4 (Group x Trial Block) Repeated Measures Analyses of Variance on the Variables HRL10 and V2

<table>
<thead>
<tr>
<th>Source</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
<td>1243.13</td>
<td>2</td>
<td>621.57</td>
<td>1968.8</td>
<td>0.000</td>
</tr>
<tr>
<td>Trial</td>
<td>4.36</td>
<td>3</td>
<td>1.45</td>
<td>4.61</td>
<td>0.005</td>
</tr>
<tr>
<td>HRL10 Group</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>x Trial</td>
<td>27.97</td>
<td>6</td>
<td>4.66</td>
<td>14.77</td>
<td>0.000</td>
</tr>
<tr>
<td>Error</td>
<td>34.10</td>
<td>108</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V2 Group</td>
<td>1.453</td>
<td>2</td>
<td>0.726</td>
<td>6.96</td>
<td>0.001</td>
</tr>
<tr>
<td>Trial</td>
<td>0.899</td>
<td>3</td>
<td>0.299</td>
<td>2.87</td>
<td>0.039</td>
</tr>
<tr>
<td>V2 Group x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trial</td>
<td>0.919</td>
<td>6</td>
<td>0.153</td>
<td>1.47</td>
<td>0.196</td>
</tr>
<tr>
<td>Error</td>
<td>11.269</td>
<td>108</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
TABLE 15

Values of \( q \) Using Duncan's Multiple Range Test for the Significance of Differences in Heart Rate Level (HRL10) Between Trial Blocks. Data is Presented for Each of the Three Subject Groups.

<table>
<thead>
<tr>
<th>Subject Group</th>
<th>1 vs 2</th>
<th>1 vs 3</th>
<th>1 vs 4</th>
<th>2 vs 3</th>
<th>2 vs 4</th>
<th>3 vs 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggressive</td>
<td>0.30</td>
<td>0.40</td>
<td>0.20</td>
<td>0.10</td>
<td>0.10</td>
<td>0.20</td>
</tr>
<tr>
<td>Retarded</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonaggressive</td>
<td>0.50*</td>
<td>1.40*</td>
<td>1.90*</td>
<td>0.90*</td>
<td>1.40*</td>
<td>0.50*</td>
</tr>
<tr>
<td>Retarded</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonhandicapped</td>
<td>0.90*</td>
<td>0.10</td>
<td>0.0</td>
<td>0.80*</td>
<td>0.90*</td>
<td>0.10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*\( p < 0.05 \).  
\( k=2, \text{ df } 108, \text{ R.95 } = 0.50 \)
\( k=3, \text{ df } 108, \text{ R.95 } = 0.52 \)
\( k=4, \text{ df } 108, \text{ R.95 } = 0.54 \)
It will be seen from Table 15 that the aggressive retarded group manifested no significant increases or decreases in mean heart rate level across trial blocks. On the other hand, the nonaggressive retarded exhibited significant decreases across each of the four blocks of trials. The nonhandicapped group showed an inconsistent pattern of both increasing and decreasing heart rate levels, first decreasing between blocks 1 and 2, and then increasing between blocks 2 and 3.

In terms of heart rate variability, Table 14 points out a significant trial effect for V2. Both the aggressive retarded and the nonhandicapped groups showed marked decreases in heart rate variability across trials, while the nonaggressive retarded group showed no consistent pattern of increase or decrease. Table 16 presents the results of an analysis using Duncan's Multiple Range Test for the significance of differences between trial blocks. Both the aggressive retarded and nonhandicapped groups show significant decreases in variability between trial blocks 2 and 4. There were no significant increases or decreases in variability for the nonaggressive retarded group.

**Sex Differences**

Similarities and differences both between and within subject groups have been pointed out in the preceding
TABLE 16

Values of q Using Duncan's Multiple Range Test for the Significance of Differences in Heart Rate Variability (V2) Between Trial Blocks. Data is Presented for Each of the Three Subject Groups

<table>
<thead>
<tr>
<th>Subject Group</th>
<th>Trial Block</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 vs 2</td>
<td>1 vs 3</td>
<td>1 vs 4</td>
<td>2 vs 3</td>
<td>2 vs 4</td>
<td>3 vs 4</td>
</tr>
<tr>
<td>Aggressive</td>
<td>0.10</td>
<td>0.10</td>
<td>0.20</td>
<td>0.20</td>
<td>0.30*</td>
<td>0.20</td>
</tr>
<tr>
<td>Retarded</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonaggressive</td>
<td>0.20</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.0</td>
</tr>
<tr>
<td>Retarded</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonhandicapped</td>
<td>0.0</td>
<td>0.20</td>
<td>0.40*</td>
<td>0.20</td>
<td>0.40*</td>
<td>0.20</td>
</tr>
</tbody>
</table>

* p 0.05

k=2, df 108, R.95 = 0.280

k=3, df 108, R.95 = 0.295

k=4, df 108, R.95 = 0.302
sections. It is the intent of this section to examine differences between male and female subjects in each group. To accomplish this, data for each subject were collapsed across all conditions to yield a mean score representative of the subject's average performance: e.g., the data for affective, neutral and baseline conditions were averaged to produce an overall mean. Three of the six dependent variables will be used for this analysis; these are HRL10, V1 and Cl. The decision to exclude the other three variables was arbitrary, but it is felt that the three variables chosen fairly represent the data as a whole. Table 17 presents mean responses per trial on the variables HRL10, V1 and Cl for the male and female subjects in each group. Table 18 provides the results of 3 x 2 (groups x sex) analyses of variance for the above variables.

It may be seen from Table 18 that there were no statistically significant differences between groups, and between the sexes for V1 and Cl. Nor was there a significant interaction between group and sex for these two variables. There was however, a significant difference between male and female subjects, and between the three groups on HRL10. The group differences on this variable were pointed out earlier. In terms of the sex differences, female subjects in all groups manifested higher mean heart rate levels than did the male subjects. A further analysis
TABLE 17

Mean Responses Per Trial on the Variables HRL10, V1 and Cl for the Male and Female Subjects in Each Group

<table>
<thead>
<tr>
<th></th>
<th>Aggressive Retarded</th>
<th>Nonaggressive Retarded</th>
<th>Nonhandicapped</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male Female</td>
<td>Male Female</td>
<td>Male Female</td>
</tr>
<tr>
<td>HRL10</td>
<td>75.1 78.6</td>
<td>76.7 84.5</td>
<td>67.0 76.1</td>
</tr>
<tr>
<td>V1</td>
<td>0.73 0.55</td>
<td>0.69 0.68</td>
<td>0.58 0.54</td>
</tr>
<tr>
<td>Cl</td>
<td>0.07 0.03</td>
<td>0.04 -0.03</td>
<td>-0.04 0.06</td>
</tr>
</tbody>
</table>

of the male-female differences is provided in Table 19, using Duncan's Multiple Range Test, the differences in mean HRL10 for male and female subjects in the nonaggressive retarded and nonhandicapped groups reach statistical significance, while those for the aggressive retarded do not.
TABLE 18

Values of F of 3 x 2 (Group x Sex) Analyses of Variance for the Variables HRL10, VI and Cl

<table>
<thead>
<tr>
<th>Source</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
<td>815.24</td>
<td>2</td>
<td>407.62</td>
<td>4.65</td>
<td>0.014</td>
</tr>
<tr>
<td>Sex</td>
<td>690.69</td>
<td>1</td>
<td>690.69</td>
<td>7.87</td>
<td>0.007</td>
</tr>
<tr>
<td>HRL10 Group x Sex</td>
<td>88.63</td>
<td>2</td>
<td>44.32</td>
<td>0.51</td>
<td>0.606</td>
</tr>
<tr>
<td>Error</td>
<td>4737.78</td>
<td>54</td>
<td>87.74</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td>0.1504</td>
<td>2</td>
<td>0.075</td>
<td>1.17</td>
<td>0.319</td>
</tr>
<tr>
<td>Sex</td>
<td>0.0935</td>
<td>1</td>
<td>0.094</td>
<td>1.45</td>
<td>0.234</td>
</tr>
<tr>
<td>VI Group x Sex</td>
<td>0.0823</td>
<td>2</td>
<td>0.041</td>
<td>0.64</td>
<td>0.532</td>
</tr>
<tr>
<td>Error</td>
<td>3.4849</td>
<td>54</td>
<td>0.065</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td>0.022</td>
<td>2</td>
<td>0.11</td>
<td>0.30</td>
<td>0.745</td>
</tr>
<tr>
<td>Sex</td>
<td>0.0</td>
<td>1</td>
<td>0.0</td>
<td>0.0</td>
<td>0.985</td>
</tr>
<tr>
<td>Cl Group x Sex</td>
<td>0.076</td>
<td>2</td>
<td>0.38</td>
<td>1.02</td>
<td>0.368</td>
</tr>
<tr>
<td>Error</td>
<td>2.015</td>
<td>54</td>
<td>0.37</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
TABLE 19

Values of q Using Duncan's Multiple Range Test for the Significance of Differences Between the Mean HRL10 Scores of Male and Female Subjects in Each Group

<table>
<thead>
<tr>
<th></th>
<th>Value of q</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggressive Retarded</td>
<td>3.5</td>
</tr>
<tr>
<td>Nonaggressive Retarded</td>
<td>7.8*</td>
</tr>
<tr>
<td>Nonhandicapped</td>
<td>9.1*</td>
</tr>
</tbody>
</table>

p 0.05  k=2, df 40, R.95 = 7.04
CHAPTER 5

DISCUSSION

This chapter presents a discussion of the results presented in Chapter 4. It was the intent of this investigation to examine the heart rate responses of three groups of subjects to affectively loaded and affectively neutral visual stimuli. Data indicating differences within subject groups, and differences between groups along two broad dimensions, developmental level and aggressivity are here first discussed. The chapter concludes with references to limitations of the study and implications for future research.

Heart Rate Level

For any individual, heart rate varies as a function of discrete internal and external environmental events. Beyond the periodic, stimulus related fluctuations in heart rate, each individual exhibits a heart rate level determined constitutionally by such factors as age, physical fitness, and the state of the cardiovascular system itself (Blanchard and Epstein, 1978). Heart rate level
may also fluctuate widely as a function of homeostatic state (e.g., stomach full versus stomach empty) and mental and physical state (e.g., rested versus fatigue) (Elliott, 1974).

The clearest finding of this investigation was that samples of aggressive and nonaggressive mentally retarded adults and nonhandicapped adults differed markedly in heart rate level. These differences were most noticeable when the nonaggressive retarded and the nonhandicapped samples are compared, with the retarded group having mean heart rate levels approximately 10 beats per minute higher than those of the nonhandicapped subjects. The aggressive retarded group manifested heart rate levels which were consistently higher than those of the nonhandicapped group, and consistently lower than those of their nonaggressive counterparts. Differences between sexes were also identified, with the female subjects in all groups exhibiting higher mean heart rates than did the male subjects. Yet, the group differences in heart rate level identified here were not necessarily caused by the higher levels for the female subjects within each group, as the females of both the nonaggressive and nonhandicapped groups were found to have significantly higher mean levels than did the males.

Heart rate did not reliably vary for any of the three groups, as a function of the visual stimulus condition.
Thus, stimulus content, in terms of affective or neutral loading, did not produce a significant effect on heart rate level. This finding is important in light of the distinction made earlier between stimulus related fluctuations in heart rate, and differences due to factors such as homeostatic and physical state. It seems probable that the differences in heart rate identified here may be due to one or more of these "constitutional" factors.

It should be remembered that all of the retarded subjects sampled are and have been institutionalized, whereas the nonhandicapped subjects as a group, lead more or less "normal" lives. Institutional routines, with lack of activity and opportunity for regular exercise, may promote constitutionally-related increases in heart rate. It is often the impression, when visiting an institution for the mentally retarded, that inactivity and quiescence are the behaviors which are reinforced most frequently, whereas the opposite are often followed by sedation and forced placement in the "quiet room."

The mean heart rate levels of the aggressive retarded group did not differ significantly from those of the nonhandicapped subjects, while those of the nonaggressive group showed a large and significant difference when compared to the nonhandicapped group. In terms of heart rate levels, the aggressive retarded sample seems more "normal" than does the nonaggressive retarded sample.
Keeping in mind the suggested relationship between activity levels and the institutional reward-punishment system, the aggressive subjects sampled here may be more active and more engaging of the environment than are the nonaggressive subjects, and are thus both more likely to be termed aggressive "problem clients" and to be more physically fit. Examining relationships between heart rate level, physical fitness, activity and aggression would perhaps be profitable areas of future research.

Heart Rate Variability

The data representing heart rate variability show group patterns similar to those for heart rate level. Although the differences between groups did not reach statistical significance, the nonaggressive retarded sample exhibited the highest levels of variability, the nonhandicapped group the lowest, and the aggressive group displayed variability levels between the two extremes. No sex differences were demonstrated on this variable for any subject group. There were also no significant changes in heart rate variability in relation to stimulus condition, except for the nonaggressive group on the variable VI. This group displayed significantly higher levels of variability in the baseline and affective conditions when compared to the neutral stimulus condition.
The finding of no overall stimulus-related changes in variability is similar to that for heart rate level reported in the previous section. The results for the nonaggressive group, however, are in need of explanation. Lacey (1967) believes that heart rate variability may change as a function of "stimulus intake" or "stimulus rejection," much as does heart rate itself. Decreases in variability may accompany cardiac deceleration in the "stimulus intake" process, while the inverse relationship would hold for periods of "stimulus rejection."

In light of the above, the results for the nonaggressive retarded group may be explained in this manner: during the baseline condition, in which no visual stimulus is shown, little attention in the form of visual concentration and cognitive processing is required, thus the heart rate fluctuates and results in higher variability. The affective stimulus presents information which may be unpleasant, such that the information is rejected and the heart rate exhibits greater variability. The neutral condition, which contains more pleasant, perhaps less socially complex information, is attended to, producing a steadying of the heart rate.

The rationale presented above is one possible way of explaining the differences in variability exhibited by the nonaggressive retarded sample. It would seem, however, that the data do not provide a clear enough relationship
between variability and stimulus condition for such a rationale to be strongly supported. Interestingly enough, the literature generally fails to discuss the relationships between heart rate variability and states of attention and arousal. Aside from the similarities in patterns of variability and heart rate level for each of the three subject groups, these data are equivocal regarding group differences in arousal, attention and cognitive processing.

Heart Rate Change

There were no significant group differences in the direction and/or magnitudes of heart rate changes (refer to Table 9, pg.72 and Figures 7 and 8, pg. 75-76). There was no effect of stimulus condition on heart rate change for any of the three groups, and there were no significant differences between the male and female subjects. Because heart rate change is theoretically a function of stimulus-related neurocardiac interactions, it would follow that individual patterns of response are the rule. These individual response styles would be a result of idiosyncracies in perceptual ability, efficiency of cognitive processing, and past experience with certain types of information. Thus, the failure to identify group differences in heart rate change is not surprising; the collapsing of individual data into averaged scores representing the group as a whole, causes a loss on information, and
makes the likelihood of identifying meaningful differences or similarities very small.

However, when individual patterns of response were examined, on the basis of whether (and how much) a subject accelerated or decelerated in response to the stimuli, differences between groups are still not evident (refer to Figure 9, pg. 80). The direction and magnitudes of heart rate changes did not differ across groups, nor did the subjects within a particular group show significantly more cardiac acceleration or deceleration in response to stimulus content. In short, even when individual response patterns were utilized as the basis for analysis, there were no differences either between or within subject groups in response to affective and neutral stimuli.

When subjects were classified as "accelerators", "decelerators" or "mixed" on the basis of their heart rate change responses across stimulus conditions (refer to Figure 10, pg. 84), no overall group differences were identified. Lacey and Lacey (1974) have used the distinction between "accelerators" and "decelerators" to describe why, within any sample of subjects, some consistently show cardiac acceleration when most exhibit deceleration in response to a stimulus. The Lacey's believe that such patterns may reflect the individual response style of a given subject.
Within both groups of retarded subjects, there were more "mixed" responders than there were subjects who exhibited a consistent acceleration or deceleration to all stimuli. In the nonhandicapped sample on the other hand, the vast majority of subjects (85%) responded consistently, either accelerating or decelerating across stimuli. When "accelerators" and "decelerators" in each group were combined and compared to those subjects who responded with the "mixed" pattern, significant differences were found between retarded and nonhandicapped subjects, with half of the subjects in each of the retarded groups responding inconsistently (accelerating on one type of stimulus and decelerating on the other) while only three of 20 nonhandicapped subjects responded inconsistently.

The above was the only finding of this investigation which clearly discriminated retarded from nonretarded subjects. Moreover, this was the only instance in which aggressive and nonaggressive retarded subjects appeared to have performed similarly. It is possible that these findings bear some relationship to the information processing capabilities of the subject groups. The inconsistency of the retarded subjects may indicate that stimulus presentation did not evoke a uniform, stereotyped heart rate response, almost as if there were an amount of "uncertainty" within the system responsible for mediating neurocardiac
107 responses. The nonhandicapped subjects on the other hand, produced consistent, individualized responses in reaction to the stimuli, potentially indicating that the stimuli were being received and reacted to in the manner most efficient for or most suitable to the individual. The above explanation and the relationships between retardation and behavioral consistency are, however, in need of further investigation.

In light of the large body of literature cited in Chapter 2, pointing out differences in heart rate change responses between retarded and nonretarded persons, two interpretations of the data presented here are possible; a) results of this investigation do not support those of previous studies in which cardiac responses have been utilized as an index of attentional and cognitive processing differences between retarded and nonretarded subjects, or b) the paradigm and/or stimuli used in this study were not effective in eliciting differential attention and cognitive activity, and thus did not produce results which would support previous investigations.

The second explanation is preferred for three reasons. First, studies which have been most effective in demonstrating (theoretically) attention-related cardiac responses, have utilized a reaction time procedure, in which the subject is required to both observe a stimulus and respond, with physical movement, on cue. The present study asked only that subjects observe, and possibly
interpret visual stimuli of differing content. Secondly, a reaction time procedure is only minimally susceptible to effects caused by differences in the experiential background of the subject, e.g., differences in the extent to which the subject is familiar with or emotionally affected by a stimulus. The visual stimuli used in this study were not tailored to the individual's background, thus differing personal interpretations of the stimuli could produce widely divergent heart rate responses. Finally, because of restrictions in the types of experimental manipulations allowed to be performed of institutionalized subjects, the visual stimuli were not as emotionally "loud" or as startling as might be necessary to produce a vivid physio-emotional response.

The above methodological problems lead to great difficulty in interpreting the heart rate change data presented here. In general, these results can neither support nor detract from the findings of previous studies, and the implications for the use of a paradigm such as these used here are uncertain. The utility of this procedure for discriminating between "groups" of subjects (grouped on the basis of characteristics such as aggression-nonaggression) is questioned.

**Interrelationships Among Dependent Variables**

In this investigation, heart rate was examined in several different ways, including absolute level, direction
and magnitude of change in relation to a stimulus, and variability for a given interval of time. The relationships between these three methods of analyzing heart rate data may provide information about the dynamics of the neurocardiac functioning of the subjects used. Table 5 (pg. 62) presents intercorrelations among dependent variables for each of the subject groups. The most striking finding of this analysis was that, for the aggressive retarded group alone, heart rate level and the direction of heart rate change were inversely related to variability. No such relationship was demonstrated for either the nonaggressive retarded or the nonhandicapped groups.

The reasons for these differences between groups are unclear, and the literature itself is uncertain as to the meaning(s) of heart rate variability, and its relation to other indices of psychophysiological functioning. For the aggressive retarded group, cardiac deceleration, which theoretically indicates orienting or information gathering responses (Lacey and Lacey, 1978; Sokolov, 1963) was associated with higher variability, while cardiac acceleration was associated with lower levels of variability. These findings do not support the contention of Lacey (1967) who believes that cardiac deceleration is accompanied by decreases in variability. However, if Lacey is correct, then the data for the aggressive sample suggest a possible inconsistency in neuro-cardiac activity not seen in the
nonaggressive and nonhandicapped subjects. Both the 
general relationship between heart rate change and vari­-
ability proposed by Lacey, and the results for the aggres­
sive group presented here are in need of further investi­
gation.

Habituation

Significant changes in response magnitude with time 
(across trials) were demonstrated for both heart rate 
level and variability. Similarities in patterns of 
habituation between the aggressive retarded and non­
handicapped groups were pointed out on both variables: 
aggressive retarded and nonhandicapped subjects exhibited 
no significant increase or decrease in heart rate levels 
across trials, but showed a marked decrease in heart rate 
variability. The nonaggressive retarded group, on the 
other hand manifested a gradual decline in heart rate 
level, but did not show a significant change in variabil­
ity.

The similarities in patterns of habituation between 
aggressive retarded and nonhandicapped subjects support 
the suggestion made earlier, that, on the basis of cardiac 
activity, the aggressive retarded subjects behave in a 
more normative fashion than do their nonaggressive counter­
parts. The pattern exhibited by the nonaggressive group 
may be a function of an interaction between constitutional 
factors, which result in high heart rate, and situational
factors such as test anxiety and unfamiliarity with the immediate environment which would account for the gradual decline in heart rate with time. The lack of decreases in variability similar to those seen in the aggressive retarded and nonhandicapped groups may have resulted from a confounding of decreases in heart rate level with variability; the gradual decline in heart rate level caused a concomitant rise in variability.

For the aggressive retarded and nonhandicapped groups, the decreases in variability may reflect decreases in anxiety over the test situation. Initially, subjects might have been unsure as to exactly what kinds of pictures they would be seeing, and what types of manipulations would be performed on them. As the subjects became less "unsure" about the process they were going through, they were able to relax, mentally and/or physically, such that heart rate variability diminished. This explanation, however, cannot account for both the steady heart rate levels of the aggressive retarded and nonhandicapped groups, and the gradually decreasing heart rate levels of the non-aggressive retarded group, unless one proposes that the heart rate levels of the nonaggressive group were artificially high at the beginning of the testing session. These relationships are suggested for future research.
Implications

The results of this investigation are inconclusive as to the relationships between aggression, mental retardation, and such psychophysiological activities as attention, information processing and arousal. Generally, the results presented here neither support nor disconfirm studies which show heart rate change to be related to attention. The analyses of heart rate change data presented here are difficult to relate to previous studies because of methodological differences and the lack of clear results.

It was hoped that differences would be found between retarded and nonretarded subjects in heart rate responses to information-containing stimuli. Such was not the case. It was also hoped that aggressive and nonaggressive mentally retarded clients could be discriminated on the basis of their heart rate responses to these stimuli. Again, such was not the case. Thus, the utility of the procedure used here, for making sweeping discriminations between "types" of subjects is questioned. The procedure may prove to be potentially valuable in a diagnostic sense: if visual stimuli could be tailored to the individual, taking into account known preferences and aversions, the effects of familiarity, novelty, etc. Programs of behavioral self control, using procedures such as shaping and desensitization, could then be based upon discrete, personally relevant stimuli or events.
The differences in the distributions of heart rate levels between groups of subjects is intriguing, in that the aggressive retarded subjects were more comparable to the nonhandicapped sample than were the nonaggressive subjects. It is possible that heart rate level, in relation to varying states of behavioral arousal (e.g., sleep versus quiet, activity versus vigorous activity) would provide an index of psychophysiological functioning capable of discriminating persons who are chronically aggressive from those who are not. The importance of such a measure would lie in its ability to identify and quantify physiological states preceding or accompanying behavioral arousal. Remediative strategies could then be directed at both the external and internal aspects of arousal, potentially providing an approach more likely to effect control of the behaviors accompanying arousal.

It is believed that, with several modification, the procedure utilized in this investigation may be of value as a diagnostic or remediative tool. In terms of heart rate change scores, the results of this study are inconclusive, perhaps due to weaknesses in the design of the procedure itself; it is possible that the stimulus pictures used here were not effective in eliciting a consistent, measurable heart rate change. Three procedural modifications are suggested. First, make the stimulus pictures more homogeneous in content, such that all stimuli within
a sequence are conceptually similar, e.g., show a set of slides of auto accidents, or homicide victims, or fist-fights, but arrange slides in groups according to content. Secondly, shorten the stimulus sequence. It may have been helpful in this study to use four or five pictures rather than the longer sequence of 20 pictures. Finally, use a longer interval between stimulus presentations, allowing the heart rate to stabilize at a baseline level before presenting the next stimulus.

Beyond these suggested modifications of the procedure, several suggestions for future research may be made. It would be interesting to utilize a reaction time procedure with aggressive subjects in an attempt to generate data which would be more easily compared to those of Lacey, with nonhandicapped adults, and to those of Krupski, with retarded subjects. Also, in light of the findings here of large differences in resting heart rate level between nonaggressive and nonhandicapped subjects, an investigation of physiological maxima and minima, e.g., measuring heart rate during physical exertion versus during sleep, would be of value in formulating an overall physiological profile of aggressive and nonaggressive individuals. Finally, identifying the relationship between aggression and physical fitness or activity level is important with respect to our treatment of behavior problems within the institutional setting. Measures of heart rate, combined with
such indices as body weight, fat density and waking activity levels could indicate whether, within an institution, those persons who are physically healthier or more active and challenging of the environment are also those who are more likely to be seen as "problem clients."
APPENDIX A

This appendix provides a description of the stimulus slides used in this dissertation. Slides are listed in the order of their presentation.

1. Affective: Large male cat with chronic cerebral electrode implant. Shown in biting attack on white rat.

2. Neutral: Large yellow cat reclining in sun.


4. Affective: Large white cat mounted in stereotaxic surgery apparatus. Cat has large incision in head, with skin and muscle reflected. Surgical instruments and bloody gauze are spread throughout the scene.

5. Neutral: Tree shrew poised on a small branch.

6. Affective: Dentist poised near dental chair. Dentist is holding oral syringe at ready near patient's mouth.


9. Affective: Man in black leather jacket shown physically attacking another man by aggressively pulling on the front of the victim's shirt. Victim displays facial expression of anguish and fear.

10. Neutral: Two expressionless men, one standing and one sitting.

11. Affective: Man in black leather jacket attacking seated man by aggressively pulling on shoulder and shirtfront. Victim displays expression of surprise and fear.

12. Neutral: Two smiling men, one standing and one sitting.
13. Affective: Female doctor preparing large syringe. Woman has intense, unfriendly expression on her face.


16. Affective: Two partially clothed men fighting. One man has his hands on the shoulders of the other man, while the victim has his arms flexed in a defensive posture. Both men display facial expressions of fear.

17. Neutral: Athletic-looking man in profile. Man has pleasant smile on face.

18. Neutral: Snow on road and rooftop of house.

19. Affective: Man with shirt torn open lying on floor, holding the bridge of his nose with both hands. Nose and fingers are bloody and man has facial expression of pain.

20. Neutral: Man seated near swimming pool on sunny day.
### APPENDIX B

#### DATA SHEET

**BIOFEEDBACK PROJECT**  
**DATA FORM - HEART RATE**

<table>
<thead>
<tr>
<th>Slide No.</th>
<th>Type:</th>
<th>Seconds:</th>
</tr>
</thead>
<tbody>
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<td></td>
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<td></td>
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<tr>
<td>4</td>
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**NAME:** ________________________  
**AGE:** ________________________  
**SEX:** ________________________  
**Comments:** ____________________

**Date:** ________________________  
**Appointment Time:** ____________  
**Unit:** ________________________  
**Bldg:** _______________________
TO: Unit Supervisors  

FROM: Bill Frankenberger  
Coordinator - CSI Biofeedback Project  

December 15, 1978

I am currently starting a project designed to supplement the programming needs of some of the institution's more aggressive residents. This initial attempt at treatment will consist of intensive biofeedback training aimed at reducing overall levels of physical arousal in aggressive individuals, in hopes of enabling them to respond more appropriately to life situations.

I plan to treat a small group of aggressive residents for a period of about four weeks, taking physiological and behavioral data, and comparing the aggressive clients to both non-aggressive retarded individuals and normal individuals. With this as a starting point, the services of the Biofeedback Project will be offered to other residents in need of new and different therapeutic methods. I propose that the new techniques employed in the Biofeedback Project will add to and perhaps enhance ongoing programming efforts for aggressive individuals here at CSI.

At present, I am attempting to identify residents who could potentially benefit from the programming offered by the Biofeedback Project. I am looking for individuals who exhibit aggressive behaviors - essentially your most aggressive or violent clients. I define aggressive people as those who hit, bite, scratch, kick, throw tantrums, pick on others, etc., damage furniture and fixtures, break windows, throw things at others, and so on. The Biofeedback Project is generally looking for those residents, both male and female, who frequently (more than once a month) cause damage to things and/or cause injury to staff and other residents through violent behavior.

Since I am not familiar with most of the residents at CSI, I need your help in identifying potential clients of the Biofeedback Project. I would like for you to nominate individuals in your unit who could benefit from special treatment and attention aimed at their aggressive behaviors. Enclosed is a form on which you may list the names of potential Biofeedback Project clients. You will notice
that one column is headed AGGRESSIVE and the other is headed NON-AGGRESSIVE. For purposes of experimental control, I would also like you to list four or five residents who are not aggressive or violent. In doing this, it may help you to first think of your most aggressive residents and then think of your least aggressive residents, listing them in the proper columns. Clients will be screened, and chosen to participate on the basis of their availability. A formal statement as to the goals, methods, and results of treatment provided by the Biofeedback Project will be placed in each client's Individualized Habilitation Plan. Services provided by this project will be scheduled so as not to interfere with present programming, and institutional consent to treatment guidelines will be followed.

I believe that the CSI Biofeedback Project has much to offer to the residents of this institution, and I hope that you can help me with this initial effort.

Bill Frankenberger, M.A.
Coordinator - Biofeedback Project
LIST OF REFERENCES


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