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PSYCHOPATHY AND THE CONDITIONING OF AUTONOMIC RESPONSES

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Abstract

A delayed, differential, classical conditioning paradigm was used to investigate defense and reward conditioning of autonomic responses in psychopaths. The CSs were tones and the UCSs were shock and pictures of nudes. The Ss were drawn from the inmate population of a maximum security penitentiary and were classified as primary psychopaths (P), secondary psychopaths (S), and nonpsychopaths (NP), according to criteria proposed by Cleckley and Karpman. The three dependent variables of chief interest, the GSR, HR, and finger vasoconstriction, were recorded simultaneously on an Offner Type R Dynograph. Differential conditioning was expressed as the amplitude of response to a reinforced CS minus the amplitude of response to the unreinforced CS. The primary hypothesis of the study was that Group P would show less defense conditioning of electrodermal, cardiac, and vasomotor responses than would Group NP. The secondary hypothesis predicted no significant differences between Groups P and NP in amount of reward conditioning on any of the autonomic measures investigated.

The results showed that of the three physiological systems studied only the electrodermal differentiated between Groups P and NP with Group P; (1) showing significantly less defense conditioning; (2) giving smaller conditioned ORs, and smaller UCRs to shock; and (3) having a significantly lower level of basal skin conductance midway through the

experiment. There was no significant difference between the two groups in reward conditioning although the tendency was for Group P to give ORs and ARs of smaller amplitude than those given by Group NP. No significant difference was found between groups in shock detection threshold or shock tolerance level - hence these variables were ruled out as significant contributors to the difference in defense conditioning. It was also shown that a difference in basal conductance between Groups P and NP was not significantly related to the observed difference in conditioning. Under both defense and reward stimulus conditions all groups showed evidence of conditioned HR deceleration, and an increase in the amplitude of vasomotor responses. There was no significant difference between Groups P and NP on any index of either cardiac or vasomotor activity.

The GSR findings pertaining to defense conditioning were interpreted as providing additional evidence that primary psychopaths are deficient in the acquisition of conditioned fear responses. The reward conditioning results indicate that there is still no evidence that primary psychopaths differ from nonpsychopaths in the conditioning of reward responses. The difference between the amount of electrodermal and cardiovascular conditioning shown by Group P was related to structural and functional differences between the physiological systems investigated.

The results of this study seem to permit the following

tentative conclusions:

(1) The GSR may be a more appropriate autonomic correlate of the psychopath's emotional reactivity than is either HR or finger vasoconstriction.

(2) The primary psychopath's autonomic conditioning deficit may be restricted to the GSR.

(3) In comparison with nonpsychopaths primary psychopaths are deficient in the acquisition of classically conditioned fear responses expressed as electrodermal measures.

(4) There is no evidence that primary psychopaths and nonpsychopaths differ significantly in the acquisition of classically conditioned reward responses.

(5) Relative to nonpsychopaths primary psychopaths appear to be electrodermally hyporeactive.

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Introduction and Review of the Literature

While an extensive body of literature is devoted to clinical descriptions of the psychopath and speculation as to etiology it is only in recent years that experimental investigators have taken an active interest in the problem. The behavior of the psychopath has been well described by Cleckley (1964, 1959), who believes that psychopathy, in addition to being distinct from neurosis or psychosis, reflects a blocking, absence or dissociation of the major emotional accompaniments of experience. Although he is mentally undisturbed by the presence of conflict or anxiety the psychopath's behavior is often unwise, distasteful and bizarre (if not actually criminal), and indicates poor judgment despite the absence of demonstrable cognitive deficit. The psychopath's behavior, according to Cleckley, seems to lack rational motivation; he does not seem to experience anxiety, remorse or shame, nor does he appear to learn from experience. Wide agreement exists among writers as to the existence of a basic core or "syndrome" of psychopathy characterized by guiltlessness, impulsivity, antisocial, aggressive behavior and an apparent inability to modify behavior as a result of past experience (Cleckley, 1959, Karpman, 1941; McCord and McCord, 1964; Gurvitz, 1952, Maughs, 1955, 1961; Albert, Brigante and Chase, 1959; Gray and Hutchison, 1964).

Karpman (1941) distinguished between two types of

psychopaths, the idiopathic (constitutional or primary) psychopath, and the secondary (neurotic) psychopath. The psychopathic behavior of the latter is said to be symptomatic of or secondary to underlying psychogenic causes such as neurosis or psychosis, whereas the behavior of the primary psychopath cannot be accounted for in these terms.

It was Karpman's view that the two groups could not be readily differentiated on the basis of observable behavior. He held that only a demonstrable lack of guilt, anxiety and conscience, and an absence of underlying neurosis or psychosis could point to true (primary) psychopathy. In this regard Hare (1969) has drawn attention to the contradiction in the use of the label, neurotic psychopath. He points out that, since the life-history, the personality structure, and the motivations of the neurotic psychopath are probably different from those of the primary psychopath, it would be more appropriate to emphasize the neurotic component, e.g., acting-out neurotic, neurotic delinquent, etc.

Several clinical observers e.g., Karpman (1941, 1961), Cleckley (1964, 1959), and Henderson (1947), view psychopathy as being related to a learning disability. These authors variously describe the psychopath as one who cannot learn the socially acceptable forms of behavior, who is unable to profit from experience or, for reasons never specified, one who is incapable of learning *per se*. Cleckley (1964) expresses the opinion that punishment is ineffective

in changing psychopathic behavior. Henderson (1947) notes that the psychopath's antisocial behavior is not significantly influenced by social, penal or medical methods of treatment. Dollard and Miller (1950) regard the psychopath as an unsuitable candidate for psychotherapy. A more explicit statement is that of Eysenck (1953), who postulates a constitutionally determined general factor of poor conditionability in psychopaths. Other investigators e.g., Lykken (1955), and Hare (1965a), relate the disorder to deficient conditioning of fear responses and autonomic underarousal.

Much of the recent experimental work in this area has dealt with the so-called "learning deficit" in psychopaths. The relevant studies are discussed in the following section.

Experimental Studies of Learning in Psychopaths

Verbal Learning. Fairweather (1953) tested the hypothesis that the psychopath could be motivated to learn under special incentive conditions of uncertainty. The subjects (Ss) of the study were prison inmates classified by the institution's clinical staff as psychopathic, neurotic, and normal. They learned a list of nonsense syllables under three experimental conditions: (1) no incentive (instructions only); (2) normative incentive (the S was given two packages of cigarettes for taking part in the experiment); and (3) uncertainty incentive (the S was to receive two packages of cigarettes provided he reached a criterion

score unknown to him at the time of learning). The results showed that all groups learned best under "uncertainty", poorest under "no incentive", and that neurotics and psychopaths were similar in performance while normals were superior to both.

While Fairweather's study is suggestive of poorer than normal performance on the part of psychopaths, Kadlub (1956), using a similar design, found no differences between psychopaths and nonpsychopaths on a serial learning task in which either cigarettes or verbal approval functioned as incentives. Kadlub's groups represented the extremes of a continuum of social adjustment and it is conceivable that his psychopathic group included a mixture of primary and secondary types. This would tend to attenuate any differences between the comparison groups.

Some clinicians (e.g., Lindner, 1944) have suggested that psychopaths have an unusually good memory. In a test of this hypothesis Sherman (1957) compared the performances of psychopathic and nonpsychopathic criminals and noncriminal neurotics. The hypothesis was confirmed in that psychopaths showed significantly greater retention of both nonsense and meaningful verbal material than did either of the other two groups. The author interpreted the results in terms of the theory (Spence and Taylor, 1951) concerning the deleterious effect of anxiety on performance. The neurotic Ss performed inefficiently while the psychopaths,

being non-anxious, performed well.

Somewhat different results were obtained by Schoper (1958), who used a similar retroactive-inhibition design, and three groups of prisoners classified as normal, neurotic, and psychopathic. The only significant difference observed was that neurotic Ss learned the original list at a slower rate than did either of the other two groups. There were no group differences in retention of the word lists.

Probability Learning. In order to test the clinical observation that psychopaths display poor judgment in a variety of situations (e.g., goal setting), Painting (1961) compared the probability learning of psychopaths and non-psychopaths. The Ss were post-narcotic addicts divided into primary and secondary psychopathic groups on the basis of their scores on the Internalization Ratio, (IR), an MMPI derived index of the direction in which anxiety is expressed. A third group of Ss consisted of college students. A two-choice partial reinforcement procedure was employed in which the S was required to learn which of two switches was likely to elicit reward (cigarettes), or result in punishment (loss of cigarettes).

The results showed first, that there were no differences between groups when the correct response on any given trial was either randomly determined or dependent upon the immediately preceding trial. Secondly, under the reward condition, when the correct response on trial n was dependent

upon trial n-1, primary psychopaths adopted a "gambling" strategy that was superior to that employed by either of the other groups. This finding is incompatible with the assumption that the psychopath is unable to profit from experience. Finally, when the correct response was dependent upon what happened two trials earlier the primary psychopath's performance showed a general deterioration. Painting's study suggests that psychopaths perform as well or better than do normal individuals when the stimulus and response are in close temporal proximity but that they do not learn as well when the correct response is dependent upon past events.

The studies reviewed in this section provide little convincing evidence that psychopaths are characterized by a general learning deficit. On the contrary, it appears that at least as regards rote learning, memory function and the learning of certain probability relationships, psychopaths do as well if not better than do nonpsychopaths.

Verbal Conditioning. Verbal conditioning studies usually involve a closer interaction or social relationship between the experimenter and the S than do other types of experiments. In addition, reinforcement is often social in nature so that verbal conditioning paradigms would appear to be especially appropriate for the study of psychopathy, a disorder that seems to involve some form of social maladjustment or lack of response to social reinforcement. Clinical

statements about the psychopath's attenuated emotional reactivity (Cleckley, 1964, 1959), his failure to benefit from psychotherapy (Bender, 1947; Dollard and Miller, 1950), and his inability to react to words that elicit emotional responses in normal people (Cleckley's concept of semantic dementia), all suggest that the psychopath should do poorly in studies of verbal conditioning.

Blaylock (1960) compared verbal conditioning in hospitalized normal Ss and two groups of prisoners. The latter were divided into those with high and those with low Pd scores on the MMPI. The correct responses were singular and plural pronouns reinforced with the comment "good", "punished" with "not so good" or followed by no comment on the part of the experimenter. All groups showed a significant increase in the use of the reinforced pronouns. There were no differences between groups under either the reward or punishment conditions.

Findings in the opposite direction were reported by Johns and Quay (1962), and Quay and Hunt (1965), who compared the verbal conditioning of psychopathic and neurotic military offenders selected on the basis of their scores on a scale of delinquency proneness developed by Peterson, Quay and Tiffany (1961). Experimental Ss were reinforced with "good" for sentences starting with "I" or "We". Control Ss received no reinforcement. No evidence of verbal conditioning was obtained for psychopaths while nonpsychopathic Ss

showed a significant increase in the use of the reinforced pronouns over trials. It should be noted that in these studies the psychopathic Ss had a high operant level for personal pronouns, and their actual increase in the use of the reinforced pronouns over trials was understandably quite small. Nonetheless, the results were interpreted as indicating a failure of psychopathic Ss to respond to secondary or generalized reinforcers of a social nature.

Bernard and Eisenman (1967) investigated the verbal conditioning of female prisoners with MMPI profiles indicative of psychopathy and student nurses with nonpsychopathic profiles. Two types of reinforcement, social and monetary, were administered for sentences beginning with "I". In the social reinforcement condition E said "good" and in the monetary condition a nickel was placed beside the S. The results showed that psychopaths conditioned better than normals under both types of reinforcement, and that for psychopaths social reinforcement was more effective than monetary reward. The authors suggested that the superiority of social reinforcement may have been due to the fact that the female prisoners had been deprived of male companionship for some time and that this may have made them particularly responsive to praise from male experimenters.

Persons and Bruning (1966) investigated the conditioning of an instrumental response in "sociopathic" and "nonsociopathic" delinquents. A normal control group was com-

posed of college students. The learning task required the S to draw a 3-inch line while blindfolded. Reinforcement consisted of knowledge of results plus a mild shock for incorrect responses. The results showed that all groups improved in performance over trials, with sociopaths showing the most rapid acquisition and nonsociopaths the slowest.

Allowing for the heterogeneity of subject classification and experimental procedures the results of studies discussed in this and in the preceding sections appear to be inconsistent with the hypothesis that the psychopath is characterized by a learning deficit and an insensitivity to social reinforcement. In terms of the distinction between learning and performance (Kimble, 1961) it is conceivable that the psychopathic Ss in some of the above studies might very well have learned the appropriate response but for several reasons (e.g., lack of motivation to receive reward, hostility towards the experimenter, suspicion of the experimenter, etc.,) they would not "go along with the experimenter" or make any effort to please him.

Avoidance Learning. One of the main characteristics of the primary psychopath is said to be a lack of anxiety (Karpman, 1941, 1961; Cleckley, 1964, 1959; Arieti, 1963). If this observation is correct, and if it is assumed that anxiety reduction is an important mediator of avoidance learning, it would offer at least a partial explanation of the primary psychopath's failure to avoid repeated punishment

and, by inference, the persistence of his antisocial behavior. This means that primary psychopaths, in comparison with nonpsychopaths, should perform poorly in avoidance learning tasks.

Lykken (1955) studied avoidance learning in primary and neurotic psychopathic criminals, defined in accordance with Cleckley's (1941) criteria, and a normal control group. The apparatus constructed by Lykken was rather ingenious and consisted of 4 switches and 20 choice points programmed to constitute a "mental maze". At each choice point the S could advance to the next choice point only by pressing an arbitrarily correct switch. In the avoidance part of the experiment one of three incorrect switches was arbitrarily programmed to deliver shock to the fingers at each choice point. The S's task was ostensibly to learn the correct sequence of responses (the "manifest" task). At the same time he could avoid shock by learning the correct sequence of punished errors (the "latent" task). The assumption here was that performance on the latent task was reinforced through anxiety reduction. The ratio of shock errors to nonshock errors was taken as an index of avoidance learning.

The results indicated that there were no differences between groups on the manifest task i.e., in maze-learning ability *per se*. However, on the "latent" task primary psychopaths showed the least avoidance learning while normal Ss were the most proficient. The results of this study

provide support for the hypothesis that primary psychopaths are deficient in avoidance learning.

Several other investigators have used modifications or variants of Lykken's design to study avoidance learning in psychopaths. Schoenherr (1964) used Cleckley's criteria to classify prisoners as primary and secondary psychopaths. Non-institutional normal Ss served as controls. The learning task consisted of several "mental mazes" similar to that of Lykken but involved fewer choice points. Schoenherr confirmed Lykken's findings as regards both avoidance learning and simple maze learning ability.

Schacter and Latané (1964), using prisoners defined as psychopathic, nonpsychopathic, and a "mixed" group, replicated Lykken's study under placebo and epinephrine conditions. The results secured under the placebo condition were similar to those obtained by Lykken (1955) and Schoenherr (1964) i.e., poor avoidance learning in psychopaths. When the Ss were injected with epinephrine, however, primary psychopaths showed "excellent" avoidance learning, a result attributed by the authors to an hypothesized chronic state of high autonomic arousal in psychopathic Ss.

The three studies discussed above provide consistent support for the hypothesis that primary psychopaths are deficient in learning to inhibit a punished response. In each case the punishment was electric shock. An obvious question is whether psychopaths would display deficient

avoidance learning with other types of punishment. Schmauk's (1968) study was designed in part to examine this question.

Schmauk (1968) used Cleckley's descriptive items and several psychometric measures to classify prisoners as primary and secondary psychopaths. A group of normal Ss served as controls. Schmauk used a learning task identical to that developed by Lykken. There were three types of punishment for incorrect responses; shock, loss of money, and verbal disapproval. Schmauk found that under the shock condition the results were the same as those obtained by previous investigators viz., primary psychopaths showed significantly less avoidance learning than did normal Ss. Primary psychopaths were also inferior to normal Ss under the social punishment condition. However, there were no differences between groups in avoidance learning when punishment consisted of loss of money. Moreover, primary psychopaths showed better avoidance when loss of money was involved than under either shock or social punishment conditions.

In summary, the studies reviewed in this section provide convincing evidence that the primary psychopath is deficient in avoidance learning when punishment consists of electric shock. The results of Schmauk's study indicate that poor avoidance learning in the psychopath may be related to the type of punishment employed. It would appear that the

psychopath places a higher value on money than on either physical punishment or social disapproval.

Eyeblink Conditioning. Eysenck (1953) considers the psychopath's most distinguishing characteristic to be the failure or near-failure to condition. Several studies are related to this hypothesis. Miller (1966) administered the MMPI to male patients confined to the criminal wards of a state hospital and selected primary and secondary psychopaths on the basis of the IR (a derived score presumably related to the expression of anxiety). Ward attendants served as controls. The study was designed to investigate the conditioning and generalization of an eyeblink response. The CS and generalization stimuli were tones and the UCS was an air puff to the eye. The CS was reinforced on 70 per cent of the trials. The criterion of conditioning was the number of conditioning trials necessary to reach five consecutive CRs. No significant differences were found between groups in either amount of conditioning or generalization. The percentage of non-conditioners was somewhat greater for primary psychopaths than for neurotic psychopaths or controls but the difference was not significant.

Franks (1956) reported that extraverts showed less GSR and eyeblink conditioning than did introverts, and concluded that psychopaths were poor conditioners. Warren and Grant (1955) found no difference in eyeblink conditioning between college students with high or low scores on the

MMPI Pd scale, although the high Pd group showed poorer discrimination in the second part of the study.

None of the above studies of eyeblink conditioning can be regarded as a crucial test of Eysenck's hypothesis. The most relevant of these is that of Miller (1966), but it is questionable whether Miller's Ss included any significant number of primary psychopaths as this term is defined by other investigators (e.g., Cleckley, 1959; Lykken, 1955; Hare, 1965; Schmauk, 1968). Primary psychopaths are not usually found in mental hospitals. The same criticism is applicable to Frank's (1956) study. Other shortcomings of these experiments include the failure to exclude voluntary responders and to control for pseudoconditioning.

GSR Conditioning. One part of Lykken's (1955) study, discussed above, was designed to investigate differential conditioning of the GSR in psychopathic Ss. Two buzzers of different timbre were used as the CS+ and the CS-, each having a duration of 5 seconds. The UCS (shock) was delivered coincident with CS offset. There were eleven trials with the CS+ and four with the CS-. Several indices of electrodermal reactivity were derived but for present purposes it will suffice to note that on those three that most directly reflected conditioning, primary psychopaths gave significantly smaller CRs than did nonpsychopaths while secondary psychopaths were intermediate. In addition, primary psychopaths extinguished more rapidly than did either

of the other two groups. Lykken's definition of a CR did not provide for direct control of the possible contribution of the orienting reflex (OR) to the CR although the indices of conditioning employed attempted to take this factor into consideration. This study nonetheless provides support for the hypothesis that primary psychopaths are inferior to non-psychopaths in the acquisition of classically conditioned fear responses.

In a more recent study of GSR conditioning and generalization in psychopaths, Hare (1965b) separated the OR and the CR on the basis of latency criteria. The Ss were prisoners classified as primary psychopaths and nonpsychopaths on the basis of Cleckley's check-list. The CS was a 7-second tone and the UCS was shock delivered at CS offset at an intensity which the S indicated was beginning to feel painful. Two tones that differed from each other and from the CS in frequency constituted the generalization stimuli. Hare found that the psychopathic group gave significantly fewer CRs, and showed less generalization than did nonpsychopaths.

Several studies (Hare, 1965c; Lippert and Senter, 1966; Schalling and Levander, 1967) of electrodermal reactivity in anticipation of painful stimulation among psychopathic and nonpsychopathic Ss may be viewed as examples of long-delay conditioning with instructions about the CS-UCS contingency. These studies also yield results consistent with the hypothesis that psychopaths are inferior to nonpsychopaths in

the conditioning of fear responses.

Schmauk's (1968) experiment, although it was not a conditioning study, is relevant to this discussion. While his Ss performed the avoidance learning task, Schmauk recorded GSR activity prior to punishment ("autonomic anticipation"). He found that when shock or verbal disapproval was involved primary psychopaths showed significantly less "autonomic anticipation" than did normal Ss, a finding consistent with the research discussed above. On the other hand, when loss of money was anticipated primary psychopaths showed as much anticipatory GSR activity as did secondary psychopaths or normal controls.

In Lindner's study (Lindner, 1943) of autonomic reactivity the Ss were prisoners with a psychiatric diagnosis of psychopath or nonpsychopath. A tone of 500 cps was presented for 60 seconds, and 30 seconds after tone termination the S received a shock on the arm. The results indicated that psychopaths displayed more electrodermal activity during the tone presentation and the temporal interval than did nonpsychopaths. However, conclusions derived from this study should perhaps be regarded as suggestive at best since the procedures employed were unconventional and the diagnosis of Ss uncertain.

Summary. The studies discussed in this section differ considerably in procedures and in diagnostic criteria, making it difficult to draw any firm conclusions. However,

a few tentative conclusions may be drawn:

Although the psychopath's learning ability in several areas has not been investigated e.g., problem-solving, concept formation, paired-associate learning etc., the empirical findings contradict the "learning deficit" hypothesis. In studies of serial-, probability-, and instrumental-learning, psychopaths seem to perform as well as do nonpsychopaths.

The bulk of the evidence suggests that psychopaths are not significantly different from nonpsychopaths in verbal conditioning. Where discrepant findings exist they are not particularly striking, and may be explainable in terms of procedural, situational, motivational or subject variables.

No conclusions seem possible as regards eyeblink conditioning since the available research is limited in both quality and quantity.

Experiments designed to investigate avoidance learning yield consistent evidence which indicates that primary psychopaths do not readily learn to inhibit a punished response.

Investigators of autonomic conditioning consistently find that primary psychopaths are deficient in the acquisition of classically conditioned fear responses.

There is some suggestion that avoidance learning and autonomic conditioning in psychopaths may be related to the type of punishment employed. Further research is needed to determine the effects of different types of punishment on

both avoidance learning and conditioning, and to find whether the psychopath's conditioning deficit extends to physiological systems other than the GSR.

The Purpose of the Study

The preceding review of the literature indicates that there is still some uncertainty as to the relationship between psychopathy and learning. Studies of verbal conditioning (Bernard and Eisenman, 1967), and eyeblink conditioning (Miller, 1966), show that psychopaths acquire conditioned responses as readily as do nonpsychopaths, thus contradicting Eysenck's (1953) hypothesis of a general factor of poor conditionability in psychopaths. Investigations of instrumental-avoidance learning and fear conditioning, which used painful stimulation, yield fairly consistent results which suggest that it may be mainly in these areas of learning that psychopaths show less conditioning than do nonpsychopaths. However, these are not universal findings. For example, Schoenherr (1964) found evidence of poor avoidance learning in psychopaths on only two out of five avoidance measures. Schmauk's (1968) results suggest that psychopaths learn to inhibit a punished response as well as do nonpsychopaths when punishment consists of loss of money but not when it is electric shock. Moreover, under these differential punishment conditions psychopaths exhibit differential, and appropriate, patterns of autonomic anticipation. It is important to note that the empirical evidence which demonstrates a lack of autonomic anticipation in psychopaths is restricted to the GSR. Hypotheses about the psychopath's ability to acquire

conditioned emotional responses could perhaps be made with greater confidence if several physiological systems were investigated simultaneously under the same experimental conditions. One major purpose of the present study is to determine whether psychopaths show deficient conditioning in autonomic systems other than the GSR. It may be noted also that no empirical data are available as to whether psychopaths differ from nonpsychopaths in the acquisition of conditioned reward responses. A second major purpose of the present investigation is to answer this question.

Because of the central position "conditioned-emotional" concepts occupy in several recent theories of psychopathy these theories will now be reviewed briefly.

Cleckley (1964, 1959) associates primary psychopathy with an attenuation of emotionality in general. The implication here is that primary psychopaths should be inferior to nonpsychopaths in the conditioning of both anticipatory fear responses and anticipatory reward responses.

Lykken (1955), drawing upon the formulations of learning theorists (Mowrer, 1939, 1940; Miller, 1948, 1951) regarding the role of anxiety reduction in mediating avoidance learning, was the first investigator to submit some of Cleckley's assertions to empirical test. However, Lykken viewed psychopathy as being related to an absence of anxiety only.

No defect is implied in the capacity for

> emotional response as such but rather a specific inability to learn to anticipate the affect naturally associated with painful or other intrinsically unpleasant situations. (Lykken, 1955, pp.16).

Several recent studies may be viewed as extensions or variants of Lykken's experiment e.g., Schoenherr (1964), Schacter and Latané (1964), and Schmauk (1968). In general these studies confirm Lykken's findings viz., that primary psychopaths are inferior to nonpsychopaths in avoidance learning when punishment consists of electric shock. Hare's research (Hare, 1965b,c) provides direct confirmation of Lykken's additional findings that primary psychopaths do not acquire conditioned fear responses as readily as do nonpsychopathic Ss. Other studies provide indirect support for Lykken's hypothesis (Lippert and Senter, 1966; Schalling and Levander, 1967). While the experimental results pertaining to fear conditioning in psychopaths are consistent, the relevant studies are few in number so that verification would be desirable. Moreover, the above investigations were restricted to the GSR and physical punishment. In this connection Schmauk's (1968) results suggest that avoidance learning and autonomic anticipation in the psychopath are related to the type of punishment employed.

Hare's (1965a) theory postulates that psychopaths have a steeper-than-normal temporal gradient of avoidance (fear arousal) and response inhibition. This model is based upon the assumption, "...that the tendency to avoid or inhibit a

punished response is a function of the degree of conditioned fear elicited by cues associated with the response." (Hare, 1969, pp.117-118). The hypothesis that the psychopath has a steeper-than-normal temporal gradient of fear arousal is analogous with what Hare (1965a) terms the psychopath's "short-range" hedonism i.e., his tendency to seek immediate gratification despite the probability of experiencing severe discomfort at a later date. One implication of this is that the psychopath's behavior is not likely to be significantly influenced by the possibility or threat of future punishment. Hare's postulate that the temporal gradient of fear arousal is lower in height for psychopaths than for nonpsychopaths is based partly upon the findings that the psychopath's conditioned fear responses are smaller in amplitude, and begin later in the stimulus sequence (closer to shock onset), than do those of nonpsychopathic Ss (Lykken, 1955; Hare, 1965c).

Empirical support for Hare's theory is provided by the results of several studies (Hare, 1965b,c; Lippert and Senter, 1966; Schalling and Levander, 1967) which indicate that psychopathic Ss show little electrodermal reactivity in anticipation of painful stimulation. Since these studies may be viewed as examples of long-delay conditioning the results are consistent with the hypothesis that psychopaths are inferior to nonpsychopaths in the conditioning of anxiety or anticipatory fear responses.

Hare (1965a) originally assumed the temporal approach or reward gradients to be the same for both psychopaths and nonpsychopaths but also acknowledged that in the absence of relevant data no firm predictions were possible.

Quay (1965) speculates that psychopathic behavior is related to basal level and/or adaptation to sensory inputs of all types. He suggests (1) that because of his lowered basal activity the psychopath requires more sensory input in order to maintain pleasant affect and efficient cortical functioning, and/or (2) the psychopath adapts rapidly to stimulation thus increasing the need for greater stimulus variation and greater stimulus intensity. The psychopath's deficient conditioning and poor avoidance learning, according to Quay, may be interpreted as failure of noxious or pleasant stimulation to arouse excitatory processes. Implicit in Quay's notions is the assumption that with higher levels of shock intensity psychopaths should condition as well as do nonpsychopaths.

Quay's notion of reduced basal level is similar in some respects to the positions taken by Cleckley, Lykken, and Hare. All argue in favor of autonomic hyporeactivity in the psychopath. Data of direct relevance to Quay's hypothesis consists of measures of basal level and habituation to stimulation. In an experiment involving shock Hare (1965c) found that primary psychopaths had (1) a lower level of basal skin conductance than did either neurotic psychopaths

or normal controls, and (2) showed greater GSR habituation to shock than did neurotic psychopaths but did not differ from normal controls. In another experiment, (Hare, 1968b), which included tones but no shock, both primary and neurotic psychopaths showed a significant decrease in basal skin conductance during the experiment while nonpsychopathic prisoners showed no significant change. There was no difference between groups in rate of GSR habituation to the tones. On the other hand, primary psychopaths showed less habituation of cardiac deceleration than did either of the other two inmate groups. While Hare's results provide partial support for Quay's hypothesis, two other studies (Lippert and Senter, 1966; Schmauk, 1968) failed to reveal any significant difference between psychopaths and nonpsychopaths in either basal skin conductance or rate of GSR habituation under a variety of stimulus conditions. Lykken (1955) regarded his findings in this area as paradoxical in that primary psychopaths showed the greatest increase in basal skin conductance during the experiment and neurotic psychopaths the least. At the same time, neurotic psychopaths displayed the greatest GSR habituation to shock and normal controls the least.

When the dependent variables are measures of basal activity and habituation to stimulation there appears to be little empirical support for the hypothesis that psychopathy is associated with autonomic hyporeactivity. However, Hare's

(1968b) findings of fewer nonspecific GSRs and less heart-rate fluctuation in psychopaths provide additional support. In the present study basal levels and habituation to stimulation will be examined in an effort to clarify some of the foregoing issues.

In summary, the theories outlined above all seem to be in agreement on the following points. In comparison with neurotic psychopaths and normals the primary psychopath is (1) physiologically underaroused, (2) shows poor avoidance learning, and (3) shows less conditioning of fear responses.

In direct opposition to the above theories is the notion advanced by Schacter and Latané (1964) that the psychopath is autonomically hyperreactive. The only evidence presented in support of this speculation is an increase in pulse rate for psychopaths following epinephrine injection. In view of this and other shortcomings in their study these results are perhaps more suggestive than conclusive.

While recent theory and experimental study have emphasized a lack of anxiety as an explanation of the psychopath's conditioning deficit, alternative explanations are possible. Eysenck (1955, 1961) has long contended that extraverts have greater tolerance for pain than have neurotics or normals. In Eysenck's theory the stable extravert is probably comparable to Cleckley's (1964, 1959) concept of the primary psychopath. Two additional variables that are related to each other and to pain tolerance are detection threshold for

shock and preference for immediate versus delayed shock.

Petrie, Collins and Solomon (1960) found that Ss with high tolerance for thermal pain tended to have higher extraversion scores than those with low pain tolerance. Using thermal stimulation of the forehead as an index of pain tolerance Lynn and Eysenck (1961) found a positive correlation between pain tolerance and extraversion ($r=.69$, $p<.01$), and a negative correlation between pain tolerance and neuroticism ($r=-.36$, $p<.05$). Schalling and Levander (1964) reported that psychopathic delinquents had a higher tolerance for electrical pain stimulation than did neurotic delinquents. However, other investigators (Hare, 1965c, 1966; Schoenherr, 1964) found no significant difference between psychopaths and nonpsychopaths in tolerance for shock.*

If psychopaths, in comparison with nonpsychopaths, do in fact have a higher tolerance for painful stimulation, it might be because of differences in detection threshold. Schoenherr (1964) found that primary psychopaths had a significantly higher threshold for detection of shock than did neurotic psychopaths or normal controls. Hare (1968a), using a more precise procedure, confirmed Schoenherr's results.

These findings may mean that psychopaths are more sensitive to increases in shock intensity above threshold than

*In the latter three studies findings on shock tolerance level were incidental to the main purposes of the experiments.

are nonpsychopaths. Alternatively, psychopaths may deliberately avoid receiving shock intensities at or close to their tolerance level, i.e., they may say they have had enough even though they are capable of tolerating more. Some recent unpublished data (e.g., Thorvaldson, 1969) tends to support this assumption. Thorvaldson determined shock detection threshold and shock tolerance level in psychopathic and nonpsychopathic Ss under "unmotivated" and "motivated" conditions. Under the latter condition Ss could earn cigarettes by lowering their detection threshold and/or by raising their tolerance level. The results of this study may be summarized as follows:

(1) Under the unmotivated condition there were no differences between groups in detection threshold or tolerance level. (2) Under the motivated condition there was no difference between groups in detection threshold. (3) Under the motivated condition psychopaths increased their tolerance level significantly above that of nonpsychopaths. The latter result is consistent with the clinical observation that psychopaths tend to avoid discomfort and also with the empirical findings (Hare, 1966) that they show less of a preference for immediate shock than do nonpsychopaths.

One implication of these studies is that in experiments involving shock, psychopaths may receive less "punishment" than do nonpsychopaths. If this is correct it might offer at least a partial explanation for their poor avoidance

learning and deficient fear conditioning. An additional aim of the present research is to obtain further evidence on the difference between psychopaths and nonpsychopaths in detection threshold for shock and shock tolerance level.

It is evident from the preceding discussion that anxiety is a concept of major importance in several theories of psychopathic behavior. The concept of anxiety as used here is briefly discussed below. This is followed by a brief consideration of the three dependent variables of chief interest in this investigation. These are the GSR, heart rate (HR), and finger blood volume (FBV). The latter is an indirect measure of vasoconstriction. A brief overview of the experimental design is then presented and finally, the hypotheses of major interest are stated.

The concept of anxiety used here is based on the theory and research of several investigators (Miller, 1951; Mowrer, 1960; Solomon and Wynne, 1954). These authorities assume that fear is an innate response to pain. Through the process of classical conditioning a neutral stimulus paired with a painful stimulus comes to elicit anticipatory fear responses called anxiety. On future occasions, when the previously neutral stimulus is presented in an avoidance learning situation, it initiates escape or avoidance reactions which are reinforced through anxiety reduction. Since fear is unobservable its presence is inferred on the basis of changes in various indexes of autonomic activity, skele-

tal-motor responses, or gross behavior, according to the situation or experimental context.

When the response to be conditioned is the GSR it seems as if its psychological significance can be meaningfully inferred only from a consideration of the stimulus context. This is because the GSR, although an innate response to pain stimulation, also occurs under stimulus conditions that could not reasonably be considered to be pain-producing or fear-evoking. It occurs e.g., in response to pictures of nudes (Lovibond, 1963), during problem-solving (Hare, 1968b), and in a variety of everyday circumstances in which pain or fear would not be assumed to be present.

In the case of cardiac responses the situation is more complex, and, for that matter, the significance of the cardiac conditioned response is still not fully understood. According to Lacey cardiac acceleration serves to attenuate stimulus input while cardiac deceleration enhances sensory intake (Lacey and Lacey, 1958; Lacey, 1959). Hare (1968b) presents evidence which suggests that the primary psychopath may be parasympathetically hyporeactive. This could mean less rapid cardiac deceleration and, if Lacey's hypothesis is correct, a reduction in sensory input. One possible consequence might be attenuation of emotionality in psychopaths.

Finger vasoconstriction can be conditioned (Gale and Stern, 1968) but its psychological significance is unclear.

However, since it is sympathetically innervated it is presumed to be correlated with emotional states such as anxiety as are the GSR and HR.

The subjects (Ss) of this study were prisoners classified as primary psychopaths (P), secondary or neurotic psychopaths (S), and nonpsychopaths (NP), on the basis of Cleckley's (1959) criteria. A non-prisoner group (NC), consisting of custodial officers, was included as a control for possible institutionalization effects. The GSR, HR, FBV, cephalic vasomotor activity, and respiration were recorded simultaneously on an Offner Type R Dynograph. The GSR, HR, and finger vasoconstriction, the three dependent variables of chief interest in this study, are presumed to be, at least in part, autonomic correlates of the S's emotional state as this is defined in relation to the experimental situation. A delayed, discriminative classical conditioning paradigm was used in which one of three easily discriminable tones was paired with electric shock, another with a picture of a nude, while a third was presented alone. The term, defense conditioning, as used here refers to anticipatory responses associated with the pairing of a CS (tone) with shock. Anticipatory autonomic responses, mediated by SNS activity, and observed under this condition are assumed to be indicants of anxiety. The term, reward conditioning, refers to anticipatory responses associated with the pairing of a CS with a picture of a nude. Since the experiment was

designed to investigate conditioning in primary psychopaths and nonpsychopaths the main statistical analysis involved an á priori comparison of the means of Group P and Group NP on all conditioning indices.

Hypotheses

The primary hypothesis of this study pertains to defense conditioning.

A Defense Conditioning

When the UCS is shock, Group P will show less conditioning than will Group NP on the following indices of autonomic activity:

1 The GSR

2 Heart Rate

3 Finger Vasoconstriction

The secondary hypothesis pertains to reward conditioning. Since there is no theoretical or empirical basis for making predictions about reward conditioning the comparisons here are stated in null terms i.e., no significant differences are predicted.

B Reward Conditioning

When the UCS is a picture of a nude there will be no significant difference in conditioning between Group P and Group NP on the following indices of autonomic activity:

1 The GSR

2 Heart Rate

3 Finger Vasoconstriction

Method

Subjects (Ss). The Ss were drawn from the inmate population of the B.C. Penitentiary, a maximum security institution housing approximately 500 prisoners. The selection procedures are discussed fully in Appendix A. On the basis of information contained in the S's file the experimenter (E) and a colleague, using Cleckley's (1959) criteria (Appendix B), and Karpman's (1941, 1961) concept of psychopathy, independently rated each S on a 7-point scale. The outcome of this procedure was the establishment of three diagnostic categories of Ss, designated Group P, Group S, and Group NP (primary psychopaths, secondary psychopaths and nonpsychopaths respectively). An index of inter-rater agreement was computed for an initial sample of 46 Ss (Scott and Wertheimer, 1962). The raters agreed on the values assigned to 32 Ss, or 70 per cent of the total. Of the remaining 14 Ss the raters were one step apart on 12 and two steps apart on 2. The index of overall agreement was 63 per cent while chance agreement was 18 per cent. A final rating of each of Cleckley's items was derived for each S by forced agreement. The inter-item correlation, and the correlation between an item and assignment of the S to one of the diagnostic categories were computed. A fourth group consisting of custodial officers (Group NC) was included as a control for possible institutionalization effects. Data were available for a final sample of 18 Ss per group

on all variables investigated with the exception of vasomotor activity. On this latter measure scores were available for 14 Ss in each group.

Age, education and IQ were obtained for all Ss, and tested for significant differences by means of analysis of variance. The F values and the group means are shown in Table 1. A significant difference was found for education. Post-hoc comparisons, using the Scheffé method (Hays, 1963, pp.483-489), showed that the only groups that differed significantly from each other were Group S and Group NC. This difference was not considered crucial to the main purpose of the study.

Apparatus. An 8 channel Offner Type R Dynograph was used to obtain simultaneous records of respiration cycle, cephalic vasomotor activity, finger blood volume (FBV), heart rate (HR), and skin resistance. Additional channels were used to record stimulus presentations. The CSs were 10-second tones delivered through padded earphones. The UCS for the defense conditioning procedure was electric shock provided by a D.C. source which permitted current intensity to be varied between .10 ma and 33 ma. The current was delivered through a concentric electrode (Tursky, Watson and O'Connell, 1965) designed so as to ensure that the area stimulated was constant for all Ss. The UCSs for reward conditioning were 16 different slides of nude women. Each slide was projected onto a screen for 2 seconds. The

Table 1

Group Means and F-Values for Age, Education, and IQ

Variable	Groups					
	P	S	NP	NC	F	P
Age	31.17	33.11	28.39	35.00	1.98	.12
Education (Grade)	9.50	8.05	9.22	11.11	3.24	.03
IQ (Revised Beta)	109.22	106.11	107.94	110.33		

intertrial intervals were controlled by a Gerbrand programmer. The CS-UCS intervals, stimulus onset and stimulus offset, and the pens recording these events, were all controlled by automatic timers. A control panel enabled E to administer stimulus combinations in accordance with a predetermined schedule. The experiment was conducted in a sound deadened room in the hospital section of the institution. Air temperature was maintained at approximately 70 degrees F by an air conditioning unit. The S relaxed in a recliner chair with his back towards the apparatus and the experimenter.

A delayed differential classical conditioning paradigm was used which consisted of two reinforced CSs and one unreinforced CS. The CSs were tones designated high (H), 1260 cps, 59 db; medium (M), 590 cps, 61 db; and low (L), 200 cps, 47 db.* The shock UCS was .5 seconds in duration and the picture UCS was 2 seconds in duration. The onset of each UCS coincided with CS termination. The intertrial interval ranged from 20 to 70 seconds with an average of about 50 seconds.

There were 16 conditioning trials with tone-shock, 16 with tone-picture, and 16 presentations of the neutral CS. The trials were administered in a predetermined random order with two restrictions. First, preliminary work had shown that if the first trial included a shock UCS some Ss

* These db values resulted from equating the frequencies for subjective loudness.

reacted with gross movements and large GSR deflections. This produced marked interference in the record and could result in loss of data. For these reasons therefore, shock was excluded from the first trial. Secondly, no CS-UCS combination could occur more than twice in succession. No adaptation trials were presented since the inclusion of a control for pseudoconditioning precluded the necessity for such a procedure. The presence of three CSs and two UCSs generated six stimulus combinations. One such combination e.g., was H-shock M-picture, and L-. The six combinations were distributed equally among each group of 18 Ss, but were administered to each group in a random order.

It was assumed that the pictures of nudes used in this study constituted an effective UCS for the conditioning of reward responses in inmates. Prior to the experiment three psychologists ranked the 16 slides from least to most attractive. The slides were then presented in this order during the experiment in order to minimize adaptation. Following completion of the experiment an operant conditioning study was conducted to test the above assumption using the same set of slides, and Ss drawn from the three prison groups who had participated in the classical conditioning study. The operant conditioning study is discussed in Appendix C.

Procedure. When a S reported to the experimental room he was told (1) that the purpose of the experiment was to secure records of physiological activity; (2) that

during the course of the experiment he would receive electrical shocks on his forearm; and (3) that his participation was voluntary. Questions by Ss aimed at eliciting additional information about the nature of the experiment were evaded. Inmate Ss were scheduled on a random basis but this could not be done for Ss in Group NC who usually arrived in the experimental room at 8:00 a.m. or after 4:30 p.m.

Beckman Biopotential electrodes one centimeter in diameter and filled with Beckman electrode paste were used to secure cardiac and skin resistance measures. Each electrode was fitted with an adhesive collar which, in addition to maintaining the electrode in a firm position, also prevented seepage of the electrolyte beyond the effective electrode area. An additional advantage was that the collar prevented the paste from drying out during the course of the experiment.

The cardiac electrodes were attached to the sternum and left side as this site was found to produce a strong EKG signal, thus avoiding the need for excessive amplification. These areas also appeared to be less susceptible to movement - induced artifact. Since most Ss came directly to the experimental room from various workshop areas their hands tended to be grimy; therefore the fingers of the left hand, to which the GSR electrodes were to be attached, were washed with soap and water. The GSR electrodes were taped to the volar surface of the tip of the first finger and the

base of the second finger except that where cuts or breaks in the skin were evident adjacent digits were used. Current density, supplied by a 15 volt cell, was approximately 9 microamps/cm^2 (Venables & Martin, 1967). Respiratory cycle was recorded by means of a strain-gage belt fastened around the upper chest. Specially constructed lightweight photocell pickups were taped to the second finger of the left hand and to the forehead in order to secure measures of vasomotor activity in these two areas. Two A.C. amplifiers with time constants of one second were used. Both pickups were shielded from light reflected from the screen during presentation of the picture stimuli. One ground electrode was taped to the S's right wrist after the skin resistance at the site had been reduced by rubbing the area briskly with Redux paste. The shock electrode was strapped to the volar surface of the right forearm.

Repeated stimulation with shock produces a decrease in the impedance (resistance) of an electrode-skin circuit. This results in an increase in both the physical intensity of the shock and subjective estimates of shock intensity. (Tursky and Watson, 1964). Because of the nature of the personality variables being investigated in this experiment it was considered desirable to reduce the variability due to this shock factor. In attempting to achieve this the method recommended by Tursky and Watson (1964) was used. The skin resistance at the shock electrode site was reduced

by rubbing the area briskly with Redux paste. A film of electrode paste was then spread over the area. The electrode was attached and the amount of paste was varied until the ohmeter registered a stable 5000 ohms. According to the results obtained by Tursky and Watson this procedure could be expected to maintain a stable subjective estimate of shock intensity throughout the experiment. The resistance of the electrode-skin circuit was monitored throughout the experiment and was found to vary between 3000 and 7000 ohms.

When all connections had been made the S was told:

> After I place these earphones on your head I want you to lean back in your chair and relax. Avoid movement as much as possible and try to stay awake. After a while you will hear tones in the earphones. There will be three different tones, a high tone, a medium tone and a low tone but they will occur at different times. The high tone will always be followed by shock to your arm, and the intensity of the shock will be the same as the last one you received. The medium tone will always be followed by a picture of a nude projected onto the screen, and the low tone will always occur by itself.

The latter part of these instructions was varied according to the stimulus sequence to which the S had been assigned.

The earphones were attached and the S's chair adjusted to a reclining position. The room was darkened except for a shielded light above the chart. All pieces of equipment to be used during the conditioning trials were switched on

so as to avoid providing the S with auditory or other cues that might signal the onset of the first trial.

During the first 10 minutes of recording no stimuli were presented so as to allow the S to adapt to the experimental situation. At the end of this period the first conditioning trial was presented without prior warning. The E had before him a list of 48 randomized trials. A trial was administered by depressing one of three silent switches while at the same time this trial was crossed off the list. The experiment was terminated about one minute after administration of the last trial. The S was given two packages of cigarettes and asked not to discuss the experiment with other inmates or staff. The total time required was about 90 minutes.

Measurements

The method of limits was used to determine shock detection threshold. The S was told that he would receive some mild shocks and that he was to indicate whether he detected any sensation by responding with "yes", or "no", or "not sure", when the E said "now". The "not sure" category was counted as a shift in sign from the previous judgment. Three alternate ascending and descending series of trials were administered with stimulus intensity being varied by .10 ma at each step. The procedure began with an ascending series and a current intensity of .10 ma. The S's mean threshold for the six series was taken as an estimate of his

detection threshold.

When detection threshold was obtained shock tolerance level was estimated as follows. The S was told, "I am now going to increase the strength of the shock one step at a time. When you feel that it is strong enough i.e., when you decide that it is sufficiently annoying or painful that you do not wish it increased further let me know". The first shock was administered at a current intensity of approximately one ma above detection threshold with each stimulation thereafter being increased by one ma. The temporal interval between stimulations was 10 seconds. The highest current intensity accepted by the S was defined as his tolerance level and was subsequently administered during the conditioning phase of the experiment.

The dependent variables of chief interest were the GSR, HR, and finger vasoconstriction.

The GSR. All skin resistance measures were converted to conductance before any statistical computations were performed. Three indices of electrodermal activity were scored for each S on all trials viz., the orienting reflex (OR), the anticipatory response (AR), and the unconditioned response (UCR). The minimal change in skin resistance required for each of these responses was a decrease of 200 ohms. This decision was made before the data were converted to micromohs and was based on the fact that for some Ss changes in resistance of less than 200 ohms could not be

measured with any degree of accuracy. The latency criteria were one to four seconds after CS onset for an OR, and between four and eleven seconds for an AR (Stewart, Stern, Winokur, and Fredman, 1961). Basal skin resistance was measured at three points in the experiment. The first, taken just before the onset of the first trial, was designated the "resting" level. The second was taken about half-way through the trials, and the third at the end of the experiment. A GSR tends to accompany bodily movements, sighs, yawns, etc., therefore a GSR was not counted if it coincided with these changes as indicated by the record.

Heart Rate (HR). The results of several studies suggest that the cardiac CR consists of an accelerative component peaking from 4 to 6 seconds after CS onset, and a decelerative component reaching its minimal value between 7 and 10 seconds after CS onset (Deane, 1964; Lang and Hnatiow, 1962; Obrist, Wood, and Perez-Reyes, 1965; Smith, 1966; Wood, 1963; Zeaman and Smith, 1965; Zimny, Stern and Feld, 1966). On the basis of these findings the use of a 10 second CS-UCS interval seemed appropriate, the assumption being that the accelerative component could be adequately represented by the mean HR during the first 5 seconds, and the decelerative component by the mean HR during the second 5 seconds. The pre-stimulus level was defined as the mean HR for the 5 seconds immediately preceding CS onset while the UCR was taken as the mean for the 5 seconds

following CS termination. These four indices of cardiac activity were scored for all Ss on all trials.

Because of the quantity of cardiac data the time required for routine computations would have been prohibitive. A device was therefore constructed to provide estimates of the means. Two fine lines 12.5 mm apart were inscribed on a piece of clear plastic. Since the chart speed was 2.5 mm per second, and since the CS-UCS interval was 10 seconds, the distance between the two lines corresponded to exactly 5 seconds of chart time. These two lines were connected by a third drawn at right angles to them. In estimating an interval mean the device was placed directly over the tachometer tracing and adjusted until the areas on either side of the third line appeared to be equal. The number of beats per minute corresponding to this position was taken as an estimate of the mean for that interval. As a check on the accuracy of this method the correlation between computed and estimated means was determined for a random sample. Two records were drawn at random from each group and two trials were selected at random from each record. This provided for a total of 64 intervals. The mean for each interval was first estimated using the device described above and was then computed by actual count. The correlation between these measures was .996.

Digital Vasoconstriction. Changes in finger blood volume were used as an indirect measure of vasoconstriction.

A vasoconstrictive response was defined as an upward shift from the baseline accompanied by a corresponding reduction in pulse amplitude. An amplitude measure was computed for all Ss on all trials. The baseline was defined as the middle of the three pulses immediately preceding response onset. Response amplitude was expressed as the distance in mm from the baseline to the middle of the pulse showing the greatest shift from baseline. The change in mm was converted to mv in terms of the preamplifier gain, e.g., if the gain was 10 mv per CM then a change of one mm was interpreted as a change of one mv. A somewhat similar measure was used by Sternbach (1964).

In computing vasoconstrictive changes no attempt was made to discriminate between an OR and an AR. Gale and Stern (1968) have demonstrated that the peripheral vasomotor OR can be differentially conditioned, and since the purpose of this study was to investigate differential conditioning in psychopaths it seemed irrelevant whether the CR was a conditioned OR or an AR. The criteria for a vasomotor CR was a latency between two and eleven seconds, and a change in magnitude of at least one mm.

Differential conditioning was expressed as the magnitude of response to a reinforced CS minus the magnitude of response to the unreinforced CS.

As indices of habituation, the electrodermal, cardiac, and vasomotor UCRs to shock and to picture stimuli at the

beginning, in the middle, and at the end of the experiment, were selected.

Results

Before reporting the results of this study the inadequacy of Group NC as a control group must be noted. As stated in a previous section Group NC consisted of custodial officers who had volunteered to participate in the experiment. It was included as a control for possible institutionalization effects with the expectation that in the absence of such effects Group NC would be similar in conditioning to Group NP. However, it was found that Group NC showed very little electrodermal reactivity in general and virtually no GSR conditioning. There was no evidence that Group NC differed significantly from the other groups on the cardiovascular conditioning indices.

There seems to be no ready explanation for these results and one can only speculate as to possible causal factors. These include the possibility that Group NC consisted of a number of individuals with psychopathic traits in which case the electrodermal reactivity of the group as a whole would be attenuated. Factors associated with this particular occupation that may also have contributed to the results include consistent and rigorous physical training and discipline, and close and constant contact with the hard-core, "prison-wise" proportion of the inmate population. The time at which physiological records were obtained may also be relevant. Most Ss in Group NC reported to the experimental room at the end of a shift, usually at

4:30 p.m. but in some cases at 8:00 a.m., whereas inmate Ss were scheduled for the hours 8:00 a.m. to 4:30 p.m. It is conceivable that these factors either singly or in combination could have resulted in the inhibition of electrodermal reactivity under the present experimental conditions.

In any event the electrodermal behavior of Group NC was considered to be sufficiently atypical of the normal so as to render this group inappropriate as a control against which to compare the performance of either Group P or Group NP. This leaves Group NP as the "normal" or nonpsychopathic group against which Group P is compared.

The inadequacy of Group NC as a control was not discovered until after the conditioning measures for the three main dependent variables had been submitted to statistical analyses. The scores for this group, therefore, were included in the statistical analyses of detection threshold and shock tolerance data, and all electrodermal, cardiac, and vasomotor conditioning indices. The scores for Group NC were excluded from the statistical analysis of basal skin conductance, and the electrodermal, cardiac and vasomotor UCR data. The findings for Group NC are reported for the detection threshold and shock tolerance data only. They will not be reported for any other variable investigated nor will any further reference be made to this group.

The results of this study are reported in the following order; shock detection threshold and shock tolerance

level followed by the electrodermal, cardiac, and vasomotor data.

Detection Threshold and Tolerance for Electric Shock. A simple analysis of variance was performed on each of these variables. The obtained F-values and the group means are presented in Table 2. There was no significant difference between groups in either detection threshold or tolerance level.

GSR Conditioning. The latency criterion for an anticipatory response (AR) was 4 to 11 seconds after CS onset. A differential AR was defined as the amplitude of response (micromohs) to a positive CS minus the amplitude of response to the neutral CS. The groups of chief interest were Group P and Group NP. The significance of a difference between these groups was tested by an á priori comparison of their means. This procedure was adopted in order to minimize Type 2 errors (Hays, 1963, pp.459-483).

The mean amplitude of differential anticipatory GSRs to the CS followed by shock is shown in Figure 1. Each point plotted in Figure 1 represents the mean differential amplitude for 4 trials and 18 Ss per group. The results of an á priori comparison, presented in Table 3, show that the difference in overall mean amplitude between Group P and Group NP was highly significant, and in the predicted direction, thus confirming hypothesis A_1. The mean amplitude of anticipatory GSRs to the CS followed by pictures of

Table 2

Group Means and F-Values for Shock Detection Threshold and Shock Tolerance Level

	Groups					
Variable	P	S	NP	NC	F	P
Shock Detection Threshold (ma)	2.01	1.88	1.70	1.90	-	
Shock Tolerance Level (ma)	13.82	12.72	16.55	11.87	1.34	.26

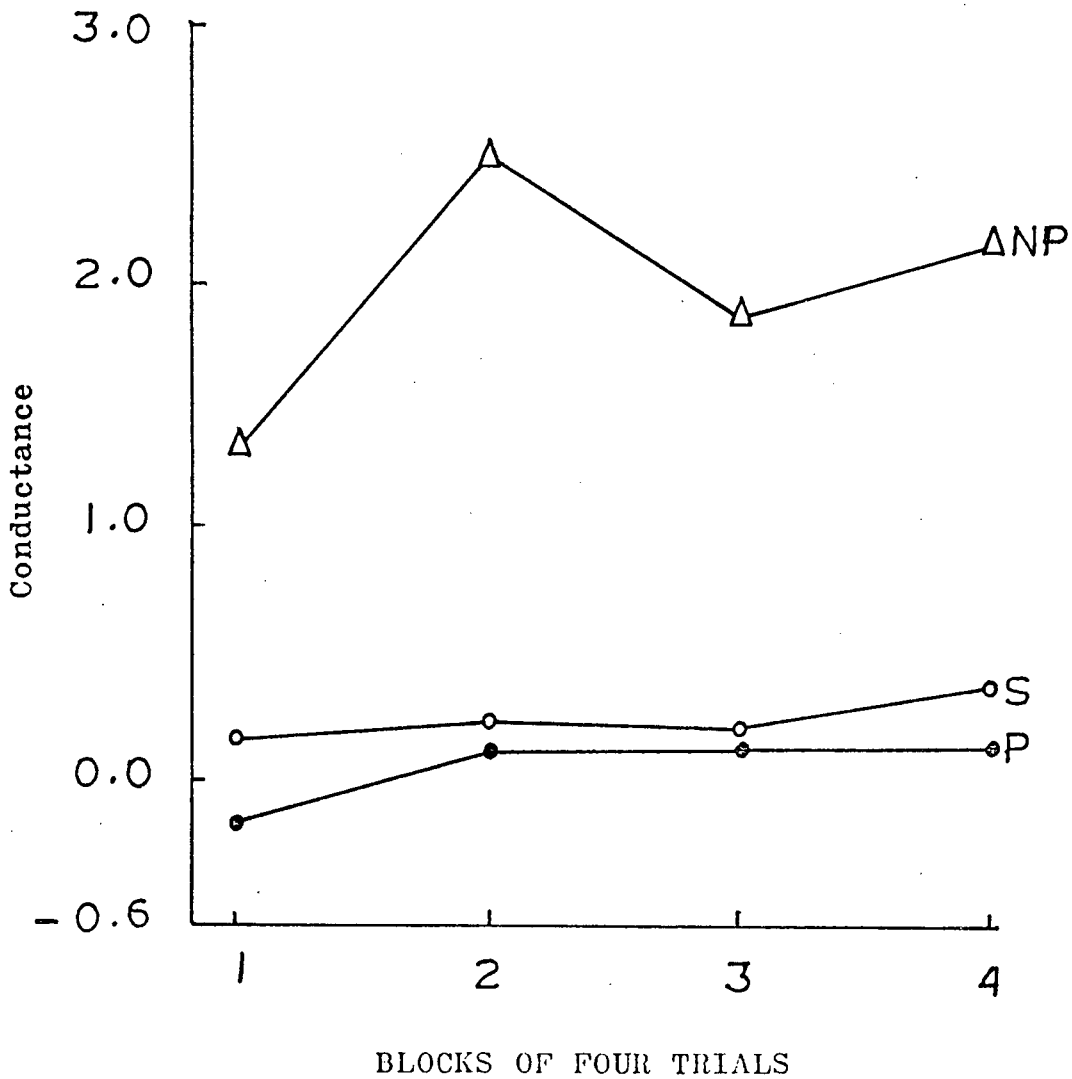

Fig.1. Mean Amplitude of Differential Anticipatory GSRs to CS-Shock.

Table 3

Summary of Orthogonal Comparison of the Mean Amplitude of Differential Anticipatory GSRs to CS-Shock for Groups P and NP

Source	df	SS	MS	F	P
Between Groups	3	10484.98			
Comparison: Groups P vs NP	1	8205.10	8205.10	8.63	<.005
Error	68	64647.81	950.70		
Total	71	75132.79			

nudes is shown in Figure 2. The corresponding á priori comparison, presented in Table 4, showed that the difference between Group P and Group NP was not significant, thus failing to reject hypothesis B_1.

The orienting reflex (OR) is an unspecific reflex produced by a change in the quality of stimulation. It is part of the alerting process of an organism and serves to increase the sensitivity of receptor systems. Recent Western and Russian research indicate that the OR may play an important role in perception and learning (Zimny and Miller, 1966; McDonald, Johnson and Hord, 1963). Gale and Stern (1967) have demonstrated that the electrodermal component of the OR can be conditioned. It would be useful therefore to determine whether psychopaths and nonpsychopaths differ with respect to the conditioning of this variable.

In this study the latency criterion of an electrodermal OR was one to four seconds after CS onset. A differential OR was defined in the same manner as a differential AR. The mean amplitude of differential ORs to the CS followed by shock is shown in Figure 3. An á priori comparison of the means of Groups P and NP showed that the difference was significant ($\underline{F}(1,34)=4.97$, $P<.05$). The data for Groups S and NC were not included in this analysis. The differential ORs to the CS followed by pictures of nudes is shown in Figure 4. No statistical tests were performed on on these data but it is obvious that only Group NP showed

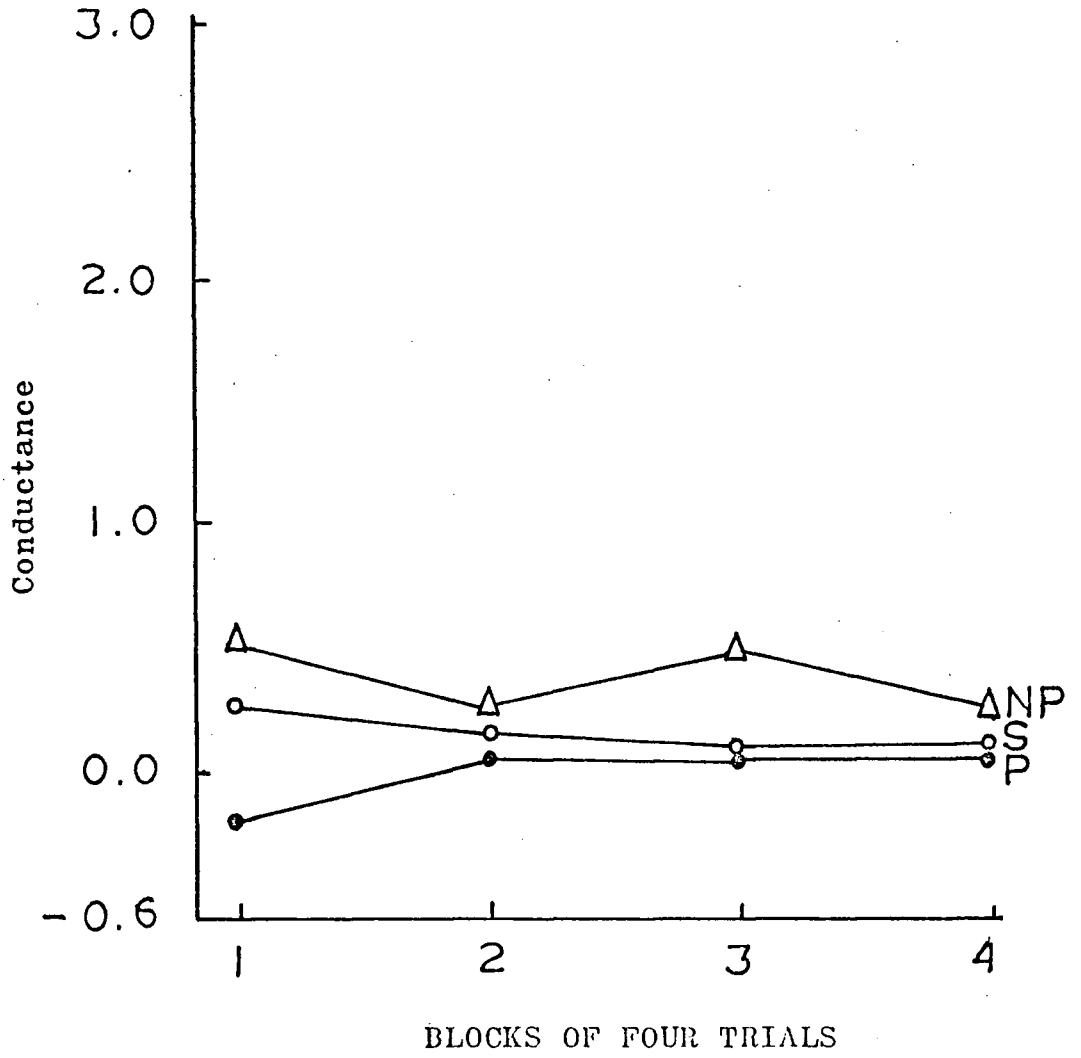

Fig.2. Mean Amplitude of Differential Anticipatory GSRs to CS-Pictures.

Table 4

Summary of Orthogonal Comparison of the Mean Amplitude of Differential Anticipatory GSRs to CS-Pictures for Groups P and NP

Source	df	SS	MS	F	P
Between Groups	3	349.68			
Comparison: Groups P vs NP	1	249.96	249.96	2.91	<.10
Error	68	5832.02	85.76		
Total	71	6181.70			

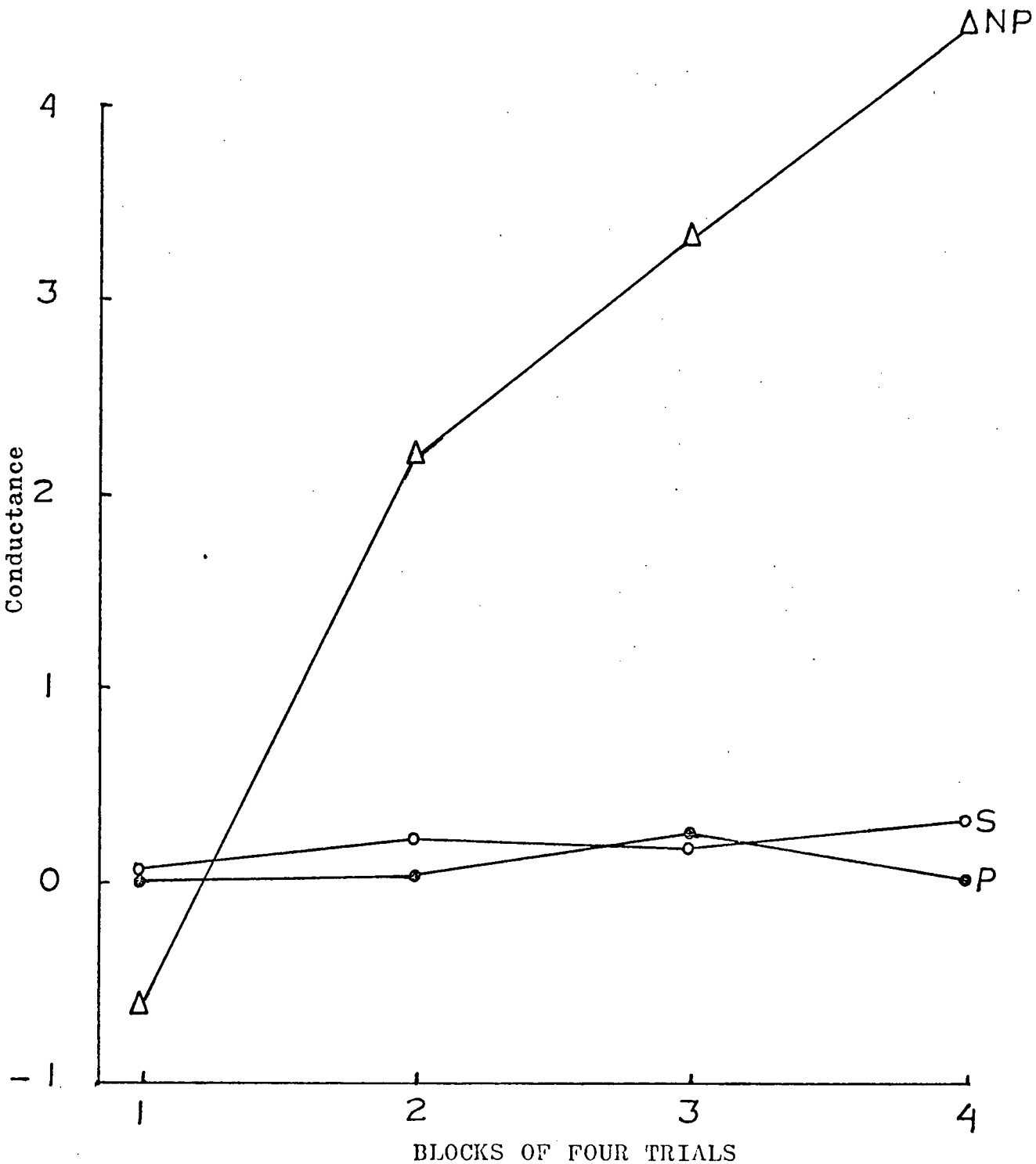

Fig.3. Mean Amplitude of Differential Electrodermal ORs to CS-Shock.

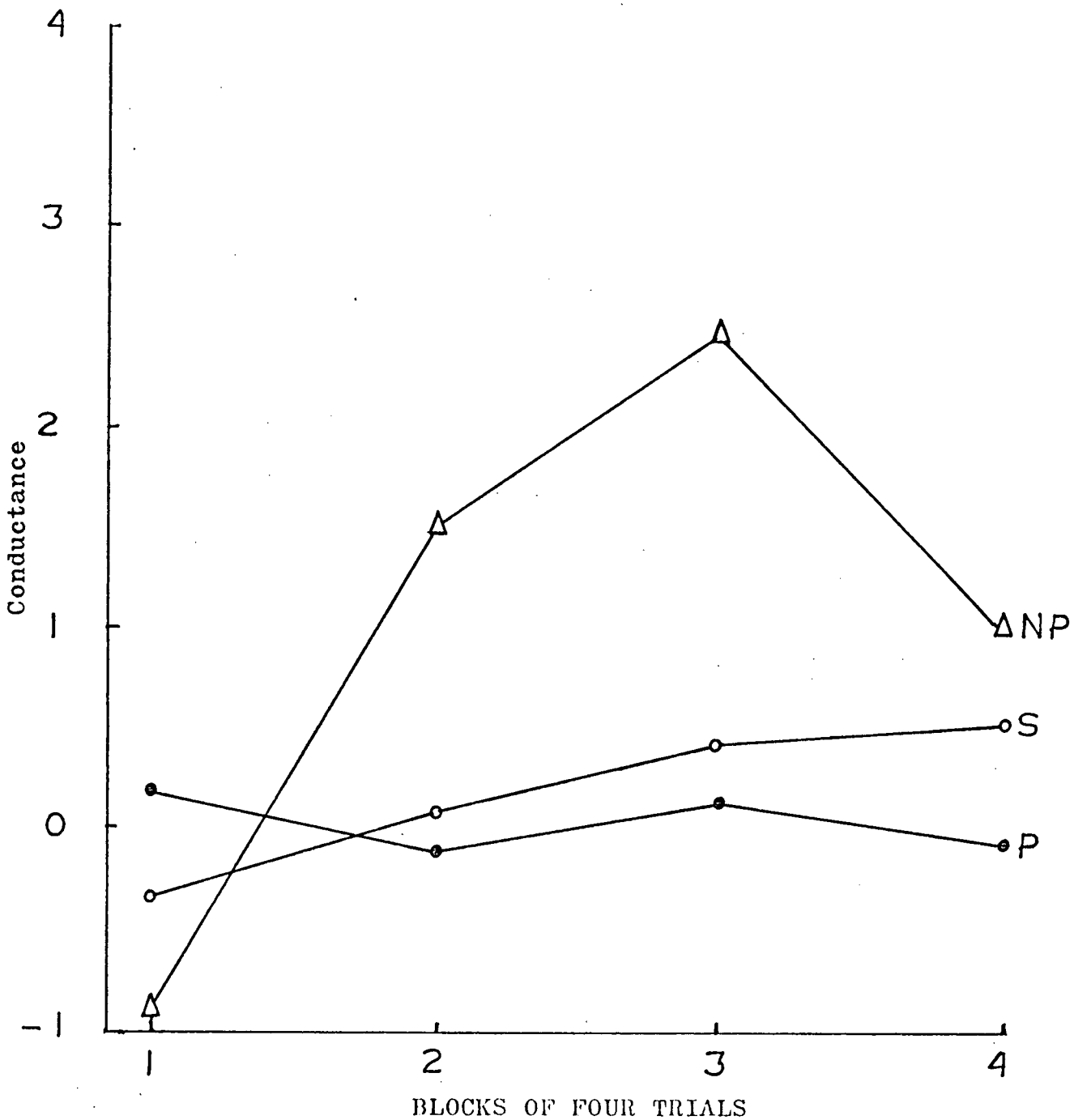

Fig.4. Mean Amplitude of Differential Electrodermal ORs to CS-Pictures.

evidence of conditioning of the OR.

Inspection of the data indicated that Group NP had a consistently higher level of basal skin conductance than did Group P. This raised the possibility that the observed difference in conditioning between these groups might be related to a difference in basal conductance (Lacey, 1956; Sternbach, 1966; Wenger, Clemens, Coleman, Cullen and Engel, 1961). In order to estimate the degree of association between basal conductance and the amplitude of ARs, rank order correlations between these variables were computed for both differential and absolute ARs. This was done for Groups P and NP combined for the mean of the first two defense conditioning trials.

The correlation between differential basal conductance and differential AR amplitude was not significant (r_s=.14), while that between absolute basal conductance and absolute AR amplitude was significant (r_s=.42, $p<.05$). In view of this latter finding the same data that entered into the correlational computations for the absolute conditioning measures were submitted to analysis of covariance (Winer, 1962), with basal conductance as the variate and AR amplitude as the criterion. The adjusted AR means were then tested for significance. For this sample of data the values of the unadjusted and the adjusted AR means (with the adjusted values in brackets) were: Group P=.37(.41), and Group NP=1.47(1.43). An á priori test, performed on the

adjusted means, showed that they differed significantly ($F(1,33)=7.26$ $p<.02$). This indicates that the difference in amount of GSR conditioning between Group P and Group NP remained even after differences in basal conductance had been taken into account.

Basal Skin Conductance. The analysis of basal skin conductance was based upon measures taken at three points in the experiment. The first (C_1), measured just prior to the administration of trial one, was taken as an index of basal level under resting conditions. However, "resting" in this context is probably something of a misnomer since the experiment itself constitutes a stressful situation for most Ss. The second point (C_2) was measured midway through the experiment, and the third (C_3) at the end of the experiment.

A two-factor analysis of variance for Groups (A), and Conductance (C), with repeared measures on the latter, was computed for these data. The results, summarized in Table 5, show that there were no significant main effects. However, the AC interaction was significant; therefore, tests were performed on the simple effects. The results of this computation, presented in Table 6, show that the Groups differed significantly on C_2, and that only Group S showed a significant change over trials. No other significant differences were found. The results, plotted in Figure 5, indicate that Group P had the lowest level of basal skin

Table 5

Summary of Analysis of Variance of Basal Skin Conductance for Three Groups (Factor A) Taken as Repeated Measures at Three Points in the Experiment (Factor C)

Source	df	MS	F	P
Between Subjects	53			
Groups (A)	2	408.88	1.08	>.20
Subjects Within Groups	51	370.77		
Within Subjects	108			
Conductance Samples (C)	2	44.34	1.11	>.20
AC	4	537.33	13.61	<.001
C x Subjects Within Groups	102	39.48		

Table 6

Summary of Analysis of Variance of Simple Effects of Basal Conductance for Three Groups (Factor A) Taken as Repeated Measures at Three Points in the Experiment (Factor C)

Source	df	MS	F	P
A at C1	2	136.71	.91	-
A at C2	2	1166.77	7.78	<.005
A at C3	2	175.05	1.10	>.20
Pooled Error*	153	149.91		
C at A1 (P)	2	21.03	.53	-
C at A2 (S)	2	1045.99	26.49	<.001
C at A3 (NP)	2	1.96	-	-
C x Subjects Within Groups	102	39.48		

* Winer (1962, p. 310)

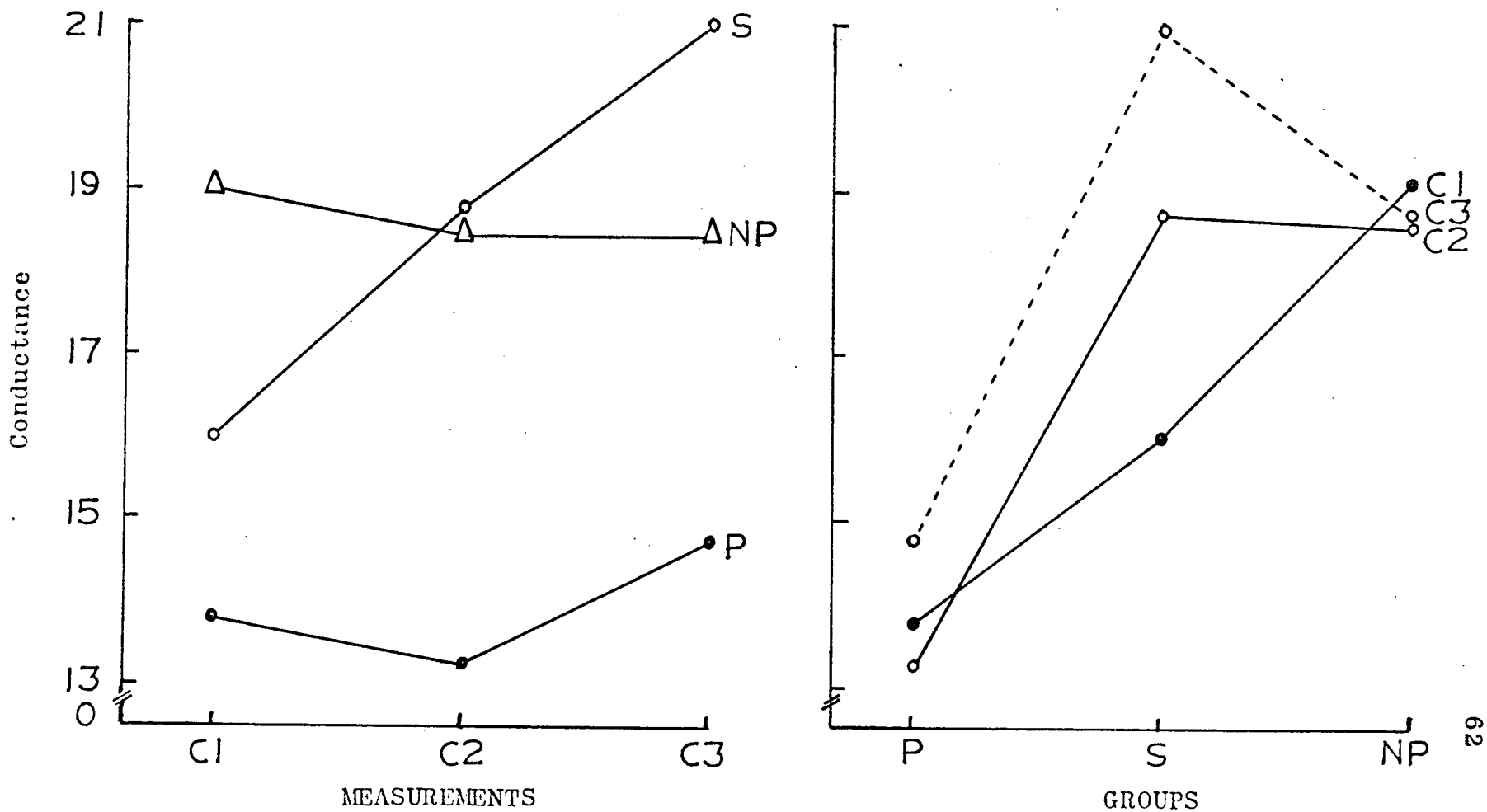

Fig.5. Mean Basal Skin Conductance for Three Groups at Three Points of Measurement (left), and for Three Points of Measurement at Three Groups (right).

conductance, and showed no significant change throughout the experiment. The level for Group NP was consistently higher than that for Group P, but Group NP also failed to show any significant change over trials. Group S showed a steady increase as the experiment progressed. In order to determine whether the difference between Groups P and NP was significant an á priori comparison of their means was computed with the data for Group S being excluded from the analysis. The difference was not significant ($F(1,34)=1.74$, $P>.10$).

GSR Habituation to the UCS. Analysis of this variable was based upon the absolute amplitude of the electrodermal UCR on conditioning trials 1,8 and 15. A two-factor analysis of variance for Groups (A), and Trials (T), with repeated measures on T was performed on these data. This was done separately for shock and for picture trials. The results for the shock trials, summarized in Table 7, show that the Groups effect was significant. The Newman-Keuls Sequential Range Test (Winer, 1962) was used to discover the source of the difference. The mean UCR amplitudes were; Group P=1.20, Group S=2.18, and Group NP=11.25. It was found that Group NP differed significantly ($P<.05$) from Group P and from Group S. The difference between Group P and Group S was not significant. These results are plotted in Figure 6. The statistical analysis of the picture trials is summarized in Table 8, and the curves are

Table 7

Summary of Analysis of Variance of the Absolute Amplitude of the Electrodermal UCR to the Shock UCS for Three Groups (A) Taken as Repeated Measures for Three Trials (T)

Source	df	MS	F	P
Between Subjects	53			
Groups (A)	2	1707.18	4.09	<.02
Subjects Within Groups	51	415.61		
Within Subjects	108			
Trials (T)	2	70.35	-	
AT	4	50.81	-	
T x Subjects Within Groups	102	98.39		

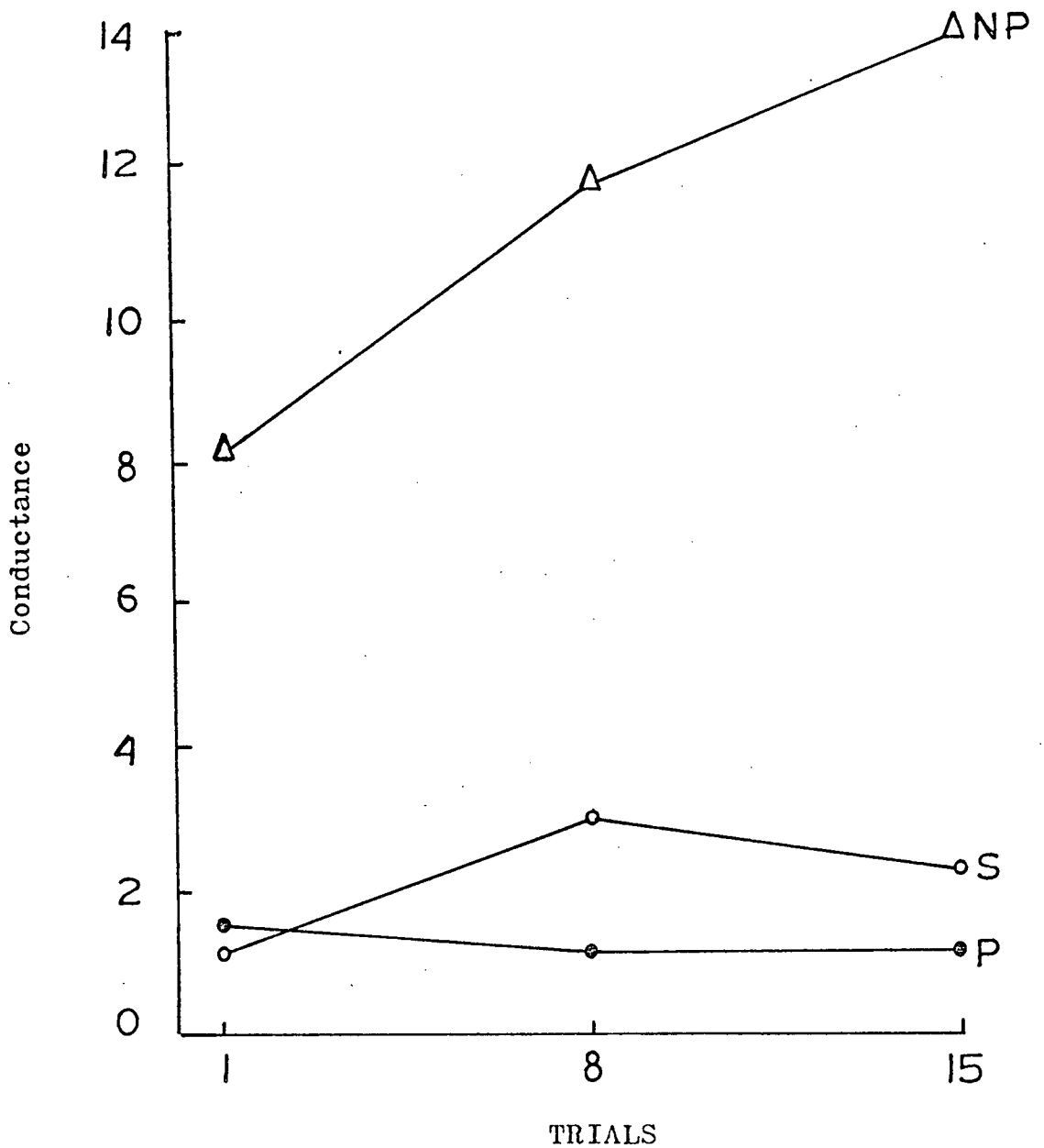

Fig.6. Mean Absolute Amplitude of the Electrodermal UCR to Shock.

Table 8

Summary of Analysis of Variance of the Absolute Amplitude of the Electrodermal UCR to the Picture UCSs for Three Groups (A) Taken as Repeated Measures for Three Trials (T)

Source	df	MS	F	P
Between Subjects	53			
Groups (A)	2	195.01	1.71	>.10
Subjects Within Groups	51	113.83		
Within Subjects	108			
Trials (T)	2	1.85	-	
AT	4	25.85	-	
T x Subjects Within Groups	102	26.31		

shown in Figure 7. There were no significant main effects or interaction. An á priori comparison on the overall means for Groups P and NP showed that the difference was not significant ($F(1,34)=1.96$, $P>10$). These findings show that Group P gave very small UCRs to both shock and picture UCSs while Group NP showed a steady increase in response amplitude throughout the experiment.

Summary. Group P gave significantly smaller conditioned ORs and ARs to CS-shock than did Group NP. Group P also tended to give smaller ARs and ORs to CS-picture than did Group NP but the differences failed to reach statistical significance. There was no significant difference between Groups P and NP in basal skin conductance under resting conditions, but they differed significantly midway through the experiment with Group P showing less conductance. Neither Group P nor Group NP showed any significant change in basal skin conductance across trials while Group S showed a significant increase. On UCR amplitude to shock Group NP gave significantly larger responses than did Group P or Group S. There was no significant difference between Groups P and NP in the amplitude of the UCR to pictures.

Cardiac Conditioning. The CS-UCS interval was divided into two 5-second periods and the mean HR was obtained for each period. It was assumed that this method of scoring would provide an estimate of the biphasic cardiac CR reported by previous investigators. A differential cardiac CR

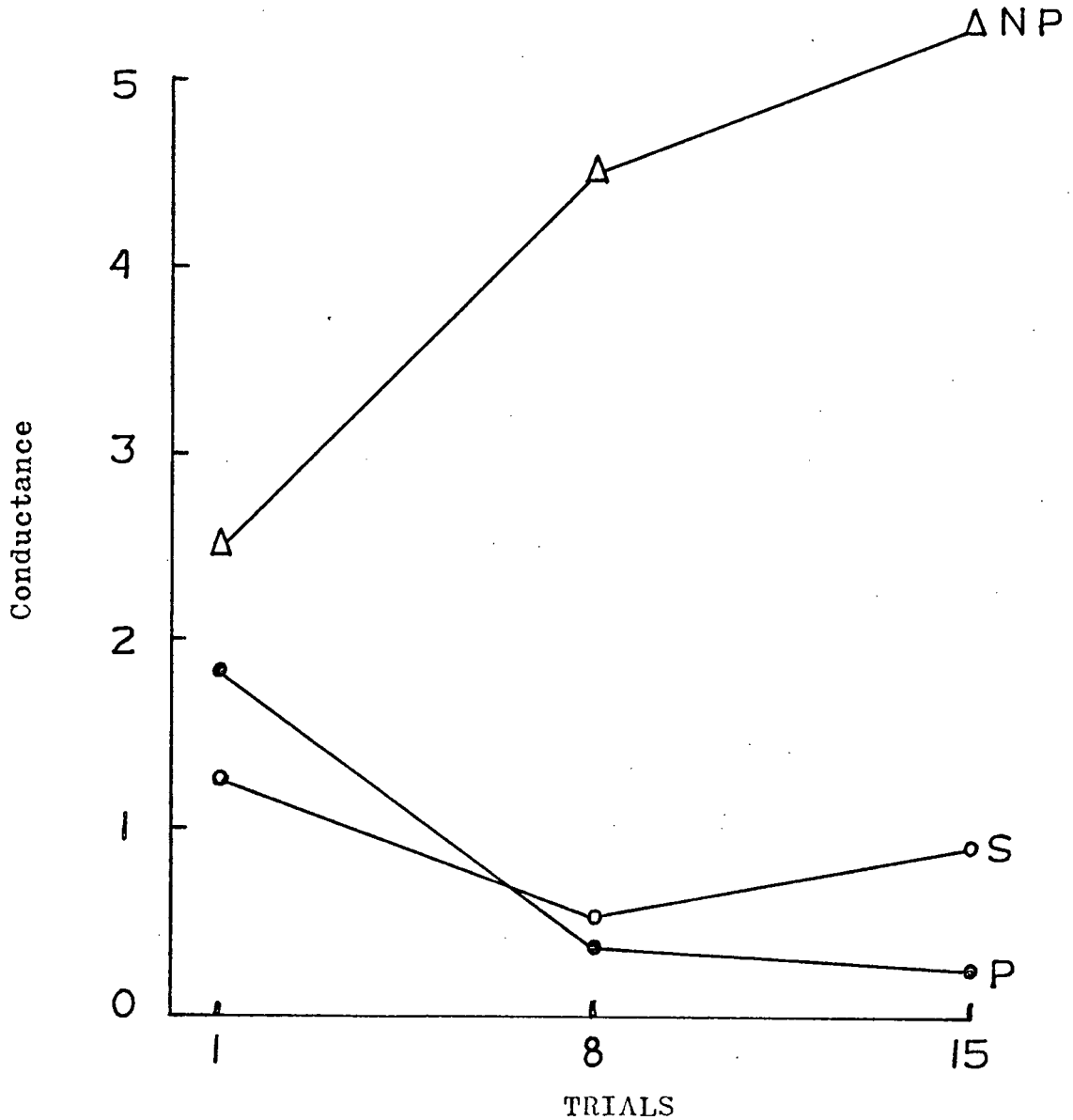

Fig.7. Mean Absolute Amplitude of the Electrodermal UCR to Pictures.

was expressed as the mean HR to a positive CS minus the mean HR to the neutral CS. This was done for the first (CS_1), and second (CS_2) CS periods.

The mean amplitude of differential anticipatory HR responses to the CS followed by shock, and to the CS followed by pictures of nudes, is shown in Figure 8. Each point plotted in Figure 8 represents the overall mean HR for 16 conditioning trials and for 18 Ss per group. The significance of the difference between Group P and Group NP was tested by an á priori comparison of their means at each CS period for shock, and for picture trials. The results of these analyses, relating to defense conditioning, are summarized in Tables 9 and 10 for CS_1 and CS_2, respectively. There was no significant difference between Group P and Group NP in mean amplitude of differential cardiac deceleration during either the first or second CS periods. These results fail to support hypothesis A_2 which predicted less defense conditioning of HR for Group P than for Group NP. The results relating to reward conditioning are summarized in Tables 11 and 12 for CS_1 and CS_2, respectively. There was no significant difference between Groups P and NP in the mean amplitude of differential cardiac deceleration during either the first or second CS periods. These results do not reject the null hypothesis B_2, which predicted no significant difference between Groups P and NP in the reward conditioning of cardiac responses.

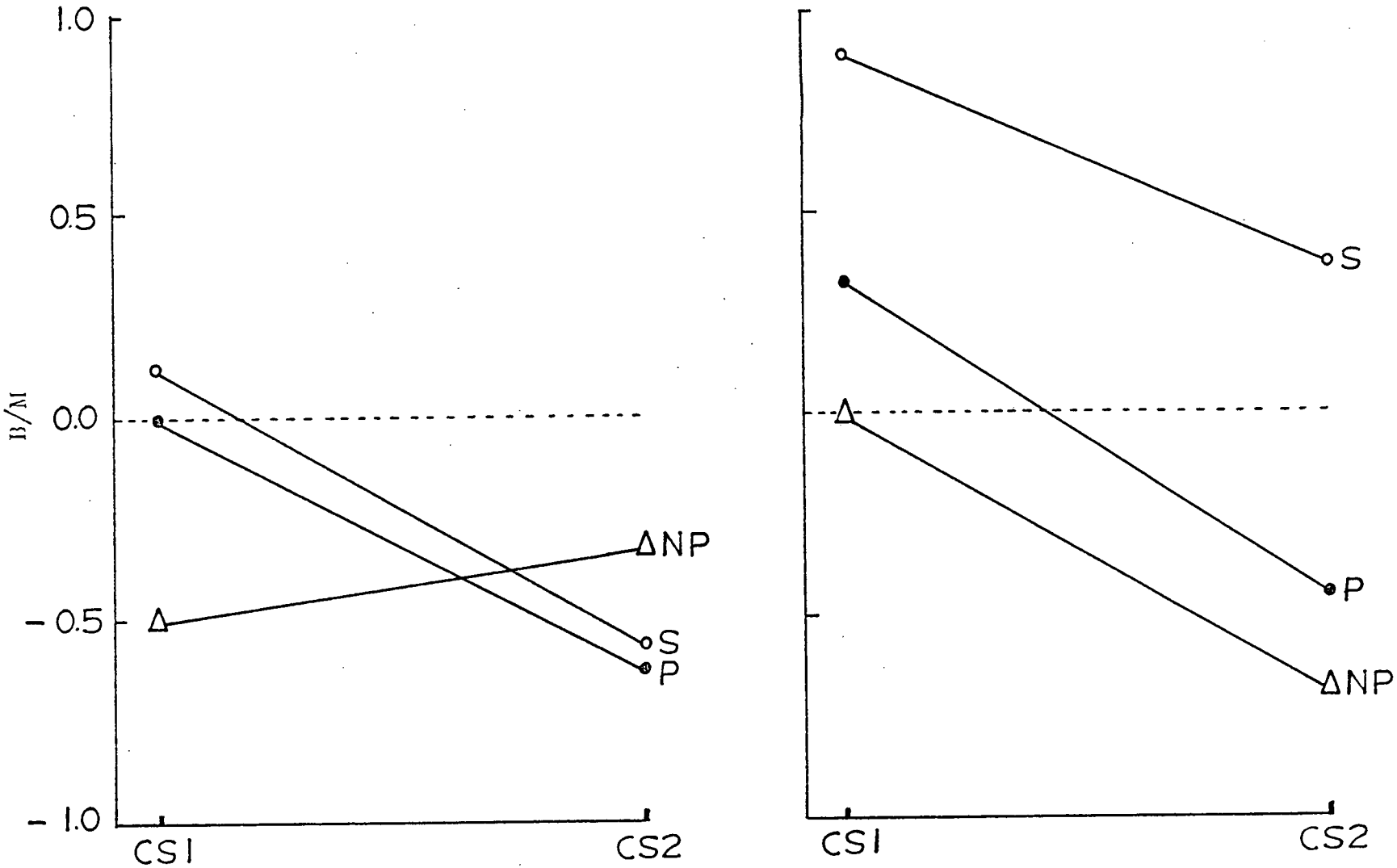

Fig.8. Mean Amplitude of the Differential Cardiac CR to CS-Shock (left), and to CS-Pictures (right).

Table 9

Summary of Orthogonal Comparisons of the Mean Amplitude of Differential Cardiac CRs to CS-Shock during the First CS Period for Groups P and NP

Source	df	SS	MS	F	P
Between Groups	3	1078.94			
Comparison: Groups P vs NP	1	738.75	738.75	1.18	>.20
Error	68	42281.67	621.79		
Total	71	43360.61			

Table 10

Summary of Orthogonal Comparisons of the Mean Amplitude of Differential Cardiac CRs to CS-Shock During the Second CS Period for Groups P and NP

Source	df	SS	MS	F	P
Between Groups	3	1055.17			
Comparison: Groups P vs NP	1	210.83	210.83	-	
Error	68	56591.11	832.22		
Total	71	57646.28			

Table 11

Summary of Orthogonal Comparisons of the Mean Amplitude of Differential Cardiac CRs to CS-Pictures During the First CS Period for Groups P and NP

Source	df	SS	MS	F	P
Between Groups	3	3842.50			
Comparison: Groups P vs NP	1	182.25	182.25	-	
Error	68	43069.45	633.37		
Total	71	46911.95			

Table 12

Summary of Orthogonal Comparisons of the Mean Amplitude of Differential Cardiac CRs to CS-Pictures During the Second CS Period for Groups P and NP

Source	df	SS	MS	F	P
Between Groups	3	6677.33			
Comparison: Groups P vs Np	1	1518.66	1518.66	2.18	>.10
Error	68	47336.40	696.12		
Total	71	54013.78			

The mean HR during the 5 seconds immediately preceding the first trial was taken as an estimate of cardiac activity under resting conditions. A simple analysis of variance was performed on this measure.* The results, summarized in Table 13, indicate that there was no significant difference between Groups in resting HR as defined above. The means for these data are presented in Table 20.

The Cardiac UCR. This index of cardiac activity was expressed as the difference between post-CS, and pre-CS, HR means. Measures were taken at three points in the experiment viz., on Trials 1,8, and 15, and were analyzed separately for shock and for picture trials. The results are plotted in Figure 9 with the data for shock trials on the left, and those for picture trials on the right. In Figure 9 a positive value indicates cardiac acceleration, and a negative value indicates deceleration. A two-factor analysis of variance for Groups (A), and Trials (T), with repeated measures on T, was performed on these data. The results of this analysis, for the shock trials, are summarized in Table 14. No significant differences were found for Groups, for Trials, or for Interaction. The statistical analysis of the picture trials is summarized in Table 15. There was no significant Groups effect and no significant interaction. However, a significant effect was found for Trials. Application of the Newman-Keuls procedure to

* The data for Group NC were included in this analysis.

Table 13

Analysis of Variance for Resting Heart Rate

Source	Df	SS	MS	F	P
Groups (Between)	3	191.48	63.82	-	
Error (Within)	68	11135.32	163.76	-	
Total	71	11327.32			

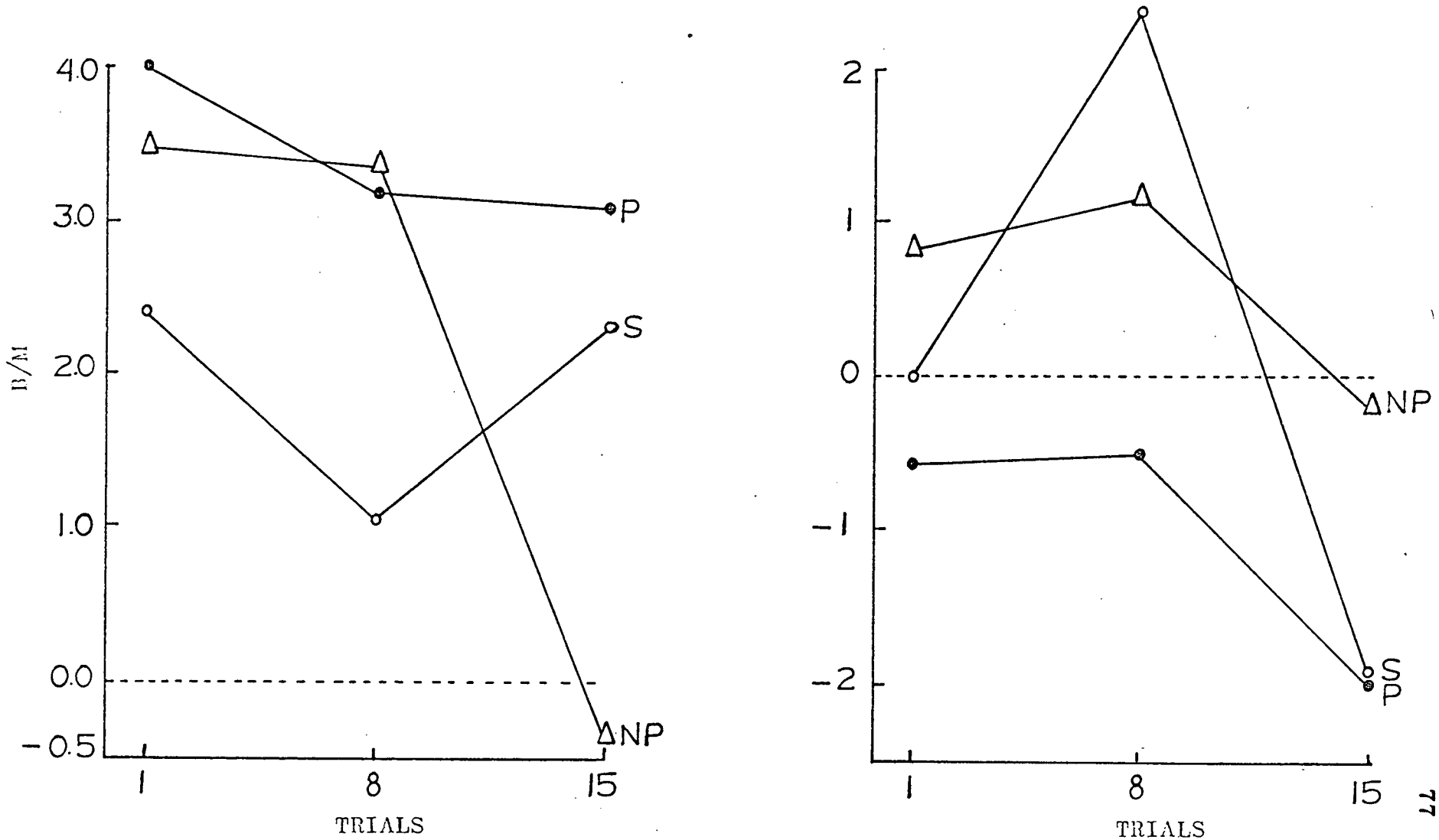

Fig.9. Mean Absolute Amplitude of the Cardiac UCR to Shock (left), and to Pictures (right).

Table 14

Summary of Analysis of Variance of the Absolute Amplitude of the Cardiac UCR to Shock for Three Groups (A) Taken as Repeated Measures for Three Trials (T)

Source	df	MS	F	P
Between Subjects	53			
Groups (A)	2	34.39	-	
Subjects Within Groups	51	45.29		
Within Subjects	108			
Trials (T)	2	33.46	1.84	>.10
AT	4	32.21	1.77	>.10
T x Subjects Within Groups	102	18.13		

Table 15

Summary of Analysis of Variance of the Absolute Amplitude of the Cardiac UCR to Pictures of Nudes for Three Groups (A) Taken as Repeated Measures for Three Trials (T)

Source	df	MS	F	P
Between Subjects	53			
Groups (A)	2	38.59	-	
Subjects Within Groups	51	39.81		
Within Subjects	108			
Trials (T)	2	79.25	3.79	<.05
AT	4	14.25	-	
T x Subjects Within Groups	102	20.90		

these data showed that trials 8 and 15 differed significantly ($P<.05$), with the amount of deceleration being greater on trial 15. Although there were no significant differences between Groups on this measure it is of interest to note from inspection of Figure 9 and Table 20 that while all groups gave an accelerative UCR to shock only Group P showed a consistent decelerative UCR to the picture stimuli.

To summarize the cardiac data, all groups showed evidence of conditioned HR deceleration on both defense conditioning and reward conditioning trials. There was no significant difference between Group P and Group NP on (1) any index of cardiac conditioning; (2) mean resting HR; (3) in the mean magnitude or direction of the cardiac UCR to shock; or (4) in the overall magnitude of the cardiac UCR to the picture stimuli.

Vasomotor Conditioning. The cutaneous vasomotor system is subject to continuous changes in tone partly as a function of its role in the maintenance of blood pressure, blood distribution, and temperature regulation. This may account, at least in part, for the findings (Unger, 1964) that some Ss show varying degrees of "spontaneous" changes in peripheral vasomotor activity thus presenting a problem in the evaluation of records. In the present study several Ss fell into this category. The number of "hyperreactors" in each group was; Group P=2, Group S=4, Group NP=3, and Group NC=4. The records of these Ss could not be evaluated

because of continuous and seemingly indiscriminative changes in vasomotor tone. After the unusable records had been excluded and the remainder balanced by randomly excluding two from Group P and one from Group NP, so that each group would contain the same number of Ss, usable records were available for 14 Ss in each group.

The mean amplitude of differential vasoconstrictive changes in the finger to the CS followed by shock is shown in Figure 10. The difference between Group P and Group NP was tested by an á priori comparison of their overall mean amplitude. The results of this analysis, summarized in Table 16, show that the difference was not significant. This means that hypothesis A_3, which predicted that Group P would show less defense conditioning of vasomotor responses than would Group NP, is not supported. The results for the CS-picture stimulus interval are plotted in Figure 11, and the corresponding statistical analysis is summarized in Table 17. The difference between Groups P and NP was not significant thus failing to reject the null hypothesis, B_3.

The Vasomotor UCR. The latency criterion of a vasomotor UCR was at least two seconds after CS termination. The baseline of this response was the middle of the two pulses immediately preceding response onset. Response amplitude was expressed as the difference in mm between the baseline and the middle of the pulse showing the greatest upward deviation from the baseline. The distance in mm

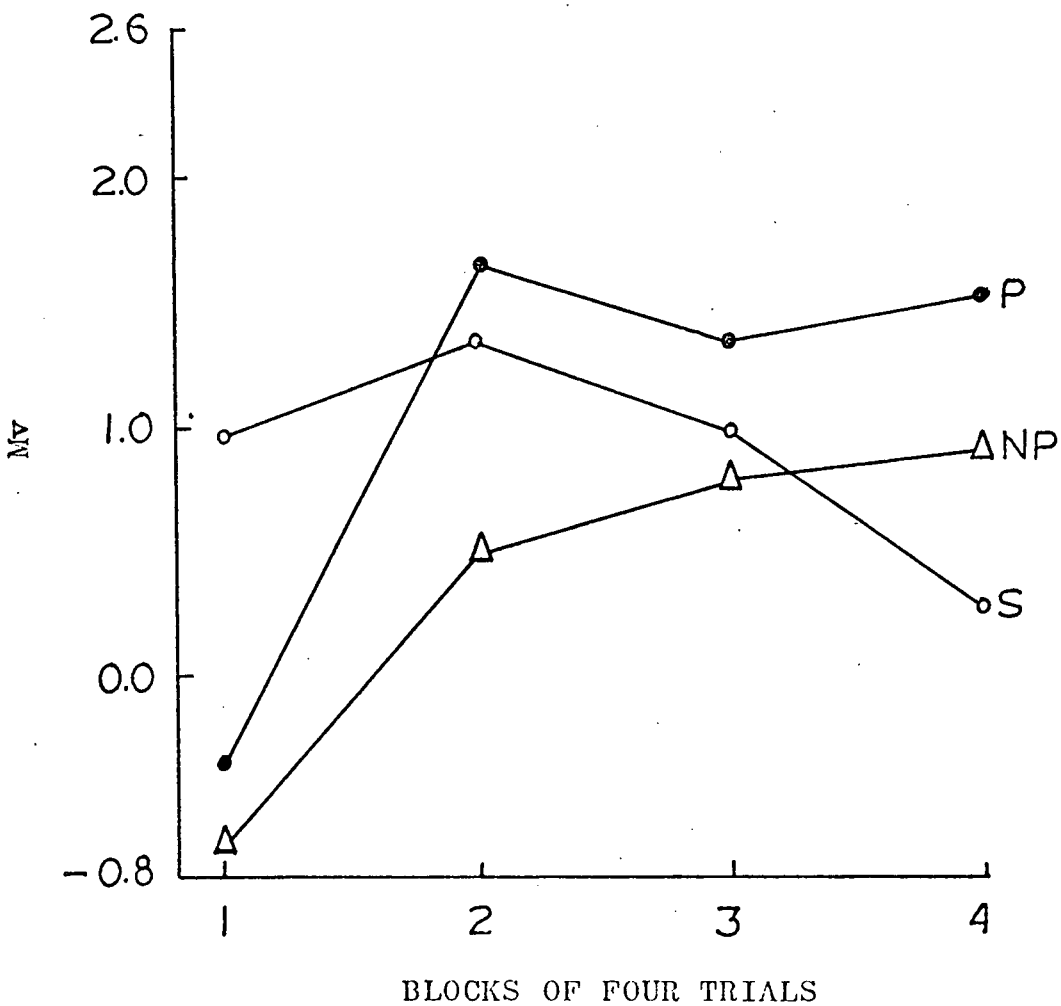

Fig.10. Mean Amplitude of Differential Anticipatory Vasoconstriction to CS-Shock.

Table 16

Summary of Orthogonal Comparisons of the Mean Amplitude of Differential Vasomotor CRs to CS-Shock for Groups P and NP

Source	df	SS	MS	F	P
Between Groups	3	3096.16			
Comparison: Groups P vs NP	1	726.85	726.85	1.52	>.10
Error	52	23793.12	475.56		
Total	55	26886.28			

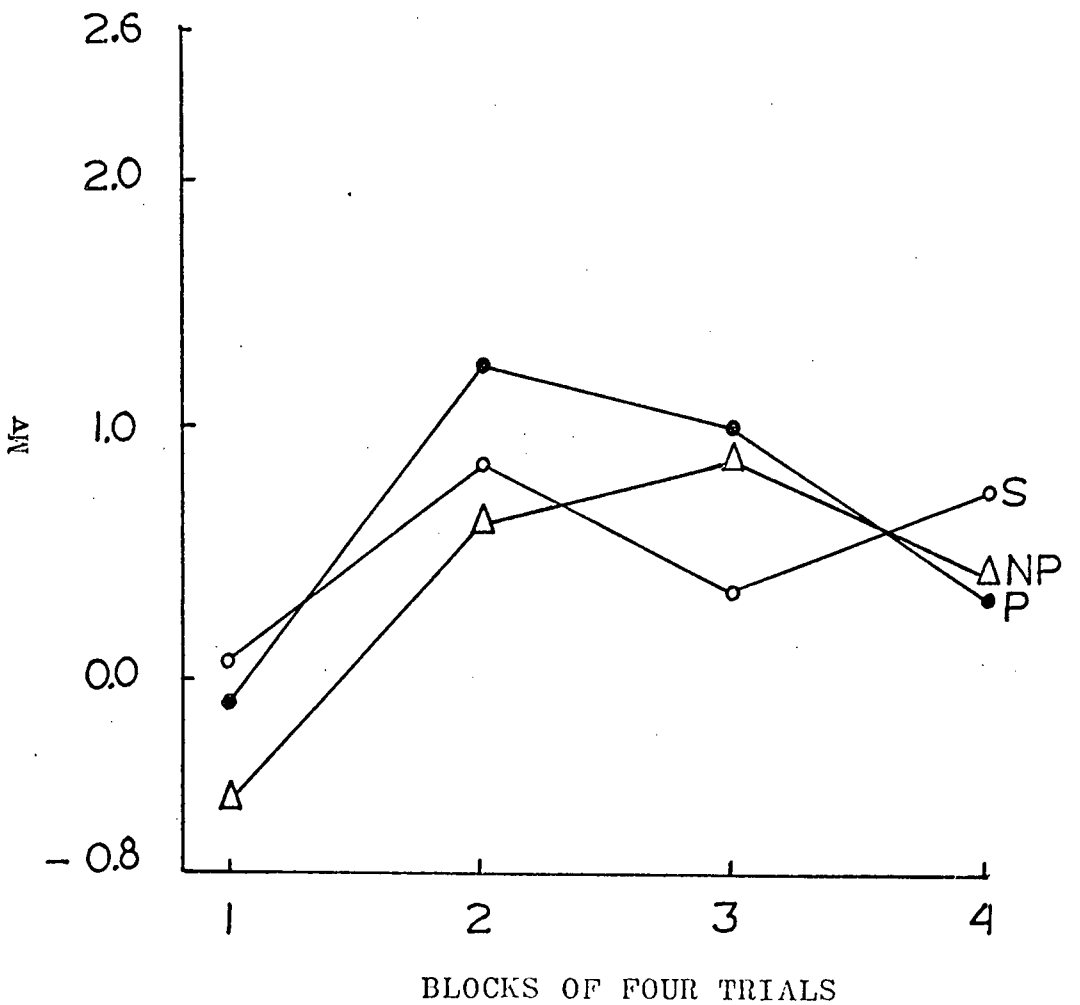

Fig.11. Mean Amplitude of Differential Anticipatory Vasoconstriction to CS-Pictures.

Table 17

Summary of Orthogonal Comparisons of the Mean Amplitude of Differential Vasomotor CRs to CS-Pictures for Groups P and NP

Source	df	SS	MS	F	P
Between Groups	3	170.56			
Comparison: Groups P vs NP	1	56.46	56.46	-	
Error	52	19283.76	370.84		
Total	55	19454.32			

was then converted to millivolts as described previously. As for the electrodermal and cardiac UCRs the vasomotor UCR was expressed as a change in absolute amplitude. However, the term "absolute" is used here only to describe the method of scoring since absolute measures of vasoconstriction were not possible with the procedures used in this study.

The vasomotor UCR was measured at three points in the experiment viz., on trials 1,8, and 15. The results are plotted in Figure 12 with the data for the shock trials on the left, and those for the picture trials on the right. The statistical analyses of these data consisted of a two-factor analysis of variance for Groups (A), and Trials (T), with repeated measures on T. The results for the shock trials are summarized in Table 18, and those for the picture trials are presented in Table 19. No significant main effects or significant interactions were revealed by either of these analyses.

In summary, no significant differences were found between Group P and Group NP in the differential amplitude of either defense or reward conditioning of finger vasoconstriction. Similarily, there were no significant differences between Groups in the mean amplitude of vasomotor UCRs to shock or picture stimuli.

In order to facilitate comparisons the means for Groups P,S, and NP, on 20 of the variables investigated are presented in Table 20.

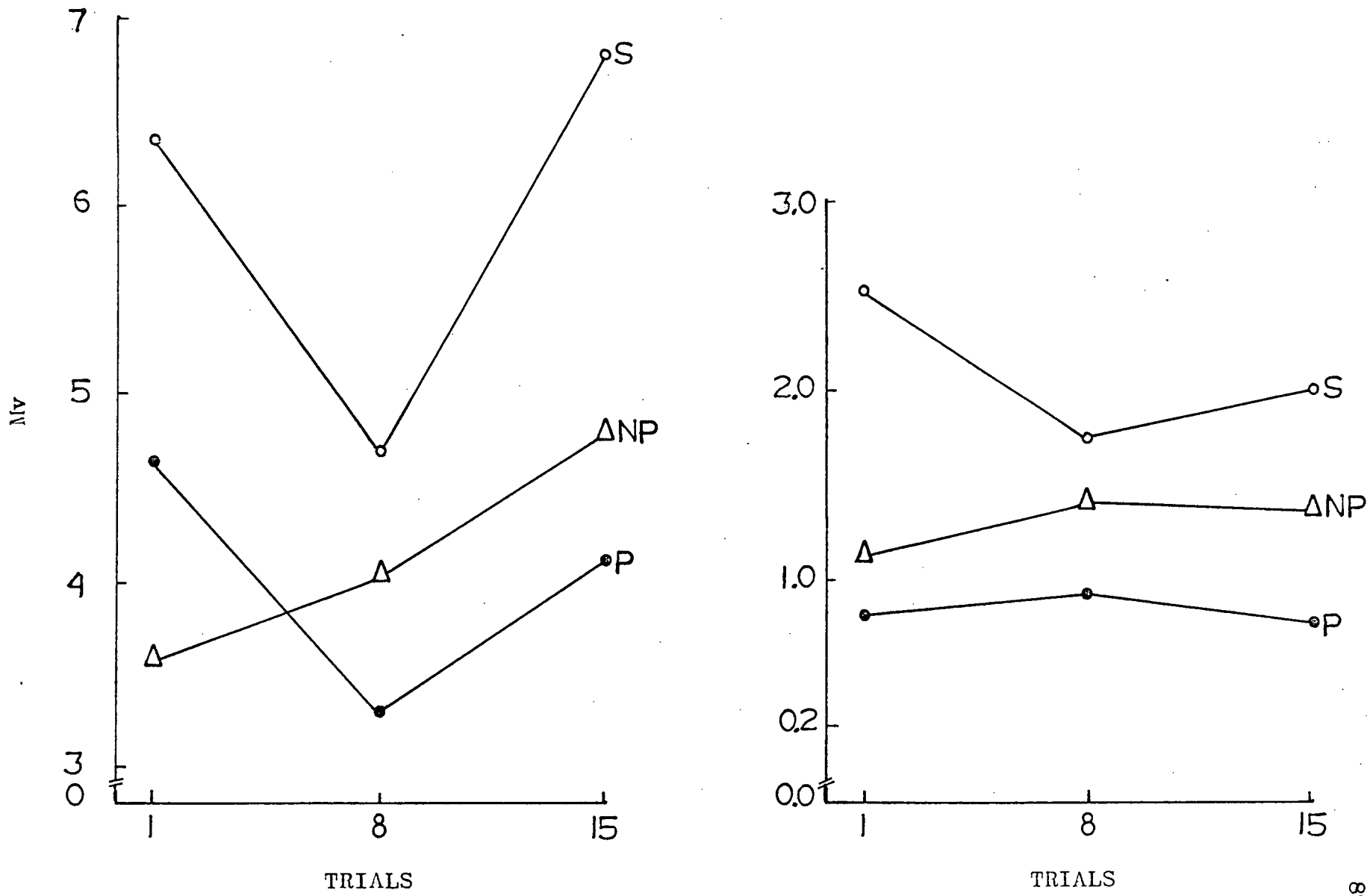

Fig.12. Mean Amplitude of the Vasomotor UCR to Shock (left), and to Pictures of Nudes (right).

Table 18

Summary of Analysis of Variance of the Amplitude of the Vasomotor UCR to Shock for Three Groups (A) Taken as Repeated Measures for Three Trials (T)

Source	df	MS	F	P
Between Subjects	41			
Groups (A)	2	48.18	1.43	>.10
Subjects Within Groups	39	33.65		
Within Subjects	84			
Trials (T)	2	13.37	1.89	>.10
AT	4	8.75	1.23	>.10
T x Subjects Within Groups	78	7.06		

Table 19

Summary of Analysis of Variance of the Amplitude of the Vasomotor UCR to Pictures of Nudes for Three Groups (A) Taken as Repeated Measures for Three Trials (T)

Source	df	MS	F	P
Between Subjects	41			
Groups (A)	2	13.41	1.93	>.10
Subjects Within Groups	39	6.93		
Within Subjects	84			
Trials (T)	2	.08	-	
AT	4	3.29	-	
T x Subjects Within Groups	78	3.60		

Table 20

The Means for Groups P, S, and NP on 20 Measures. The Electrodermal Measures are Expressed in Micromohs, the Cardiac Measures in Beats Per Minute, and the Vasomotor Measures in Millivolts. The Shock Detection Threshold and Shock Tolerance Data are Expressed in Milliamperes. The Measures Indicated in the Table by the Letters a Through t are Identified as Follows:

a Shock Detection Threshold

b Shock Tolerance Level

c Basal Skin Conductance

d Differential Amplitude of Electrodermal AR to CS-Shock

e " " " " " " AR to CS-Pictures

f " " " " " " OR to CS-Shock

g " " " " " " OR to CS-Pictures

h Absolute Amplitude of Electrodermal UCR to Shock

i " " " " " UCR to Pictures

j Resting Heart Rate

k Differential Amplitude of Cardiac CR During CS_1 to CS-Shock

l " " " " " " " CS_2 " " "

m Differential Amplitude of Cardiac CR During CS_1 to CS-Pictures

n Differential Amplitude of Cardiac CR During CS_2 to CS-Pictures

o Absolute Amplitude of Cardiac UCR to Shock

p " " " " " " Pictures

q Differential Amplitude of Vasomotor CR to CS-Shock

r " " " " " " " " CS-Pictures

s Absolute Amplitude of Vasomotor UCR to Shock

t " " " " " " " Pictures

Table 20 (continued)

Group	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t
P	2.01	13.82	13.95	.04	-.01	.12	.06	1.20	.73	71.50	.00	-.62	.32	-.45	3.74	-1.02	1.07	.67	4.03	.83
S	1.88	12.72	18.60	.25	.14	.25	.22	2.18	.89	74.94	.12	-.57	.90	.37	1.93	.14	.91	.52	5.98	2.11
NP	1.70	16.55	18.60	1.99	.41	2.40	1.07	11.25	4.10	73.39	-.50	-.32	.00	-.67	2.19	.62	.74	.62	4.15	1.31

Discussion

To recapitulate the main findings of the study, it was found that Group P differed significantly from Group NP on only one index of autonomic conditioning viz., the GSR. The difference was in the direction of smaller CRs for Group P and was found only for defense conditioning. The following discussion is organized along lines similar to those used in reporting the results.

Electrodermal Measures. Several variables, other than psychopathy, that might possibly have been related to differences in GSR conditioning were investigated. On one of these, shock detection threshold, there was no significant difference between groups. This result is consistent with Thorvaldson's (1969) findings but is at variance with research reported by Schoenherr (1964), and Hare (1968a) which indicated that primary psychopaths had higher thresholds than did normal controls. Inmates from the same institution served as Ss in this experiment as well as in those conducted by Thorvaldson and Hare so that the discrepancy in results is difficult to account for unless procedural factors are invoked as an explanation.

A second variable was tolerance for shock. There was no significant difference between groups on this measure, a result consistent with previous research (Schoenherr, 1964; Hare, 1965c; Thorvaldson, 1969). However, Thorvaldson found that primary psychopaths increased their tolerance

level significantly above that of nonpsychopaths under special incentive conditions. It is thus probable that, if sufficiently motivated, the present Ss of Group P could have tolerated higher levels of shock intensity than those indicated. Even if this assumption is correct however it would not explain satisfactorily the relatively small amount of GSR conditioning shown by Group P. If the level of shock intensity accepted by the Ss of Group P was insufficient to elicit anticipatory GSRs it should also have proved inadequate for the conditioning of cardiovascular responses. Contrary to this expectation however there was no significant difference between Groups P and NP in the amplitude of either cardiac or vasomotor CRs.

A difference in basal skin conductance can also be excluded as an explanation of the difference in amount of conditioning. The difference between Groups P and NP in the amplitude of anticipatory GSRs remained after the difference in basal levels had been statistically controlled.

The difference between the two main groups in GSR conditioning cannot be accounted for in terms of the latency criteria of electrodermal ARs. This is indicated by the finding that Group P gave smaller conditioned ORs than did Group NP.

It seems a reasonable assumption therefore that, in this study, the difference in GSR conditioning between Groups P and NP is related to the variable of psychopathy.

The results of this part of the study clearly demonstrate that Group P, in comparison with Group NP, was deficient in the ability to acquire classically conditioned fear responses. These results are consistent with previous research. Thus Lykken (1955) found that primary psychopaths gave significantly smaller anticipatory GSRs than did normal controls when the UCS was shock. Hare (1965c) obtained similar findings for psychopathic and nonpsychopathic criminals. Schmauk's (1968) study showed that primary psychopaths displayed less GSR activity when shock was anticipated than did normal Ss. The results are in agreement with other studies which may be viewed as involving a form of long-delay conditioning with instructions about the CS-UCS contingency. These investigators (Hare, 1965b; Lippert and Senter, 1966; Schalling and Levander, 1967) found that psychopathic Ss showed a relative lack of electrodermal reactivity in anticipation of painful stimulation. The present findings are interpreted as confirming hypothesis A_1, and as providing additional support for the theoretical positions of Cleckley (1941), Lykken (1955), and Hare (1965a) that the primary psychopath is deficient in the acquisition of classically conditioned fear responses. By implication, these results also support Hare's (1965a) hypothesis of a steeper-than-normal gradient of fear arousal in psychopaths.

No reward conditioning data have previously been reported for psychopathic Ss. The present results do not permit

rejection of the null hypothesis (B_1) although the difference between Groups P and NP approached significance with Group P giving somewhat smaller responses. This finding is consistent with the results of the operant conditioning study, reported in Appendix C, which demonstrated that pictures of nudes are adequate reinforcers of instrumental responses in primary psychopaths. The reward conditioning results are consistent with Lykken's assumption that psychopathy is associated with an absence of anxiety only, but at variance with Cleckley's assertion that psychopaths are characterized by an attenuation of emotional reactivity in general. It is possible that the psychopath's conditioning deficits are rather specific with respect to both the types of rewards and punishments employed, and the physiological system investigated. The present results as well as those of Schmauk (1968) lend some support to this assumption.

There was no significant difference between groups in basal skin conductance under resting conditions but there was a significant difference midway through the experiment with Group P showing the lowest level. Basal conductance was consistently higher for Group NP than for Group P but neither group showed any significant change during the experiment while Group S showed a significant increase. Assuming that basal skin conductance is an index of emotional reactivity (Malmo, 1962) these results appear to be consistent with the rationale of the selection procedures.

The non-anxious Ss of Group P showed the least reactivity while the presumably anxious Ss of Group S showed a steady increase in basal level which might be interpreted as indicative of increasing tension. Group NP was intermediate.

While the basal conductance data are consistent with theories of psychopathy (e.g., Lykken, 1955; Hare, 1965a) they are in only partial agreement with previous research (e.g., Hare, 1965c). Hare (1968a) found that both primary and secondary psychopaths showed a significant decrease in basal skin conductance during the experiment while nonpsychopaths showed no change. Hare's study involved tones but no shock so it is conceivable that the failure of any of the groups in the present study to show a decrease in basal conductance was due to the presence of shock. Lykken (1955) found that primary psychopaths showed the greatest increase in basal conductance, and secondary psychopaths the least, results exactly the opposite of those found here. Lykken regarded his findings as paradoxical and suggested they might have been due to seasonal variations in temperature as his groups were tested at different times of the year. Other investigators (Lippert and Senter, 1966; Schmauk, 1968) found no significant difference in basal conductance between primary psychopaths and nonpsychopaths under a variety of stimulus conditions.

Group NP gave significantly larger electrodermal UCRs to shock than did either Groups P or S. Moreover, Group NP

showed an increase in UCR amplitude over trials while the other two groups showed no change. These findings are in agreement with Lykken's (1955) research which indicated that normal Ss showed the least GSR habituation to shock and secondary psychopaths the most. However Hare (1965c) found no significant difference between primary psychopaths and normal controls in rate of GSR habituation to shock. It is possible that some of these discrepancies are related to procedural differences e.g., as to whether shock was present or absent, or to the shock intensities used. Inspection of Table 2 indicates that in this study all groups accepted comparatively high levels of shock intensity.

The present findings indicate that primary psychopaths show less electrodermal reactivity to stimulation than do nonpsychopaths. The results thus support the hypothesis (Hare, 1968b) that psychopathic Ss are autonomically hyporeactive (at least as regards electrodermal activity), and also provide some support for Quay's (1965) speculations regarding reduced basal levels in psychopaths. These findings however provide no support for the proposition (Schacter and Latané, 1964) that psychopaths are autonomically hyperreactive.

Cardiovascular Measures. Since similar results were obtained for cardiac and vasomotor conditioning both variables are discussed under the same heading. To summarize the findings: No significant differences were found between

Group P and Group NP in; (1) resting HR; (2) any index of either cardiac or vasomotor conditioning or; (3) rate of cardiac or vasomotor habituation to shock or picture UCSs. All groups showed conditioned cardiac deceleration during the second half of the CS-UCS interval on both shock and picture trials. All groups showed an increase in the amplitude of finger vasoconstriction during the CS-UCS interval on both shock and picture trials. In scoring vasomotor responses no attempt was made to separate ORs and ARs. However, the differential conditioning curves for vasoconstriction appear to be identical to those obtained by Gale and Stern (1968) who used a longer latency criterion in their definition of a vasomotor CR. This suggests that scoring vasomotor ORs and ARs separately in this study would not have changed the results appreciably. The results obtained for the electrodermal responses support this assumption. In any event the failure to separate possible vasomotor ORs and ARs is not considered crucial to the main purpose of this study which was to determine the conditionability of autonomic responses in psychopaths. The results are interpreted as failure to confirm hypotheses A_2 and A_3 which predicted less defense conditioning of cardiac and vasomotor responses for Group P than for Group NP. On the other hand, these findings do not permit rejection of the null hypotheses B_2 and B_3, which predicted no significant differences in reward conditioning between Groups P and NP.

The primary hypothesis of this study was that Group P would show less defense conditioning of autonomic responses than would Group NP. This hypothesis was confirmed for the GSR but not for the cardiac or vasomotor measures. In the absence of a relevant theoretical or empirical basis no predictions were made about reward conditioning in psychopaths. The secondary hypothesis therefore was formulated as a null hypothesis and not as a test of any particular theory. The experimental results fail to reject this hypothesis so there is still no evidence that psychopaths differ from nonpsychopaths in the reward conditioning of autonomic responses. The present findings suggest first, that the relationship between psychopathy and the conditioning of emotional responses may be more complex than previously assumed. Secondly, simple generalizations about autonomic conditioning in psychopaths are probably unwarranted. Finally, assumptions about the relationship between different indices of autonomic conditioning may be oversimplified.

The following discussion considers some of the known differences between the physiological variables investigated in this study. The aim of this discussion is to try to reconcile the seemingly contradictory results of electrodermal and cardiovascular conditioning obtained for Group P.

Conflicting reports appear in the literature concerning the form of the cardiac CR, and the physiological basis of cardiac changes in human Ss during classical conditioning

procedures (Lang and Hnatiow, 1962; Obrist, 1963; Obrist, Wood and Perez-Reyes, 1965; Smith, 1966; Wood, 1963; Wood and Obrist, 1967; Zeaman and Smith, 1965). Some of the contradictory results may be partly due to procedural differences as well as to the various purposes of different investigators. An additional source of variability may be the complexity of the cardiac system itself and its interactions with other autonomic structures. While electrodermal mechanisms are exclusively innervated by sympathetic (SNS) fibers, the cardiac system is innervated by both sympathetic and parasympathetic (PNS) fibers. Cardiac deceleration is a function of vagal inhibition, and vagal activity is regulated by PNS innervation. Heart rate acceleration is a sympathetically mediated response. However, acceleration is positively correlated with respiration amplitude so that an increase in HR may occur (as a function of respiratory changes) in the absence of significant SNS discharge. Furthermore, cardiac acceleration may reflect a momentary decrease in vagal restraint with little or no sympathetic involvement. This means first, that in classical conditioning paradigms the only possible cardiac index of sympathetic activity is acceleration. Secondly, in order to assume SNS involvement in HR acceleration, respiratory and vagal influences must be controlled.

Recent empirical findings (Wood, 1963; Wood and Obrist, 1964; Obrist et al, 1965) indicate that under the usual

classical conditioning procedures the only possible cardiac CR is deceleration. This is the case even when a sympathetically mediated response (acceleration) would be expected as with a noxious or painful UCS. The reason for this, according to evidence presented by Obrist et al (1965), is that with conventional classical conditioning procedures sympathetic cardiac activity is masked by vagal inhibition. These investigators found that conditioned sympathetic cardiac activity was clearly manifested only with a very intense UCS (shock), and then only when vagal innervation was blocked. It was suggested that the initial acceleration observed in classical conditioning studies with intact vagus and high intensity shock, reflects a momentary decrease in vagal restraint rather than a sympathetic effect. The basis for this conclusion by Obrist et al (1965) was that in their experiment the initial acceleration had a shorter latency and peaked much earlier in the CS-UCS interval than did the sympathetically mediated acceleration observed with vagal blockade. Moreover, the initial, short-latency acceleration was found to be positively correlated with respiration whereas no correlation was found between the later acceleration and respiration amplitude. This leaves only deceleration as a possible CR.

If the cardiac results of the present experiment are interpreted in terms of the findings outlined above it seems unlikely that the changes observed during the CS-UCS

interval were manifestations of sympathetically mediated activity. Inspection of Figure 8 indicates that the only group which showed any evidence of acceleration was Group S during the reward conditioning procedure. This does not necessarily mean that SNS mediated cardiac activity was not involved - that SNS activity was present is indicated by the acceleratory UCR to shock (Figure 9). It means that any conditioned sympathetic activity present would have occurred late in the CS-UCS interval and would have been masked by the dominant vagal response. Therefore, since it is generally assumed that the autonomic correlates of emotional states such as fear are sympathetically mediated there does not appear to be any necessary conflict between the present electrodermal and cardiac findings as they pertain to defense conditioning in Group P. The primary hypothesis, that psychopathic Ss do not readily acquire conditioned fear responses, is not contradicted by the cardiac conditioning results. What may be at issue is the appropriateness of cardiac measures as correlates of conditioned emotional responses.

The activities of the cardiovascular system include heart rate, blood pressure, blood volume and stroke volume, and because of the interactions between these functions it is difficult to know exactly the significance of cardiac conditioning. A theory proposed by Lacey (Lacey, 1956, 1959; Lacey, Kagan, Lacey and Moss, 1963) relates HR

acceleration to stimulus rejection and deceleration to sensory intake. One problem with this interpretation, and for that matter an unresolved paradox of cardiac conditioning, is that while the cardiac CR to noxious or painful stimulation is deceleration the UCR is always reported as acceleratory. On the other hand, when the UCS is pleasant or rewarding both the CR and UCR are deceleratory. Obrist (1968) suggested that conditioned cardiac deceleration may serve inhibitory and facilitory functions similar to those proposed by Lacey for acceleration and deceleration respectively. Thus, deceleration would serve to reduce the noxious qualities of the UCS (shock) or enhance the reception of a pleasant UCS (pictures of nudes). Why deceleration should have these functions is not clear. If these speculations are correct they imply a relationship between cardiac deceleration and an attention process. However, in view of the complex and as yet little understood interactions between cardiac, cortical, and autonomic activity, further speculation at this time is probably unwarranted.

The results obtained for the differential amplitude measures of finger vasoconstriction show that Group P conditioned as well or better than did Group NP on both CS-shock and CS-picture trials. While the reason for the discrepancy between electrodermal and vasomotor conditioning shown by Group P is not readily apparent, perhaps the most reasonable and parsimonious explanation is one based on

functional differences between the two systems.

The principal source for the following observations is Sternbach (1966). Like the sweat glands involved in electrodermal activity the peripheral blood vessels involved in vasomotor activity receive only SNS innervation. There are, however, several important differences between the two systems. Sweat gland activity is cholinergically mediated while the activity of the peripheral blood vessels is adrenergically mediated. At least one result of this difference in transmitter substances at the effector sites is that the sweat glands do not participate in the mass innervation of SNS activity produced by medullary secretions. The cutaneous vasomotor system is involved in temperature regulation, in maintaining blood pressure, and blood distribution, in the nourishment of the skin, and in general in maintaining homeostatic balance. The fact that sympathetic fibers regulate both vasoconstriction and vasodilation suggests the possibility that two kinds of adrenergic substances may be involved. One of these is presumed to have an excitatory function resulting in constriction and the other an inhibitory function resulting in dilation. There is however no direct evidence in support of this assumption (Sternbach, 1966). In connection with this latter point Darrow has stated:

> And the frequent identification of vasoconstriction with sympathetic activity and of vasodilation with parasympathetic action is

> likewise often in disregard to the facts. Not only do vasomotor functions represent in many instances the resultant of a balance between opposed neurohumoral influences, a change in either one of which may alter the vasomotor tone, but the existence of both sympathetic cholinergic vasodilators (---) and adrenergic vasodilators (---) is always a threat to such interpretation (Darrow, 1966, p.6).

Electrodermal and vasomotor activity differ in another sense. The sweat glands appear to be the only SNS-innervated effectors that are insensitive to injections of adrenaline and noradrenaline (Sternbach, 1966). This suggests that as an index of autonomic activity skin resistance changes are in certain respects atypical, and may not provide a simple measure of sympathetic action. One possible implication of these differences may be that the GSR is a more appropriate correlate of an individual's emotional state than is finger vasoconstriction. These observations, as well as the results of this experiment, suggest that generalizations from the GSR about activity in the rest of the sympathetic nervous system may be unwarranted.

In summary, there appears to be sufficient complexity and variability within and between the electrodermal and vasomotor systems to account for the present results. In addition, it is well known that the correlations between various indices of conditioning are small and statistically insignificant. Martin (1963) found no significant relationship between several measures of electrodermal activity and

eyelid conditioning. Other investigators (e.g., Lacey et al, 1952, 1953; Wenger et al, 1961; Sternbach, 1966) have reported a similar lack of relationship between different indices of autonomic conditioning.

Summary and Conclusions

This study was designed to investigate defense and reward conditioning of autonomic responses in psychopaths. The Ss were drawn from the inmate population of a maximum security penitentiary and classified as primary psychopaths (P), secondary psychopaths (S), and nonpsychopaths (NP), according to criteria proposed by Cleckley and Karpman. A group of custodial officers was included as a control for possible institutionalization effects. There were 18 Ss in each group. A delayed, differential, classical conditioning paradigm was used in which each of three auditory CSs was paired 16 times with electric shock, with pictures of nudes, and presented alone. The three dependent variables of chief interest were the GSR, HR, and finger vasoconstriction. These were recorded simultaneously on an Offner Type R Dynograph. Differential conditioning was expressed as the amplitude of response to a reinforced CS minus the amplitude of response to the unreinforced CS.

In keeping with previous theory and research it was predicted that Group P would show less defense conditioning of electrodermal, cardiac, and vasomotor responses than would Group NP. In the absence of a relevant theoretical or empirical basis no predictions were made as to the direction of differences in reward conditioning. A simple null hypothesis was formulated which predicted no significant difference between Groups P and NP in reward condi-

tioning on any of the autonomic measures investigated.

The results indicated that Group N showed an inexplicable lack of electrodermal reactivity. This group therefore was excluded from further consideration. This left Groups P and NP as the groups of chief interest. Of the three physiological systems investigated only the electrodermal differentiated between Groups P and NP with Group P; (1) showing significantly less defense conditioning; (2) giving significantly smaller conditioned ORs, and smaller UCRs to shock; and (3) having a significantly lower level of basal skin conductance midway through the experiment. There was no significant difference between Groups P and NP in reward conditioning, although the tendency was for Group P to give ORs and ARs of smaller amplitude than those given by Group NP. There was no significant difference between groups in shock detection threshold or shock tolerance level - hence these variables were ruled out as significant contributors to the difference in defense conditioning. It was also shown that a difference in basal conductance was not significantly related to the observed difference in conditioning between Group P and Group NP. Under both defense and reward stimulus conditions all groups showed evidence of conditioned HR deceleration, and an increase in the amplitude of vasomotor responses. There was no significant difference between Groups P and NP on any index of either cardiac or vasomotor activity.

The GSR findings pertaining to defense conditioning were interpreted as providing additional evidence that primary psychopaths are deficient in the acquisition of conditioned fear responses. The reward conditioning results indicate that there is still no evidence that primary psychopaths differ from nonpsychopaths in the conditioning of reward responses. The difference between electrodermal and cardiovascular conditioning shown by Group P was related to structural and functional differences between the physiological systems investigated.

The results of this study, which replicates and extends previous research concerning the relationship between psychopathy and conditioning, seem to permit the following tentative conclusions. The findings confirm the hypothesis that primary psychopaths do not readily acquire conditioned fear responses. These results also indicate that the primary psychopath's conditioning deficit; (1) does not extend to reward conditioning; and (2) may be restricted to electrodermal responses. The study shows also that the primary psychopath differs from the nonpsychopath on other dimensions of electrodermal activity; he gives smaller conditioned ORs; he has a lower level of basal skin conductance, and he shows less electrodermal reactivity to painful stimulation. In brief, the primary psychopath, in comparison with the nonpsychopath, appears to be electrodermally hyporeactive, at least in response to painful stimulation, and

possibly in general. To the extent that measures of autonomic activity can be taken as correlates of emotional states these results suggest that the GSR may be a "purer" of more adequate index of such states than either HR or digital vasoconstriction. The GSR may be a more appropriate indicator of emotional reactivity in that it seems to be less "contaminated", or less involved in cognitive activity and homeostatic functions than is the cardiovascular system.

These conclusions may of course be tenable only within the present experimental context. It must be emphasized that the results are based on samples obtained from the population of a particular penitentiary and may not hold for other prison populations, and may be even less applicable to nonincarcerated populations. The results found for Group NC emphasize this possible limitation in the generality of the findings.

Bibliography

Albert, R. S., Brigante, T. R., & Chase, M. The psychopathic personality: A content analysis of the concept. Journal of General Psychology, 1959, 60, 17-28.

Arieti, S. Psychopathic personality: Some views on its psychopathology and psychodynamics. Comprehensive Psychiatry, 1963, 4, 301-302.

Bender, L. Psychopathic behavior disorders in children. In R. M. Lindner & R. J. Soliger (Eds.), Handbook of Correctional Psychology. New York: Philosophical Library, 1947, 360-377.

Bernard, J. L. & Eisenman, R. Verbal conditioning in sociopaths with social and monetary reinforcement. Journal of Personality and Social Psychology, 1967.

Blaylock, J. J. Verbal conditioning performance of psychopaths and nonpsychopaths under verbal reward and punishment. Unpublished doctoral dissertation. State University of Iowa, 1960.

Bryan, J. H. & Kapche, R. Psychology and verbal conditioning. Journal of Abnormal Psychology, 1967, 72, 71-73.

Cleckley, H. M. The Mask of Sanity. St. Louis, C. V. Mosby, 1941.

Cleckley, H. M. The Mask of Sanity (4th ed.). St. Louis, C. V. Mosby, 1964.

Cleckley, H. M. Psychopathic states. In S. Arieti, (Ed.) American Handbook of Psychiatry. New York: Basic Books, Vol. 1, 1959.

Darrow, C. H. Physiological and clinical tests of autonomic function and autonomic balance. In R. A. Sternbach, Principles of Psychophysiology, New York: Academic Press, 1966.

Davis, R. C. Response patterns. In R. A. Sternbach, Principles of Psychophysiology, New York: Academic Press, 1966.

Deane, G. E. Human heart rate responses during experimentally induced anxiety: A follow-up with controlled respiration. Journal of Experimental Psychology, 1964, 67, 193-195.

Dollard, J., & Miller, N. E. Personality and Psychotherapy. New York: McGraw-Hill Book Co. The., 1950.

Eysenck, H. J. The Structure of Personality. London: Methuen, 1953.

Eysenck, H. J. A dynamic theory of anxiety and hysteria. Journal of Mental Science, 1955, 101, 28-51.

Eysenck, H. J. (Ed.) Handbook of Abnormal Psychology. New York: Basic Books, 1961.

Fairweather, G. W. The effect of selected incentive conditions on the performance of psychopathic, neurotic and normal criminals in a serial rote learning situation. Unpublished doctoral dissertation, University of Illinois, 1953.

Franks, C. M. Recidivism, psychopathy and personality. British Journal of Delinquency, 1956, 6, 192-201.

Gale, E. N. & Stern, J. A. Conditioning of the electrodermal orienting response. Psychophysiology, 1967, 3, 291-301.

Gale, E. N., & Stern, J. A. Classical conditioning of the peripheral vasomotor orienting response. Psychophysiology, 1968, 4, 342-348.

Guilford, J. P. & Lyons, T. C. On determining the reliability and significance of a tetrachoric coefficient of correlation. Psychometrica, 1942, 7, 243 - 249.

Gurvitz, M. Developments in the concept of psychopathic personality (1900-1950). British Journal of Delinquency, 1952, 2, 88-102.

Gray, K. G., & Hutchinson, H. C. The psychopathic personality. A survey of Canadian psychiatrists opinions. Canadian Psychiatric Association Journal, 1964, 9, 452-461.

Hare, R. D. A conflict and learning theory analysis of psychopathic behavior. Journal of Research in Crime and Delinquency, 1965, 2, 12-19. (a)

Hare, R. D. Temporal gradient of fear arousal in psychopaths. Journal of Abnormal Psychology, 1965, 70, 442-445. (b)

Hare, R. D. Acquisition and generalization of a conditioned-fear response in psychopathic and nonpsychopathic criminals. Journal of Psychology, 1965, 59, 367-370. (c)

Hare, R. D. Psychopathy and choice of immediate versus delayed punishment. Journal of Abnormal Psychology, 1966, 70, 25-29.

Hare, R. D. Detection threshold for electric shock in psychopaths. Journal of Abnormal Psychology, 1968, 73, 268-272. (a)

Hare, R. D. Psychopathy, autonomic functioning, and the orienting response. Journal of Abnormal Psychology, 1968. (b)

Hare, R. D. Psychopathic behavior: Theory and Research. John Wiley & Sons, Inc., 1969.

Hays, W. L. Statistics for Psychologists. Toronto: Holt, Rinehart & Wilson, 1963.

Henderson, D. K. Psychopathic states. New York: Norton, 1947.

Johns, J. H. & Quay, H. C. The effect of social reward on verbal conditioning in psychopathic and neurotic military offenders. Journal of Consulting Psychology, 1962, 26, 217-220.

Kadlub, K. J. The effects of two types of reinforcements on the performance of psychopathic and normal criminals. Unpublished doctoral dissertation. University of Illinois, 1956.

Karpman, B. On the need of separating psychopathy into two distinct clinical types: The symptomatic and the idiopathic. Journal of Criminal Psychopathology, 1941, 137-152.

Karpman, B. The structure of neurosis: With special differentials between neurosis, psychosis, homosexuality, alcoholism, psychopathy and criminality. Archives of Criminal Psychodynamics, 1961, 4, 599-646.

Kimble, G. A. Hilgard and Marquis' Conditioning and Learning. New York: Appleton-Century-Crofts, Inc., 1961.

Lacey, J. I., Bateman, D. E., & Van Lehn, R. Autonomic response specificity and Rorschach color responses. Psychosomatic Medicine, 1952, 14, 256-260.

Lacey, J. I., Bateman, D. E., & Van Lehn, R. Autonomic response specificity. Psychosomatic Medicine, 1953, 15, 8-21.

Lacey, J. I. The evaluation of autonomic responses. Toward a general solution. Annals of the New York Academy of Science, 1956, 67, 123-164.

Lacey, J. I., & Lacey, B. C. The relationship of resting autonomic activity to motor impulsivity. (Research publication of the Association of Nervous and Mental Diseases), 1958, 36, 144-209.

Lacey, J. I. Psychophysiological approaches to the evaluation of psychotherapeutic process and outcome. In F. A. Rubenstein & M. G. Parloff (Eds.), Research in Psychotherapy. Washington, D.C.: American Psychological Association, 1959, 160-208.

Lacey, J. I., Kagan, J., Lacey, B. C., & Moss, H. A. The viceral: Situational determinants and behavioral correlates of autonomic response patterns. In P. J. Knapp (Ed.), Expression of the Emotions in Man. New York: International University Press, 1963, 161-196.

Lang, P. J., & Hnatiow, M. Stimulus repetition and the heart rate response. Journal of Comparative and Physiological Psychology, 1962, 55, 781-785.

Lindner, R. M. Experimental studies in constitutional psychopathic inferiority. Journal of Criminal Psychopathology, 1943, 3, 252-276, 484-500.

Lindner, R. M. A formulation of the psychopathic personality. Psychiatry, 1944, 7, 59-63.

Lippert, W. W., & Senter, R. J. Electrodermal responses in sociopaths. Psychonomic Science, 1966, 4, 25-26.

Lovibond, S. A. Conceptual thinking, personality and conditioning. British Journal of Social and Clinical Psychology, 1963, 2, 100-111.

Lykken, D. T. A study of anxiety in the sociopathic personality. (Doctoral dissertation, University of Minnesota), Ann Arbor, Michigan, University Microfilms, 1955.

Lynn, R., & Eysenck, H. J. Tolerance for pain, extraversion and neuroticism. Perceptual and Motor Skills, 1961, 12, 161-162.

Martin, I. Eyelid conditioning and concomitant GSR activity. Behavior Research and Therapy, 1963, 1, 255-265.

Maughs, S. B. Psychopathic personality. Review of the literature 1947-1954. Archives of Criminal Psychodynamics, 1955, 1, 291-325.

Maughs, S. B. Current concepts of psychopathy. Archives of Criminal Psychodynamics, 1961, 4, 550-557.

Malmo, R. B. Activation. In A. J. Bachrach (Ed.), Experimental Foundations of Clinical Psychology. New York: Basic Books, 1962, 386-422.

Miller, N. E. Studies of fear as an acquirable drive: I. Fear as motivation and fear reduction as reinforcement in the learning of new responses. Journal of Experimental Psychology, 1948, 38, 89-101.

Miller, N. E. Learnable drives and rewards. In S. S. Stevens (Ed.), Handbook of Experimental Psychology. New York: John Wiley & Sons, Inc., 1951.

Miller, J. E. Eyeblink conditioning of primary and neurotic psychopaths. (Doctoral dissertation, University of Missouri), Ann Arbor, Michigan: University Microfilms, 1966.

Mowrer, O. H. A stimulus-response analysis of anxiety and its role as a reinforcing agent. Psychological Review, 1939, 46, 553-565.

Mowrer, O. H. An experimental analogue of "regression" with incidental observations on "reaction formation". Journal of Abnormal and Social Psychology, 1940, 35, 56-87.

Mowrer, O.H. Learning theory and behavior, New York: John Wiley & Sons, Inc., 1960.

McCord, W., & McCord, J. The psychopath: An essay on the criminal mind. Princeton, New Jersey: Van Nostrand, 1964.

McDonald, D. G., Johnson, L. C., & Hord, D. J. Habituation of the orienting response in alert and drowsy subjects. Psychophysiology Division, United States Navy Medical Neuro-psychiatric Research Unit, San Diego, December 1963, Report Number 63-17.

McNemar, Q. Psychological Statistics. New York: John Wiley & Sons Inc., 1962.

Obrist, P. A. Cardiovascular differentiation of sensory stimuli. Psychosomatic Medicine, 1963, 25, 450-458.

Obrist, P. A., Wood, D. M. & Perez-Reyes, M. Heart rate during conditioning in humans: Effects of UCS intensity, vagal blockade, and adrenergic block of vasomotor activity. Journal of Experimental Psychology, 1965, 70, 32-42.

Obrist, P. A. Heart rate and somatic-motor coupling during classical aversive conditioning in humans. Journal of Experimental Psychology, 1968, 77, 189-193.

Painting, D. H. The performance of psychopathic individuals under conditions of positive and negative partial reinforcement. Journal of Abnormal and Social Psychology, 1961, 62, 352-355.

Persons, R. W. & Bruning, J. L. Instrumental learning with sociopaths. Journal of Abnormal Psychology, 1966, 71, 165-168.

Petrie, A., Collins, W., & Solomon, P. The tolerance for pain and for sensory deprivation. American Journal of Psychology, 1960, 73, 80-90.

Peterson, D. R., Quay, H. C., & Tiffany, T. L. Personality factors related to juvenile delinquency. Child Development, 1961, 32, 355-372.

Quay, H. C., & Hunt, W. A. Psychopathy, neuroticism and verbal conditioning. A replication and extension. Journal of Consulting Psychology, 1965, 29, 238.

Quay, H. C. Psychopathic personality as pathological stimulation-seeking. American Journal of Psychiatry, 1965, 122, 180-183.

Solomon, R. L., & Wynne, L. C. Traumatic avoidance learning: The principles of anxiety conservation and partial irreversibility. Psychological Review, 1954, 61, 353-385.

Schacter, S., & Latané, B. Crime, cognition and the autonomic nervous system. In M. R. Jones (Ed.) Nebraska symposium on motivation. Lincoln: University of Nebraska Press, 1964, 221-275.

Schalling, D., & Levander, S. Spontaneous fluctuations in skin conductance during anticipation of pain in two delinquent groups differing in anxiety proneness. Reports from the psychological laboratories, University of Stockholm, 1967, 238, 1-7.

Schalling, D., & Levander, S. Ratings of anxiety-proneness and responses to electrical pain stimulation. Scandinavian Journal of Psychology, 1964, 5, 1-9.

Sherman, L. J. Retention in psychopathic, neurotic and normal subjects. Journal of Personality, 1957, 6, 722-729.

Schoenherr, J. C. Avoidance of noxious stimulation in psychopathic personality. (Doctoral dissertation, University of California, Los Angeles), Ann Arbor, Michigan: University Microfilms, 1964.

Schoper, C. A. A study of learning and retention with neutral and social-primitive words in normal, psychopathic and neurotic criminals. Dissertation Abstracts, 1958, 18, 1871.

Schmauk, F. J. A study of the relationship between kinds of punishment, autonomic arousal, subjective anxiety, and avoidance learning in the primary psychopath. Unpublished Ph.D. dissertation. Temple University, 1968.

Scott, W., & Wertheimer, M. Introduction to Psychological Research. New York: John Wiley & Sons Inc., 1962.

Smith, R. W. Discriminative heart rate conditioning with sustained inspiration as respiratory control. Journal of Comparative & Physiological Psychology, 1966, 61, 221-226.

Spence, K. W., & Taylor, J. Anxiety and strength of the UCS as determiners of the amount of eyelid conditioning. Journal of Experimental Psychology, 1951, 42, 183-188.

Stewart, M. A., Stern, J. A., Winokur, G. D., & Fredman, S. An analysis of GSR conditioning. Psychological Review, 1961, 68, 60-67.

Sternbach, R. A. Some relationships among various "dimensions" of autonomic activity. Psychosomatic Medicine, 1960, 22, 430-434.

Sternbach, R. A. The effects of instructional sets on autonomic responsivity. Psychophysiology, 1964, 1, 67-72.

Sternbach, R. A. Principle of Psychophysiology. New York: Academic Press, 1966.

Tursky, B., & Watson, P. D. Controlled physical and subjective intensities of electric shock. Psychophysiology, 1964, 1, 151-162.

Tursky, B., Watson, P. D., & O'Connell, D. N. A conentric shock electrode for pain stimulation. Psychophysiology, 1965, 1, 296-298.

Thorvaldson, S. A. Detection threshold and tolerance level for electric shock in psychopaths. Unpublished M.A. Thesis. University of British Columbia, 1969.

Unger, S. M. Habituation of the vasoconstrictive orienting reaction. Journal of Experimental Psychology, 1964, 67, 11-18.

Venables, P. H., & Martin, I., (Eds.), A manual of psychophysiological methods. New York: John Wiley & Sons Inc., 1967.

Walker, H., & Lev, J. Statistical Inference. New York: Henry Holt & Co., 1953.

Warren, A. B., & Grant, D. A. The relation of conditioned discrimination to the MMPI Pd personality variable. Journal of Experimental Psychology, 1955, 49, 23-27.

Wenger, M. A., Clemens, T. L., Coleman, D. R., Cullen, T. D., & Engel, B. T. Autonomic response specificity. Psychosomatic Medicine, 1961, 23, 185-193.

Winer, B. J. Statistical principles in experimental design. New York: McGraw-Hill, 1962.

Wood, D. M. A determination of the effects of respiration upon the classically conditioned heart rate response. (Doctoral dissertation, University of Western Carolina), 1963.

Wood, D. M., & Obrist, P. A. Minimal and maximal sensory intake and exercise as unconditioned stimuli in human heart rate conditioning. Journal of Experimental Psychology, 1967, 74.

Woodworth, R. S., & Schlosberg, H. Experimental Psychology. New York: Henry Holt & Co., 1954.

Zeaman, D. R., & Smith, R. W. Review of some recent findings in human cardiac conditioning. In W. T. Prokasy, (Ed.), Classical conditioning. A symposium. New York: Appleton-Century-Crofts, 1965.

Zimny, G. H., & Miller, F. L. Orienting and adaptive cardiovascular responses to heat and cold. Psychophysiology, 1966, 3, 81-92.

Zimny, G. H., Stern, J. A., & Feld, S. P. Effects of CS and UCS relationships on electrodermal response and heart rate. Journal of Experimental Psychology, 1966, 72, 177-181.

Appendix A

Subject Selection Procedures

Selection of Subjects

The Ss were drawn from the population of approximately 500 inmates of the B.C. Penitentiary, a maximum security institution. The initial step in the selection procedures was to obtain the cooperation of the institution's clinical staff. The concepts of psychopathy proposed by Karpman (1941, 1961) and Cleckley (1959, 1964) were discussed with three members of the clinical staff consisting of a psychologist, a psychiatrist and a classification officer. Each was requested to submit the names of inmates known to them personally and whom they could roughly categorize as primary psychopaths, secondary psychopaths and nonpsychopaths. The experimenter and a colleague then read each potential S's file and independently checked Cleckley's 15 items for each S. On the basis of the checklist evaluations the S was then rated on a 7-point scale. All the information contained in a file was used to determine whether an item was applicable or inapplicable to the S. For most Ss the file included psychometric data, psychological assessments, psychiatric evaluations, classification reports, medical reports, statements by police, adult and juvenile criminal records, letters or other communications by and to the S, custodial officer's reports on the S's institutional behavior, and in some cases statements made by probation officers. If the rater felt confident that the S met the principal criteria of primary psychopathy he was given a rating

of one on the 7-point scale. If he felt less certain about the degree of primary psychopathy the S was assigned a rating of 2. If the rater felt confident that a S met none of the criteria of either primary or secondary psychopathy he was given a rating of 7, and one about whom the rater felt less certain was assigned a rating of 6. Individuals who fell between these two extremes, in that they exhibited varying degrees of psychopathic behavior but who also displayed signs judged to be indicative of neurotic adjustment, were assigned ratings of either 3, 4 or 5. Excluded were known or suspected cases of brain damage, psychotics, homosexuals, drug addicts, and individuals whose files did not contain enough information to permit assignment to one of the three diagnostic categories. Subjects for Group NC were selected more or less at random from a total of 40 custodial officers who had volunteered to participate in the experiment.

When a sufficient number of inmate Ss had been selected in the manner described above, indexes of inter-rater agreement were computed for both the 7-point scale and for each of Cleckley's 15 items. In order to provide a final rating for each item for each S, differences between raters were resolved by forced agreement, and this final rating was used in computing interitem correlations, and the correlations between an item and assignment of a S to one or the other extreme categories of psychopathy.

The personality characteristics denoted by Cleckley's descriptive items e.g., lack of anxiety, failure to learn from experience etc., were viewed as being logically continuous variables for which only dichotomous scores were available in the present investigation. Psychopathy was also assumed to represent a continuous variable for which only categorical data were available. These assumptions made it possible to use the tetrachoric correlation (rt) (Walker and Lev, 1953) to estimate the degree of association between items, and between an item and assignment of a S to one of the two extreme categories of psychopathy. This latter correlation was restricted to Groups P and NP since the rt is applicable only to dichotomously scored data.

Results

A total of 104 files were read before acceptable physiological records were secured for a final sample of 54 inmates with 18 Ss in each of the three groups, primary psychopaths (Group P), secondary psychopaths (Group S), and nonpsychopaths (Group NP). Forty-four Ss were lost for one reason or another before any records could be obtained. Of the 60 records secured, 6 were rejected for the reasons stated in Table 4. It is of interest to note that of the 9 Ss who refused to participate in the experiment, 7 had been assigned to Group P. Of the custodial staff (Group NC) one S's record was rejected because of an irregular EKG.

An index of inter-rater agreement (Scott and Wertheimer,

1962) on the 7-point scale was computed for 46 Ss out of an initial sample of 50, four of whom were rejected as unsuitable. The raters agreed exactly on 32 Ss or 70 per cent of the cases. Of the remaining 14 Ss the raters were one step apart on 12 and two steps apart on 2. The index of overall agreement between raters was 63 per cent while chance agreement was estimated as being 18 per cent.

When the raters' evaluations of Cleckley's items were tabulated and entered in fourfold tables it was found that in many instances the frequencies were concentrated in one cell while the remaining cells were empty or contained only a few entries. Since this made it impossible, and of course unnecessary, to compute correlation coefficients the degree of correspondence between raters was expressed as percentage of agreement. This was done for each item and for each group. The results, shown in Table 1, indicate that agreement ranged from 66 per cent to 100 per cent for individual items while the mean percentage of agreement for groups was Group P=95.7, Group S=90.7 and Group NP=96.8.

The tetrachoric correlation coefficient (rt), an estimate of the Pearson r, is a measure of the relationship between two theoretically continuous variables for which only dichotomous data are available. Unlike the phi coefficient the rt provides an estimate of the population correlation and ranges from -1.00 to 1.00 regardless of the marginal frequencies (Walker and Lev, 1953; McNemar, 1962).

Table 1

Percent of Agreement Between Raters
on Scoring of Cleckley's Items

ITEMS	GROUPS P	S	NP	MEAN
1	100	100	100	100
2	100	89	100	96
3	89	94	83	89
4	100	78	100	93
5	100	72	94	89
6	94	89	94	92
7	100	100	94	98
8	100	100	94	98
9	89	89	100	93
10	100	100	94	98
11	100	66	100	89
12	100	100	100	100
13	66	89	100	85
14	100	94	100	98
15	100	100	100	100
MEAN	95.7	90.7	96.8	

The tetrachoric correlation between the final ratings of each of Cleckley's items for 54 Ss produced a matrix of 105 coefficients with values ranging from -.93 to 1.00 as shown in Table 2. The correlation for 56 pairs of items or 53 per cent of the total differed significantly from zero with $P<.01$. The remainder were not significant ($P>.05$). In Table 2 a positive correlation indicates a tendency for both of a pair of items to be either applicable (scored 1) or inapplicable (scored 0), and the greater the proportion of Ss for whom both items are scored either 1 or 0 the larger the correlation. A negative correlation indicates a tendency for one of a pair of items to be applicable and the other inapplicable, and the greater the proportion of Ss for whom one of the items is scored 1 or the other scored 0 the larger the correlation.

In order to facilitate the computation of the rt between an item and assignment of the S to one of the final diagnostic categories, it was assumed that Groups P and NP represented the extremes of a dimension of psychopathy, and the correlation was restricted to these two groups. The rts between each of Cleckley's items and assignment of a S to Groups P or NP are presented in Table 3. The values range from -.60 to 1.00 and 12 of the 15 coefficients differ significantly from zero at the .01 or .05 levels. In Table 3 a positive correlation means that the proportion of Ss in Group NP for whom an item is inapplicable (scored 0)

Table 2

Tetrachoric Correlation Between Each of Cleckley's Items Based on the Final Rating

ITEMS	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	1.00*	1.00*	-.68*	1.00*	1.00*	1.00*	-.70*	-.42	-.60	.94*	-.52	1.00*	-.59	-.59
2		.04	.27	.04	.04	.06	-.93*	1.00*	-.64*	1.00*	-.72	1.00*	-.63	-.62
3			-.13	.39	.39	.33	-.19	.45*	-.28	.35	.04	.10	.55*	.19
4				.95*	.86*	.96*	.97*	.84*	.65*	.92*	.27	.35	-.21	.46
5					.91*	.94*	.88*	1.00*	.86*	.95*	1.00*	.47*	.30	.85*
6						.88*	.88*	.94*	.86*	.89*	.04	.22	.05	.48
7							.97*	.85*	.62*	.93*	.06	.55*	.32	.50
8								.95*	.87*	.93*	.24	.54*	.06	.67*
9									.85*	.91*	.86*	.39*	.27	.84*
10										.85*	.52	.38	.10	.17
11											-.02	.35	.22	.41
12												.80*	-.63*	.96*
13													.32	.25
14														.22

*P<.01

Table 3

Tetrachoric Correlation Between Each Item and Assignment of Ss to Group P and Group NP

ITEM	rt
1	.00
2	.00
3	-.73**
4	-.99**
5	1.00**
6	1.00**
7	1.00**
8	1.00**
9	1.00**
10	-.87**
11	1.00**
12	1.00*
13	-.60**
14	.00
15	-.84**

**P<.01

*P<.05

Table 4

Disposition of Inmate Sample

	Freq.	Totals
Reasons for loss or rejection of Ss before physiological records were secured		
Refused	9	
Transferred		
Paroled		
Discharged	12	
Deported		
Homosexual	4	
Psychoses	1	
Drug Addiction	1	
Low IQ (epilepsy)	1	
Considered dangerous	1	
Failed to fit required category	11	
Not needed	4	44
Reasons for rejection of physiological records		
Subjects judged to be psychotic	2	
Instrument failure	2	
Excluded at random to equalize the Ns	2	6
Final number of usable records obtained	54	54
Total number of files read		104

exceeds the proportion in Group P to whom the item is applicable (scored 1). Thus item 11 e.g., is applicable to 17/18 Ss in Group P and is inapplicable to 18/18 Ss in Group NP. The rt between item 11 and assignment to one of the two categories is 1.00, and is significant at the .01 level indicating high discriminative power. A negative correlation means that the proportion of Ss in Group P for whom an item is applicable (scored 1) exceeds the proportion in Group NP for whom the item is inapplicable (scored 0). Item 4 e.g., is applicable to 18/18 Ss in Group P and is inapplicable to 13/18 Ss in Group NP. For item 4 rt= -.99 ($P<.01$) thus indicating reasonably good discrimination.

However, a significant rt does not necessarily mean that an item has discriminative power. Inspection of the distributions indicates that the following items, despite some high and significant rts, fail to discriminate the two groups; items 1, 2, 10, 12, 14, and 15. Item 12 e.g., is applicable to 18/18 Ss in Group P and to 17/18 Ss in Group NP so that its discriminative power is nil despite a correlation coefficient of unity. Of the 15 items, items 3, 4, 5, 6, 7, 8, 9, 11 and 13 discriminate significantly between Groups P and NP.

Discussion

Inspection of Table 1 indicates that the lowest percentage of inter-rater agreement occurred on item 13 as it

applied to Group P, and on item 11 as it applied to Group S. Item 13 refers to the primary psychopath's "sexual peculiarities" and proved to be the most difficult item to rate for this group. It seems likely that this difficulty, and the low agreement, was due to the ambiguity of the item itself, and to the different interpretations placed upon it by the raters. It is of interest to note in Table 3 that item 13 shows only moderate correlation with assignment of Ss to Groups P and NP. Item 11 refers to the psychopath's lack of "response to special consideration or kindness", and the low percentage of agreement between raters on this item as it applied to Group S reflects the fact that of the three categories Group S proved to be the most difficult to rate. This is further indicated in the lower percentage of inter-rater agreement for Group S in comparison with Groups P and NP as shown in Table 1. This difficulty is perhaps not surprising when viewed in relation to Group S's assumed position on the psychopathic dimension, and in terms of the criteria involved in its selection. It is of interest to note that both raters felt that the easiest S to identify was the extreme primary psychopath. However, when the S appeared to fall somewhere between the primary and neurotic or secondary types, identification was difficult.

The finding that only 53 per cent of the interitem correlations differed significantly from zero, taken

together with the data presented in Table 3, which shows that only 60 per cent of the items discriminate between the two extreme categories, suggests that certain of Cleckley's items contribute little or nothing to the diagnosis of psychopathy, at least under the present selection procedures. It is possible however that more items would show discriminative power if all three categories were included in the determination of the degree of association between an item and assignment to one of the categories.

In this connection it must be noted that the tetrachoric r has a much larger sampling error than the product moment r for the same size N. This means that rt is much less stable than r particularly for high correlations and extreme cuts in the distribution (McNemar, 1962). Moreover, since no transformation exists for handling the sampling errors of high tetrachoric correlations the standard error of the rt can only be approximated. The formula used to compute an approximate standard error in the present study was first published in 1924 (Guilford and Lyons, 1942) and was reproduced by McNemar (1962). However, a search of the literature back to 1960 failed to turn up a suitable alternative. In addition, the use of the tetrachoric r requires the assumptions that the dichotomized variables are continuous and normally distributed, and that the regressions are linear. In view of these considerations the tetrachoric correlations presented in

Tables 2 and 3 should be interpreted conservatively.

The possibility of rater bias must be noted. The raters were familiar with the concepts of psychopathy proposed by Cleckley (1964, 1959) and Karpman (1941, 1961). Acceptance of the proposition that primary psychopathy is related to a particular set or pattern of personality traits could conceivably result in the rater assigning to the primary group only those Ss who displayed this pattern in totality. One possible outcome of such a procedure might be the selection of a group of individuals who demonstrated an extreme degree of primary psychopathy. Further, acceptance of the above proposition could result in the rater inferring the presence (or absence as the case may be) of the traits in question without sufficient justification. If e.g., the available information indicated that in the case of a particular S 90 per cent of the characteristics were present (or absent), and if the rater inferred the remainder no great harm would be done since the probability of his inference being warranted would be reasonably high. However, if only about 50 per cent of the traits were applicable and the rater were to infer the balance there would be a high probability of misclassification.

Thus, although both raters were aware of these pitfalls and made a conscientious effort to avoid them the possibility still exists that some Ss, especially those on

the borderline, were misclassified. Nonetheless, despite these drawbacks the overall results of the selection procedures considered in conjunction with the results of the major study indicate that a reasonable degree of success was achieved in separating the prison sample into three diagnostic categories.

Appendix B

Cleckley's Descriptive Items

Your cooperation is requested in selecting subjects for the personality study now being conducted. Please note carefully the list of 15 descriptive items below, paying particular attention to those items marked with an asterisk. These are the principal criteria. The list will be used to select three groups according to whether or not the criteria apply to them. Inmates who, in your judgment, clearly fit all the principal criteria are eligible for inclusion in Group I; those who do not fit one or more of the principal criteria are eligible for inclusion in Group II; and those to whom few or none of the criteria apply are eligible for Group III.

On the attached chart please list the names of inmates known to you. Then check each name against each of the 15 descriptive items denoted by the numbers 1 to 15 at the top of the chart. When an item applies to a particular subject place a check mark in the appropriate square; when an item does not apply leave the square blank; when you are doubtful place a question mark in the appropriate square but use the question mark as sparingly as possible.

****

A general description of the sociopathic personality, taken from the APA Diagnostic and Statistical Manual, 1952, is as follows: Sociopathic Personality Disturbance, Antisocial reaction: This term refers to chronically antisocial individuals who are always in trouble, profiting

neither from experience nor punishment, and maintaining no real loyalties to any person, group, or code. They are frequently callous and hedonistic, showing marked emotional immaturity, with lack of sense of responsibility, lack of judgment, and an ability to rationalize their behavior so that it appears warranted, reasonable, and justified.

The term includes cases previously classified as "constitutional psychopathic state" and "psychopathic personality". As defined here the term is more limited, as well as more specific in its application.

****

Criteria

1. Average or superior intelligence.

*2. Free from irrationality and other commonly-accepted symptoms of psychosis.

*3. Free from any marked nervousness or other common symptoms of psychoneurosis.

4. No sense of responsibility. "Though he may give an early impression of being a most reliable person, it will soon be found that he has no sense of responsibility whatsoever to others. Furthermore, the question of whether or not he is to be confronted with his failure or his disloyalty and called to account for it appears to have no effect at all on his attitude."

5. Disregard for truth. "...is to be trusted no more in his accounts of the past than in his promises for the future or his statement of present intentions...however...no matter how vividly or how repeatedly his utter falsity is demonstrated to him, he is not confounded but continues to expect his work to be regarded as a very serious matter."

*6. No sense of shame. "...does not show the slightest evidence of humiliation or regret. This is true of matters pertaining to his personal and selfish pride and to esthetic standards that he avows as well as to the moral or humanitarian matters."

*7. Antisocial behavior without apparent compunction. "He will commit theft, fraud, and other deeds for astonishingly small stakes and under much greater risks of being discovered than will the ordinary scoundrel. He will, in fact, commit such deeds in the absence of any apparent goal at all."

*8. Inability to learn from experience. "Despite his excellent rational powers he continues to show the most exercrable judgment about attaining what one might presume to be his ends. It is this writer's opinion that no punishment will make (him) change his ways."

*9. General poverty of affect. "Vexation, spite, quick and labile flashes of quasiaffection, peevish resentment, shallow moods of self-pity, puerile attitudes of vanity, absurd and showy poses of indignation are all within his emotional scale...but mature, wholehearted anger, true or consistent indignation, honest, solid grief, sustaining pride, deep joy, despair are never found within this scale."

*10. Lack of genuine insight. "In a special sense (he) lacks insight to a degree seldom if ever found in other mental disorder. He has absolutely no capacity to see himself as others see him. Occasionally, however, he will perfunctorily admit himself to blame for everything and analyze his case from what seems almost to be a psychiatric viewpoint. Yet (he), shows not only a deficiency but apparently a total absence of insight as a real and moving experience."

*11. Little response to special consideration or kindness. "No matter how well he is treated...he shows no reaction of appreciation except superficial and transparent protestations."

*12. No history of sincere attempts at suicide.

13. Sex life shows peculiarities. "...they regard sexual activity very casually. None...(seem to have)...particularly strong sex-cravings even in (the) uncomplicated and poverty-stricken sense (of literal physical contact). They usually have records of great promiscuity which is readily understandable in view of their almost total lack of self-imposed restraint."

14. No strongly adverse or neuropathic heredity; family background not markedly sociopathic or deviant.

15. Onset of psychopathic characteristics no later than early twenties.

Appendix C

Reinforcing Effects of Pictures of Nudes on the Operant Behavior of Psychopaths

Reinforcing Effects of Pictures of Nudes on the Operant Behavior of Psychopaths

Several investigators (e.g., Lovibond, 1963; Davis, 1966; Wood and Obrist, 1967) have found pictures of nudes to be an effective UCS in studies of autonomic conditioning. One could be more certain that reward conditioning is involved in such studies if it could be shown that pictures of nudes were effective reinforcers in an instrumental conditioning paradigm.

If a S increases his rate of a given response when the increase in rate is followed by a particular stimulus, it may be assumed that the stimulus was reinforcing to the S. In other words, if pictures of nudes constitute a reward for the S i.e., something he will expend effort to gain, he would be expected to increase his rate of response when the increase in rate is reinforced with pictures of nudes. To test this hypothesis an operant conditioning experiment was designed in which reinforcement was contingent upon an increase in the rate of a button-pressing response. The study was restricted to prisoners designated primary psychopaths (Group P), secondary psychopaths (Group S), and nonpsychopaths (Group NP).

Method

Subjects (Ss). Of the 30 Ss who participated in the present study 28 had served as Ss in the classical conditioning experiment described in the preceding pages. Ten

Ss were drawn more or less at random from each of Groups P and S but since Group NP had been reduced in numbers as a result of transfers to other parts of the institution only 8 of the original group of 18 were available, hence random selection from this group was not possible. Two new members, selected in accordance with the selection procedures previously described, were added to Group NP to make a total of 10.

Apparatus. The experiment was conducted in the same room as that used in the physiological experiment with all non-essential equipment being removed. A spring-loaded push button fastened to the surface of a table was wired to an impulse counter. The experimenter, the impulse counter, a six volt battery and a slide projector were located behind a 4x8 sheet of wallboard while the S was seated at a table containing the push button on the opposite side of the wallboard. A hole had been cut in the wallboard to accommodate the projector lens. The picture was projected onto a blank wall painted white, the room was always in semi-darkness and an effort was made to disguise the true nature of the experiment as much as possible. The same set of pictures that were used in the previous study were used in the present investigation and were presented in the same order.

Procedure. When the S entered the experimental room he was told that all he would be required to do was press

a button, that he would receive no electric shock, and no questions would be asked. In addition, he was informed that every time he depressed the button a number would register on a counter located on the table behind him and that he would hear the counter register. It was emphasized that he should depress the button all the way otherwise it would not register on the counter. He was then asked to press the button a few times so as to get the "feel" of it.

The experimenter took his place and instructed the S; "When I say 'start' I want you to begin pressing the button as fast as you can and continue until I say 'stop'". The counter was set to zero and the S was told to start. After 15 seconds he was told to stop and the cumulative total of button presses was recorded. This was defined as a "maximum rate" trial. Four such trials were administered to each S with the counter being set to zero after each trial and the total per trial recorded. All trials were 15 seconds in duration and the intertrial interval was 10 seconds. Temporal intervals were timed with a stop watch.

Following completion of the four "maximum rate" trials the S was told; "From now on you may press the button at any rate you wish. Begin when I say 'start' and continue until I say 'stop'". Trials 5 to 14 inclusive were defined as the operant level. Beginning with trial 15 the S was reinforced at the end of the trial for slight increases in rate above his mean operant rate. Reinforcement

ranged from "minimum" to "maximum". Minimum reinforcement was defined as exposing a picture for the shortest duration of which the projector was capable (about .5 sec.), and was contingent upon the S's rate of response exceeding his average operant rate by two or three presses. Thus, if a S's average operant rate was 67 and if his rate on trial 15 or on subsequent trials was 69 he received minimum reinforcement. No reinforcement was provided for a rate less than operant rate. Maximum reinforcement consisted of a 10 second exposure, and was contingent upon the S's rate equalling or exceeding his highest maximum rate. Between these two extremes the amount of reinforcement delivered was roughly proportional to the S's increase in rate of response.

The S's maximum rate, obtained at the beginning of the experiment, was used as the ultimate criterion of conditioning, and helped determine the amount of reinforcement to deliver. If, during the conditioning trials, the S's rate was approximately half-way between his mean operant rate and his maximum rate he received approximately 50 per cent reinforcement. On the other hand, if the S's rate decreased, reinforcement was decreased, and if his rate showed an abrupt and marked drop, reinforcement was withheld even though his rate was still above his operant level. In other words, the aim of the experiment was to shape the S's response towards a constant increase in

rate until it approximated his maximum. The experiment was terminated when one of the following conditions had been met.

(A) When the S's rate approximated or exceeded his "maximum" rate and had been maintained for at least two of the last three trials.

(B) When the S reached a plateau and seemed unable or unwilling to go beyond it even though it was still less than his "maximum" rate.

(C) When 25 conditioning trials had been administered and the S had received only a few scattered reinforcements or no reinforcements (essentially a failure to condition).

In order to prevent, as far as possible, biasing the responses of future Ss, each individual was asked to avoid discussing the experiment with other inmates. For the same reason no systematic attempt was made to question the S as to his awareness of the response-reinforcement contingency.

Results

Since different Ss required different numbers of trials to reach criterion, or until the experiment was terminated, the results were converted to Vincent units (Kimble, 1961; Woodworth and Schlosberg, 1954) in order to provide a common basis for comparison. The total number of trials administered to a S including operant trials but not "maximum rate" trials, was divided into sixteenths,

thus providing 16 equal units for each S. The "maximum rate" trials were also converted to Vincent units but independently of operant and conditioning trials. Thus, if a S received 32 trials exclusive of "maximum" trials his base unit was 32/16=2 trials. This meant that his two highest "maximum rate" trials were taken as an estimate of his response capability, and each of his 16 base units was expressed as a percentage of his "maximum" rate. The first five units were designated operant level, and the remaining eleven units were designated conditioning level. Because of the conversion to Vincent units, unit 5 comprises data from both operant and conditioning trials for some Ss.

In order to determine whether the conditioning rate differed significantly from the operant rate the mean operant rate (the first 5 units) and the mean of the last 5 units were obtained for each S. These were designated the levels factor. An analysis of variance was then computed with Levels and Groups as the two factors. The results, presented in Table 1, show that the Levels differed significantly while there was no difference between Groups and no significant interaction. This indicates that all Groups increased their rate of response significantly above their operant level as a function of reinforcement with pictures of nudes. These results are plotted in Figure 1. The number of Ss in each group falling in each of

Table 1

Analysis of Variance on Difference in Response Rates Between First Five Operant Levels and Last Five Reinforced Levels for Groups P, S and NP

Source	df	SS	MS	F	P
Groups	2	349.93	174.97	.37	
Levels	1	9647.00	9647.00	20.40	.001
Levels x Groups	2	1459.00	729.51	1.54	.22
Error	54	25534.00	427.86	---	
Total	59	36990.00			

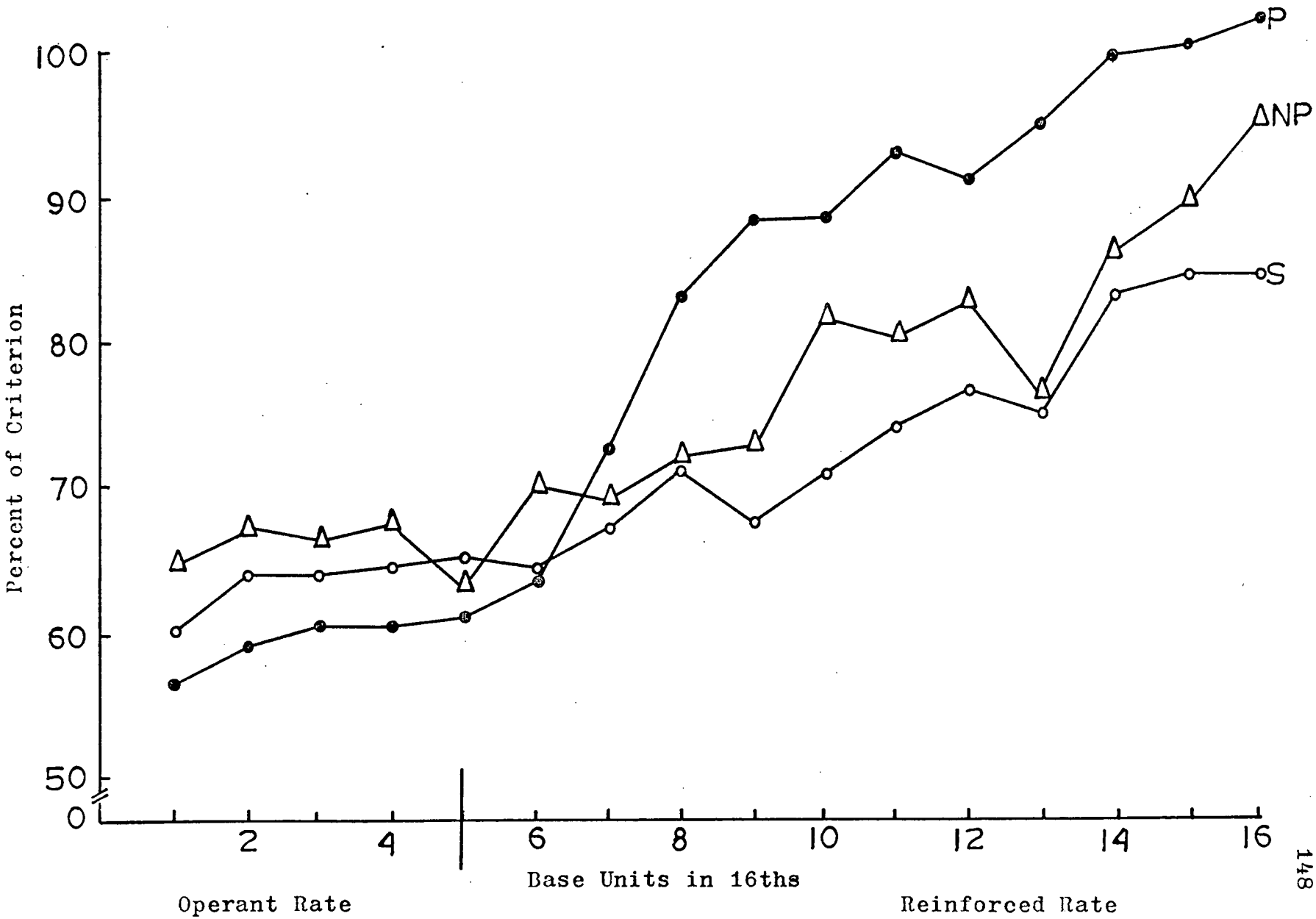

Fig.1. Increase in rate of a button-pressing response as a function of reinforcement with pictures of nudes.

the termination categories is shown in Table 2. Because of the small expected frequencies the chi square test was inapplicable to these data, however, it seems unlikely that the Groups differed significantly with respect to the various categories. The mean number of trials for each group was, Group P=22.3, Group S=27.5, and Group NP=26.0. The means for Groups S and NP were inflated by one S in each group who required 43 and 41 trials respectively.

Discussion

The results confirm the hypothesis that, at least within the present experimental context, pictures of nudes constituted a reward stimulus for primary psychopaths. Inspection of Figure 1 indicates that Group P increased its rate of response earlier in the conditioning series, and reached a higher level of responding than either Groups S or NP although the difference was not significant. However, not all Ss responded in this manner - thus one S in Group P, three in Group S, and two in Group NP failed to condition. These findings are in marked contrast to the results of some previous studies (Lykken, 1957; Schoenherr, 1964; Schacter and Latané, 1964) of instrumental learning in psychopaths involving painful reinforcement. However, the results are consistent with studies of verbal conditioning in psychopaths involving both social and non-social reinforcers (Blaylock, 1960; Bryan and Kapche, 1967; Bernard and Eisenman, 1967, and of nonverbal conditioning

Table 2

Distribution of Ss in each of the Termination Categories

Termination Categories	Groups		
	P	S	NP
A	3	4	4
B	6	3	4
C	1	3	2

with verbal reinforcers (Persons and Bruning, 1966). Taken together these results provide support for the hypothesis (Hare, 1969) that the psychopath's relatively poor performance on certain types of learning tasks may be related to motivational variables e.g., lack of proper incentive rather than a learning deficit per se.