THE RELATIONSHIP BETWEEN IMPULSIVITY AND ELECTRODERMAL CONDITIONING

A thesis submitted to the
University of Southampton, for the
degree of
Master of Philosophy
by

Joan Heather Hemming

University of Southampton, 1977.

ABSTRACT

FACULTY OF SOCIAL SCIENCES

PSYCHOLOGY

Master of Philosophy

THE RELATIONSHIP BETWEEN IMPULSIVITY AND ELECTRODERMAL CONDITIONING

by Joan Heather Hemming

Literature pertaining to personality and conditioning is reviewed and interest centered on the relationship between impulsivity and conditioning.

A previously developed conditioned procedure is modified to assess differential electrodermal responding to an aversive conditioned stimulus in extinction. Experiment I determines the most appropriate data transformation and measure of differential responding.

An impulsivity scale is formulated from certain items in Eysenck's personality inventory, form A. Reliability and validity of this scale are assessed.

Experiment II tests the main hypothesis, that impulsivity is inversely associated with conditionability, together with the influence of neuroticism on this relationship. A subsidiary hypothesis, that impulsivity and neuroticism have similar relationships with arousal, is examined. Results indicate that impulsivity has a significant inverse relationship to differential responding in extinction, while neuroticism tends to increase conditioning. Some non-significant trends suggest that impulsivity and neuroticism may be associated with low arousal.

Literature concerning relationships between psychopathy, criminality, conditioning and arousal is reviewed. Experiment III tests hypotheses derived from Eysenck's criminality theory, studies concerning

psychopathy and our Experiment II results. The main hypothesis is supported in so far as prisoners, selected for good home backgrounds, display significantly less differential responding in extinction than students. However, impulsivity scores do not differentiate prisoners from students. This latter result is thought to be associated with age differences between groups. Quadrant analysis for impulsivity and neuroticism indicates a predominance of high impulsives, low neurotics in prisoners and low impulsives, high neurotics in students.

Prisoners are less aroused than students when stimulus specific reactivity is considered but not when comparing groups for spontaneous fluctuations. This result is attributed to higher distractability in prisoners but equal arousal between groups. Within the prison group both these measures of arousal show significant inverse correlations with impulsivity.

Results are complex, but suggest some support for the main hypothesis concerning impulsivity and conditioning.

ACKNOWLEDGEMENTS

I would like to thank Dr. T. D. McComb for initiating the conditioning procedure and organising data collection at H.M. Prison, Leyhill.

I am very grateful to Dave Smith for his surveillance and maintenance of equipment throughout the research programme.

I am indebted to Rob Bray for re-collation of electrodermal data in terms of conductance rather than resistance and to Tony Waring for composing computer programmes to transform raw data.

My thanks to Dr. D. A. Siddle for his advice on reporting the research and his meticulous criticism of the first three chapters. Thanks also to Jim Ward for his continuing interest and support throughout the latter research stages.

I appreciate the help and co-operation given by the Governor, Assistant Governors, staff and inmates of H.M. Prison, Leyhill and all University personnel and students who participated as subjects.

Finally, my thanks to Anne Griffiths who typed all these pages so very conscientiously.

This thesis is dedicated to Kafka (1925, 1926).

TABLE OF CONTENTS

List of figures

List of tables

List of tables (Cont/d)

List of tables (Cont/d)

List of tables (Cont/d)

Introduction and overview.

This thesis has two main aims:- a) To assess relationships between conditioning and personality with particular emphasis on impulsivity, and b) to investigate relationships between conditioning, personality and criminality.

Hypotheses are based on Eysenck's (1957) model of personality. Subsequent theory and research concerning conditioning, arousal, personality and criminality suggested certain theoretical modifications. Eysenck's (1957) theory and literature relevant to modifications of hypotheses is reviewed in Chapter 1.

Before the modified hypothesis concerning conditionability and impulsivity could be tested, each concept was explored and satisfactory methods of measurement devised.

Chapter 2 discusses the concept of conditionability together with methodological considerations. Chapter 3 is concerned with details of data analysis and measurement of conditioned discriminative responding. Experiment I determines the most appropriate index of conditionability.

Chapter 4 reviews literature relevant to impulsivity measurement, devises an impulsivity scale and tests its reliability and concurrent validity.

Measurement of conditionability and impulsivity was then considered adequate and the hypothesis concerning conditioning and impulsivity could be tested (Chapter 5). Experiment II indicated some support for the hypothesis that impulsivity was inversely related to differential responding to a conditioned stimulus in extinction. A neuroticism/impulsivity quadrant analysis showed a trend for neuroticism to influence the relationship between impulsivity and differential responding in the direction postulated by Gray (1970). Relationships between personality and arousal indices were also examined. Trends suggested that arousal might be inversely related to impulsivity and neuroticism. (Chapter 5)

Experiment III tested a number of hypotheses derived from Experiment II results and theories of criminality and psychopathy (discussed in Chapter 6).

An experimental group of prisoners was selected for 'good' home backgrounds, to control for environmental causes of criminality. These prisoners were compared with students for differences in conditioning, arousal and personality indices. Relationships between these physiological variables and personality within the prison sample, were also examined.

Experiment III indicated that the selected prisoners were not significantly more impulsive than students. However, comparisons correcting for age differences suggested some support for the hypothesis. Selected prisoners were also significantly less neurotic than students ($p < .05$). Selected prisoners displayed significantly less differential responding in extinction than students ($p < .01$). Considering arousal indices, only stimulus specific responding showed the postulated difference ($p < .01$). Half-time recovery, a possible indicant of abnormality, was also significantly longer in selected prisoners than students ($p < .01$). Within the prison sample, impulsivity was not significantly associated with differential responding in extinction but was significantly related to the two most reliable arousal indices (spontaneous fluctuations, $p < .05$) stimulus specific responding, $p < .05$). There were also indications that psychoticism (P) and Psychopathy (Pd and Ma) were associated with low initial arousal.

It can be seen this investigation indicates that impulsivity is related to differential responding in students but to lack of arousal in selected prisoners. This suggests that impulsivity may be only one of a number of variables associated with criminality and lack of conditionability.

CHAPTER I

PERSONALITY AND CONDITIONING

Historically, numerous relationships between personality and physical attributes have been postulated. In particular, interest has centred on Hippocrates' four temperament types:- melancholic, choleric, phlegmatic and sanguine, which he related to the body "humours". From Greek civilisation to the present day, these type definitions have been modified and associated with different physiological functions (Roback 1952).

The first consistent experimental attempt to link temperament types with physiological functioning was pioneered by Pavlov, and in general, the Russian approach has concentrated on relationships within physiological systems and the association of consistent physiological differences with the temperament types. The Western approach, on the other hand, has concentrated on personality traits which define a type and has searched for physiological correlates of these traits. Recently, attempts have been made to combine these two approaches. (Gray 1964, Eysenck 1967).

Although the Western approach can be divided into general theories such as that of Eysenck (1957, 1967) and more specific theories such as that of Spence (1964a) the concept of conditionability is central to both theories. Spence and his associates (Spence 1964b) have concentrated on testing certain modified postulates of Hullian theory, using anxiety as a drive within the conditioning paradigm. Eysenck, on the other hand, uses conditionability as the central construct in a broad behavioural theory explaining individual differences in such diverse fields as intelligence, social attitudes, politics and criminality (Eysenck 1957, 1965, 1967, 1970).

Since Eysenck has endeavoured to integrate a large proportion of the work concerned with personality, arousal, conditioning and criminality his work is discussed in detail. Eysenck's (1957) original theory laid the basis for the further research in personality (Discussed in Section 1)

Theory and research on arousal became increasingly important in the personality field. This is reviewed in Section 2. Eysenck (1957) considered that neuroticism and extraversion were independent personality dimensions. However, these two personality dimensions showed similar relationships to arousal, suggesting that they lacked independence. Claridge (1967) attempted a resolution by postulating two underlying arousal systems (Section 3).

During this time, Gray's (1964) re-interpretation of nervous system strength in terms of arousal, revived interest in Pavlovian theory and its recent developments (Section 3.2 and 3.3).

Eysenck (1967) reformulated his theory to incorporate these inter-related fields (Section 3.4). Later, Gray (1970, 1971a and 1971b) combined Eysenckian theory with Mowrer's (1960) version of two factor theory. This, together with empirical evidence, suggested that aversive conditionability, rather than appetitive or instrumental conditioning, was the relevant variable in personality and criminality theories (Section 4).

Evidence comparing sociability and impulsivity factors of extraversion indicated that impulsivity alone accounted for previously observed relationships between extraversion and conditionability. A similar emphasis on impulsivity rather than sociability, was apparent in theory and research concerning criminality and psychopathy. Hence impulsivity was substituted for extraversion in personality and criminality theories (Section 4.6).

Section I.

1.1. Theoretical Background.

1.1.1. Eysenck's (1957) personality theory.

Essentially, Eysenck (1957) relates early Pavlovian concepts of excitation-inhibition balance to conditionability and individual differences in personality and behaviour. Pavlov's (1910) original nervous system classification was determined from ease of conditioned salivary response formation. The excitatory type, who was said to have a predominance of excitation over inhibition, was characterised by easy development of positive (excitatory) conditioned responses which were stable under diverse conditions; inhibitory conditioned responses, on the other hand, were unstable. The inhibitable type was said to have a predominance of inhibition over excitation, and this was evidenced by difficulty in developing positive (excitatory) conditioned responses and their instability once developed; this type did develop stable inhibitory responses. The balanced type developed stable excitatory and inhibitory conditioned responses (Pavlov 1910).

1.1.1.1. The excitation-inhibition balance, conditionability and personality. Since Pavlov's central nervous system link between the conditioned stimulus (CS) and the unconditioned stimulus (UCS) was strengthened by excitation in the cortical cells, Eysenck (1957) argued that excitation was associated with conditioning. The positive exponential acquisition curve of a conditioned response (CR) was said to represent a growth of excitation at central nervous system synapses. The decrease in CR magnitude during extinction was said to reflect growth of inhibition.

Pavlov originally equated ease of formation of positive excitatory conditioned responses with a predominance of excitation and relative lack of inhibition, thus inhibitory CRs were formed slowly if at all.

Difficulty in the formation of positive excitatory CRs was equated with a predominance of inhibition and ease of formation of inhibitory CRs.

Eysenck (1957) thus equated strength of excitation and its speed of growth under the concept of conditionability, while inhibition was the reverse process related to speed of CR extinction. Conditionability could thus be assessed from CR strength, CR acquisition speed or CR extinction speed. These indices were assumed to be interchangeable measures of conditionability, based on individual differences in predominance of excitation or inhibition in the central nervous system.

Pavlov (1930) was also interested in psychopathology and in particular, differences between hysterical and dysthymic neuroses. Basically, he considered that hysterical conversion symptoms; fugues amnesias and paralyses, were of an inhibitory nature, i.e. some perceptual or motor system was inhibited from its normal mode of action. Dysthymia, which usually included anxiety states, obsessions and phobias, seemed to show evidence of excess excitation potential with lack of inhibition potential. Eysenck (1957) related these clinical observations to Pavlov's early work on conditioning, thus hysterical conversion symptoms were associated with a predominance of inhibition, while dysthymia was associated with a predominance of excitation in the excitation-inhibition balance.

Jung (1921) described the hysterical character as an exaggeration of normal extraverted attitudes, while the appearance of hysterical conversion symptoms counteracted this exaggeration to produce a more introverted character. Dysthymics could more readily be classified as extreme introverts and Jung described this disorder as extreme sensitivity, proneness to exhaustion and chronic fatigue. Eysenck (1957) employed this observation to equate hysteria-dysthymia with extraversion-introversion.

Pavlov's original excitation-inhibition balance could thus be linked to extraversion-introversion through the abnormal dimension of hysteria-dysthymia. Predominance of excitation compared with inhibition determined introverted behaviour, while predominance of inhibition compared with excitation determined extraverted behaviour. Neuroticism exaggerated these differences.

1.1.1.2. Formulation of Eysenck's (1957) theory. The postulate of individual differences:-

> "Human beings differ with respect to the speed with which excitation and inhibition are produced, the strength of the excitation and inhibition produced, and the speed with which inhibition is dissipated. These differences are properties of the physical structures involved in making stimulus response connections."

The typological postulate:-

> "Individuals in whom excitatory potential is generated slowly and in whom excitatory potentials so generated are relatively weak, are thereby predisposed to develop extraverted patterns of behaviour and to develop hysterical-psychopathic disorders in cases of neurotic breakdown; individuals in whom excitatory potential is generated quickly and in whom excitatory potentials so generated are strong, are thereby predisposed to develop introverted patterns of behaviour and to develop dysthymic disorders in case of neurotic breakdown. Similarly, individuals in whom reactive inhibition is developed quickly, in whom strong reactive inhibitions are generated, and in whom reactive inhibition is dissipated slowly, are thereby predisposed to develop extraverted patterns of behaviour and to develop extra-hysterical-psychopathic disorders in case of neurotic breakdown; conversely individuals in whom reactive inhibition is developed slowly, and in whom weak reactive inhibitions are generated, and in whom reactive inhibition is dissipated quickly, are predisposed to develop introverted patterns of behaviour and to develop dysthymic disorders in the case of neurotic breakdown."

(Eysenck 1957, P.114).

Eysenck's hierarchical personality theory:- Eysenck (1957) associated a high degree of conditionability with introversion, through the postulated relationship between introversion and predominance of excitation in nervous system balance. Conversely, lack of conditionability was associated with extraversion, through the relationship between extraversion and predominance of inhibition in nervous system balance.

Eysenck's hierarchical theory is depicted in Figure 1.1.

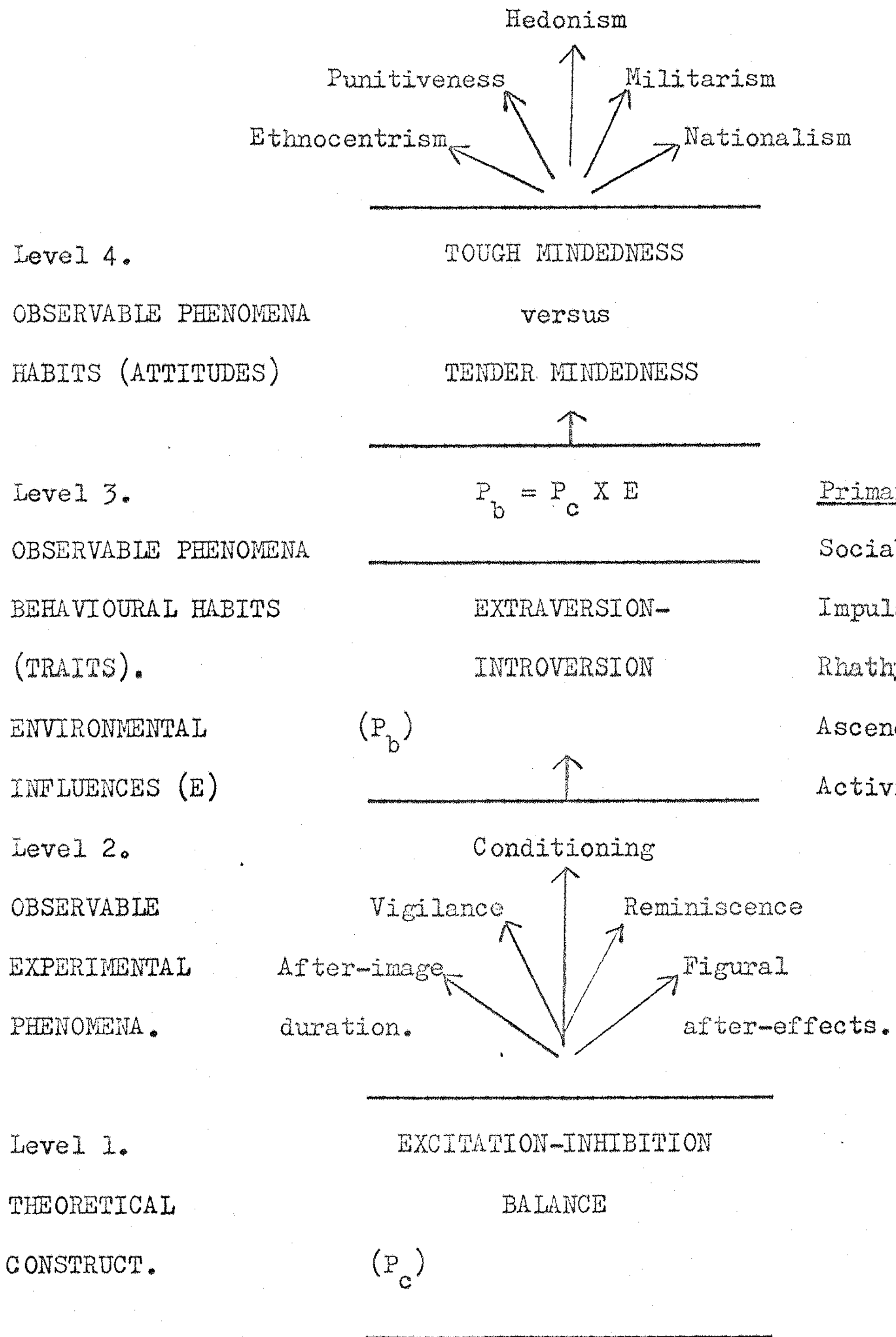


Fig. 1.1. Eysenck's hierarchical theory of personality

Claridge (1967, P.3)

1.1.1.3. Conditionability, personality and socialisation. Eysenck (1957) argued that clinical descriptions of hysterics and dysthymics suggested a difference in degree of socialisation. Hysterics, were characterised by indulgence in anti-social and asocial behaviour and thus appeared to be under-socialised. On the other hand, dysthymics, characterised by excessive anxiety over trivial misdemeanours, appeared to be over-socialised. Eysenck attributed this difference to differences in degree of conditionability, which he argued was an important aspect of socialisation. Hence hysterics were said to have a low degree of conditionability and dysthymics were said to be over-conditionable. In this connection, Eysenck made use of Mowrer's (1947) version of two factor learning theory. Mowrer divided learning into conditioning and habit formation. Conditioning was the attachment of unpleasant emotions to signals associated with problem onset, while habit formation was attachment of pleasant emotions to problem solution. The former case was designated training and the latter teaching. Eysenck considered training to be mediated by conditioned reactions of an autonomic kind, in particular anxiety. A high degree of conditionability was associated with introversion, so that it followed that introversion should also be associated with a high degree of socialisation. The conclusion was that, under equal environmental pressures, extraverts should be under-socialised and introverts oversocialised. Neuroticism was said to exaggerate extraversion-introversion differences by increasing habit strength. As a result of conditionability differences, introverts were thought to have strong socialised habits and extraverts comparatively strong anti-social habits. Increased arousal due to neuroticism, was said to augment the strongest habits, thus the introvert's strong socialised habits and the extravert's comparatively stronger anti-social habits would be differentially augmented by neuroticism.

1.1.2. Criticism of Eysenck's (1957) theory.

1.1.2.1. Generalisation from the hysteria-dysthymia dimension to extraversion-introversion. The hysteria-dysthymia dimension was equated with extraversion-introversion on the basis of Jung's (1921) clinical observation that extraverts tended to develop hysterical illnesses and introverts dysthymic illnesses. However, Jung also considered that hysterical conversion symptoms counteracted exaggeration of extraversion. Thus personality characteristics of hysterics and dysthymics may not necessarily be generalisable to normal extraversion-introversion.

The hypothesis that an extraverted pre-morbid personality develops dysthymic symptoms has not been tested in longitudinal studies. However, Foulds (1965) developed his Hysteroid-Obsessoid questionnaire to measure personality differences rather than symptom differences in neurotic samples. This scale correlated with Maudsley Personality Inventory (MPI) extraversion in both neurotic ($r = .84$) and normal samples ($r = .81$). This suggests that measurement of personality traits rather than symptom differences is generalisable from neurotic to normal samples, but other correlates of these illness groups need not be generalisable to normal groups.

Foulds distinguished hysterical personality from hysterical symptoms. He considered that psychiatric diagnoses tended to vary according to the emphasis on personality traits or illness symptoms. Ingham and Robinson (1964) supported this notion by their summary of studies using the MPI to test personality differences between hysterics, dysthymics and normals. The extraversion scale distinguished dysthymics from hysterics but did not distinguish hysterics from normals. Hysterics could be divided into hysterical personalities and those presenting hysterical symptoms. Data from subjects displaying hysterical personalities supported Eysenck's hypothesis in so far as these subjects had higher extraversion and neuroticism scores than normals. The conversion hysterics did not differ significantly from normals on extraversion. Both hysterical personalities and dysthymics suffered from anxiety and depression. Ingham and Robinson thus suggested that diagnostic differences between groups relied on the hysterics' obvious use of illness symptoms for manipulative purposes and on their histrionic behaviour. When no obvious conversion symptoms were present, diagnoses seemed to depend on personality differences.

Earlier, Foulds (1961) stressed the illogicality of Eysenck's assumption that hysteria-dysthymia could be used interchangeably with extraversion-introversion. He considered that even if most hysterics were extravert and most dysthymics introvert, one could not assume that most extraverts were hysterics and most introverts dysthymics. Hysterics have been found to have higher MPI E scores and to be less conditionable than dysthymics (Franks, 1957), but this does not validate either dimension as a measure of extraversion, since differences could be due to other variables associated with illness. Similarly, the assumption that neuroticism exaggerates extraversion-introversion differences implies one specific change associated with neuroticism, action of other illness variables is not considered.

Pavlov's (1930) postulated predominance of inhibition in hysteria was based on the presence of conversion symptoms and it is this group which does not display higher MPI E-scores than normals. Jung suggested that the pre-morbid personality was extravert. During illness, libidinal energy was diverted from its normal outlet in extraverted behaviour into maintenance of conversion symptoms. It could thus be argued that conversion symptoms had an introverting effect on behaviour. On the other hand, conversion symptoms may be caused by environmental factors and be unrelated to pre-morbid personality, as Pavlov (1935c) later suggested.

It can be seen that there is little justification for using hysterics, classified from presence of conversion symptoms, as a criterion group for extraversion. Similarly, correlates of hysteria-dysthymia classified from personality questionnaires in patient samples need not be applicable to normal extraversion-introversion.

1.1.2.2. The excitation-inhibition balance, conditionability and personality. The excitation-inhibition balance and personality:- Eysenck (1957) associated predominance of inhibition with extraversion and predominance of excitation with introversion by generalisation from hypothesised differences in the excitation-inhibition balance of hysterics and dysthymics.

Pavlov (1930) did in fact, associate neurasthenia (dysthymia) with a predominance of excitation and hysteria with a predominance of inhibition. However, he also associated neurasthenia with the excitable, choleric type and hysteria with the inhibitable melancholic type. Pavlov thus equates the extraverted choleric with Eysenck's introverted illness, while the introverted melancholic was associated with Eysenck's extraverted illness. Furthermore, Pavlov maintained that hysterics possessed "weak" cortical cells, which lapsed easily into the inhibitory state. Inhibition of cortical cells was said to release subcortical unconditioned reflexes resulting in a predominance of emotional behaviour. e.g. extreme inhibition occurred in schizophrenia when it also permeated to subcortical centres, reducing their activity. In the Jungian typology, schizophrenia was regarded as an introverted illness.

Later, Pavlov (1935b) suggested that nervous system weakness was associated with strong external inhibition, rather than internal or conditioned inhibition. He reversed his previous association between neurasthenia and strong excitation, to an association between neurasthenia and nervous system weakness. This allowed the introverted illness (neurasthenia) and the melancholic to be logically associated with nervous system weakness. The previously described neurasthenic was re-designated as hypersthenia, while hysteria retained its relationship to nervous system weakness along with other possible nervous system disorders. Pavlov (1935c) found that early environmental deprivation could cause easy elicitation of passive defence reflexes, a characteristic associated with hysteria and previously used to assess nervous system weakness. This result cast doubt on the assumption that nervous system weakness was a genetically determined characteristic of hysterics.*

Pavlov (1910) originally equated nervous system strength with excitation and weakness with inhibition. Eysenck (1957) developed Pavlov's original theory. When considering nervous system strength as an equivalent dimension to excitation-inhibition Eysenck's hypothesis can almost be reversed. Dysthymia (neurasthenia) can be identified with nervous system weakness and hence predominance of inhibition, while predominance of inhibition is associated with Pavlov's (1935a) extraverted choleric type. It can thus be seen that later developments in Pavlovian theory are not compatible with Eysenck's (1957) theory.

Conditionability:- Originally Pavlov (1910) considered that excitation could be measured by ease of CR acquisition and was inversely related to ease of CR extinction. Eysenck (1957) regarded CR acquisition and CR extinction as interchangeable measures of conditionability. Later Pavlovian work indicated that this assumption was incorrect.

Petrova (1928) demonstrated the independence of excitatory and inhibitory processes. Strong excitatory and strong inhibitory CRs could be generated in certain dogs with strong nervous systems. This led Pavlov (1931) to revise his early (1910) theory, in which strong

* (For a full discussion of Pavlovian and neo-Pavlovian dimensions and nervous system activity, see P.38-41)

excitation equated nervous system strength and predominance of excitation. Cortical cells, which could sustain excitation now defined nervous system strength, while growth of excitation or inhibition were independent properties of strong nervous systems. The speed of formation of both positive (excitatory) and negative (inhibitory) CRs was associated with mobility in strong equilibrated nervous systems. In this special case, speed of acquisition and extinction could be equated, and then in the reverse direction to that postulated by Eysenck. Thus different measures of conditionability such as CR acquisition and extinction are not necessarily interchangeable.

1.1.2.3. Conditionability, personality and socialisation. Eysenck (1957) used Mowrer's (1947) two process learning theory to explain individual differences in socialisation. The theory divided learning into habit formation and autonomic conditioning. Eysenck equated anxiety mediated autonomic conditioning with other types of learning and conditioning, so postulating an association between lack of conditionability, extraversion and under-socialisation.

Originally, Mowrer's (1957) two process theory postulated different bases for instrumental and classical conditioning. There was thus no necessity to assume that individual differences in classical conditioning were generalisable to instrumental conditioning.

Recently, Mowrer (1960) revised two process learning theory so that classically conditioned emotional responses determined motivation for behaviour. The theory was two factored in that there were two possible reinforcers, drive increment and drive decrement, acting on the original drive state of the organism. Primary incremental reinforcement was punishment and primary decremental reinforcement was reward. There is physiological evidence to suggest that reward and punishment may be independent systems (Gellhorn & Loufbourrow 1963, Routtenburg 1969).

Thus anxiety mediated autonomic conditioning need not be generalisable to appetitive conditioning.

The methodology for assessing individual differences in anxiety mediated autonomic conditioning has not always fulfilled the necessary criteria for classical CR elicitation. During acquisition of a classical CR, there are two factors to consider; reliable UCR elicitation and association of UCS and CS. Pavlov (1927) tended to concentrate on the latter, but did mention that this could not occur if the dog was not in a state of alimentary excitation, i.e. hungry. In anxiety conditioning, the UCS must elicit some form of fear or anxiety to which the CS can become attached. Franks (1957) found predicted hysteria-dysthymia conditionability differences, but used a weak UCS which did not always elicit a UCR, indicating a possible lack of anxiety elicitation in some subjects. Eysenck, in postulating a unitary factor of conditionability, has tended to ignore individual differences in anxiety elicitation, which via aversive conditioning, may be crucial for mediating socialisation.

Eysenck argued that increased arousal due to neuroticism, became attached to the strongest habits, causing introverts to be more socialised and extraverts less socialised. Since conditionability is associated with introversion and Eysenck subsumes habit formation and anxiety mediated conditioning under the same concept of conditioning, it is unclear why extraverts should have developed stronger anti-social habits than social habits. Weak conditionability should be equally applicable to both habits so neither should be preferentially exaggerated by neuroticism, i.e. increased arousal becoming attached to the habit highest in the hierarchy. Further illogicalities in the assumption that neuroticism exaggerates extravert-introvert differences was discussed above (P.11).

It can be seen that Eysenck's hypothesis associating extraversion and under-socialisation with anxiety mediated conditionability is not necessarily generalisable to other types of conditionability (e.g. those concerned with the appetitive system) or with conditionability assessed from experiments which have failed to produce a reliable UCR. There is also little support for the notion that neuroticism exaggerates extraversion-introversion differences.

1.1.3. Eysenck's (1965) modification to his theory in the light of experimental evidence.

Eysenck (1965) concentrated on the inhibition side of his postulate of individual differences. He noted that cortical excitation could facilitate conditioning, but he placed primary emphasis on the inhibitory construct. A number of experiments relating personality to eyeblink and electrodermal conditioning were summarised. The experiments varied considerably in design and measurement of both conditioning and personality and did not always support Eysenck's hypothesis. However, Eysenck concluded that conditionability differences between extraverts and introverts were maximal when experimental parameters favoured growth of inhibition.

The three parameters specified by Eysenck (1965) as favouring growth of inhibition were:-

a) Partial as opposed to continuous reinforcement.

b) Differential conditioning as opposed to single stimulus conditioning.

c) Weak as opposed to strong UCS.

1.1.3.1. Reinforcement Schedule. Pavlov associated inhibition with speed of CR extinction during presentation of a CS which was not followed by a UCS. Eysenck thus argued that any non-reinforced trial would increase growth of inhibition. Moreover, extraverts being more susceptible to inhibition development, would show a relatively greater decrease in speed of CR acquisition under partial reinforcement, than would introverts.

1.1.3.2. Differential Conditioning. Eysenck (1965) considered that, in a differential conditioning paradigm, neutral filler stimuli (CSs-) facilitated growth of inhibition in a manner similar to growth of inhibition associated with non-reinforced CSs+. On this basis, he argued that differential conditioning, as opposed to single stimulus conditioning, would maximise introversion-extraversion differences.

1.1.3.3. UCS Strength. Eysenck suggested that inhibition was unlikely to develop under strong stimulation, since strong stimulation would cause excessive reticular excitation. He argued that excessive reticular excitation blocked the ability to develop CS-UCS associations. Neuroticism was associated with high levels of reticular arousal, so that strong stimulation would cause excessive excitation sooner in neurotics than in stables. Thus use of a strong UCS would result in correlations between neuroticism and conditioning. Hence optimal parameters for obtaining correlations between introversion and conditioning were those using a relatively weak UCS.

Eysenck and Levey (1972) invoked individual differences in excitation to explain conditioning effects in extraverts and introverts. This resulted in a change of optimal parameters for introverted conditioning. Details of this change and the test of this modified hypothesis are discussed later (P.49)

SECTION 1.2.

1.2. Arousal

1.2.1. Definitions.

An activity dimension has long been recognised as an important variable contributing to personality differences. However, difficulties have arisen in attempts to define and measure this variable.

Malmo (1959) classified arousal measurement into three convenient approaches:-

1) EEG and neurophysiology.

2) "Behavioural energetics".

3) Learning theorist's search for a measure of drive.

1.2.1.1. EEG and neurophysiology. This approach was developed by Lindsley (1957). He suggested that the EEG was associated with changes in the ascending reticular activating system (ARAS); certain lesions in the ARAS abolished activation EEG and caused somnolent behaviour, while stimulation of the ARAS induced activation EEG. Similarly, Fuster (1958) reported that concurrent ARAS stimulation of moderate intensity improved performance of a visual discrimination task in monkeys. Higher intensity stimulation increased errors and reaction time. This supports the notion that ARAS stimulation increases activation, which in turn bears an inverted-U relationship to performance.

Malmo (1959) concluded that activation could be defined as the continuum from deep sleep to extreme excitement and this continuum was a function of the amount of cortical bombardment from the ARAS. Activation was a phenomena of slow changes, which could be assessed from basal activity in various physiological response systems. Furthermore the relationship between activation and behavioural efficiency could be described by an inverted-U curve.

1.2.1.2. "Behavioural energetics". Duffy (1962) distinguished between direction and intensity of behaviour. Direction of behaviour was maintained by responses to relationships between surrounding stimuli, while intensity of behaviour was equated with activation. Activation could be measured as the force of overt action or as changes in internal processes associated with energy release. She suggested that direct measures of overt action were less useful than measurement of internal processes, since overt action was subject to intervention by inhibitory activity. Her final definition of activation was:-

"...the extent of release of potential energy, stores in the tissue of the organism, as this is shown in activity or response."

Duffy (1962, P.17).

1.2.1.3. Learning theorist's search for a measure of drive. Hebb (1955) distinguished two effects of a sensory event, a cue function or cortical efficiency and the arousal or vigilance function. This arousal function was considered synonymous with a general drive state. At low arousal levels, a response which increased arousal would tend to be repeated, resulting in positive attraction for mild risk-taking, fear, problem solving and frustration. However, when arousal was at a high level, a response could interfere with cue function and cortical efficiency. Hence an optimal level of arousal for effective behaviour was postulated.

Spence (1956) equated anxiety with drive, when anxiety was measured by the Manifest Anxiety Scale (MAS), correlations between anxiety and conditioned eyeblink acquisition were generally low. However, situationally induced anxiety increased acquisition speed of electrodermal conditioning (Beam 1955) and eyeblink conditioning (Sweetbaum 1963).

1.2.1.4. Integration of these three approaches. Gray (1964) integrated these three approaches by considering physiological measures of arousal as indicators of the present level of organism alertness, which depended upon antecedent conditions concerned with drive. The intensity with which behaviour occurred represented the consequent summation of drives and arousal level. This integration is summarised in figure 1.2.

Determinants

Stimulus intensity.

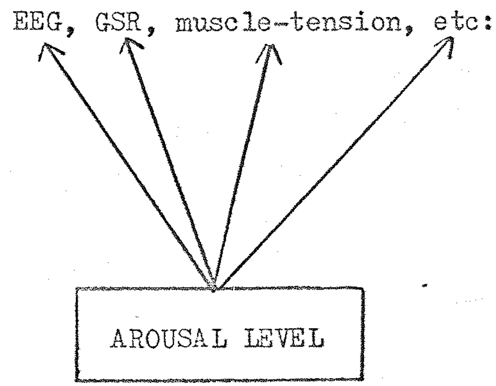
Drive (internal stimuli)

Novelty.

Miscellaneous (drugs, fatigue etc:)

Individual differences.

Indices



Determinates
(by an inverted U function)

Alertness.

Intensity or magnitude of response.

Efficiency of learning.

Efficiency of performance.

Fig. 1.2. Integration of three approaches to activation

Gray (1964, P.296)

1.2.2. Unitary nature of arousal.

Activation theorists (Malmo 1959, Duffy 1962, Lindsley 1957) have tended to regard activation as a unitary dimension. Lacey (1967) opposed this notion on two main points, these were:-

a) Interindividual and intraindividual correlations between autonomic measures were not large enough for any measure to be regarded as an indicant of activation level.

b) Different situations reliably produced different patterns of physiological response.

Lacey also suggested that electrocortical, autonomic and behavioural arousal were separate arousal systems, since they could be dissociated pharmacologically (Wikler 1952) or by localised lesions in the central nervous system (Bradley 1958). Contradictions between arousal measures could then be experimentally induced to demonstrate their independence. Activation in these systems could occur simultaneously, since use of intensive aversive stimulation would cause similar responses in each system. However, this need not imply that each system reflected part of an overall activation process. He argued that the arousal systems interacted, so that arousal in one system could de-arouse another system, e.g. cardiac activity and blood pressure could have an inhibiting effect on electro-cortical activity, via the carotid sinus.

Duffy (1962) separated response direction from behavioural intensity, the latter was equated with activation. Lacey considered that activation was not only multi-dimensional but also reflected response direction as well as behavioural intensity. Heart rate deceleration and reduction in systolic blood pressure were associated with situations requiring environmental intake, while concentration and environmental rejection produced the converse heart rate and blood pressure changes.

Taylor and Epstein (1967) supported Lacey's first criticism in so far as heart rate was found to vary with skin conductance directly, inversely or not at all. Bowen (1971) replicated these results using different experimental situations, however his interpretation was compatible with a unitary concept of activation. He considered that simultaneous decrease in heart rate and increase in skin conductance indicated that cognitive aspects (information) of cardiac functioning could be superimposed on gross cardiac responsiveness to autonomic arousal. When heart rate was not corrected for basal level, both heart rate and skin conductance were greater in a high shock condition than in a low shock condition.

Eason and Dudley (1970) tested the independence of Lacey's three postulated arousal systems. Difficulty and incentive were varied to assess activation level changes by using each subject as his own control. Physiological indices in all three systems varied in the predicted direction supporting the notion of generalised arousal or activation. Heart rate decreases did occur but these did not mask the overall increase.

Thayer (1970) found that skin conductance, heart rate, blood volume and muscle action potential all correlated with changes in activation assessed from the Activation-Deactivation check list. Similarly, Cutrow etal (1972) monitored nine different peripheral response systems which all responded significantly in the predicted direction during deception.

It can be seen that there is support for Malmo and Belanger's (1967) suggestion that Lacey's disagreement stems from use of different types of data. Lacey studied brief situational (phasic) responses whereas activation level is concerned with long term changes in basal activity (tonic activation). It thus seems reasonable to assume that arousal is a unitary dimension which is imperfectly represented in central and peripheral response systems.

1.2.3. The inverted-U hypothesis.

The Yerkes-Dodson law was revived when an inverted-U relationship between activation and behavioural efficiency (cue function or performance level) had been described. Level of performance increased with increasing activation, from low activation to a point optimal for a specific function. Beyond the optimal point, the relationship ceased to be monotonic, while further increases in activation caused a drop in performance, (Malmo, 1959).

Originally the Yerkes-Dodson law expressed an inverted-U relationship between learning and drive level. An increase in drive (electric shock) increased learning up to an optimal level, after which further increases in drive decreased learning. There was also an optimal drive level for a learning task, this decreased with increasing task difficulty, (Broadhurst 1959).

Malmo suggests two possible causes for performance decrement after activation increases beyond the optimal point:-

a) Cortical causation; A neuron in a cell assembly may fail to respond if it acquires a high response threshold from repeated activity. This response failure would be transmitted to the whole cell assembly causing performance decline.

b) Response competition; Hebb (1955) considered that over-stimulation could interfere with the precise adjustments involved in cue function. This could facilitate irrelevant responses in a manner analagous to Hull's (1943) effects of high drive (D) raising the threshold for competing habits ($_{S}H_{R}$s).

Malmo tends to favour the former explanation since he reports that extremely simple responses such as bar pressing and salivation produced an inverted-U when plotted against activation. He argues that these responses can have little competition and hence habit interference is unlikely. Stennett's (1957) results suggest that cortical mechanisms may be implicated in performance decrease. He found that alpha rhythm had an inverted-U relationship with heart rate. However, Surwillo (1965) was unable to replicate this result and suggested that Stennett's observation was an artefact of his statistical analysis.

In contrast to Malmo's simple response relationships with activation, Spence (1964) reports a rectilinear relationship between activation and measures of learning and performance of conditioned reflexes. There are also indications that high levels of anxiety (activation) do not retard learning but do interfere with performance of a learned motor response. Matarazza, Ulet & Saslow (1955) found that middle range MAS scorers took less time to learn a human stylus maze than high or low scorers, but when number of trials required was the learning criterion, there was a rectilinear relationship with MAS anxiety. However, there was a failure to replicate this experiment (Matarazzo & Matarazzo, 1956). This issue is thus unresolved.

An extensive literature suggests a certain degree of support for the inverted-U relationship between activation and performance. Courts (1942) reviewed previous studies of relationships between muscular tension and performance. In general, studies reporting performance facilitation have utilized simple learning tasks (e.g. memorisation, pursuit learning) or simple performance tasks (e.g. reaction time, tapping, adding columns of digits). More complex tasks requiring either re-organisation of motor responses (e.g. mirror star tracing) or reasoning (e.g. mental arithmetic) have tended to show performance decrement under muscular tension on both simple and complex tasks. These studies relied on the assumption that variation in muscle tension was related to activation level changes. Pinneo (1961) was able to lend some support to this assumption although he failed to replicate the inverted-U relationship. Increased muscular tension correlated with arousal increases measured by heart rate, respiration, EEG and palmar conductance. The increase in errors with increased tension may have been a function of attention division between dynometer squeezing and the tracking task.

Lazarus, Deese & Osler (1952) summarised studies in which psychological stress had been manipulated, either by failure or by distraction such as electric shock or verbal disparagement. In general, failure had little or no effect on visual or rote memory tasks but performance on tasks involving reasoning decreased. Two exceptions were cited, Hurlock (1924) found that pacing stress in code learning was followed by initial improvement and later decrement, while Lazarus and Eriksen (1952) noted that failure stress on the digit symbol test produced greater subject variability in improvement and decrement. Most of these experiments suggest support for the inverted-U hypothesis when moderately complex tasks are considered, these experiments are based on the assumption that stress increases activation, however few report any concurrent physiological data. This om ission was rectified by Martens & Landers (1970). Palmar sweating showed the predicted significant decrease from high to low stress, while heart rate displayed a significant increase in the high stress group only and this was towards the end of the experiment. These physiological indices could be regarded as lending partial support for the assumption that stress increases activation. Neither heart rate nor palmar sweating showed significant relationships to trait anxiety measured by the Children's Manifest anxiety scale, although there was an inverted-U relationship between trait anxiety and performance. This inconclusive result could be due to inter-individual differences in physiological indices being dictated by factors unconnected with arousal (Lacey, 1967).

Duffy (1962) produced a most extensive review of the inverted-U hypothesis and related literature. She considered that many experiments did support the hypothesis but these experiments were not always replicable (e.g. Schlosberg & Kling 1959). Some doubts were cast on the hypothesis by anecdotal evidence which indicated that individuals were capable of superior performance under extreme excitement. Thayer's (1970) study suggests that there may be two types of activation, General Activation described as lively, active and vigorous, and High Activation described as jittery, intense and fearful. These types of activation were assessed from the Activation-Deactivation Adjective Check List which assessed transitory feelings during testing. Both types of activation correlated with physiological indices but the pattern of correlation magnitude varied. It is possible that individual differences in tendency for general activation or high activation arousal in response to stimulation, could account for Duffy's observations concerning superior performance under extreme excitement.

On the whole the evidence seems to justify Duffy's conclusion that when other factors are constant, integration of behaviour is less likely to be maintained when activation levels are very low or very high.

1.2.4. Physiological bases of activation and arousal.

Various physiological bases have been postulated for regulation and maintenance of activation levels. The ascending reticular formation has most frequently been associated with levels of wakefulness and alertness (e.g. Moruzzi & Magoun, 1949), while other subcortical centres have been associated with emotion and drive (e.g. Papez, 1937). Later theorists (Gellhorn & Loofbourrow 1963; Routtenberg 1968, 1969) have postulated variations in physiological structures and function underlying two main arousal systems. The hypothalamus has been implicated in integration and regulation of arousal from all systems, both central and peripheral (Duffy, 1962).

Samuels (1959) has emphasised the importance of the ascending reticular activating system (ARAS). Stimulation of the ARAS produced alpha blocking and other signs of behavioural arousal, while lesions in the brain stem portion of the ARAS produced coma. When the projecting thalamic nuclei were intact, lesions in the brain stem reticular formation produced a hypo-kinetic animal which could not be roused behaviourally, but the EEG still showed an activation pattern to intense stimulation, although this did not outlast the period of stimulation. When the sensory projection paths to the cortex were transected, animals showed behavioural and electro-physiological arousal over sustained time periods, even though specific impulses failed to reach the cortex. Samuels concluded that the brain stem reticular formation could induce cortical arousal independent of any specific sensory stimulation, but conscious perception of impulses would not occur in the absence of non-specific reticular activity.

Gellhorn and Loofbourrow (1963) cite evidence from drug studies suggesting that the reticular formation does not always determine arousal. Physostigmine causes cortical asynchrony (arousal) while atropine produces cortical synchrony (sleep) without affecting behaviour. On this basis, they suggest that both arousal and emotion occur as a result of visceral brain activation, with particular emphasis on the hypothalamus.

Recent conceptions of brain function have tended to emphasise structural interaction in etiology and maintenance of behaviour, rather than assigning specific functions to each neural structure. Various interactive feedback loops have been associated with different functions, which has led to the development of arousal theories implicating two separate but interacting systems. Originally Papez and MacLean postulated a "visceral" theory of emotion, in that the visceral brain was said to interpret experience in terms of feeling rather than intellectualised symbols. The neocortex was essential for mental operations but could receive "emotional colouring" from the visceral brain (Gellhorn & Loofbourrow, 1963). According to MacLean (1954) the visceral brain includes the hippocampus, amygdala, cingulum, septum and hypothalamus, while the reticular formation is essential for maintaining activity in these structures.

The discovery of hypothalamic reward centres (Olds & Milner, 1954) and aversion centres in the amygdala (Delgada, Roberts & Milner, 1954) have implicated the visceral brain in motivation. McCleary and Moore (1965) reviewed recent evidence for these centres. Reward centres paralleled the course of the medial forebrain bundle (MFB) up to the highly rewarding centres in the lateral hypothalamus. Punishment areas were predominantly in the mid-brain, in the reticular formation and the ventro-medial parts of the thalamus. Other punishment areas occurred in the dorsal hippocampus, lateral amygdala, ventral surface of the hypothalamus and the fornix tract. The cingulate gyrus and amygdala were found to facilitate responses, while the septum and some points in front of the septum inhibited responses. Damage to the septum disrupted passive but not active avoidance, while cingulate lesions disrupted active but not passive avoidance.

Routtenberg (1968) considered two similar arousal systems. Arousal system I was the medial core of the brain stem ARAS described by Moruzzi & Magoun (1949), while arousal system II included the limbic midbrain system and ascending and descending components of the MFB. He associated arousal system I with production of neocortical desynchronisation, and argued that if this system was damaged its function could be performed by arousal system II. Arousal system I was concerned with drive or organisation of responses and arousal system II with incentive or reward. He suggested that septal stimulation quietened arousal system I, while hypothalamic stimulation augmented arousal system I. These systems were in dynamic equilibrium, one system being able to suppress activity in the other system. Experiments attempting to differentiate functions of the two arousal systems led to a reformulation. Routtenburg (1969) hypothesised that the reticular system was concerned with processing outputs of well organised motor acts, while the limbic system was concerned with processing inputs which could be either rewarding or aversive.

Duffy (1962) emphasised the hypothalamus as the regulator of activation level. She considered that it was influenced by the following four main factors:-

a) Inhibitory hypothalamic centres which depress excitatory centres activity.

b) Sensory stimuli which control hypothalamic activity through afferent impulses they can set up.

c) Internal environment which can influence the hypothalamus through its rich vascular supply and the cerebro-spinal fluid.

d) Cortical and thalamic centres which can exert excitatory and inhibitory influences on the hypothalamus.

The hypothalamus was said to regulate peripheral systems via the autonomic nervous system. Gellhorn & Loofbourrow (1963) concluded that stimulation of the anterior part of the hypothalamus produced parasympathetic activity, while stimulation of the posterior hypothalamus produced sympathetic activity. Sympathetic activity increased excitation or arousal while parasympathetic activity decreased excitation. Other sympathetic and parasympathetic centres were found in the medulla oblongata, these could be either activator or depressor centres for each branch of the autonomic nervous system. Stimulation could cause mixed parasympathetic and sympathetic activity, resulting in antagonistic effects on dually enervated end organs, but normally the sympathetic system was dominant.

It can be seen that the limbic system, the hypothalamus and the reticular activating system are implicated in the etiology of arousal, while the hypothalamus can be considered to regulate arousal in the different cortical, subcortical and peripheral feedback loops.

SECTION 1.3.

Eysenck's (1967) Theoretical Reformulation

Eysenck's reformulation was necessitated by the growing body of literature, suggesting that extraversion and neuroticism lacked independence in their relationship to postulated underlying physiological mechanisms. The solution was to incorporate current concepts of arousal by emphasising the excitation side of his excitation-inhibition balance. This allowed him to postulate two arousal systems and to utilize neo-Pavlovian theory.

Before Eysenck's reformulation can be discussed Claridge's (1960, 1967) experimental evidence and conclusions must be reviewed. This will be followed by a discussion of the concept of nervous system strength and Gray's interpretation in terms of arousal.

1.3.1. Lack of extraversion-neuroticism independence.

Claridge (1960) tested Eysenck's (1957) theory on a sample of neurotics and a sample of psychotics. A number of tests said to measure individual differences in inhibition were factor-analys ed together with MMPI and MPI data. Factor analyses for each sample produced four similarly identifiable factors.. Factor I was intelligence, factor II was introspective abnormality or questionnaire neuroticism, factor III was labelled drive and factor IV was extraversion and inhibition. Difficulties for Eysenck's theory arose when considering factors II and III. Factor II had loadings of -.53 on extraversion and .6 on neuroticism measured from the MPI. Comparisons with MMPI loadings suggested that this was a maladjustment factor. Factor III had a loading of .3 on MPI neuroticism and no significant loading on extraversion, MMPI scales for factor II had almost no loadings on this factor.

Data from hysterics and dysthymics suggested that they possessed high and low levels of central inhibition, respectively. Normals tended to fall between these groups, while psychotics were similar to hysterics. The relatively low level of E-scores in hysterics and the performance of dysthymics indicated an exaggeration of inhibitory effects predictable from E-scores alone. Claridge considered that drive differences could account for this shift on the excitation-inhibition balance in neurotics. Autonomic differences between hysterics and dysthymics suggested that cortical inhibition and drive could be central or excitatory processes.

Claridge & Herrington (1963) equated drive with autonomic reactivity and sedation threshold, while Spiral After Effect (SAE) was said to measure sensory function. These two indices tended to correlate in neurotic populations since dysthymia and hysteria represented extremes of both dimensions. However, in normal populations they were thought to be independent. Claridge's (1967) two arousal system model summarises his interpretation of experimental results. The neuroticism dimension was represented by a diagonal from low arousal modulation (sensory function) and low tonic arousal (drive) to high arousal modulation and high tonic arousal, while psychoticism was the opposite diagonal from low arousal modulation and high tonic arousal to high arousal modulation and low tonic arousal. Normals were distrubuted around the centre. See Figure 1.3.

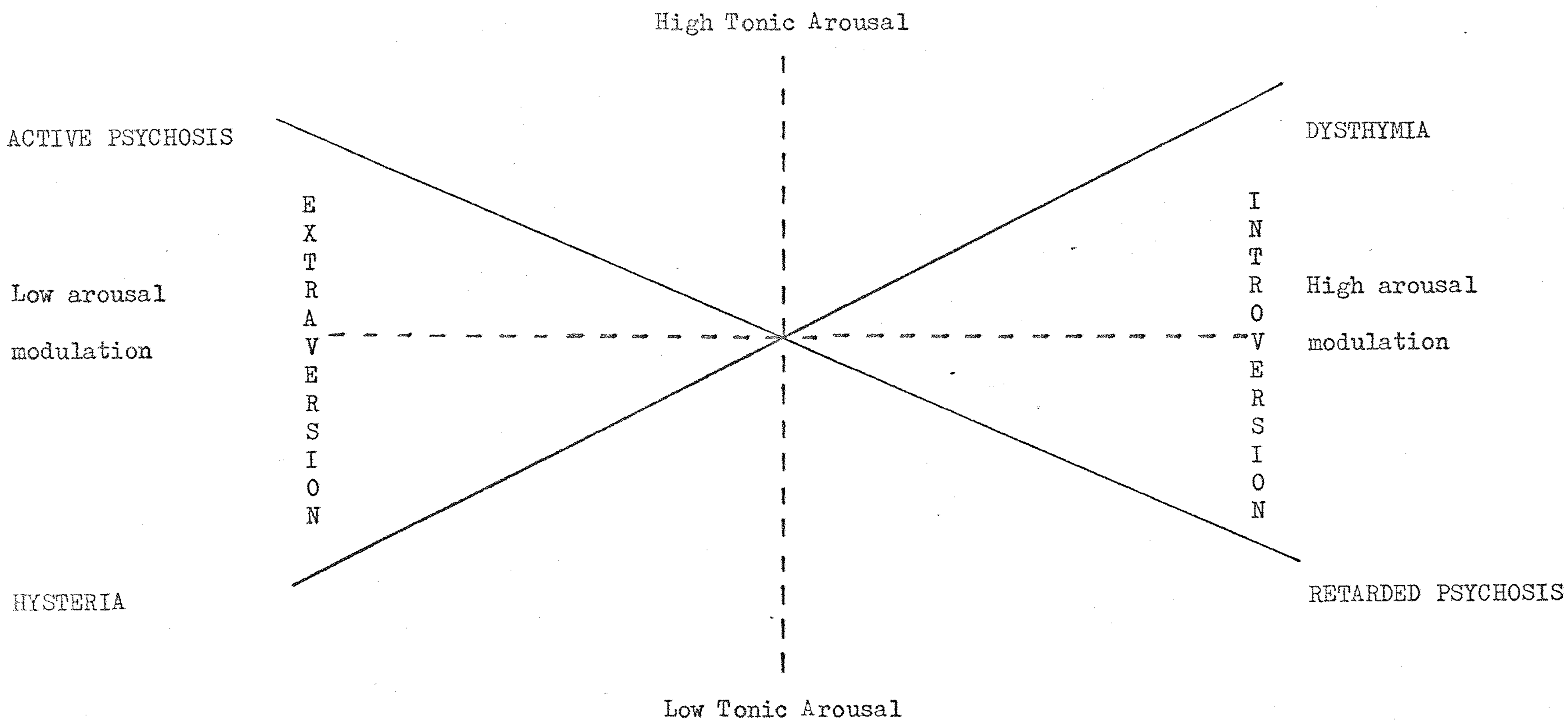


Fig 1.3. Summary diagram of Claridge's two arousal system model

Claridge (1967, P.189)

1.3.2. Nervous system strength.

Pavlov (1922) defined nervous system strength in terms of the working capacity of cortical cells. This could be measured as either the maximum amount of work a cell could perform in response to a single high intensity stimulus or as the maximum time a cell could continue working after repeated application of a moderate intensity stimulus. Cortical cells were said to contain an excitatory substance which, in weak cells, was in short supply or subject to rapid functional distruction.

Operationally, strength is defined in terms of the threshold of transmarginal inhibition (TTI) which is measured by the point at which further increase in stimulus intensity, instead of resulting in increased response (Law of Strength) result in a response decrement. The functional significance of TTI is said to involve protection of cortical cells from damages due to over-excitation.

Subjects with weak nervous systems reach TTI at lower levels of stimulation (in the case of high intensity stimuli) or fewer presentations of a moderately intense stimulus than do subjects with strong nervous systems. Alternatively, subjects with weak nervous systems may display a greater response decrement after a fixed number of stimulus presentations than do subjects with strong nervous systems.

Pavlov's main index of nervous system strength was the magnitude of a conditioned reflex to an ultra-strong stimulus. A CR which obeyed the Law of Strength indicated a strong nervous system, a small CR indicated an intermediate nervous system, while lack of a CR was said to indicate a weak nervous system. This test was recommended only for dogs which had already shown indications of nervous system strength, since ultra-strong stimuli applied to dogs with weak nervous systems could cause neurosis.

Human indices of nervous system strength tended to avoid the use of ultra-strong stimuli. Most indices utilized the temporal aspect of nervous system strength or other indirect measures derived from theoretical relationships to nervous system strength.

Pavlov's temporal aspect of working capacity of cortical cells could be measured by extinction with reinforcement. A conditioned reflex (CR) was established and then elicited, with reinforcement, a number of times in rapid succession. TTI was indicated by a decrease in reflex magnitude at the end of a series of rapid CR elicitations. Absence of a decrease indicated a strong nervous system. In humans, Teplov (1964) applied this aspect using the photochemical reflex (PCR). A strong flash of light directed at both eyes served as the UCS, this could be paired with various other stimuli used as CSs. UCRs and CRs were decreases in sensitivity. Nervous system strength was determined from differences in CR magnitude to CSs presented before and after the series of extinction with reinforcement trials. The TTI and hence nervous system weakness, was indicated by a fall in CR magnitude. No change or increase in CR magnitude indicated a strong nervous system.

An important indirect measure of nervous system strength in humans involves administration of caffeine. Caffeine was said to increase cortical excitability and hence the effective intensity of applied stimuli. Thus subjects with weak nervous systems could be taken up to their TTI without use of ultra-strong stimuli. This theory involves the assumption that caffeine affects both weak and strong nervous systems equally. However, work summarised by Gray (1964) suggests that caffeine affects weak nervous systems more than strong nervous systems. Comparisons between measures of nervous system strength using caffeine and non-caffeine trials could thus increase assessment reliability, since greatest change would be expected in weak nervous systems.

Teplov (1964) suggested that nervous system weakness resulted from high reactivity and sensitivity, thus low sensory thresholds should be associated with low TTI. This hypothesis was supported by Nebylitsyn (1964), who reported a significant negative relationship between strength and sensitivity in both visual and auditory systems. In discussing his results, he suggested that the relationship between TTI (R) and absolute threshold (r) was a constant.

Nebylitsyn also considered that reaction time obeyed the law of strength, since reaction time decreased as stimulus intensity increased. Reaction time did not display TTI. At high stimulus intensities there were no differences between weak and strong nervous systems. This result caused Nebylitsyn to re-define (R) in broader terms as: "the limit of functioning in general."

Nebylitsyn (1964, P.237).

Various criticisms have been levelled at the theory of nervous system strength outlined above.

Teplov (1964) considered that there was no justification for assuming that TTI induced by an ultra-strong stimulus was equivalent to TTI assessed from the temporal index of working cell capacity. Similarly, other indices of nervous system strength may not be interchangeable. Nebylitsyn (1964) assessed nervous system strength in visual and auditory analysers. Three indices of nervous system strength were utilized for the visual analyser:- a) The induction method based on shape of the induction curve (a further development of Pavlovian theory of nervous system strength) and changes in this curve induced by caffeine, b) Extinction with reinforcement using a visual CS, and c) Alteration in sensitivity produced by caffeine. Two indices were used in the auditory analyser, alteration in sensitivity produced by caffeine and extinction with reinforcement using an auditory CS. Gray observed that 20 to 25% of Nebylitsyn's subjects showed a discrepancy between strength in the visual analyser and strength in the auditory analyser, while sensory thresholds within the two analysers gave a non-significant correlation of .263. This lack of correlation in sensitivity between analysers was also observed by Ippolitov (1972). Within analysers different indices of sensitivity correlated (.51-.76), but between analysers no correlation was significant.

Strelau (1972) regarded inter-analyser differences in diagnoses of nervous system type as a manifestation of partial properties of nervous systems. Previously, Teplov (1964) had suggested that there were a set of general nervous system properties which formed the basis of temperament, while partial nervous system properties were associated with special abilities. The controversy concerning the "true" index of nervous system type is still unresolved. Strelau considered that partial properties masked the general properties, while Nebylitsyn (cited by Strelau, P. 70) proposed that properties of the dominant centre represented the nervous system type.

It can be seen that assessment of nervous system strength can vary according to analyser and method employed. However, there has been some consistency when one analyser (usually visual) has been used. The problem of inter-analyser differences in strength and sensitivity is unresolved, but within analysers sensitivity has been associated with nervous system weakness.

Variations in measures of nervous system strength and sensitivity between analysers indicate that these are not simple nervous system properties and that the equation of these properties with any personality trait is an oversimplification of experimental evidence.

1.3.3. Gray's interpretation of nervous system strength in terms of arousal.

Gray (1964) equates the inverted-U relationship between performance and arousal, with the Pavlovian Law of strength and threshold of transmarginal inhibition (TTI).

Originally, The Yerkes-Dodson law was based upon the inverted-U relationship between drive and learning. Increases in drive were induced by electric shock (Broadhurst, 1959). Later this concept of drive was generalised to arousal while learning was regarded as one aspect of efficient performance. Drive can be compared with increases in stimulus intensity, while increases in conditioned response magnitude (law of strength) followed by a decrease in conditioned response magnitude (TTI) describe an inverted-U.

Gray relates individual differences in nervous system strength to differences in arousability mediated by the reticular system.

Nebylitsyn (1964) reported an association between nervous system strength and high sensory thresholds. Gray associated high sensory thresholds with low arousal, since sensory thresholds rose during sleep (Oswald, 1962) and electric shocks were less acutely perceived during experimentally induced relaxation (Miller, 1926). Conversely, low sensory thresholds were associated with high arousal since sensory thresholds could be decreased by increasing muscle tension (Freeman, 1948).

Nervous system strength has been measured by the intensity of electrical stimulation of the eye at which maximum critical frequency of flashing phosphene is reached (CFP). Weak nervous systems reach CFP at lower intensities than strong nervous systems. Gray regards this measure as an example of weak nervous system's superior performance at low stimulus intensities. He considers this measure to be comparable to other measures of the ability to give discrete responses to closely spaced stimuli. Within this category, he includes two-flash threshold and highest frequency at which evoked cortical potentials are able to follow flicker. Nervous system weakness was associated with high arousal, since CFP was raised by stimulants (e.g. caffeine) and lowered by depressants (e.g. sodium amytal) (Gray, 1964, P. 315), two-flash threshold was lowered under high drive (Eysenck & Willett, 1964) and arousal increased the frequency at which the cortex was able to follow flicker indicated by evoked potentials.

Nebylitsyn reported that reaction time followed the Law of Strength. At low stimulus intensities, weak nervous systems performed more efficiently than strong nervous systems. Gray argued that reaction time was related to arousal, since increased arousal induced by increasing muscle tension, decreased reaction time (Freeman, 1937) while decreased arousal during relaxation and drowsiness increased reaction time (Miller, 1926; Oswald, 1962).

Gray argues that the above indicators of nervous system strength, sensory thresholds, visual efficiency and reaction time, are all mediated by the reticular system. He relates level of arousal directly to bombardment of the cortex by impulses from the ascending reticular system, this is in turn dependent upon external determinants (See Fig: 1.3). Individual differences in arousability determine the reticular response and hence the degree of reticular bombardment on the cortex. Hence nervous system weakness was related to high arousability and nervous system strength was related to low arousability.

Gray described the weak nervous system as more sensitive, less stable and more excitable than the strong nervous system. The capacity of cortical cells to pass into the inhibitory state was directly dependent upon this excitability or arousability. His summary of the relationship between performance efficiency, stimulus intensity and arousability is shown in Figure (1.4).

Gray concluded that arousability and reticular bombardment of the cortex were positively related to each other:

> "up to the point at which transmarginal inhibition is induced in the weak nervous system: beyond that point, level of arousal is (paradoxically) higher in individuals low on the dimension of arousability."
>
> Gray (1964, P.326).

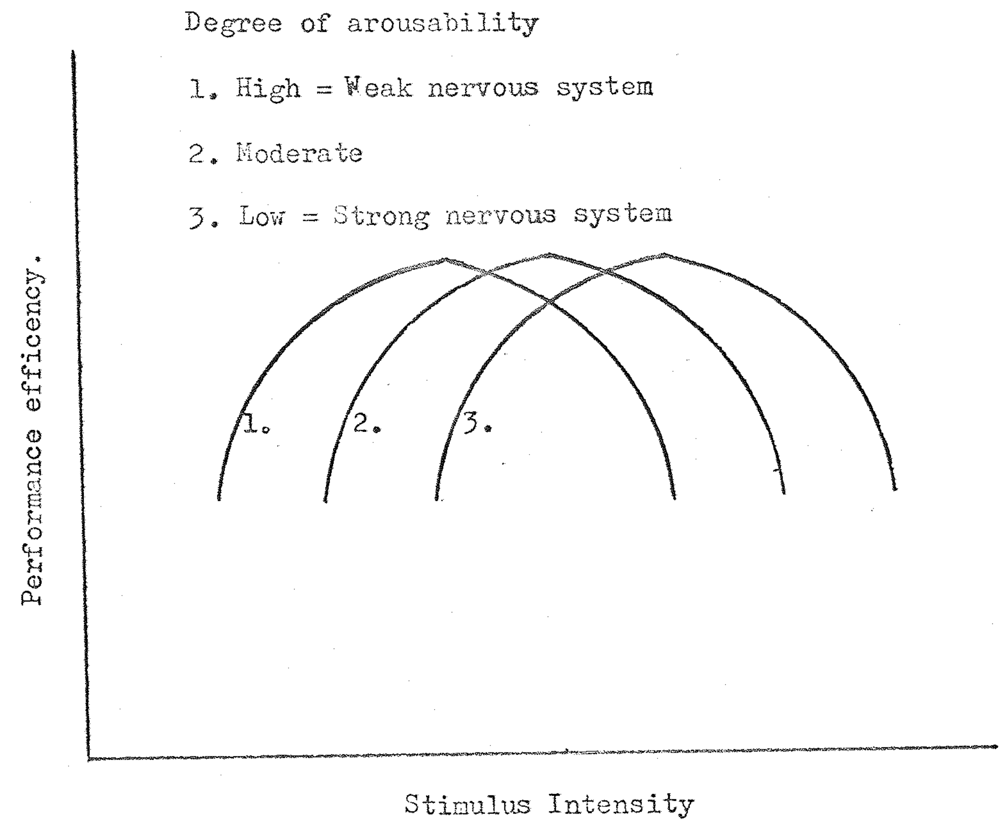


Fig 1.4. Stimulus intensity, arousability and performance efficiency

Gray (1964, P.306)

1.3.4. Eysenck's (1967) theoretical reformulation.

1.3.4.1. Biological bases of extraversion and neuroticism. Eysenck (1967) shifted towards emphasising individual differences in excitation rather than inhibition. The theory was comparable to activation and arousal theories. Recent attempts to resolve relationships between arousal and personality by considering two arousal systems (Claridge, 1967) led Eysenck to suggest a cortical-reticular arousal system as the basis for extraversion and a limbic activating system as the basis for neuroticism. Neo-Pavlovian nervous system weakness was equated with introversion, while Gray's (1964) hypothesis relating arousal to nervous system weakness, was said to confirm the relationship between extraversion and the cortico-reticular feedback loop.

Activation theorists postulated a dimension from deep sleep to excitement and panic (See P. 20) Eysenck associated this activation dimension with both neuroticism and introversion. This suggested an anxiety factor related obliquely to his two orthogonal traits. However, this notion was difficult to reconcile with the fact that both dysthymics and hysterics had neuroticism in common. If such an anxiety factor existed it implied the existence of an orthogonal factor from high neuroticism, high extraversion to low neuroticism, low extraversion. Eysenck found no recognition given to such a factor in any of his statistical studies and hence considered its existence unlikely.

The resolution to the above dilemma was to invoke the notion of two arousal systems, which allowed both extraversion and neuroticism to be independently associated with different arousal systems. Following Morgan (1965), Eysenck considered that the Papez-MacLean theory was a general description of experimental evidence establishing the limbic system as the seat of emotions with hypothalamic control. The subcortical structures which Eysenck included in the limbic system were the hippocampus, amygdala, cingulum, septum and hypothalamus. He maintained that this system was the basis of neuroticism. Gellhorn & Loofbourrow (1963) implicated the cortical-reticular feedback loop for the other arousal system, which Eysenck associated with extraversion.

Eysenck maintained that the two arousal systems were partially independent, in that cortical arousal could occur during problem solving activity without necessarily involving the limbic system, whereas activation of the limbic system would also involve cortical arousal; thus measures of cortical arousal could be used for monitoring emotional activation but measures of emotional activation could not be used for monitoring cortical arousal.

Eysenck distinguished cortical arousal from limbic activation as follows:- The cortical arousal pattern, without activation of the limbic system, involved a minimum of autonomic and skeletal activity of low intensity and quick recovery, being primarily concerned with perception and cognition. In contrast, limbic activation represented a generalised sympathetic emergency reaction with strong skeletal muscle involvement. Thus an anxiety dimension, such as Duffy's (1962) activation level, would only become apparent when strong emotions were involved frequently or for long periods, causing cortical arousal and limbic activation to become synonomous. Eysenck maintained that this condition occurred only in the small proportion of the population classified as neurotic.

Eysenck's argument associating the cortical-reticular feedback loop with extraversion, incorporated Gray's (1964) hypothesis relating arousability to neo-Pavlovian nervous system weakness. Eysenck considered Gray's summary of weak nervous system characteristics to be descriptive of introversion, hence their relationships to cortical-reticular arousal were also applicable to introversion. Phenomena associated with nervous system weakness were low sensory thresholds, eas. y elicitation of orienting reflexes (ORs) and high CFF thresholds. The reticular activating system was implicated in increasing cortical arousal since it controlled components of the OR, including generalised EEG arousal, and sensory thresholds could be lowered by reticular stimulation. High cortical arousal was associated with increased cortical excitation and low sensory thresholds were characteristic of introversion. Similarly, CFF thresholds, higher in weak nervous systems, were assumed to be indicative of high cortical arousal, since they could be increased by cortical stimulation such as increase in background stimulation, instructions to pay attention and administration of caffeine. Thus introversion, via its association with nervous system weakness, was related to both the reticular formation and the cortex, without involving the limbic system and its associated sub-cortical structure.

Eysenck suggested that the basis of cortical inhibition were thalamocortical mechanisms isolated by Magoun (1963). Excitation of these mechanisms was said to inhibit excitation in the ascending reticular activating system (ARAS). A lower threshold in these mechanisms was associated with a dampening of stimulation and extraversion. High thresholds in these inhibiting mechanisms heightened stimulation of the ARAS, resulting in increased sensitivity characteristic of introversion. Petrie (1966) was cited by Eysenck (1967, P.138) as support for the notion that extraverts dampened stimulation while introverts heightened stimulation. Petrie reported that stimulus augmenters, individuals whose kinesthetic after-effect was greater than the original shape, were more frequently introverts, while stimulus reducers, individuals whose kinesthetic after-effect was smaller than the original stimulus, were more frequently extraverts.

Conditioning was associated with the cortical-reticular feedback loop only, since onset of transmarginal inhibition was indexed by a decrement in conditioned responses, and transmarginal inhibition was equated with lowered cortical arousal caused by over-excitation of the cortex. Individuals high on a dimension of cortical arousability showed conditioned response decrement at lower stimulus intensities then individuals low on a dimension of cortical arousability. Thompson & Obrist (1964) were cited by Eysenck (1967, P.246) as support for the cortical nature of conditioning. They summarised EEG work relating to conditioned response acquisition. In early conditioning trials, generalised EEG de-synchronisation was reported, this later became localised to specific motor and sensory areas after repeated conditioning trials. Conditioned EEG changes occurred before the appearance of a conditioned motor response, when both were elicited.

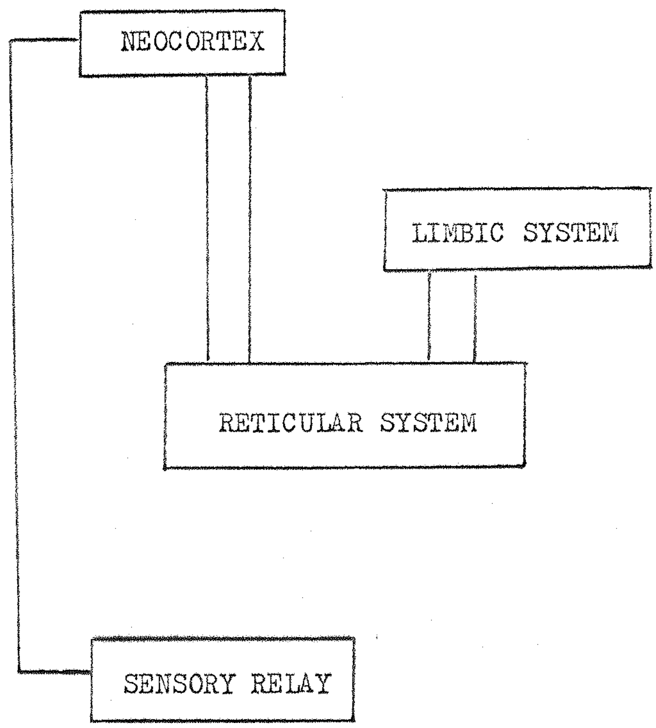
Eysenck concludes that introversion and conditioning are both associated with the cortical-reticular feedback loop only. Neuroticism, he associates with a disrupting influence from the limbic system, which he considers a separate entity, occurring only on rare occasions or in abnormal populations. Eysenck's (1967) model of two arousal systems is shown in figure (1.5).

1.3.4.2. <u>Rationale for Parameters which highlight the differences between extraverts and introverts.</u> It will be recalled that Eysenck (1965) specified three parameters favouring conditioning in introverts (See P.18). Due to the (1967) modification to his theory, the rationale for parameter choice was altered, to allow for individual differences in cortical excitation as well as inhibition. The three parameters manipulated by Eysenck & Levey (1972) were:-

a) Weak UCS as opposed to strong UCS.

b) Short CS-UCS interval as opposed to long CS-UCS interval.

Higher controlling mechanisms.



Reflex or autonomic mechanisms.

Fig 1.5. Diagram of Eysenck's two arousal systems

Eysenck (1967, P.240)

c) Partial reinforcement as opposed to continuous reinforcement.

The modified rationale for use of these parameters is given below:-

a) UCS strength:- Eysenck & Levey equated extraversion-introversion with strength-sensitivity of the nervous system. Since the weak nervous system was said to have lower sensory and pain thresholds than the strong nervous system, they assumed that objectively identical UCSs would be subjectively stronger for introverts than for extraverts. Introverts would thus produce stronger CRs than extraverts. Furthermore, they suggested, that with a strong UCS, the weak nervous system of introverts developed transmarginal inhibition, resulting in decreased conditioning. On the other hand, in the strong nervous system of extraverts, a strong UCS would increase excitation without reaching the threshold of transmarginal inhibition and conditioning would be enhanced.

A weak UCS would tend to adapt quickly and produce inhibition, Growth of this inhibition to the UCS would tend to be greater in extraverts than introverts, resulting in comparatively reduced conditioning in extraverts.

b) CS-UCS interval:- Determination of the optimum CS-UCS interval for introverts again relied on equating nervous system weakness with introversion. Teplov's school has associated fast reaction time with nervous system weakness. This suggested that introverts would react better to short CS-UCS intervals than extraverts, provided the UCS was not strong enough to invoke transmarginal inhibition.

c) Reinforcement schedule:- The rationale for greater conditionability in introverts than extraverts under partial reinforcement, was attributed to differential growth of inhibition as previously stated in the (1957) theory (See P. 18).

d) Experimental manipulation of parameters:- Eysenck & Levey (1972) reported an experiment in which the above parameters were manipulated. The conditioning index was speed of acquisition of a conditioned eyeblink response, and subjects were selected in terms of their scores so that there were three levels of extraversion (high, medium and low) and three levels of neuroticism (high, medium and low).

Combining optimal parameters for conditioning in introverts gave the predicted correlation (r = .40) between speed of CR acquisition and introversion. Combining non-optimal parameters for introverts showed a negative correlation (r = -.31). *

Considering acquisition curves for each parameter separately, maximum predicted differences occurred with use of weak UCS. Short CS-UCS interval did show predicted personality differences, but on the last trial this difference was only half that observed with use of weak UCS. Partial reinforcement showed a very slight predicted difference in the last trial only. Use of strong UCS did show some superiority for extraverted conditioning after the first 24 trials. Long CS-UCS interval and 100% reinforcement showed no personality differences.

The shape of acquisition curves for introverts and extraverts under their relevant favourable and unfavourable parameters differed. Introverts, under favourable parameters, achieved a high level of conditioning relatively quickly, this did not change much after more CS-UCS pairings. Under their unfavourable parameters, introverts showed a slower but regular increase, which eventually brought them to the level obtained under favourable parameters. Extraverts, under favourable and unfavourable parameters were more variable. After 48 trials under unfavourable parameters, only 12% had conditioned, while under favourable parameters 92% conditioned.

The prediction that a weak UCS favoured conditioning in introverts

* (Analysis of variance did not give significant differences for the separate parameters, so that mean acquisition curves may not describe the results very accurately.)

was most strongly supported. The theory underlying this prediction emphasised individual differences in inhibition, in particular inhibition associated with the UCS. This type of inhibition or adaptation need not be related to inhibition in the Hullian sense. The predicted influence of Hullian inhibition under partial reinforcement had relatively little effect on personality differences in conditionability. A strong UCS did not prevent conditioning in introverts, which would be the case if transmarginal inhibition had been induced, but merely decreased the growth of acquisition compared with extraverts. It would thus appear that the weak UCS caused adaptation of the UCR in extraverts, thus preventing conditioning, not through lack of conditionability, but by omission of a UCR to which the CS could become attached.

Section 1.4.

Evidence for Eysenck's (1967) Reformulation.

1.4.1. Extraversion and neuroticism as separate factors.

Eysenck (1967) assumed that neuroticism and extraversion had separate biological bases, since they always emerged as separate factors in his analyses. The original (Eysenck 1947) three primary factors of extraversion, neuroticism and psychoticism were determined from factor analyses of individual differences in neurotic, psychotic and normal groups. The two neurotic groups, hysterics and dysthymics, determined extraversion-introversion while comparisons between these neurotic groups with normals determined the neuroticism dimension. Personality tests to measure extraversion and neuroticism were constructed from these factor analyses which insured orthogonality between the factors (Eysenck 1960). Other personality researchers, notably Cattell (1957, 1965) using factor analyses to extract factors without regard to orthogonality, have found anxiety factors correlating with both Eysenck's neuroticism and extraversion factors. Although Eysenck demonstrates that neuroticism and extraversion are uncorrelated, this may be a function of test construction rather than a reflection of any basic biological difference. Further support for the orthogonality of the two factors is adduced by the fact that both hysteria and dysthymia have neuroticism in common. However, Claridge (1967) has suggested that hysteria-dysthymia could represent an anxiety factor, while Eysenck's neuroticism factor could be associated with general maladjustment rather than anxiety arousability alone. Although Eysenck has argued that no factor orthogonal to anxiety exists, Claridge has postulated a psychoticism dimension orthogonal to anxiety, while Eysenck has himself suggested that impulsivity is associated with high extraversion and high neuroticism, indicating the existence of an orthogonal factor. Gray

(1970, 1971 a and b) has taken this suggestion one step further and associated this factor with anti-social behaviour.

It can be seen that dividing individual differences into two orthogonal factors of extraversion and neuroticism does not necessarily imply that these traits have separate biological bases.

1.4.2. Separation of two arousal systems.

Although Gellhorn & Loofbourrow (1963) did suggest a two arousal system, they also emphasised the intricate network of connecting fibres between the two systems. Furthermore, they maintained that the neocortex was essential for interpreting emotional states. This interpretation of emotional states involved the hypothalamus, the limbic system, the reticular system and other areas of the neocortex. The amygdala was particularly associated with fear and anger, while the limbic system was associated with pleasure. "Emotional colouring" associated with perception and cognition implicated the subcortex in this apparently cortical activity. Hence Eysenck's contention, that cortical arousal could occur independently of limbic activation is equivocal.

Eysenck considered that limbic activation was mainly involved in the sympathetic emergency reaction, thus under normal circumstances, its involvement could be ignored. Gellhorn & Loofbourrow clearly emphasise involvement of limbic activation in all degrees of emotion and its parallel action during cortical activity. Similarly, Routtenburg (1969) concluded that limbic activation was essential for processing rewarding and aversive inputs. This indicates that limbic system involvement is not confined to emergency reactions or to populations classified as neurotic.

1.4.3. Extraversion-introversion and nervous system strength-sensitivity: possible relationship to dynamism of nervous processes.

Eysenck (1967) equated nervous system strength with extraversion, by incorporating Gray's hypothesis relating nervous system strength to arousability, in his theory concerning a cortical-reticular basis of extraversion-introversion. However, Gray (1964) did himself suggest that his concept of arousability and hence nervous system strength-sensitivity, was most closely associated with neuroticism or manifest anxiety. On the other hand, Mangan (1972) has put forward the opposite hypothesis to Eysenck (1967) by identifying transmarginal inhibition with Hullian inhibition. Rapid growth of inhibition in extraverts is thus associated with early onset of transmarginal inhibition and hence nervous system weakness.

Eysenck's theory relating nervous system weakness to cortical-reticular arousal and introversion relies on associations between the cortical-reticular loop and indicators of nervous system weakness which utilise the lower end of the arousal continuum and the Law of Strength.

There are indications that nervous system weakness is related to introversion when sensory and pain threshold are considered. Mean pain thresholds (Haslam, 1967) and auditory thresholds (Smith, 1967) were significantly lower in introverts than in extraverts. This was substantiated by Siddle, Morrish, White & Mangan (1969) using visual sensitivity. However, only low N scorers were included in this latter study.

Indicators of nervous system strength utilising the upper end of the arousal continuum suggest that extraversion is related to nervous system weakness rather than strength. Mangan & Farmer (1967) used Nebylitsyn's reaction time method for determining nervous system weakness. Extraverts re-acted near maximally at lower stimulus intensities than introverts. White, Mangan, Morrish & Siddle (1969) used duration of after-image to a moderately strong stimulus, under conditions of decreasing inter-stimulus interval, as a measure of transmarginal inhibition. This measure correlated with neuroticism (r = -.59) and extraversion (r = -.44). Similar results were obtained by Zhorov & Yermolayeva-Tomina (1972) using reaction time indices of nervous system strength. The slope of the curve of reaction times to stimuli of increasing intensity was significantly related to extraversion (r = -.344). However, White & Mangan (1972) failed to replicate White et al (1969). Onset of transmarginal inhibition under placebo, sodium amytal and caffeine conditions was positively related to neuroticism and unrelated to extraversion. On the basis of these findings, Mangan (1972) suggested that extraversion was related to nervous system strength at low stimulus intensities but weakness at high stimulus intensities. However, this suggestion is difficult to reconcile with significant correlations between sensitivity and onset of transmarginal inhibition reported by Nebylitsyn (1964) and White et al (1969).

It has been suggested that temporal and reaction time indices may be contaminated by other nervous system properties. Rozhdestvenskaya (1964) considered that nervous system strength indexed by the fall in CR magnitude, after repeated presentations of a CS, could be contaminated by the hypnotic effect of monotonous stimulation or by a disturbance in nervous activity connected with destruction of a stereotype. Weakness of the inhibitory process would be indicated in the former case, while the latter case suggested inertness of the nervous processes. Similarly, reaction time indices rely to some extent on ergographic factors. Rozhdestvenskaya et al (1960) factor analysed indices of nervous system strength. Ergographic measures did not load on a strength factor defined from visual and auditory measures. Mangan (1972) related ergographic measures of transmarginal inhibition to Hullian inhibition and hence extraversion.

It can be seen that the relationship between nervous system strength and personality, involving upper limits of the "Law of Strength" is unresolved. Evidence involving lower limits of the "Law of Strength" suggests a more consistent relationship between nervous system weakness and introversion, particularly at low levels of neuroticism. Neuroticism appears to be unrelated to sensory thresholds (Granger, 1957), although high N scorers may obscure the relationship with introversion (Siddle etal, 1969).

A further complicating factor is the neo-Pavlovian dimension of dynamism. Eysenck (1957) assumes that speed of formation and extinction are interchangeable measures of conditionability related to introversion. Dynamism of the excitatory process is indexed by speed of formation of positive CRs, while dynamism of the inhibitory process is measured by speed of formation of inhibitory CRs (extinction). Contrary to Eysenck, Nebylitsyn (1966) considered that dynamism of excitation and inhibition were independent nervous system properties. Degree of equilibrium in dynamism could be assessed from the relative superiority of speed of formation of positive CRs compared with speed of formation of negative CRs. Gray (1967) compared equilibrium in dynamism with Eysenck's (1957) excitation-inhibition balance, on the assumption that dynamism in excitation was negatively related to dynamism in inhibition. The introvert then corresponded to the individual with a predominance of excitation in dynamism. Other empirical evidence suggests that this relationship may be confined to physiological indices of dynamism.

Marton (1972) assessed various indices of dynamism in extreme groups of extraverts and introverts. Extraverts had significantly greater OR extinction rates than introverts, assessed from EEG and electrodermal measures. Similarly, extinction of sensory connections was faster in extraverts than in introverts. However, speed of extinction of a conditioned motor reaction did not differ between the groups. Concurrent electrodermal and EEG measures indicated that EEG indices did extinguish faster in extraverts than in introverts, electrodermal indices showed no group differences. Qualitative group differences in CR stabilisation led Marton to conclude that introverts remained longer in the emotional, plastic phase, while extraverts stabilised motor conditioning with a concurrent extinction of physiological indices. Hence extraverts were said to extinguish sensory connections easily but to have difficulty in extinguishing a stabilised motor pattern.

Evidence suggesting that extraversion rather than introversion is related to predominance of excitation in dynamism can be compared with Marton's stabilisation of conditioned motor responses. Kulyutkin, Zyryanova & Sukhobskaya (1972) found that impulsive problem solvers (a type having similarities with extraverts) tended to have strong nervous systems or a predominance of excitation in dynamism, while cautious problem solvers (introverts) tended to have weak nervous systems or a predominance of inhibition in dynamism. Dynamism was assessed by Korotkin's (1949) eyeblink technique i.e. number of trials to stabilise a conditioned eyeblink and its inhibitory differentiation. This measure of dynamism must thus be regarded as a separate index which does not relate to extraversion in the predicted manner.

Marton's results are not unequivocal evidence in support of the relationship between physiological measures of excitation in dynamism and introversion, since Halmiova and Uherik (1972) failed to replicate her results. Physiological indices of OR extinction intercorrelated but were unrelated to extraversion. However, they did not use extreme groups of extraverts and introverts.

Relationships between mobility and personality lend indirect support to the hypothesised relationship between predominance of excitation in dynamism and introversion. Mobility was defined as the speed at which nervous processes proceed (Mangan, 1967), this concept was later replaced by dynamism in the Pavlovian scheme. Mangan reports small correlations between extraversion and two indices of mobility; induction of after-image ($r = -.24$) and duration of after-image ($r = -.29$). The former index also correlated with neuroticism ($r = .42$).

It can be seen that neither nervous system strength nor dynamism of nervous processes bears a simple relationship to extraversion-introversion. Evidence suggests that indicators of nervous system strength, utilising the lower end of the arousal continuum, are related to extraversion but this relationship may only apply to low levels of neuroticism. Indicators of nervous system strength using TTI may be confounded by other nervous system properties but this explanation does not reconcile positive correlations with sensitivity and negative correlations with introversion. The predicted relationship between predominance of excitation in dynamism and introversion appears to be confined to physiological measures, while standard Russian indices (Korotkin's technique) of predominance of excitation in dynamism may be related to extraversion.

1.4.4. Extraversion-introversion and arousal.

The relationship between personality and arousal is equivocal. Eysenck (1967) associated cortical-reticular arousal with extraversion-introversion alone. This dimension was said to be independent of neuroticism provided limbic system arousal was avoided. Spence (1964) reported increased arousal due to situationally induced drive or anxiety, while arousal also showed small correlations with their Manifest Anxiety Scale (MAS). Eysenck considered that these results were compatible with his theory, since MAS anxiety correlated with both introversion and neuroticism measured with the MPI (Kelly & Martin, 1969).

Duffy (1962) reviewed literature concerning relationships between personality and arousal. In general relationships tended to vary. Individuals with labile, high activation EEG could be calm and non-anxious but susceptible to rapid and violent reactions, alternatively, they could be hyperactive, hyperemotional, hypersensitive, nervous individuals. She suggested that the affect of activation level varied with degree of inhibitory ability. Depending on the latter, high activation could lead to impulsive disorganised behaviour or to sensitive, alert, vigorous and co-ordinated responses to the environment. In the case of anxiety, excessive potential activity was continuously but irregularly curbed by inhibitory processes, resulting in unco-ordinated motor responses. Similarly, stress effected rate and range of behaviour, exerting excessive excitatory or inhibitory effects with dis-organisation in both cases.

Duffy's summary suggests a two arousal system model. This notion was developed by Claridge (1967) and Eysenck (1967). Duffy's "inhibitory ability" can be compared with Claridge's concept of arousal modulation. Further comparison is difficult unless Duffy's labile EEG is regarded as a measure of drive or tonic arousal. However, this opposes Claridge's arousal modulation or inhibitory ability measured by EEG indices.

1.4.4.1. Cortical-reticular arousal and personality. Both Claridge's arousal modulation and Eysenck's cortical reticular arousal were said to be related to extraversion-introversion alone.

Claridge's indices of arousal modulation were spiral after effect and EEG activity. These indices are included in Eysenck's indices of cortical reticular arousal, together with peripheral system activity of low intensity and fast recovery.

Evidence relating extraversion to these indices is reviewed under the following headings:- a) Spiral after effect, b) EEG activity and c) peripheral system activity:-

a) Spiral after effect: Predicted relationships between short spiral after effects and extraversion were reported by Damodar & Murthy (1967) and Castellow (1972). Holland (1966) and Reason(1966) failed to find any association between spiral after effect and extraversion. Interactions between extraversion and neuroticism may obscure relationships with spiral after effect, since Levy & Long (1966) found that impulsive students had shorter spiral after effects than non-impulsive students but anxiety increased the spiral after effect. Similarly, Knowles & Krasner (1965) reported the predicted relationship between extraversion and spiral after effect in stable subjects but the reverse relationship in high N subjects.

Inconsistencies in reported relationships between extraversion and spiral after effect may be, in part, due to methodological errors. Kristjansson & Brown (1973) compared three different instructions for judging spiral after effect length. Only one instruction; "report the end of the first faster phase of decay", resulted in the predicted relationship between spiral after effect and extraversion. Instructions to "report when after effect appears to stop", or "report when absolutely sure that the second phase has ended", gave results showing no relationship to extraversion.

It can be seen that evidence is not sufficient to draw firm conclusions regarding relationships between personality and spiral after effect duration.

b) EEG activity: Various measures of EEG activity have been associated with cortical excitation and hence introversion. Eysenck (1957) argues that extraverts have a greater level of cortical inhibition. They should thus have higher alpha amplitude and higher alpha index than introverts. Later, Eysenck (1967) suggested that neuroticism exaggerated extraversion-introversion differences in cortical activity.

In general, research has tended to concentrate on alpha activity. Fenton & Scotton (1967) review the literature concerning relationships between personality and EEG activity. They cite evidence relating high alpha index to extraversion (Gottlober, 1938) to lack of neuroticism (Eysenck, 1947) and to lack of anxiety (Ulett et al, 1953 and Brockway et al, 1954). Eysenck (1967) considers that empirical work lends support to his hypothesis. However, he appears to equate alpha amplitude and alpha frequency. These measures have been found to be negatively correlated (Knott & Travis, 1937). Given that high alpha amplitude indicates low cortical arousal, high alpha frequency must indicate high cortical arousal.

Savage (1964) reports the predicted relationship between extraversion and high alpha amplitude. This result is substantiated by Marton & Urban (1966) who found that extraverts had lower alpha frequency than introverts. However, this latter result is equivocal since nine introverts displaying no alpha rhythm were excluded. Fenton & Scotton reported no relationships between either extraversion or neuroticism and alpha index, mean alpha amplitude or alpha blocking responses to serial paired light flashes. Contradictory results were obtained by Broadhurst & Glass (1969). They reported a negative correlation between extraversion and both alpha index and rate of EEG potential change.

Gale et al (1969) found that extravert EEG was higher in integrated output across the whole measured range than introvert EEG. His measure of alpha abundance is thus likely to be correlated with alpha index and hence lend support to Eysenck's hypothesis.

Reported relationships between EEG arousal indices and neuroticism tend to conflict. Gale et al (1971) reported greater abundance for most frequencies in high N scorers than in low N scorers. Fenton & Scotton found no relationship between EEG arousal indices and N scorers (See above). In direct contradiction, Winter, Broadhurst & Glass (1972) noted that high N scorers were associated with low EEG amplitude while there were no significant differences between high and low E scorers.

There are some indications that neuroticism and extraversion may interact. Savage (1964) found that high N extraverts had lower alpha amplitude than low N extraverts. This contradicts Eysenck's (1967) hypothesis concerning the exaggeration effects of neuroticism. Gale et al (1969) suggests that Savage's results may be associated with low levels of stimulation causing onset of light sleep.

Gale et al (1971) gives an extensive list of possible methodological errors in research relating personality and EEG indices. In the light of this list and the discrepant results obtained, no conclusions concerning these relationships can be drawn.

c) Peripheral response system activity: Eysenck's description of cortical-reticular activity in peripheral systems emphasises low intensity and fast recovery. Cortical-reticular arousal could thus be indexed by spontaneous activity, reactivity to mild stimuli or slow OR habituation. Crider & Lunn (1971) review a number of studies concerning relationships between these measures in the electrodermal system. The consistent correlations allowed them to conclude that they were alternative indices of electrodermal lability. This conclusion could be generalisable to other peripheral response systems. The inclusion of OR habituation as an index of autonomic lability is controversial. In neo-Pavlovian theory, OR habituation is one index of inhibition in dynamism similar to CR extinction. OR habituation could thus be comparable to Eysenck's measure of conditionability. However, considering OR habituation as a measure of arousal or of conditionability does not change its predicted relationship to extraversion in Eysenck's theory.

The predicted inverse relationship between spontaneous electrodermal activity and extraversion has been found by Crider & Lunn (1971) and Coles, Gale & Kline (1971). However, Purohit (1966), Burdick (1966), Uherik (1971) and Montgomery (1972) failed to find any relationship between personality and spontaneous electrodermal activity.

Conflicting relationships between reactivity to mild stimuli and neuroticism have been reported. Coles et al found high N scorers more electrodermally reactive than low N scorers for two habituation measures and total number of responses. However, Sadler, Mefferd & Houck (1971) report low N scorers as more electrodermally reactive than high N-scorers. Similarly, Kelly & Martin (1969) found that neurotic patients were less electrodermally reactive than normal controls, while number of GSRs to warning light and to UCS airpuff gave negative loadingson an anxiety factor. This anxiety factor had a loading of .71 on MPI N and a loading of -.39 on MPI E. Sadler et al do suggest an interaction between E and N which effectively reverses Eysenck's predicted relationship with extraversion for high N groups. Kelly & Martin's sample may be biased towards high neuroticism, hence reversing predicted relationships.

Dodge (1966) measured vaso-constructive ORs to signal tones. Introverts oriented earlier, more strongly and more consistently than extraverts. The former measure could be equated with reactivity to mild stimuli and hence support Eysenck's hypothesis.

OR habituation rate has been directly associated with extraversion (Mangan & O'Gorman, 1969) and inversely associated with neuroticism (Howarth & Meares, 1973, Coles et al, 1971).

It can be seen that reported relationships between personality and these three arousal indices are equivocal. Spontaneous electrodermal activity shows the most consistent relationship to introversion, since two studies confirm this relationship and none of the reviewed studies report the reverse relationship. Studies reporting relationships between personality and both reactivity and OR habituation suggest the possibility of an extraversion/neuroticism interaction. Stables may maintain the predicted arousal/extraversion relationship while neurotics reverse this relationship.

1.4.4.2. <u>Activation and Personality.</u> Eysenck (1967) equated limbic activation with neuroticism. He confined changes in limbic activation to strong sympathetic reactions in neurotic samples or to rare emergency situations in normal samples. However, situational stress has been shown to increase basal peripheral system activity in normal samples (Duffy, 1962). Claridge (1967) associated all autonomic activity with tonic arousal. This included both phasic and tonic peripheral indices together with sedation threshold. His model, based on abnormal groups, associates tonic arousal with drive rather than neuroticism (See P.37). However, he did also suggest that hysteria/dysthymia could be an alternative measure of normality. Thus tonic arousal could be associated with extraversion-introversion.

Direct inter-individual comparisons of basal level activity may not necessarily be comparing arousal differences. Electrodermal measures taken during relaxation have been found to be higher in some individuals than measures taken during stress in other individuals (Lykken et al, 1966). It was thus concluded that inter-individual differences in basal level skin conductance were more closely related to physical and structural differences than to arousal differences. This conclusion could be generalisable to other peripheral systems. Direct comparisons between basal level skin conductance and personality have failed to reveal any relationship (Coles et al 1971).

Inter-individual comparisons of basal level changes have shown inconsistent relationships with personality. Montgomery (1972) reported greater basal level conductance variability in high N scorers than low N scorers. However, Kelly & Martin (1969) found greater reactivity to stress in controls than in neurotics. Reactivity was assessed from differences between lowest heart rate and forearm blood flow/minute during relaxation and highest readings during stress. A neuroticism/extraversion interaction could account for some of the discrepancy in these results, since Sadler et al (1971) noted that skin conductance declined in stable extraverts and neurotic introverts but remained unchanged in neurotic extraverts and stable introverts.

It can be seen that basal level measures are unsatisfactory arousal indices, while basal level changes have shown inconsistent relationships with personality.

1.4.5. Personality and conditioning: Empirical evidence.

The basis of Eysenck's (1957, 1967) personality theory is the postulated inverse relationship between conditionability and extraversion. This relationship has been challenged by Spence (1964) who considers that anxiety or neuroticism facilitate conditioning. Lovibond (1964) endeavoured to reconcile these hypotheses by postulating defensive and appetitive conditioning based on mutually inhibitory arousal systems. Similarly, Gray's (1970, 1971 a and b) modification to Eysenck's theory suggested that conditioning was mediated by sensitivity to punishment or sensitivity to reward. Respective sensitivities were said to have different neurological bases. These modifications to Eysenck's hypothesis set a precedent for considering appetitive and aversive conditioning as separate dimensions.

Aversive conditioning studies can be further subdivided. It has been suggested that active avoidance conditioning is maintained by the appetitive or "go" system, while passive avoidance is maintained by the aversive or "stop" system (Mowrer 1960, Rescorla & Solomon 1969, Gray 1971, a and b). Active avoidance can thus be considered in conjunction with appetitive conditioning.

The two main types of aversive classical conditioning studied have been eyeblink and autonomic conditioning. Martin & Levey (1969) consider that some cases of eyeblink conditioning have similarities with active avoidance conditioning. If CS-UCS interval is short, then eyeblink CR may result in avoidance of full UCS strength.

It can be seen that the division of conditioning into two main types, appetitive and aversive, is indicated. Appetitive conditioning can be said to include classical appetitive conditioning, verbal operant conditioning and both appetitive and avoidance instrumental conditioning. Aversive conditioning appears to be most readily represented by autonomic conditioning, while eyeblink conditioning may be mediated by either appetitive or aversive systems depending on efficacy of UCS avoidance by eyeblink.

1.4.5.1. Personality and appetitive conditioning. Table I shows the variability of reported relationships between appetitive or instrumental conditioning and personality. Considering appetitive conditioning, three studies support Eysenck's hypothesis in so far as they report an inverse relationship between conditioning and extraversion. Six studies show no relationship between conditioning and extraversion. One verbal conditioning study found a direct relationship between conditioning and extraversion, while Nicholson & Gray's measure of reward sensitivity contradicts Eysenck's hypothesis when second order correlations only are considered. Relationships between conditioning and neuroticism tend to be random. Two studies show direct relationships while two other studies show inverse relationships between conditioning and neuroticism. The remaining six studies found no relationship. Considering each type of appetitive conditioning separately:-

a) Classical conditioning: Salivary conditioning methodology used in both reviewed studies tends to be unsatisfactory. Willett (1960) demonstrated that simple insertion of a cotton dental roll under the subject's tongue (Razran's 1935 method of measurement used in both studies) increased salivation in the presence of a non-reinforced stimulus, while inter- and intra- subject variability was so great that measurement was considered ambiguous.

Lovibond's (1963) study assumes that slides of nude females are positive reinforcers for all males. Reinforcement value is likely to depend upon previous experience and aesthetic appreciation either variable could be related to personality differences.

It can be seen that none of the classical conditioning studies

TABLE I

Appetitive and instrumental conditioning, sensitivity to reward and punishment.

Author	Date	Measure	Reinforced Contingency	Reinforcement	Subjects	Acquisition	Extinction	E-scale	N-scale	Relationship E	Relationship N
Instrumental conditioning:-											
1. Taffel	1955	Sentence completion	"I" & "We"	"Good"	90 psychotic & neurotic patients	Anxious more than non-anxious ($p<.05$)			MAS		+
2. Eysenck	1959	Sentence completion	Muscular activity verbs	"Hm-mm"	19extraverts 28introverts	Extreme Is more than extreme Es		MPI E		-	
3. McDonell & Inglis	1962	Sentence completion	"I" & "We"	"Good"	65 under-graduates	No difference	No difference	MPI E		NS	
4. Jawanda	1966	Sentence completion	"I" & "We"	"Good"	120 adults	Is more than Es Ss more than Ns		MPI E	MPI N	-	-
5. Laungani	1968	Sentence completion	"I" & "We"	"Good"	54secondary school children	Es more than Is		JEPI E		NS	
6. Mohan & Claire	1968				80 subjects	Es more than Is Ns more than Ss		MPI E	MPI N	+	+
7. Kipnis	1971	Sentence completion	Pronouns based on pre-experimental frequency	a)Social praise	52 students	Non-impulsives increased ($p<.01$) Impulsives did not increase significantly		Kipnis Impulsivity Scale		-	
				b) Money		No difference					
8. Montuori	1972	Sentence completion				Aware non-anxious more than aware anxious			State-trait Anxiety Inventory for Children, MAS		-
Appetitive classical conditioning:-											
1. Bindra, Paterson & Strzelecki	1955	Salivar	Bell	Lollipop		No difference			MAS		NS
2. Willett	1960	Salivar	White light	25 mgs ascorbic acid	100 trainee apprentices	No difference		MPI E	MPI N	NS	NS
3. Lovibond	1963	Electro-dermal	One of several tones or lights	Coloured slides of nude females	100 male students	No difference Conditioning rate & OST $r = -.22$ ($p<.05$) Differential conditioning & OST, $r = -.35$ ($p<.05$)		MPI E Object Sorting test (OST)	MPI N	NS -?	NS
Instrumental and active avoidance conditioning:-											
1. Davidson, Payne & Sloane	1966	Finger withdrawal		Shock	40 neurotic females	E,r =.12:N,r =.13 MAS, r = .23 ($p<.05$)	E,r= .06: N,r = .14 MAS, r = .29	MPI E	MPI N MAS	NS	NS +?
2. Otis & Martin	1968	Sentence completion	Evaluative verbs as opposed to non-evaluative verbs	Loud buzzer	192 students	LN,LE better than HN,LE HN,HE better than LN,HE		MPI E	MPI N	NS	NS
3. Sadler & Mefferd	1971	Lever press	One of four switches	Slide change	60 students	Ss more than Ns LN,LE more than LN,HE Interaction ($p<.1$)	HN,HE,& LN,LE more than LN,HE & HN,LE Interaction ($p<.05$)	EPI E	EPI N	NS	NS
Sensitivity to reward and punishment:-											
1. Nicholson & Gray	1972										
a) Reward		Peak shift generalis-ation	Lever Press	Poker chips exchangeable for sweets	14 children		a) Ist order correlation E, r = .10:N,r = .28 TRS, r = .59 2nd order correlation E, r = .59	JEPI E	JEPI N Teachers rating Scale(TRS)	+?	+?
b) Punishment		Peak shift					b) E, r = -.35:N, r = -.29 TRS, r = .37			NS	NS

reviewed lends any support to Eysenck's hypothesis.

b) Operant verbal conditioning: Taffel's (1955) conditioning technique reinforcing "I" and "We" has been criticised on methodological grounds. Persons & Persons (1965) noted a ceiling effect for elicitation of "I" and "We" in psychopaths studies by John's & Quay (1962). Eysenck equates psychopathy with extraversion, hence a similar ceiling effect could operate in normal extraverts when "I" and "We" are reinforced. This criticism is not applicable to Eysenck (1959) or Kipnis (1971). In both cases extreme extraverts conditioned less than extreme introverts when reinforced verbally. However, introduction of tangible reward reduced these differences to a non-significant level.

A further source of confounding may be evaluative content of the stimulus word which can effect response choice (Mandel & Goodstein, 1969).

It can be seen that there is some tentative evidence to support Eysenck's hypothesis providing reinforcement is verbal. However, the lack of difference with tangible reinforcement suggests that it may be reinforcement value of verbal praise which relates to degree of extraversion rather than conditionability.

c) Instrumental conditioning, appetitive and active avoidance: Considering this category as a whole, there is little direct support for Eysenck's hypothesis. However, there is the suggestion that extraversion and neuroticism interact to show a relationship with conditionability.

Davidson et al (1966) found no significant correlations between finger withdrawal and MPI E or N, although MAS anxiety correlated with conditioning in acquisition and extinction. Only the former was significant (p .05).

Sadler & Mefferd (1971) and Otis & Martin (1968) had non-significant main effects but comparable significant interactions. Eysenck's hypothesis was supported when N was low but reversed in high N subjects.

Sadler & Mefferd explained these interactions by relating extraversion to lack of cognitive control and neuroticism to increased arousal. Neuroticism increased response rate regardless of reinforcement contingencies. Extraversion-introversion differences were attributed to coarse grained or impulsive assessment or to fine grained analysis of the situation.

Sadler & Mefferd's explanation of extravert-introvert differences appears tautological. Impulsive cognitive assessment can be regarded as one aspect of extraverted behaviour (Level 3 in Eysenck's hierarchical model P.9). Following this model, impulsive behaviour cannot be said to determine conditioning differences, which in turn, determine extraversion-introversion differences. Neuroticism effects may be peculiar to these instrumental conditioning experiments where a fairly complex motor response, involving choice of alternatives, is required. Arousal has been said to have an inverted U relationship with performance of complex motor learning (See P.30), if arousal is related to introversion and neuroticism, then neuroticism should improve extravert's performance but could disrupt performance of highly aroused introverts.

It can be seen that these instrumental conditioning studies suggest that Eysenck's hypothesis may be supported only when N scores are low.

1.4.5.2. <u>Personality and aversive conditioning.</u> Considering eyeblink and electrodermal conditioning separately:-

a) Personality and eyeblink conditioning:- Spence (1964) reviewed studies of relationships between MAS anxiety and conditionability. Comparisons between high and low MAS anxiety groups showed

TABLE II

Summary of eyeblink conditioning studies

	Author	Date	Reinforcement	UCS	Discrimination	Subjects	Acquisition	Extinction	E-scale	N-scale	Relationships E	Relationships N
1.	Franks	1956	Partial	Weak	No	60 normals 60 neurotics	R, r = -.48	R, r = -.37	Guildford R		-	
2.	Franks	1957	Partial	Weak	No	60 students	E, r = -.46		MPI E		-	
3.	Farber, Spence & Bechtoldt	1957	100%			103 students	MAS, r = .29 R, r = .007 C, r = .37		Guildford R	MAS Guildford C	NS	+
4.	Das	1957	Partial			63 students	E, r = -.08		MPI E		NS	
5.	Brebner	1957	60%	.068 lbs / in²	No	8 extraverts 8 introverts	Amended results non-significant		MPI E extremes		NS	
6.	Symon	1958	60%	.068 lbs / in²	No	8 extraverts 8 introverts	No difference	Trend for extraverts to have more CRs than introverts	MPI E extremes		NS	
7.	Shagass & Kerenyi	1958	60%	Weak	No	30 neurotics	R, r = -.359 (p < .05) C, r = .383 (p < .05)		Guildford R	Guildford C	-	+
8.	Franks & Leigh	1959	Partial	Weak	No	20 inpatient neurotics 20 outpatient neurotics 20 asthmatics 20 normals	E, r = -.26 (p < .05)		MPI E		-	
9.	Willett	1960	Partial	Weak	No	80 adolescents	E, r = -.08		MPI E		NS	
10.	Field & Brengelman	1961	Partial	Weak	No	33 prisoners	Summed E, r = -.17		MPI E		NS	
11.	Sweetbaum	1963	90%			56 patients	Anxious more than non-anxious		Guildford R	Diagnosis	NS	+
12.	Franks	1963	Partial	Weak	No	21 alcoholics 28 normals	a) E, r = -.10 b) E, r = -.01		MPI E		NS	
13.	Al-Issa	1964	100%			90 apprentices	E, r = -.31 (p < .05)		MPI E	MPI N	-	NS
14.	Spence & Spence	1964	100%	100 psi 50 msecs	No	100 male students 60 female students	E, r = -.076:N, r = .224 (p < .01). MAS, r = .179 (p < .05).		MPI E	MPI N	NS	+
15.	McPherson	1965	60%	.068 lbs / in²	No	8 extraverts 8 introverts from 150 students	Es more than Is	Es more than Is	MPI E		NS	
16.	Kelly & Martin	1969	100%	6 lbs/in² 60 msecs	No	20 neurotics 20 normals	No difference	No difference	MPI E	MPI N	NS	NS
17.	Piers & Kirchner	1969	50%	Weak	No	45 high conditioners 34 low conditioners from 270 students	High conditioners more introverted and more neurotic		MPI E	MPI N	-	+
18.	Upadhaya & Murthy	1970				10 extraverts 10 introverts 10 dysthymics 10 hysterics	Is more than Es (p < .02) Is more than Hs (p < .05)	No difference	Neyman Kohlstedt diagnostic test for extraversion		-	NS
19.	Finkenseiper, Systerman & Timmer	1970					Anxious introverts less conditionable than others				-?	-?
20.	Barratt	1971	100%	15.1 psi 30 msecs	Yes	60 extreme scorers from 151 students	Low impulsives more conditionable than high impulsives		Barratt's Impulsivity Scale MPI E	Barratt's Anxiety Scale MPI N	-	NS
21.	Eysenck & Levey	1972	Partial	Weak	No	144 males	Introverts more conditionable than extraverts				-	
			100%	Strong	No		No difference				NS	

that in twenty-one of the twenty-five studies reviewed, high MAS groups gave a better conditioning performance than low MAS groups. Eleven of the seventeen comparisons involving 36 or more subjects were significant ($p < .05$). Two of the eight studies with less than thirty-six subjects were significant. No study gave significant results in the opposite direction. Kelly & Martin (1969) found that MAS anxiety correlated with both MPI E-scores ($r = -.52$, $p < .001$) and MPI N-scores ($r = .84$, $p < .001$), hence reported relationships between conditionability and MAS anxiety could indicate an inverse relationship between conditionability and extraversion, a direct relationship between conditionability and neuroticism or a combined relationship between these personality variables and conditionability.

Table II shows a summary of relationships between personality and eyeblink conditioning, excluding studies reviewed by Spence (1964).

Comparing the tabulated studies, it can be seen that nine studies report significant inverse relationships between conditionability and extraversion, while thirteen studies show non-significant results. Five studies report direct relationships between conditionability and neuroticism, while six studies show no significant relationships. Two studies (Finkenseiper et al 1970 and Barratt 1971) suggest that the diagonal from high N, low E to low N, high E correlates with conditionability. There is thus a statistical bias in reported results which tends to support Eysenck's hypothesis concerning conditionability and extraversion, together with a positive relationship between conditionability and neuroticism.

Eysenck (1965) considered that his hypothesis was supported when experimental parameters favoured development of inhibition. Parameters specified were weak UCS, partial reinforcement and discrimination learning. One study (Barratt 1971) reports use of discrimination learning. In this study, Eysenck's hypothesis was supported in that impulsiveness was inversely related to conditioning and there was no relationship between conditioning and anxiety.

Twelve studies report use of partial reinforcement with weak UCS. Distribution of these results is not substantially different from the total distribution of results. Six studies report the predicted inverse relationship between conditioning and extraversion, while the other six studies found no significant relationships. Two studies report significant direct relationships between conditioning and neuroticism, while the other two studies found no significant relationships.

Six studies used parameters not recommended by Eysenck (1965), i.e. strong UCS or 100% reinforcement. One study (Al-Issa, 1964) found a significant inverse relationship between conditioning and extraversion. However, the other five studies gave non-significant results. Three studies reported a direct relationship between conditioning and neuroticism, while two studies found no significant results. Hence use of Eysenck's non-recommended parameters reduces the proportion of significant relationships between conditioning and extraversion but does not change the proportion of significant relationships between conditioning and neuroticism.

Most reported relationships between personality and conditioning concern conditioning measured in acquisition. Only one of the five studies using an extinction measure of conditioning, (Franks 1956) found the predicted relationship between conditioning and extraversion. Mcpherson (1965) reported a non-significant trend for extraversion to be directly related to conditioning in extinction. Hence most support for Eysenck's hypothesis concerning extraversion and for a relationship between conditioning and neuroticism is confined to acquisition measures of conditionability.

It can be seen that significant relationships between conditionability and personality indicate an inverse relationship between conditionability and extraversion together with a direct relationship between conditionability and neuroticism. A number of non-significant results have been reported but no significant direct relationship between conditionability and extraversion has been found. The reverse relationship between conditionability and neuroticism is suggested by Finkenseiper et al. Anxiety combined with introversion was directly associated with conditionability. These significant results tend to be confined to acquisition measures of conditionability and are not necessarily generalisable to extinction measures of conditionability.

b) Personality and electrodermal conditioning:- Table III summarises relationships between personality and electrodermal conditioning. Five studies reported a significant inverse relationship between conditionability and extraversion, eleven studies had non-significant results, while one study reported a direct relationship between conditionability and extraversion. There is thus a statistical bias towards supporting Eysenck's hypothesis concerning conditionability and extraversion.

Relationships between conditionability and neuroticism suggest a random distribution of results. Vogel (1960) reports a positive relationship between conditioning and neuroticism, Lykken substantiates this result within his sociopathic sample but not from comparisons between neurotic sociopaths and normal controls. Ten studies report non-significant relationships, while Clum (1968) found a negative relationship between conditioning and neuroticism.

Eysenck (1965) specifies partial reinforcement, weak UCS and discrimination learning as parameters for obtaining hypothesised relationships between personality and conditionability. Wilson (1968b)

TABLE III

Summary of electrodermal conditioning studies.

	Author	Date	Reinforcement	UCS	Discrimination	Subjects	Acquisition	Extinction	E-scale	N-scale	Relationships E	Relationships N
1.	Franks	1956	Partial	Weak	No	60 normals 60 neurotics	Dysthymics more than hysterics ($p < .005$)	Dysthymics more than hysterics ($p < .025$) Normals less than dysthymics ($p < .025$)	MPI E		-	
2.	Lykken	1957	Partial	Strong shock	Yes	19 primary psychopaths 20 neurotic psychopaths 15 normals	Primary psychopaths less than neurotic psychopaths less than normals		Psychopaths v. Normals	Primary v. neurotic psychopaths	-	+?
3.	Becker	1960	Partial	Shock		62 students	No difference		MPI E		NS	
4.	Martin	1960	Partial	Strong 110 dbs		23 subjects	No difference		MPI E	MPI N	NS	NS
5.	Vogel	1960	50%	Strong noise	Yes	18 alcoholics	Is conditioned faster than Es ($p < .005$)		MPI E	MPI N	-	+
6.	Vogel	1961	50%	Strong noise	Yes	40 alcoholics 40 non-alcoholics	Is conditioned faster than Es		MPI E		-	
7.	Halberstam	1961	Partial	Medium shock	Yes	18 dysthymics 18 hysterics 18 normals	Dysthymics faster than controls faster than hysterics ($p < .005$)		MMPI scales	MMPI scales	-	
8.	Becker & Matterson	1961	Partial	Strong shock		4 extreme groups for E & N from 273 students	No difference		Guildford R extremes		NS	
9.	Lovibond	1963	100%	Weak Shock	Yes	100 males students	No difference		MPI E Object sorting test	MPI N	NS NS	NS
10.	Davidson, Payne & Sloane	1964	Partial	Strong shock	No	73 students	No difference		MMPI	MAS	NS	NS
11.	Davidson, Payne & Sloane	1966	Partial	Strong shock	No	40 neurotic female patients	E, $r = -.17$, N, $r = .21$ MAS, $r = .23$	E, $r = -.22$, N, $r = .27$ MAS, $r = .23$	MPI E	MPI N MAS	NS	NS
12.	Purohit	1966	100%	500 cps 120 dbs	No	64 males students 64 female students	E, $r = .04$, N, $r = .06$	E, $r = .04$, N, $r = .01$	MPI E	MPI N	NS	NS
13.	Wilson	1968	50%	Mild shock	Yes	15 high school students	E, $r = .45$ ($p < .05$)		EPI E	EPI N	+	NS
14.	Cowan	1968	Partial	Shock	Yes	41 males	Only aware conditioned No differences		Unstated	Unstated	NS	NS
15.	Clum	1968	60%	Shock	Yes	52 male armed service enlistees 17 normals & 35 psychiatric patients	a) E, $r = -.02$ b) E, $r = .23$, N, $r = -.43$ ($p < .01$) MAS, $r = -.41$ ($p < .05$)		MPI E	MPI N MAS	NS NS	NS -
16.	Morgenson & Martin	1969	20%	1000 cps 106 dbs 1 sec.	Yes	115 male civil servants	Only aware conditioned No differences		EPI E	EPI N	NS	NS
17.	Moriearty	1972	100% except 1	Shock	No	36 MAS extreme students		No difference		MAS		NS

reported use of all three recommended parameters and his result was the one exception showing a significant direct relationship between conditioning and extraversion. Franks (1956) found support for Eysenck's hypothesis using partial reinforcement and weak UCS. Extraversion showed a significant inverse relationship with conditioning measured in acquisition and extinction. Lovibond (1963) used weak UCS and discrimination learning but found no significant relationships between conditioning and personality.

Eight studies report using partial reinforcement and discrimination learning with strong UCS. Relationships between conditionability and personality are similar to those observed when considering all electrodermal studies. Four studies found significant inverse relationships between conditioning and extraversion, while the other four studies failed to find significant relationships. Conditionability showed a random relationship to neuroticism.

Four studies reported using either partial reinforcement or discrimination learning with strong UCS, none had significant results.

The remaining two studies used Eysenck's non-recommended parameters; 100% reinforcement, strong UCS and no discrimination. These all reported non-significant relationships between conditioning and personality.

Considering electrodermal conditioning, it can be seen that most evidence in support of Eysenck's hypothesised relationship between conditionability and extraversion, has been obtained from studies using partial reinforcement, discrimination learning and strong UCS. Studies using the recommended weak UCS have given conflicting results, while use of two or more non-recommended parameters have shown non-significant relationships. Franks (1956) reports the only significant relationship between extraversion and conditioning measured in extinction. The other three studies giving extinction measures found no significant relationships.

Neuroticism has shown inconsistent relationships with conditionability.

1.4.5.3. <u>Conclusions drawn from empirical evidence concerning personality and conditioning.</u> In general, support for Eysenck's hypothesis relating conditionability to introversion is confined to conditioning studies said to be associated with the aversive or "stop" system, rather than conditioning associated with the appetitive or "go" system.

Relationships between personality and classical appetitive conditioning have not been adequately tested. Operant verbal conditioning studies suggest that extraversion may be inversely related to the reinforcement value of verbal praise rather than to conditionability. Active avoidance and instrumental conditioning requiring a well organised motor response may be inversely related to extraversion at low N-levels only. At high N-levels a direct relationship between extraversion and conditionability has been reported.

The majority of aversive classical conditioning studies have tended to support Eysenck's hypothesis concerning extraversion or to have shown non-significant results. Relationships between conditioning and neuroticism have been more variable. In general, eyeblink conditioning has either been directly related to neuroticism or no significant relationships have been reported. In contrast, electrodermal conditioning relationships with neuroticism have been randomly distributed.

In eyeblink conditioning studies, weak UCS combined with either partial reinforcement or discrimination learning have been the parameters for most studies reporting significant inverse relationships between extraversion and conditioning. Neuroticism has shown the same bias towards a direct relationship with conditioning using either weak or strong UCS.

Electrodermal conditioning studies have tended to give more variable and more non-significant results than eyeblink conditioning studies. However, more electrodermal than eyeblink conditioning studies have used the non-recommended strong UCS as opposed to the recommended weak UCS.

Electrodermal studies using strong UCS have shown some inverse relationships between conditioning and extraversion provided strong UCS has been combined with Eysenck's (1965) two other recommended parameters; partial reinforcement and discrimination learning.

1.4.6. Conclusion to Chapter 1.

This thesis has two main aims: to investigate relationships between conditioning and personality and to investigate relationships between conditioning, personality and criminality.

Central to Eysenck's hierarchical personality theory, is the inverse relationship between conditioning and extraversion. In a related hypothesis, Eysenck (1957, 1970) associates anti-social behaviour and hence criminality with lack of conditionability and extraversion (See P.10).

Eysenck's criminality theory is based on Mowrer's (1947) version of two factor theory. Training and hence socialisation was said to be mediated by unpleasant autonomic CRs. Theoretically, Mowrer (1960) and Gray (1971a and b) advocate division of conditioning studies into types mediated by either an appetitive or "go" system or by an aversive or "stop" system. Empirical evidence (See P.69-81) suggests that support for hypothesised relationships between conditionability and extraversion is confined to aversive classical conditioning studies. Mowrer (1947) specifies classical aversive autonomic conditioning as the mediator of socialisation processes. However, results obtained from eyeblink conditioning studies may be generalisable to autonomic conditioning. The direct test of Eysenck's hypotheses concerning conditionability, personality and criminality thus involves use of aversive classical autonomic conditioning.

Empiral evidence reporting the hypothesised inverse relationship between aversive conditionability and extraversion tended to be strongest when at least two of Eysenck's (1965) specified parameters were used. In eyeblink conditioning studies, weak UCS was the most important parameter, while electrodermal conditioning studies could have a strong UCS provided this was combined with partial reinforcement and discrimination learning. Eysenck & Levey's (1972) eyeblink conditioning study is discussed on(P. 49 - 53). They found predicted extraversion-introversion conditioning differences with use of weak UCS, partial reinforcement and short CS-UCS interval. There were no extraversion-introversion conditioning differences with use of strong UCS, 100% reinforcement and long CS-UCS interval. UCS strength was the most important differentiating parameter. In extraverts, weak UCS tended to result in UCR adaptation. A CS-UCS pairing which does not have a UCR cannot be regarded as an aversive classical conditioning trial (Pavlov, 1927). CR acquisition rates of extraverts and introverts would thus be more closely associated with sensitivity differences rather than conditioning differences. Sensitivity has been found to be greater in introverts than extraverts when neuroticism is low (See P.57), hence resulting conditioning measures would tend to be higher in introverts.

A further consideration in aversive classical conditioning studies is the influence of CS-UCS contingency awareness. This problem is discussed in detail in Chapter 2. From Table III it can be seen that the two electrodermal conditioning studies considering awareness differences found that only aware subjects conditioned, while within this group there were no significant relationships between conditioning and personality. It is possible that comparatively low sensitivity in stable extraverts mitigates against attainment of CS-UCS contingency awareness and hence CR acquisition when UCS is weak. Support for this notion is indicated from comparisons of Eysenck & Levey's diagrams of CR acquisition curves for extraverts and introverts under their respective favourable parameters. Acquisition of high CR frequency is gradual in introverts but comparatively sudden in extraverts.

Eysenck & Levey's diagrams suggest a tendency for introverts to stabilise at lower CR frequencies than extraverts. This tendency can be compared with Russian measures of dynamism of nervous processes.

Korotkin's (1949) eyeblink conditioning index specifies number of trials to CR stabilisation. If extraverts stabilise at a higher level than introverts, then this criteria may be fulfilled sooner in extraverts than introverts (See P. 60).

It will be recalled (P. 70 -81) that most conditioning studies reviewed reported relationships between personality and conditioning measured in acquisition. However, Eysenck's (1957, 1970) and Trasler's (1962) theories of criminality suggests that anti-social behaviour is inhibited by arousal of previously acquired aversive CRs. The conditioned basis of socialisation was said to be acquired in childhood and to generalise to other anti-social behaviour during development. Arousal of previously acquired CRs depends upon their original acquisition and present degree of extinction. During childhood socialisation, undesirable behaviour results in further conditioning trials from parents who provide an efficient socialisation programme. Hence individual differences in CR acquisition should be diminished by the differential number of CS-UCS pairings required to achieve equal CR acquisition. i.e. extraverts should need more CS-UCS pairings than introverts to achieve equal CR acquisition. Thus an experimental paradigm reflecting efficiency of parental conditioning techniques in later adulthood, should provide equal CR acquisition but reflect individual differences in adult CR arousal by using extinction as the conditioning measure.

Relationships between personality and CR extinction measures tend to substantiate reported relationships between personality and CR acquisition measures. Lack of sensitivity in extraverts, CS-UCS contingency awareness and awareness of extinction onset differences could account for variable relationships reported when weak UCS is used. However, three studies (Purohit, 1966, Moriearty, 1972 and Kelly & Martin, 1969) used strong UCS, one hundred per cent reinforcement and no differential conditioning.

Subjects were thus likely to be aware of reinforcement contingencies and extinction onset. Lack of differential stimuli may account for non-significant relationships between personality and CR acquisition and extinction. Increase in response frequency during acquisition and relative response decline during extinction can be accounted for by sensitisation effects of strong stimulus application and its subsequent removal, rather than any conditionability differences.

It can be seen that an adequate test of Eysenck's personality theory and related criminality theory should use an autonomic conditioning paradigm of efficient socialisation techniques. This involves CR acquisition for all subjects and a measure of differential conditioning in extinction.

Eysenck (1970) regards criminality as a normally distributed personality trait, with prisoners occupying the extreme criminality end. Twin studies suggested that there was an inherited component in the predisposition to commit crime. Eysenck considers that this component may be related to conditionability. A similar theory applies to psychopathy. Both criminals and psychopaths are said to be extravert and lack conditionability. (This notion is discussed in detail in Chapter 6).

Eysenck & Eysenck (1970) assessed extraversion in prison and non-prison samples. However, results could not be said to support their hypothesis. They suggested that some sociability items may not have been appropriate in prison environments and hence advocated use of impulsivity items to assess extraversion in prisoners.

Evidence for a relationship between psychopathy and extraversion is equivocal. However, there seems to be agreement that impulsivity is a main diagnostic characteristic of psychopaths (Hare, 1970). There is also evidence to suggest that psychopaths are difficult to condition (Lykken, 1955, 1957). Lack of conditionability may thus be more closely associated with impulsivity in psychopaths rather than the total extraversion scale.

There is also the possibility that it is the impulsivity component of extraversion rather than sociability, which correlates with lack of conditionability in normal samples. Eysenck & Levey (1972) re-analysed their data in terms of impulsivity and sociability. Impulsivity items accounted for all variability in conditioning, while sociability items were unrelated to conditionability. This result can be compared with Barratt (1971) who reported a significant relationship between eyeblink conditioning and impulsivity measured with his Impulsivity scale.

This thesis aims to assess relationships between conditioning and personality and their application to criminality. It can be seen that impulsivity is a superior measure of extraversion in prison samples and some support for Eysenck's theory was drawn from psychopathic samples. In normal samples, the sociability component of extraversion was found to be unrelated to conditioning. Hence it was thought appropriate to use an impulsivity scale as the measure of extraversion in this study.

The fulfilment of the two main aims of this thesis are arranged as follow:-

Chapter 2. Concepts of conditioning are discussed and methodological considerations reviewed.

Chapter 3. A conditioning technique is described and measurement procedure clarified by results from Experiment I. This experiment compares normality of distribution in use of different data transformations and mean response magnitude in extinction after CS-UCS pairings with mean response magnitude in extinction after presentation of unpaired CSs and UCSs. The latter comparison determines the most appropriate index of discriminative responding to a conditioned stimulus.

Chapter 4. Personality measurement with reference to impulsivity is discussed. An impulsivity scale is developed, together with a test of reliability and its relationship to other personality dimensions.

Chapter 5. Experiment II is reported. This experiment determines relationships between conditioning and personality, together with relationships between arousal indices and personality.

Chapter 6. Literature concerned with personality, conditionability and criminality is reviewed.

Chapter 7. A selected prison sample and a student sample are compared for personality, conditioning and arousal indices. Inter-relationships between these variables are examined in the prison sample.

CHAPTER 2.

Concept and measurement of conditionability.

This chapter discusses the concept and measurement of conditionability in order to determine the most appropriate conditioning index and conditioning parameters.

2.1. Conditioning and awareness.

The concept of conditionability has been challenged on various grounds. Pavlov (1932) distinguished conditioning in the first signalling system from conditioning in the second signalling system. This dichotomy between relational learning and "true" conditioning was elaborated by Mowrer (1938) and Razran (1955). The controversy centres around acquisition and elicitation of CRs when subjects are unaware of the CS-UCS contingency.

Razran (1955) argued that conditioning without awareness could occur and drew support for this arguement from five categories of evidence:-

a) Classical conditioning can occur in animals low in the phyletic scale.

b) Classical conditioning can occur in decorticate animals and spinal preparations.

c) Classical conditioning can occur in humans when the CS is below the perceptual threshold.

d) Classical conditioning in humans can occur when the CS and/or UCS is of internal origin (Interoceptive conditioning).

e) Classical conditioning can occur when the CS-UCS contingency is embedded in a masking task, or when misleading instructions about the experiment are administered.

Recently, however, this evidence has been questioned. For example, Dawson (1973) rejected the first two classes of evidence on the grounds that relational learning need not occur in the same way in humans and animals, and because its presence or absence could not be determined in lower animals. With regard to the third class of evidence, Eriksen (1960) reviewed literature concerned with subliminal conditioning and concluded that it was,

"....for the most part negative and at best controversial".

(Eriksen 1960, P.283)

Eriksen noted that perceptual threshold was usually defined as the point on the stimulus continuum which was perceived 50% of the time. If 50% of the stimuli could be perceived, conditioning with CS-UCS contingency awareness is not precluded.

Evidence for conditioning without awareness in Razran's last three categories depends on the validity of awareness assessment. Eriksen considered that operational definitions of "awareness" were inadequate, since motivation and understanding of the subject were not taken into account, while adequacy of post experimental questioning was not evaluated. He suggested a system of scaling subjective verbalisations in terms of accuracy and specificity.

Dawson & Reardon (1973) assessed construct validity of recall and recognition awareness measures and found a short recognition method most valid. When this method was used there was no evidence of conditioning without awareness. They summarised previous research in terms of awareness assessment methods used, and found that reports of conditioning without awareness used either a short recall questionnaire (Lacey & Smith, 1954; Wieland, Stein & Hamilton, 1963) or a long recall questionnaire (Fuhrer & Baer, 1969; Wilson, Fuhrer & Baer, 1971; Baer & Fuhrer, 1973). Research reporting no conditioning without awareness utilised either a long recognition questionnaire (Chatterjee & Eriksen, 1960; 1962) or a short recognition questionnaire (Dawson, 1970; Dawson & Grings, 1968).

Dawson & Biferno (1972) assessed awareness during the experimental session as opposed to post session assessment. Subjects depressed buttons throughout the experiment to indicate probability of receiving an electric shock (UCS). Awareness was manipulated, so that one group was less likely to become aware than another group. There was no conditioning in unaware subjects, while the point in time at which awareness was first indicated (by a high subjective probability of UCS reception) marked the onset of conditioned discrimination.

Degree of awareness appears to be unrelated to degree of conditioning. Dawson & Furedy (1973) measured subjective estimates of receiving shock (UCS) on a continuum from "certain to receive shock" to "certain not to receive shock". There was no relationship between degree of awareness and conditioning performance. A further study was reported, in which awareness was assessed by means of a dial, that was moved continuously throughout the experiment, to indicate subjective expectancy of receiving shock. This method was extremely sensitive to differences in CS+ and CS- but showed no correlation with conditioning performance.

Grant's (1973) review of differential eyelid conditioning suggests that awareness is associated with relational learning but not "true" conditioning. Previously, Spence &Taylor (1951) considered that eyeblink responses could be voluntary or conditioned. Respective CR topography distinguished voluntary V-form responders from conditioned C-form responders. Perry, Grant & Schartz (1971) divided aware subjects into C-form and V-form responders. The effect of awareness was significant for V-form responders but not for C-form responders. Hence "true" conditioning indicated by C-form responding was unrelated to degree of awareness.

The experimental results reviewed above can be accounted for in terms of Dawson & Furedy's "gate" theory of conditioning and awareness.

These authors and Grant (1973) suggested that awareness was a necessary but not sufficient stipulation for conditioning to occur. Once the "gate" was opened or awareness occurred, then conditioning might or might not occur, if the "gate" did not open then conditioning could not occur.

2.2. Relational learning and "true" conditioning.

Relational learning occurs when subjects become aware of CS-UCS contingencies, either through verbal information or experience. Verbal information alone can increase response frequency (Bridger &Mandel, 1964) but on no account can this increase be regarded as "true" conditioning. However, verbal information and experience may have a "true" conditioning component. If CS-UCS contingency awareness can be removed after CR acquisition, any remaining CRs could be regarded as "true" conditioning.

It has been suggested that all conditioning is relational learning. Wilson (1968a) demonstrated that instructions could reverse a previously established CR+. Subjects were informed of the CS-UCS contingency prior to differential CR acquisition. At extinction onset, subjects were informed that shock would follow CS- and not CS+. The previously established discrimination was reversed with subjects responding more to CS-.

Bridger & Mandel (1964) measured electrodermal differential conditioning in two groups. All subjects wore electrodes for receiving shock and were informed of the CS-UCS contingency. One group received the threatened shock, while the other group received no shock. Both groups increased CR frequency during acquisition. Before extinction, both groups were told there would be no more shock. The shocked group continued to respond to CS+ while the threatened group extinguished quickly. These results were replicated by Bridger & Mandel (1965), when disbelief of informed extinction onset was reduced by removing shock electrodes before extinction. A further replication was carried out by Dawson & Grings (1968). Sensitisation from increased arousal due to reception of electric shocks was controlled by unpaired CS and UCS presentations in relational learning groups. The classical conditioning group with masked CS-UCS pairings failed to condition. Information regarding CS-UCS contingency increased CRs, while informed extinction abolished this effect in relational learning groups.

Hartman & Grant (1962) compared CRs during informed extinction after continuous and after partial reinforcement. Information reduced responding after partial reinforcement but not after continuous reinforcement. This suggests that the partial reinforcement effect, of increased responding, may be a cognitive assessment of the probability of UCS reception when extinction onset is unknown.

When cognitive effects have been eliminated or considerably reduced there still appears to be evidence of conditioning. Hilgard & Humphreys (1938) tested subjects for retention of a conditioned discrimination some months after their initial training. Many subjects could not report the CS-UCS contingency but still displayed differential conditioning. Forgetting the CS-UCS contingency excludes the possibility of disbelief, which could be said to operate when extinction onset information is given.

It can be seen that relational learning without threatened UCS presentation increases CRs and that this effect can be removed by extinction onset information. Information plus CS-UCS experience or information without CS-UCS experience increases CRs in acquisition, while informed extinction onset abolishes CRs in the information without experience condition. In the information plus experience condition CR rate is decreased and cognitive effects such as the partial reinforcement effect are abolished.

2.3. Conditioning and motivational factors.

Motivational factors have been manipulated experimentally by varying instructions to subjects. Hilgard & Humphreys (1938) demonstrated the effect of instructions on eyelid CRs. One group received no instructions, another was instructed to support the discrimination by responding promptly to CS+ and not to respond to CS-, a third group was instructed to respond to CS- but not to CS+, while a fourth group was instructed to respond to neither stimulus. Voluntary restraint did not prevent conditioning but did change response frequency. Increasing order of response frequency was:- Group 4, group 3, group 1, group 2. Instructions to respond and not to respond, respectively enhanced and diminished response frequency.

It has been suggested that some eyelid CRs are under voluntary control (V-form responses) while other CRs are "true" conditioned responses (C-form) (Spence & Taylor, 1951). Bunde, Grant & Frost (1970) found that the two response types were differentially affected by instructional CSs. The eyeblink response was conditioned to the words "PUFF" and "NO PUFF". V-form responders were affected, in that "PUFF" as CS+ produced better discrimination than "NO PUFF" as CS+. C-form responders were unaffected. Use of "BLINK" and "DON'T BLINK" as CS+ exaggerated this affect. Thus the instructional affect on eyeblink conditioning may be confined to responses thought to be associated with relational learning rather than "true" conditioning.

Dawson & Reardon (1969) suggest that instructions do affect electrodermal conditioning. Group I was told that "the intelligent thing is to become conditioned", group 2 was told that, "the intelligent thing is not to become conditioned". Group 3 was a control group with no instructions and group 4 were given neutral instructions. The facilitatory group I conditioned better than the inhibitory group 2.

These experiments suggest that motivational factors may affect conditioning performance. Measures of conditionability should thus attempt to equalise motivational for all subjects.

2.4. Conditioning and masking tasks.

Motivational factors can be controlled by directing them into a masking task. However, the type of masking task chosen can affect conditioning performance.

Ross & Nelson (1973) have reported that a masking task unrelated to CS+ and CS- differentiation reduces conditioning performance, while a masking task related to the differentiation could increase performance. In this regard, Nelson (1971) found that time estimation as a masking task, largely eliminated differential responding. On the other hand, Ross & Nelson found less differential response reduction when the subject was required to make a differential response to CS+ and CS-. They concluded that the unrelated masking task effect was not due to response acquisition failure but to similar CR acquisition to CS+ and CS-, even when subjects were aware of the CS-UCS contingency.

The masking task effect may be confined to relational learning rather than "true" conditioning. Grant's (1973) V-form responders used awareness to improve CR performance more than C-form responders. Introduction of a masking task reduced CR performance of V-form responders only.

Both Grant and Ross & Nelson concluded that decline in performance due to a masking task could be associated with a distraction-attention dimension.

It can be seen that subjective motivation can be directed away from the conditioning procedure by a masking task unrelated to CS-UCS contingencies. A masking task related to CS-UCS contingencies may increase CR performance while an unrelated masking task may reduce CR performance according to its distraction affect. Thus an appropriate masking task should direct the subject's attention to CS+ and CS- without requiring any differential response.

2.5. Central and peripheral factors in conditioning.

2.5.1. Central factors. The importance of CS-UCS contingency awareness in establishing CRs in humans indicates that central factors are involved in peripheral CR elicitation. Although the role of awareness in animals is difficult to establish, there is other evidence indicating central linkages in CR performance.

Maltzman (1968) discussed the ability of animals to learn without prior performance. Animals could learn a path through a maze to a goal object by being transported along the path. An S-R peripheral theory would predict no differences in maze performance between transported animals and controls with no previous experience. Beritoff (1965) found that dogs improved their performance in the transported, experimental condition even when stimuli were restricted. He suggested that dogs acquired a geographical image of goal location associated with neo-cortical activity. Other evidence for central linkages was found when either or both external stimuli and peripheral response were eliminated. Doty & Giurgea (1961) paired electrical stimulation of a cortical sensory area with stimulation of a motor area which evoked a motor response. After several pairings, a conditioned motor response could be evoked by stimulation of the sensory area alone. Beck & Doty (1957) administered a standard procedure for conditioned leg flexion to calal-eptic cats who had had the relevant leg de-efferated. When this leg was re-innervated, conditioned leg flexion could be elicited. Thus experi-mentally manipulated central linkages were sufficient to establish peripheral CRs.

2.5.2. Peripheral factors. Cadoret (1963) considered that conditioning measured in one response system was related to that response system's reactivity rather than some general conditioning factor. He assessed conditioning in electrodermal and digital vasomotor response systems.

Four groups of subjects received randomly ordered conditioning combinations of two electric shock strengths and three different auditory UCSs. Electrodermal CRs were defined as the largest response during a 7 second CS. Vasomotor CRs were differences in diastolic finger volume, measured from CS onset to offset. The conditioning index for between subject comparisons was number of above median CR+s after CS-UCS pairings minus number of above median CR-s after CS-control symbol pairings. Differences were rank ordered within each group. Tonic values, spontaneous activity and UCS reactivity were measured in both systems. Correlations between sound and shock conditioning were significant within each response system but not between response systems. Electrodermal CRs were more consistent ($r = .606$, $p < .001$) than vasomotor CRs ($r = .375$, $p < .01$). Spontaneous electrodermal activity was significantly related to electrodermal conditioning using an auditory UCS ($r = .329$, $p < .05$) but not using shock UCS ($r = .195$). There were no significant relationships between spontaneous vasomotor activity and vasomotor conditioning. A reverse relationship between spontaneous electrodermal activity and vasomotor conditioning using auditory UCS was observed ($r = .537$, $p < .001$).

Cadoret's measure of conditioning may be confounded. It is assumed that the control run assesses a CR- unaffected by conditioning. Subjects were unaware of session separations and sessions were ordered randomly. Responses in a control session occurring after an experimental session could thus be contaminated by a conditioning factor, while experimental sessions could be influenced by preceding experimental or control sessions.

Purohit (1966) replicated Cadoret's results using electrodermal CRs to assess conditioning. Conditioning was measured by number of responses, greater in amplitude, than the tenth adaptation response. Conditioning in acquisition and extinction correlated with spontaneous electrodermal activity but not with heart rate lability. However, sensitisation effects were not controlled. i.e, overall increased responsiveness caused by increased arousal from aversive stimulation. Thus apparent CR increase may not have been due to conditioning.

Within any response system, CR amplitude appears to be related to OR amplitude. Maltzman & Raskin (1965) reported separate conditioning experiments using electrodermal and digital vasomotor response systems. Subjects, within each response system, who gave large ORs showed a better conditioning performance than subjects who gave relatively small ORs. However, the amplitude factor contaminates this conditioning measure, since control groups maintained their original OR amplitude difference, although maintained OR amplitude was less than CR amplitude in experimental groups.

It can be seen that conditioning measures used in the above experiments are related to respective response system reactivity and not to conditioning measured in different response systems. In the former two studies, order effects and sensitisation confound results, while the latter study indicates that amplitude should be controlled when comparing conditioning in different response systems.

2.5.3. <u>Central and peripheral factors.</u> The controversy concerning the relative influence ofcentral and peripheral factors in conditioning can be resolved by postulating a central factor which is differentially represented in peripheral response systems. A peripheral response is then, in part, determined by the relative vulnerability of particular response systems to influence from a central factor.

Dykman, Mack & Ackerman (1965) considered that CR acquisition was a gradual phenomenon. The first CR indications were manifested in the preferred response system but as CR integration occurred, all systems responded in some degree. They studied heart rate, respiration rate, blood pressure and motor components of a differential, non-avoidance, leg flexion response in 6 dogs. Non-specific motor reactions preceded undifferentiated autonomic reactions, which preceded leg flexion in acquisition. Extinction occurred in the reverse order. Dogs manifested individual response specificity, so that rank ordering in each system, was maintained across all experimental procedures.

Morgenson & Martin (1968) monitored electrodermal and vasomotor systems concurrently in a differential conditioning paradigm. They replicated Maltzman & Raskin's results, in that high OR groups gave higher CR amplitudes than low OR groups when response systems were considered separately. Measures within response systems were highly correlated but correlations between response systems were relatively low. However, removal of the amplitude factor by partial correlation within the electrodermal system, reduced the correlation between first auditory OR and mean CR amplitude from $r = .441$ ($p < .001$) to $r = .228$ ($p < .05$). Similarly, when linear trend (change over trials) was corrected for amplitude, the correlation between linear trend and first OR dropped from $r = .441$ ($p < .001$) to $r = -.035$.

Barr & McConaghy (1972) compared appetitive and aversive conditioning in electrodermal and penile response systems. Analysis of results using CR amplitude replicated the above experimental results, in that significant relationships were found within response systems but not between response systems. Use of Martin & Levey's (1969) work ratio controlled for peripheral system differences in response amplitude. This work ratio is the ratio of CR amplitude at UCR onset compared with UCR amplitude. Some significant correlations between response systems were demonstrated using this measure in Table 2.1.

TABLE 2.1.

Comparisons between response systems and within response systems for different experimental conditions.

	Comparison.	r	Significance.
a)	Appetitive penile with aversive penile.	.429	$p < .01$
b)	Appetitive GSR with aversive GSR.	.013	NS
c)	Appetitive penile with appetitive GSR.	.285	$p < .05$
d)	Appetitive penile with aversive GSR.	.138	NS
e)	Aversive penile with aversive GSR.	.313	$p < .05$
f)	Aversive penile with appetitive GSR.	.310	$p < .05$

Barr & McConaghy (1972, p.222)

It can be seen that within either aversive or appetitive experiments considered separately, conditioning in both response systems correlated significantly with each other.

Response systems were also compared for rate of CR growth and a similar pattern of correlations was obtained.

The two non-significant correlations involve aversive GSR. The electrodermal system is sympathetically ennervated, hence responses to aversive stimulation should be greater than responses to appetitive stimulation, which is associated with the para-sympathetic system. The penile response system has dual ennervation from both sympathetic and para-sympathetic branches of the autonomic system, hence its appetitive response should differ from the simple aversive sympathetic electrodermal response.

On the whole, it can be seen that measurement of conditioning in any response system depends on the respective response system's reactivity. When this reactivity is taken into account, significant correlations between response systems are observed, indicating presence of central factors in peripheral CRs.

2.6. Choice of response system.

2.6.1. The electroencephalographic system (EEG). The EEG is generally assumed to be a direct reflection of underlying cortical activity. Different EEG patterns characterize arousal from deep sleep to heightened alertness, while interest has centered on alpha rhythm (10$\pm$1 cycles per second), in particular, alpha blocking as an OR indicant. Physiological artefacts can arise from non-cortical sources such as muscles, skin, eyes and heart. Anxious subjects tend to be more alert and display more muscle and movement artefact than normal non-anxious subjects, while EEG may also be effected by sympathetic tone, adrenaline output and other chemical factors (Margerison, St. John-Loe & Binnie, 1967).

Difficulties associated with the measurement of conditioned alpha blocking were reviewed by Putney (1973). Definitions of alpha blocking have frequently been in terms of a substantial or 50% reduction in three or more waves. Putney considered that previously observed instability of alpha blocking and inability to obtain conditioned alpha blocking, could have been associated with this coarse measurement. He used proportional amplitude reduction which enabled small conditioned reductions to be taken into account. Comparisons of acquisition and extinction with a preceding sensitisation run, demonstrated conditioned alpha blocking. However, the technique was limited to certain subjects who had moderate or persistent alpha rhythm in their resting records.

Proponents of two arousal system theories suggest that cortical activity need not be related to autonomic arousal (Eysenck, 1967, Claridge, 1967). This consideration mitigates against using EEG as an indicant of autonomically mediated responses. Furthermore, the apparent necessity for subject selection may confound possible relationships between personality and conditioning.

2.6.2. Peripheral response systems. Peripheral response systems are more directly influenced by autonomic activity than is EEG, a possible exception being muscle action potential. Muscle action potential is closely associated with central nervous system activity and hence shares the theoretical disadvantages of EEG indices. Irrelevant muscle activity has been associated with mental effort, anxiety and depression but relatively little is known about this measure (Lippold, 1967).

Other peripheral response systems can be divided into sympathetically ennervated systems (i.e, electrodermal and digital vasomotor systems) and dually ennervated systems (i.e, heart rate, respiratory rate, blood pressure, salivary and penile response systems.

Dual ennervation from sympathetic and parasympathetic branches of the autonomic nervous system tends to confuse response measurement. A stimulus may cause sympathetic arousal, which in turn, arouses the parasympathetic system to restore equilibrium. Increases or decreases in a dually ennervated response system can be caused by changes in either of the two antagonistic branches of the autonomic system.

Heart rate is an example of an extensively used, dually ennervated, peripheral response system. The OR is characterised by heart rate deceleration, whereas the defence reaction (DR) is associated with heart rate acceleration (Graham & Clifton, 1966). Both ORs and DRs are associated with increase in skin conductance, indicating a sympathetic component to both responses. Heart rate deceleration of the OR suggests that parasympathetic activity obscures sympathetic activity. Hence single sympathetically ennervated response systems are superior monitors of sympathetic arousal compared with dually ennervated response systems.

The two sympathetically ennervated response systems, electrodermal and digital vasomotor, do not always give an identical representation of sympathetic activity. Mednick (1957) found that length of CS-UCS interval differentially effected semantic conditioning performance in vasomotor and electrodermal systems. A ten second CS-UCS interval increased vasomotor CRs compared with electrodermal CRs, while a half second CS-UCS interval increased electrodermal CRs compared with vasomotor CRs.

Differences in sympathetic representation in vasomotor and electrodermal response systems may be associated with their different nerve ending chemical transmitters. The transmitter for sweat gland is cholinesterase and the transmitter for vasomotor fibres is noradrenaline (Lader, 1967).

The digital vasomotor response is measured by changes in pulse volume as indicators of blood flow change, which is dependent on vasomotor tone of skin arterioles and thus reflects sympathetic discharge. The OR is characterised by a sharp increase in vasoconstriction and hence decrease in pulse volume. This increase is not always easy to distinguish from other background activity, such as respiration and transient or sustained vasoconstriction. These difficulties are well demonstrated in Lader's (1967, P.175, Fig:5,5) diagrams of vasoconstriction records.

It can be seen that electrodermal responses may differ from vasomotor system responses but the electrodermal system is not as liable to range limitations and response onset is less ambiguous than the vasomotor system. The electrodermal response system was thus considered most suitable for use in aversive conditioning experiments.

2.7. Experimental parameters.

It will be recalled that Eysenck (1965, 1967) considered choice of experimental parameters, an important variable in conditionability assessment. He suggested that introverts would condition better than extraverts when experimental parameters were under-arousing.* However, it was concluded that under-arousing parameters reduced CR acquisition in extraverts by introducing confounding variables. Hence individual differences in conditionability should be most apparent when experimental parameters eliminated confounding variables and conditionability was assessed during CR extinction.

2.7.1. Differential conditioning. Three main procedures have been used to assess conditionability, these are:-

a) The response to be conditioned is habituated before acquisition. Conditioning is then defined from some CR frequency criterion. (Spence, 1964; Franks, 1956).

b) A standard habituation phase gives a baseline for responding. Conditioning is then assessed by increase in response amplitude, frequency or magnitude, after CS-UCS pairings (Purohit, 1966).

c) Comparison stimuli on the same stimulus continuum as the CS are presented throughout the experiment. Conditioning is then defined as increase in CR+ compared with CR-. (Morgenson & Martin, 1969; Vogel, 1960; 1961).

Stewart, Stern, Winokur & Fredman (1961) argue that use of methods (a) and (b) deal with adaptation and recovery of unconditioned responses, rather than true conditioned responses. They define a true conditioned response as:

".... a response to the conditioned stimulus (CS) which is not elicited by the CS before it has been paired with the unconditioned

*(See P. 49-53 for detailed discussion of recommended parameters).

stimulus (UCS)".

(Stewart et al, 1961, P.66).

In order to measure a true conditioned response, they suggest using a long CS-UCS interval (7.5 seconds). Two responses can then be identified, the OR appearing soon after the CS and the anticipatory response (AR) appearing near in time to expected UCS presentation. They argue that the AR is the true conditioned response. However, Lockhart & Grings (1963) analysed Stewart et al's data and found a correlation (r = .90) between OR and AR frequency. They concluded that the OR had also been conditioned.

Kimmel (1964) found that all above threshold stimuli elicited an EDR prior to conditioning, but using an 8 second interval, he found that the EDR reached its peak amplitude after a few seconds and remained there during the entire CS-UCS interval. As training progressed, early portions of the initial response declined, shifting the peak towards UCS presentation time. He suggests that Stewart et al's second "true" CR is the remains of a total reaction after early and middle portions have been reduced.

Gale & Stern (1967) compared conditioning effects on ORs to CS+ and CS-. Thirty CS-UCS pairings with a 9.5 second interval were interspersed with thirty unreinforced discrimination stimuli. The OR to reinforced stimuli did not adapt, while the OR to unreinforced stimuli adapted.

It can be seen that increase in response to a CS, when a short CS-UCS interval is used, can be described as a conditioned response. On this point, the three procedures can be considered valid conditioning procedures. However, Stewart et al's criticism, that methods (a) and (b) deal with adaptation and recovery of unconditioned responses, is still valid. Method (c), differential conditioning, allows adaptation and recovery of unconditioned responses to be taken into account. It is thus the most valid method of assessing conditionability.

2.7.2. UCS strength. Eysenck & Levey (1972) found no conditioning differences between extraverts and introverts using a strong UCS, but a weak UCS retarded acquisition in extraverts. A weak UCS did not always elicit a UCR, particularly when extraverts were considered (see P. 51).

Some studies have endeavoured to elicit a constant UCR by presenting different UCS strengths, based on subjective tolerance (Hare, 1970). However, subjective tolerance itself may be influenced by personality variables. Schalling & Levander (1964) found that non-anxious psychopaths had higher electric shock tolerance levels than anxious psychopaths. Other studies (Hare, 1965b) have found no differences in UCS tolerance between psychopathic types, but as Hare (1970) acknowledges, psychopaths are less likely to accept more pain than necessary.

Personality differences in UCS tolerance were considered to be one aspect of susceptibility to punishment, and hence, following Gray (1970, 1971 a and b) possible differences should be included in conditionability assessment. Thus a strong UCS which elicits consistent large amplitude responses in all subjects is recommended.

Aversive autonomic conditioning studies have generally used electric shock (Hare, 1970) or loud noise (Vogel, 1960; 1961). Disadvantages of electric shock are associated with subjective expectations and subsequent unwillingness to volunteer for experiments, regardless of shock strength. Hence a strong auditory UCS of equal strength for all subjects is recommended.

2.7.3. CS-UCS interval. Eysenck & Levey (1972) considered that a short CS-UCS interval favoured introvert's conditioning, provided UCS was weak (See P. 51).

Eysenck & Levey used a short latency eyeblink response, which is not directly comparable to the longer latency of the EDR. Kimmel &

Pennypacker (1963) compared differential EDR conditioning using four CS-UCS intervals; .25, .5, 1 and 2 seconds respectively. Differential conditioning increased as a function of CS-UCS interval. It was thus considered appropriate to use a 2 second CS-UCS interval for measures of conditionability.

2.7.4. Reinforcement. Eysenck & Levey (1972) predicted that partial reinforcement would favour introverted conditioning. However, their experimental results showed that this variable contributed least to extravert-introvert differences in conditioning.

Although the partial reinforcement effect increases responding during extinction, information regarding extinction onset abolishes this effect (Hartman & Grant, 1962). Consequently, there appear to be no advantages in using partial reinforcement. However, the conditioning technique, to be developed, is an analogue of the socialisation process, and since socialisation is thought to be mediated by conditioning on a partial reinforcement schedule, partial reinforcement should be employed in the conditioning paradigm.

2.8. Conditioning methodology.

At the end of Chapter I, it was decided that CR extinction measures gave a better analogue to the socialisation process than CR acquisition measures. CR extinction measures also have the advantage over CR acquisition measures, in that contamination from relational learning can be removed. "True" conditioning can be measured by informing subjects of CS-UCS contingencies before acquisition, so that all conditioning trials are effective, and informing subjects of extinction onset in order to remove relational learning effects.

Motivational factors can be controlled by directing subjects' attention away from the conditioning procedure by use of a masking task. However, unrelated masking tasks can reduce differential responding, while masking tasks requiring a different motor response to CS+ and CS- can exaggerate conditioning. The masking task should thus direct subjects' attention to CS+ and CS- without requiring any voluntary response from the subjects.

In Chapter I, aversive autonomic conditioning was considered to be directly related to socialisation processes, while eyeblink conditioning might be indirectly related to socialisation provided an aversive UCS was used. In section 2.5. measures of conditioning in peripheral response systems were considered to be a reflection of central processes, and hence suitable for monitoring aversive conditioning. Within response systems, the electrodermal system was considered superior to other systems, since it had only sympathetic ennervation and was not range restricted.

Experimental parameters used in conditioning studies have been a controversial topic. However, evidence suggests that differential conditioning measures should be used. A two second interval has been found to be most satisfactory in EDR conditioning, while the necessity for a reliable UCR indicates use of strong UCS. Partial reinforcement is recommended since it gives a closer analogy to socialisation processes than complete reinforcement.

It can be seen that conditionability should be measured by electrodermal CR extinction with awareness of CS-UCS contingencies and extinction onset. Experimental parameters should be differential conditioning, two second CS-UCS interval (onset to onset), strong UCS and partial reinforcement.

CHAPTER 3.

Development of a measure of conditionability.

This chapter describes a previously developed conditioning procedure (McComb, 1970) and determines the most appropriate data transformation together with a conditionability index, experimentally.

3.1. Conditioning procedure.

3.1.1. Apparatus. The subject sat in a comfortable chair in a sound attenuated chamber in front of the manifest task and conditioning stimuli.

The manifest task was a car driving simulator, consisting of a black box containing a plastic coated metal drum (18" in diameter), a portion of the drum was visible through a window cut out of the box front. This window was illuminated from above by a filament lamp placed just inside the box. The drum was rotated by an electric motor connected to a horizontal spindle through its centre. A narrow, irregular track was etched on the drum surface. A moveable metal pointer in the illuminated window, rested on the drum surface. This pointer was attached to a shaft extending out in front of the box, connected to a circular disc with a handle mounted on its circumference. The metal pointer could thus be moved horizontally across the drum surface, by turning the handle. (See figure 3.1).

Conditioning stimuli were 5 lights (red, green, blue, orange and white) mounted immediately above the box window, equidistant from each other, in a horizontal row. The auditory stimulus was white noise at 100 db s.p.l, .0002 dynes / cm^2. This was generated by a Behaviour Apparatus white noise generator and presented from an 8 Watt Beocord (Denmark) speaker, placed at the subject's feet. Both visual and auditory stimuli were operated by switching 24 volts DC through relays controlled by pre-programmed tape.

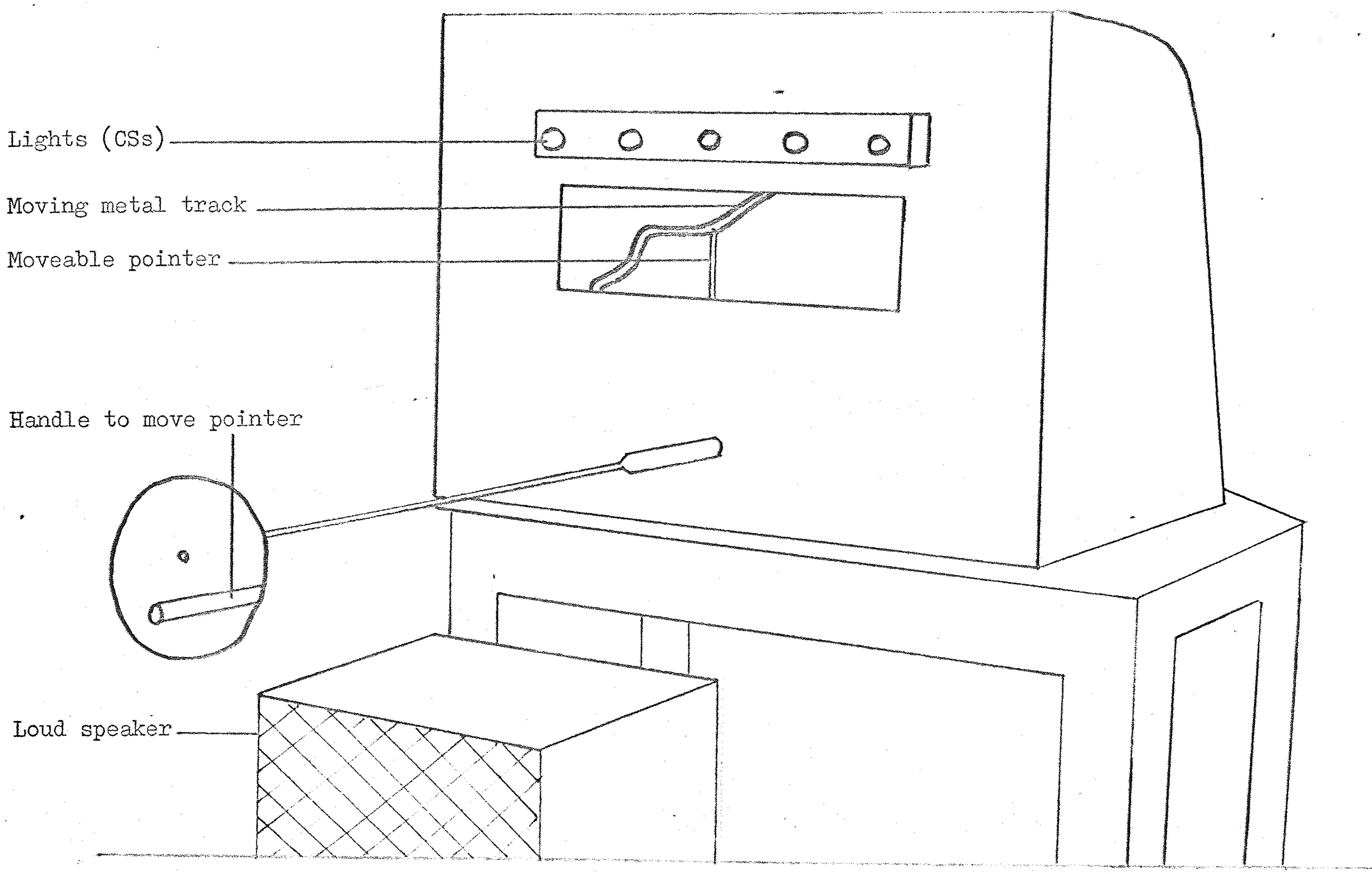


Fig 3.1. Apparatus for conditioning procedure

Control and monitoring equipment were in a room adjacent to the sound attenuated chamber. Stimulus presentations were controlled by paper tape, fed through an 8 channel tape reader, set to step once every second. Programmed tape was also coded to record all stimulus presentations on the event channel of a Grass Model 7 polygraph.

The Grass Model 7 polygraph gave a continuous electrodermal record in resistance, baseline and sensitivity could be varied to produce maximum accuracy of recorded response for each subject. Minimum amplitude recorded was 50 ohms. The polygraph was accurate to within ± 10% up to 100 K ohms. Few subjects exceeded this level.

3.1.2. Circuit. A constant current circuit was used, since the advantages of this method (Edelberg, 1967) seemed to outweigh advantages and disadvantages of a constant voltage circuit.

In a constant current circuit, subject's resistance is measured directly, by measuring voltage across the electrodes arising from passage of a constant current. In a constant voltage circuit, a source of low voltage is connected across the electrodes and current measured by inserting a small resistance and recording voltage drop accross it. Drop in voltage is proportional to current.

Montague & Coles (1966) recommended the constant voltage method. They argue that a constant current system depends, not only on current density per unit area, but on effective density per physiological unit. Sweat glands act in parallel, so conductance varies linearly with number of active sweat glands (See P.120 for details). In a constant voltage circuit, voltage across each active unit will be constant, total current varying with number of active units, but current density per unit area remaining the same.

Lykken & Venables (1971) demonstrated that a constant voltage circuit needed less sensitivity and base line re-settings. It also had the advantage of producing a record in conductance units, rather than resistance produced by a constant current circuit.

It can be seen that it would have been preferable to use a constant voltage circuit. However, at the start of the research programme the two methods had not been adequately compared.

3.1.3. Electrodes. The reference electrode was a Ag-AgC1, B1 SLE electrode. The dorsal surface of the wrist, between the ulna and ulnare was abraded until slight reddening of the skin occurred. The electrode was filled with Cambridge jelly and attached to the abraded site by means of adhesive tape. This type of abrading is generally considered to lower resistance at the electrode site, to less than 1 K ohm and hence be regarded as negligible.

The active electrode was a dry, Ag-AgC1 disc, 2.5 cm^2 giving approximately 10 micro-amps per cm^2 at the electrode sight. It was held in place on the palm of the hand, by a perspex clamp containing a spring as shown in figure 3.2.

The active electrode was recommended by Edelberg (1967) since its size reduces current density and hence polarisation. In practice, this electrode tended to lose its Ag C1 coating. This did not appear to affect recording.

It has been suggested that a large, dry, active electrode is subject to error from surface sweat. Effective electrode area would thus be electrode area plus area connected by surface sweat (Venables & Christie, 1973).

Use of a range correction in data analysis may overcome some of the disadvantages connected with use of this large, dry active electrode.

3.1.4. Method. The experiment was presented as a driving task with instructions to try to maintain a pointer or car on an irregular moving

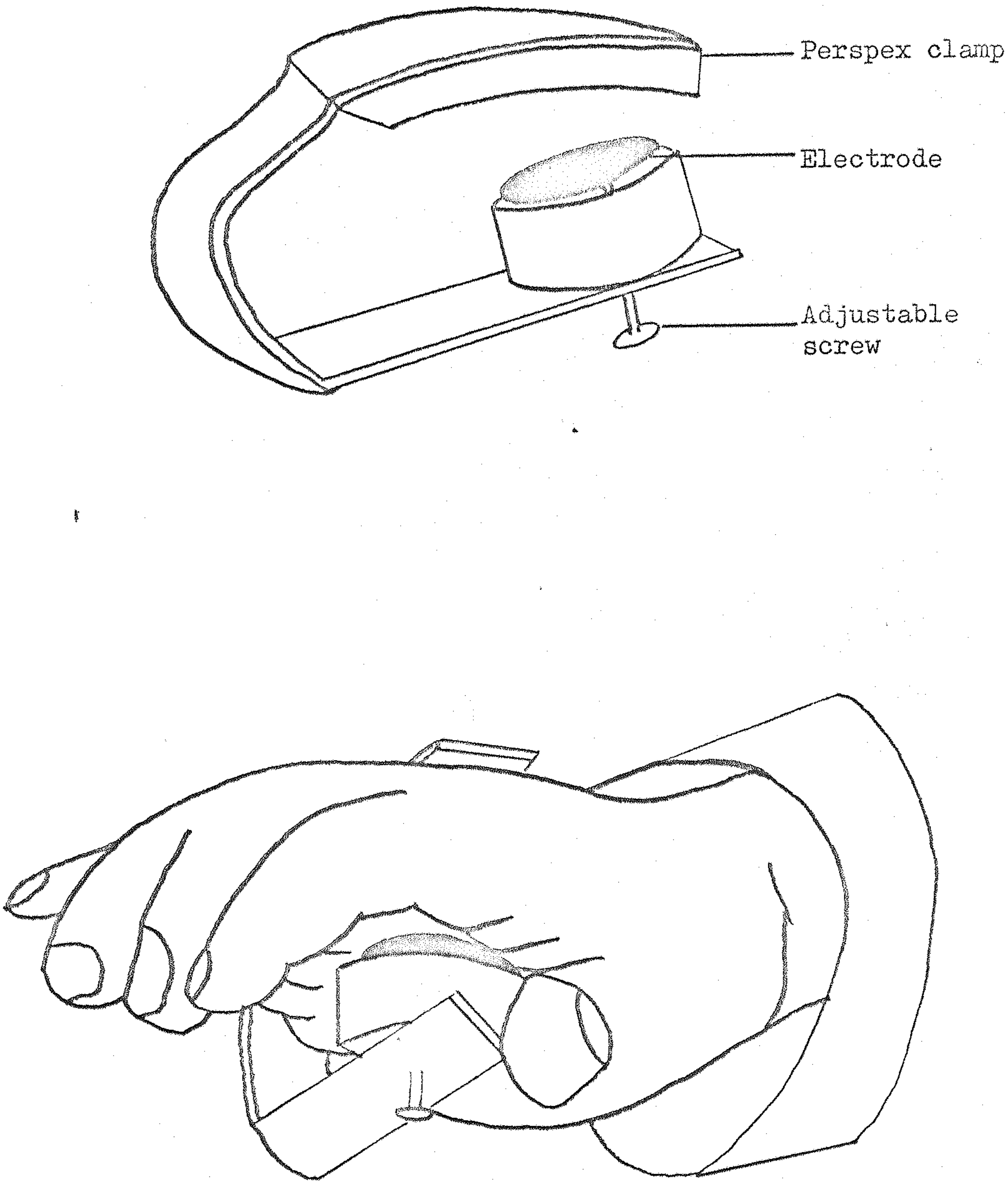


Fig 3.2. Palmar electrode and its placement

track or road. The task served to direct the subject's attention to the conditioning stimuli and to maintain a minimal level of alertness. Subjects could be observed from the control room via a one-way window set behind the seated subject.

Electrodermal activity was recorded continuously on a Grass Model 7 polygraph. Two electrodes were attached to the non-preferred hand.

A two second visual stimulus was presented every 9, 12 or 15 seconds (onset to onset) in a predetermined random order with restrictions over runs of any particular colour. UCS onset occurred at CS termination, and lasted for one second.

All subjects were given a short practice session before the experiment began, this consisted of one presentation of each visual stimulus and an unpaired UCS. Subjects were informed of this sequence beforehand and afterwards given the opportunity to refuse to participate. No subject refused.

The experiment was divided into three phases:- habituation, acquisition and extinction. The procedure is summarised in the Table 3.1. below:-

TABLE 3.1.

Experimental Procedure.

Habituation.	Acquisition.	Extinction.
5 presentations of each of the 5 lights.	13 presentations of each of the 5 lights. 10 reinforced CS-s. 3 unreinforced CS-s.	15 presentations of each of the 5 lights. Divided into 3 blocks.

The subject was told to start driving and informed that he would receive any of the stimuli which had occurred in the practice session. He was left shut in the sound attenuated chamber and received the habituation phase of 5 presentations of each of the 5 lights. When this phase was completed, the experimenter entered the sound attenuated chamber, turned on the light and gave the following instructions:-

"So far, you have had no noise, now you will be getting some. The noise will always be preceded by this orange light".

The experimenter pointed to the orange light while giving instructions. The light was turned out, the experimenter left the room and started the acquisition phase. This consisted of 13 presentations of each of the 5 lights including 10 CS-UCS pairings. Inter CS intervals (onset to onset) ranged from 40 to 80 seconds resulting in a mean interval of 60 seconds.

After acquisition, the subject was again interrupted and told:

"You will now be getting no more noise. I am disconnecting the leads to the loudspeaker, so that it is quite impossible for you to receive any more noise."

The experimenter disconnected the leads and laid them on the table in front of the subject. She left the room and started the extinction phase, consisting of 15 presentations of each of the 5 lights.

Following extinction, the subject had the electrodes removed and was allowed to leave.

The apparatus and conditioning procedure were originally devised and developed by McComb (1970).

3.2. The electrodermal response. (EDR).

3.2.1. Physiological bases of electrodermal activity. Theories concerning physiological bases of electrodermal activity, were summarised by McCleary (1950). Three main theories were considered:-

a) The vascular theory, originally proposed by Foré (1888), suggested that electrodermal activity was caused by vasodilation.

b) The secretory theory, originally proposed by Tarchanoff (1890), suggested that electrodermal activity was caused by sweat gland secretion.

c) The muscular theory, proposed by Sommer (1902), suggested that involuntary muscular activity caused electrodermal responses. This theory was later modified by Sidis & Nelson (1910), who considered that the EDR was an EMF produced by covert muscular activity.

Evidence in favour of the muscular theory is ambiguous. Cutting motor nerves eliminates the EDR but also cuts sweat gland and blood vessel nerves. Increase in muscle tension by voluntary muscular activity causes an EDR, but exercise causes changes in all physiological response systems. French (1944) compared simultaneous recordings of EDR and finger tremor. Finger tremor had a shorter latency and faster decay time than the EDR. He concluded that the EDR was an autonomic response, since rate of conduction was slower than in somatic motor systems.

Lader & Montague (1962) found clear evidence to support the secretory theory rather than the vascular theory. EDR and pulse volume were recorded simultaneously from the same finger, under two different drug conditions. Bretylium, a drug which abolished vaso-motor activity, left the EDR unimpaired, while atropine, a drug which abolished the EDR, left vasomotor activity intact.

3.2.2. Electrodermal activity measured in conductance. Montague & Coles

(1966) proposed an electrical model of the skin. (See Figure 3.3.). When two electrodes are placed on the body surface, then resistance between them is due mainly to the stratum corneum (outer layer) of the skin. This is perforated by sweat ducts, which are potentially conducting pathways, depending on sweat gland activity. Active sweat glands act as resistors in parallel, so that overall conductance is the sum of conducting pathways.

Sweat gland activity switches the sweat ducts into the circuit, resulting in total resistance = $\dfrac{1}{\frac{1}{R_o} + \frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3} + \ldots \frac{1}{r_n}}$

or expressed in conductance:-

Total conductance = $C_o + C_{c1} + c_2 + c_3 + \ldots . . c_n$

The difference between measuring resistance change and conductance change is readily apparent when real data are used. e.g. in Figure 3.4., resistance change = a - b, whereas conductance change = $\frac{1}{b} - \frac{1}{a}$

If a = 10.6 Kohms and b = 10 Kohms, then resistance change = 10.6 - 10 = 0.6 Kohms.

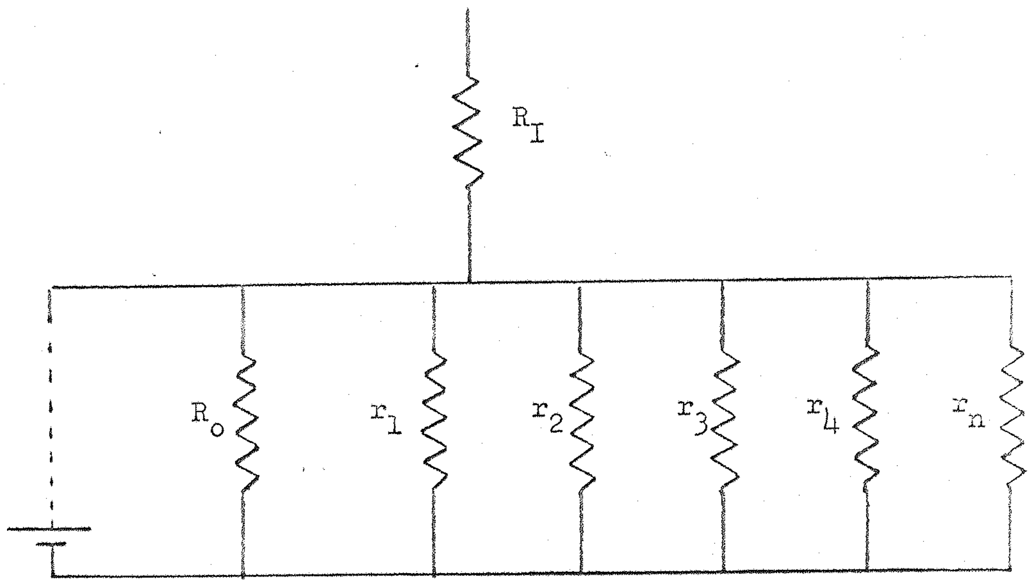
Conductance change = $\frac{1}{10} - \frac{1}{10.6} = .566 \times 10^{-6}$ mhos.

If a = 100.6 and b = 100 Kohms, then resistance change = 100.6 - 100 = 0.6 Kohms. The same as above.

However, conductance change = $\frac{1}{100} - \frac{1}{100.6} = .00596 \times 10^{-6}$ mhos.

It can be seen that use of conductance or resistance units, seriously effects the final data obtained.

If Montague & Coles' model is correct then conductance units should be chosen. There is empirical support for their model. Lader (1970) recorded EDR simultaneously from two fingers. Atropine, a drug which abolishes EDR, was introduced into one finger and saline into the control finger. The EDR of the atropinised finger was



KEY

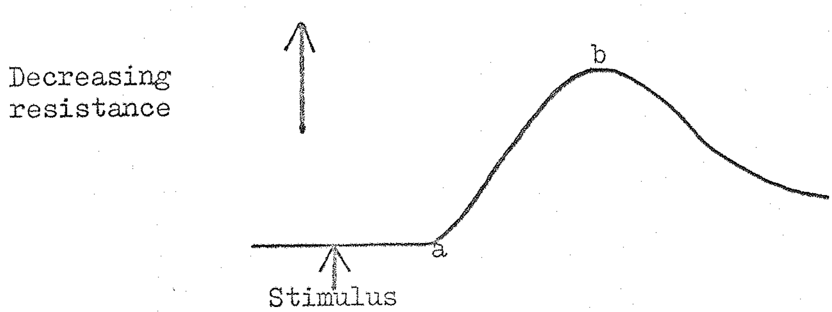
R_I = Resistance of body interior, which is comparatively small.

R_o = Small residual conductance unaccounted for by sweat gland activity.

r_1 to r_n = Sweat ducts.

Figure 3.3. Schematic diagram of the stratum corneum

Montagu & Coles (1966, P.262)



a = response onset. b = response peak.

Figure 3.4. A hypothetical EDR in resistance

expressed as a percentage of the corresponding control EDR. When each EDR was quantified in conductance, a regular exponential decrease was obtained from readings over a 40 minute period. When each EDR was quantified in resistance, there were gross irregularities in responses obtained over the 40 minute period.

EDR reliability has also been compared using resistance and conductance. Bull (1972) recorded EDR in two sessions with a one week interval. Mean EDR magnitude of responses to tones were reliable when measured in conductance ($p < .01$) but not when measured in resistance.

It can be seen that Montague & Coles' electrical model of the skin has empirical support, hence EDR should be measured in conductance units.

3.3. Quantification of electrodermal conditioning.

The most common EDR measures employed have been:-

a) Latency: Time from stimulus onset to response onset.

b) Recruitment: Time required for response to reach its peak.

c) Response probability: Number of responses expressed as a percentage of number of stimulus presentations.

d) Response amplitude: Change in electrodermal activity following a stimulus, expressed in ohms or mhos. This measure excludes instances of non-response to a stimulus.

e) Response magnitude: Response amplitude including instances of non-response to a stimulus.

f) Response area: Area under the response curve, derived from amplitude and duration of the response.

There has been a general assumption that all these measures are equivalent measures of Hull's (1943) excitatory potential. However, evidence suggests that this assumption may be invalid.

Hilgard & Campbell (1936) found that amplitude curves of eyelid conditioning tended to increase over trials. Spence (1956) confirmed this tendency. However, measures of response latency do not replicate this tendency. Martin & Levey (1969) reviewed evidence which reported both increases and decreases of response latency over acquisition trials. Differences between measures were also found by Humphreys (1943). He factor analysed five measures of eyelid conditioning:- a criterion measure (trial number of fifth CR), frequency, amplitude, latency and magnitude. Factor I included acquisition latency, extinction frequency and extinction latency. Factor II consisted of acquisition amplitude, extinction amplitude and UCR amplitude. Prescott (1964) replicated this study using EDR data. Factor I included CR magnitude in acquisition and extinction and first

OR amplitude. Factor II had highest loadings on frequency and short latency. This suggests that measures of CR amplitude and CR magnitude differ from measures of CR latency and CR frequency.

Martin & Levey (1969) recommend various other measures of conditioning with particular reference to eyelid conditioning. These measures depend on comparisons between the CR and subsequent UCR during acquisition. e.g. Barr & McConaghy (1972) used Martin & Levey's work ratio to measure electrodermal CR acquisition (See P. 100). However, Martin & Levey's measures are specific to CR acquisition and cannot be used in extinction.

Prescott's factor analysis of electrodermal conditioning a latency/frequency factor and a magnitude factor for acquisition and extinction. Martin & Levey consider latency an equivocal measure of conditioning and hence magnitude data was considered to give the most valid measure of conditioning.

3.2.4. Response criterion. It has been argued that CRs are ORs to UCS ommission from a compound CS-UCS stimulus (Badia & Defran, 1970). Use of the traditional short (.5 second) CS-UCS interval resulted in an ommission OR superimposed upon the response to CS. A long (3 or 5 second) CS-UCS interval caused either a multiple response or separate responses to CS and UCS. Later, Gliner, Harley & Badia (1971) were unable to obtain consistent om ission ORs to the second stimulus element of a compound stimulus with a 5 second CS-UCS interval. This suggests that increased responding using a short CS-UCS interval may also be inconsistent.

Inspection of our acquisition records showed a "where is it response" to om itted UCSs. This was particularly obvious after the first unreinforced UCS. The shape of this response differs from the CS-UCS multiple response, in displaying a number of multiple responses and a longer recovery time. Figures 3.5. and 3.6. show the comparison between typical examples of these compound responses.

The two second interval was considered long enough to show multiple responses rather than incremental responses to CSs in extinction. Hence a response to a stimulus was counted if it occurred between 1 and approximately 3 seconds after stimulus onset. The latter criterion was determined from the longest CR latency in acquisition. In the case of multiple responses occurring within the criteria, the first response was measured.

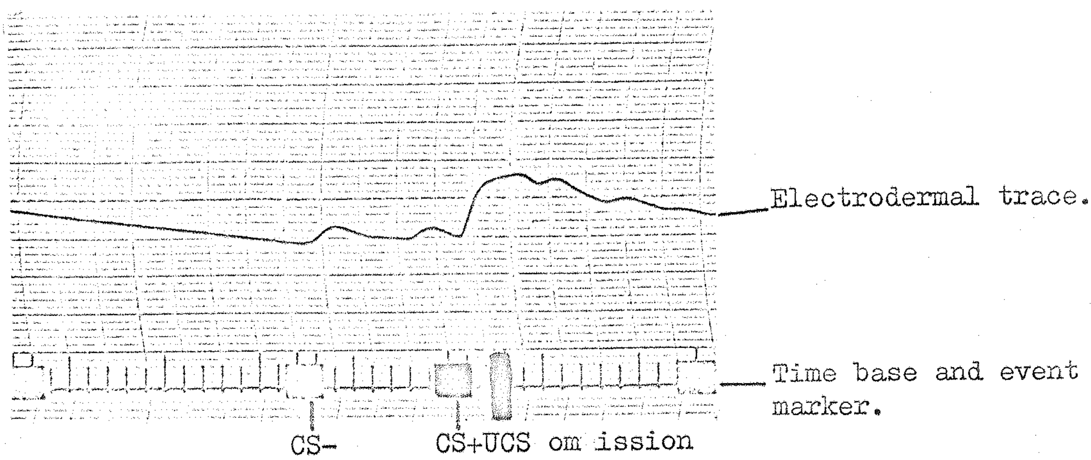


Figure 3.5 Response to CS+ and UCS om ission.

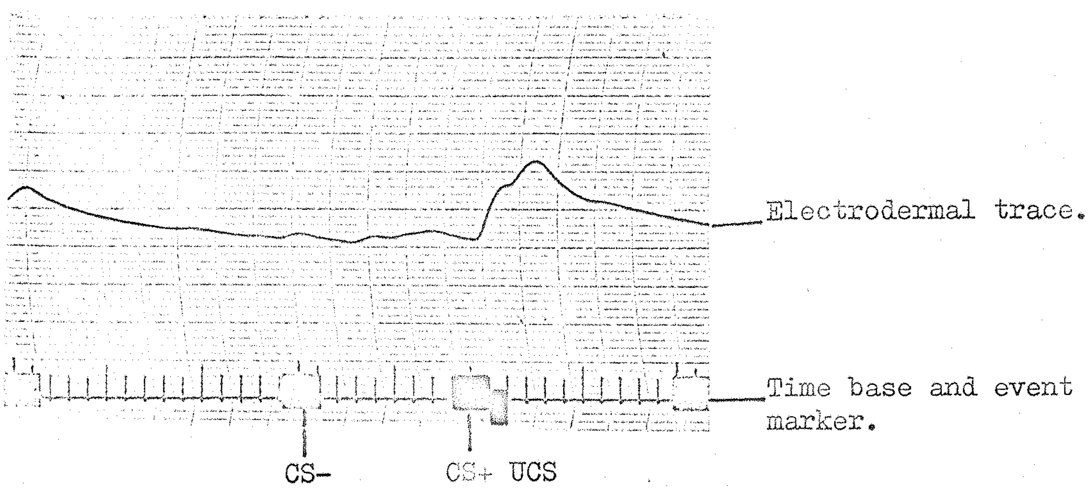


Figure 3.6 Response to CS+ UCS compound stimulus.

3.4. Data transformation and measurement discriminative responding.

EXPERIMENT I.

3.4.1. Data transformation. Electrodermal activity can be extremely variable, both within and between subjects. In magnitude data, responses and "zero responses" to a standard number of stimuli are summed. If the original single responses are not transformed, then it is possible for response magnitude to be determined by one large amplitude response alone or many small amplitude responses. Since, in the former case, this can lead to gross data distortion, it has been customary to use some type of data transformation. This has usually been a log transformation, although alternatives such as square root have normalised data (Ziener & Schell, 1971).

Two types of log transformation can be used:-

a) Log of change in conductance.

$$\text{Log } \frac{1}{b} - \frac{1}{a}$$

See figure 3.4. for notation.

b) Change in log conductance.

$$\text{Log } \frac{1}{b} - \log \frac{1}{a}$$

See figure 3.4. for notation.

The latter transformation takes initial response level into account. Benjamin (1963) suggested that electrodermal data should be corrected for initial basal level, since Wilder's (1956) Law of Initial Values (LIV) stated that response amplitude was related to pre-stimulus level. Benjamin gave, as an example of LIV in electrodermal activity, response to a auditory stimulus, measured in resistance change correlated with initial skin resistance ($r = .965$).

The importance of the LIV in electrodermal data has been questioned by Lykken & Venables (1971). They consider that operation of the LIV in electrodermal data has four causes:-

a) Use of resistance instead of conductance.

Using Montague & Coles' (1966) model of the skin, they argue that change in one parallel resistance has an effect on total resistance, which is dependent upon all resistance values in parallel. Change in one parallel conductance is additive and thus potentially independent of total conductance. The fact that correlations between tonic and phasic responses measured in resistance were generally higher than those measured in conductance, was considered support for this notion.

b) A common factor extraneous to electrodermal activity is being measured.

When response amplitude is constant, no correlations between SCR and SC within individuals may be apparent, while between subject correlations may be inflated by individual differences in response amplitude.

c) If SCL is already high, the maximum possible SCR may be limited.

Negative SCL/SCR correlations will tend to be produced when SCL is high, but no correlations when SCL is low. Alternatively, when SCL is low there may be larger correlations for strong stimuli than for weak stimuli.

d) Different tonic SCLs may represent different arousal states.

An SCR to a moderately painful shock could be high for a drowsy subject, lower for a moderately alert subject and low for a subject already excited near his upper limit.

Lykken, Rose, Luther & Maley (1966) demonstrated that between subject comparisons of tonic SCL were not necessarily related to inter-subject differences in arousal. Minimum skin conductance was obtained during a relaxation period, while maximum skin conductance was measured while subjects blew up a balloon until it burst. Some subject's maximum skin conductance could be less than other subject's minimum skin conductance. They argue that one subject under stress is not less aroused than another subject during relaxation, therefore subjective limits are determined by structural and physiological factors unrelated to arousal. Thus it may not be appropriate to remove all correlation between tonic and phasic responses.

Lykken & Venables (1971) consider that conductance measurement removes correlation due to mathematical properties of resistance measurement, while a log transformation is unnecessary if data is corrected for response range. Lykken (1972) compared uncorrected conductance data with data obtained from two types of range correction. An experiment testing predictability of shock locus was used to determine which transformation demonstrated the predicted effect best. The two range corrections were:-

a) A range correction using maximum and minimum tonic conductance.

$$\text{Response} = \frac{SCR}{SC}\text{ range.} = \frac{SC\frac{1}{b} - SCL_{Min:}}{SCL_{Max:} - SCL_{Min:}} - \frac{SC\frac{1}{a} - SCL_{Min:}}{SCL_{Max:} - SCL_{Min:}}$$

b) A range correction using maximum response amplitude.

$$\text{Response} = \frac{SCR}{SCR_{Max:}} = \frac{SC\frac{1}{b} - SC\frac{1}{a}}{SCR\ Max\ \left(\frac{1}{B} - \frac{1}{A}\right)}$$

Maximum response of each subject, to one of a series of electric shocks, was used to determine $SCR_{Max:}$. Uncorrected raw conductance data gave inconsistent results. Method (a), range correction showed a slight trend in the predicted direction, while the hypothesis was confirmed significantly using method (b) range correction.

It can be seen that there are three main methods of data transformation which have substantial theoretical and experimental advantages. There is also a fourth possible transformation, if method (b) range correction produces skewed data, then this range correction could be logged.

The resulting four possible transformations are:-

i) Log of change in conductance.

$$\text{Log} \ \frac{1}{b} - \frac{1}{a}$$

ii) Change in log conductance.

$$\text{Log} \ \frac{1}{b} - \log \frac{1}{a}$$

iii) Change in conductance expressed as a proportion of change in conductance of maximum response.

$$\frac{\text{SCR} \quad \frac{1}{b} - \frac{1}{a}}{\text{SCR}_{\text{Max:}} \quad \frac{1}{B} - \frac{1}{A}}$$

iv) Log change in conductance expressed as a proportion of change in conductance of maximum response.

$$\text{Log} \left[\frac{\text{SCR} \quad \frac{1}{b} - \frac{1}{a}}{\text{SCR}_{\text{Max:}} \quad \frac{1}{B} - \frac{1}{A}} \right]$$

The usual criterion to assess efficient data transformation is normally distributed data. Lack of normal distribution precludes any further parametric analyses.

3.5. Measurement of discriminative responding.

Discriminative responding must be measured by some form of comparison between CR + magnitude and CR - magnitude. Three different methods can be used for this comparison:-

a) CR+ magnitude can be expressed as a percentage of total response magnitude to all stimuli (McComb, 1970).

$$\text{Differential response} = \frac{CR}{CR+ \; + \; CR-} \times 100.$$

b) The difference between CR+ magnitude and CR- magnitude can be used.

$$\text{Differential response} = CR+ \; - \; CR-.$$

c) Mean CR+ magnitude can be regressed on mean CR- magnitude.

$$\text{Differential response} = \frac{CR+ \; - \; r.CR-}{1 - r^2}.$$

where r = correlation between CR+ and CR-.

Use of method (a) can lead to data distortion, particularly when a subject has a large number of "zero responses". e.g. a subject could have one very small CR+ and no CR-s in a whole extinction block. The resultant values of differential responding would be 100%, which is an artefact of this measure, rather than a proper estimate of differential responding.

Method (b) has the advantage of simplicity. However, if the difference between CR+ magnitude and CR- magnitude correlates with CR- magnitude, it could be contaminated by a general electrodermal activity factor.

Method (c) removes influence from any general electrodermal activity factor. The disadvantage of this method is that results from one experiment are not directly comparable with further experiments. If between experiment comparisons are required, then all data must be re-analysed for the new total correlation coefficient to be used for regression. If CR- is effected by CS-UCS pairings, then CR- is not an appropriate baseline for a regression analysis.

Martin & Levey (1969) define a conditioned response as the gain in response which cannot be predicted from initial response value. They propose a three stage model of CR acquisition:-

a) Stimulus registration.

b) Registration of the CS-UCS contingency.

c) Conditioned stage of response integration and shaping. Estes (1972) suggested a two-stage process for differential CR acquisition:-

a) Increase in responding to all stimuli on the same stimulus continuum.

b) Increase in CR, with a simultaneous decline in responding to other stimuli on the same continuum.

Information regarding CS-UCS contingency should eliminate Martin & Levey's first two stages, while Estes' stages can be regarded as a division of Martin & Levey's third stage.

Evidence for a decline in CR-, when a masking task is used, is controversial (See P. 72). In the conditioning procedure, outlined above, an effort was made to direct subjects' attention to CS+ and CS-. A driving task was used and the different coloured lights (CSs) were compared to lights seen driving at night. However, unlike Ross & Nelson (1973), no differential response was required although the masking task was not unrelated to CSs. The effect of this masking task is thus uncertain.

There are three possible courses that CR- could follow; Martin & Levey's third stage suggests that CR- habituates without regard to changes in CR+. In this case a regression analysis to control for electrodermal activity and response habituation would give an uncontaminated measure of differential conditioning.

CR acquisition could show a mixture of Estes' two stages as suggested by Ross & Nelson's masking task effect, or CR acquisition could follow Estes' postulated second stage.

On the assumption that CR acquisition is the reverse process of CR extinction, there are three possible extinction patterns:

a) CR+ decline to meet CR- increase.

b) CR+ greater than CR-, both declining in parallel.

c) CR+ decline with lower unaffected OR habituation of CR-.

These three patterns are represented diagramatically in figures 3.7, 3.8 and 3.9.

If extinction follows course (c), then a regression analysis is appropriate to control for electrodermal activity. However, if extinction follows course (a) or (b), control lights (CSs-) are also affected by CS-UCS pairings and hence cannot be used to assess baseline responding in a regression analysis.

An experiment was therefore designed to include an assessment of CS-UCS pairings on control lights (CSs-).

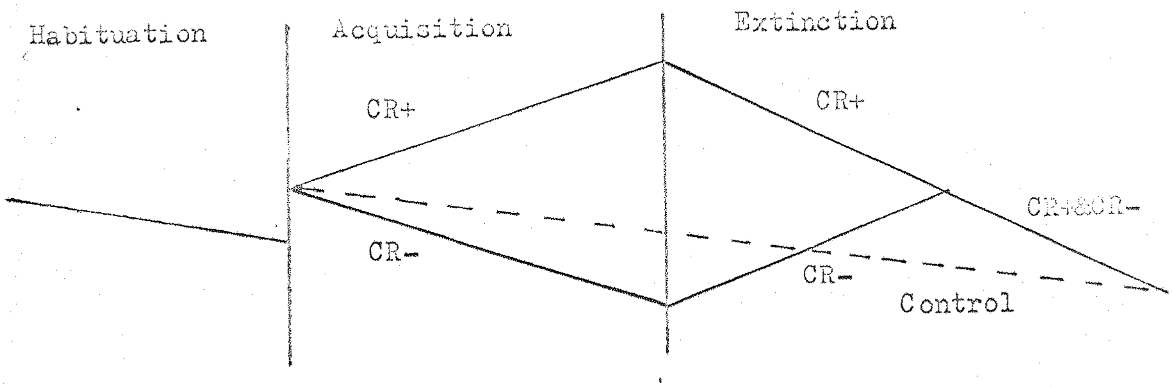


Fig. 3.7   A reversal of Estes's second stage

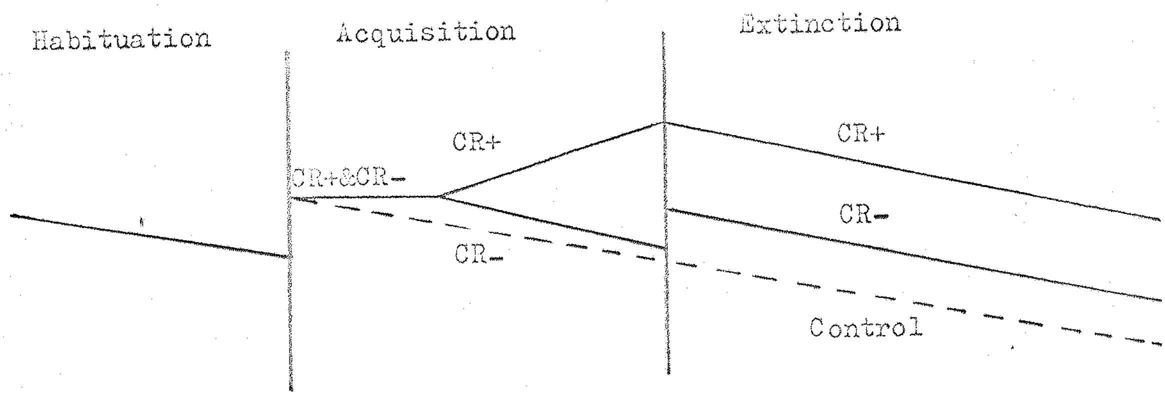


Fig. 3.8.   A reversal of an intermediate stage suggested by the masking task effect

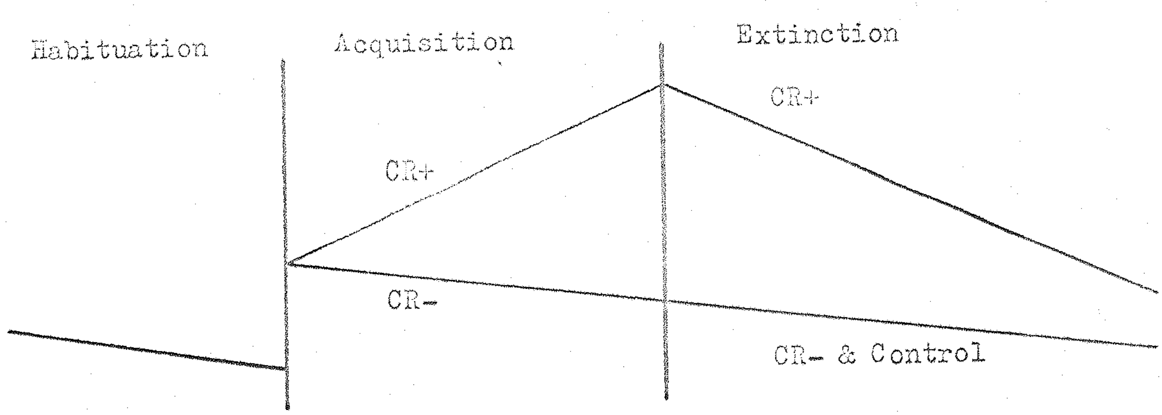


Fig. 3.9.   Increase and decrease in CR+ only

3.6. Experimental method.

The experimental procedure has been previously described (P. 112-118). A control procedure was programmed onto tape. This procedure was identical to the experimental procedure except for the acquisition phase. The acquisition phase was changed so that no UCSs were paired with CSs. Ten unpaired "UCSs" were presented at specified random intervals between visual stimuli, with restrictions over preceding lights, such that each "UCS" preceded each light twice. These "UCSs" were presented to control for possible sensitisation effects from presentation of arousing stimuli.

Inter-subject variability was taken into account by using subjects as their own controls. Order effects were controlled by dividing subjects into two groups; one group were given the control procedure first and the experimental procedure one week later, while the other group had the procedure order reversed.

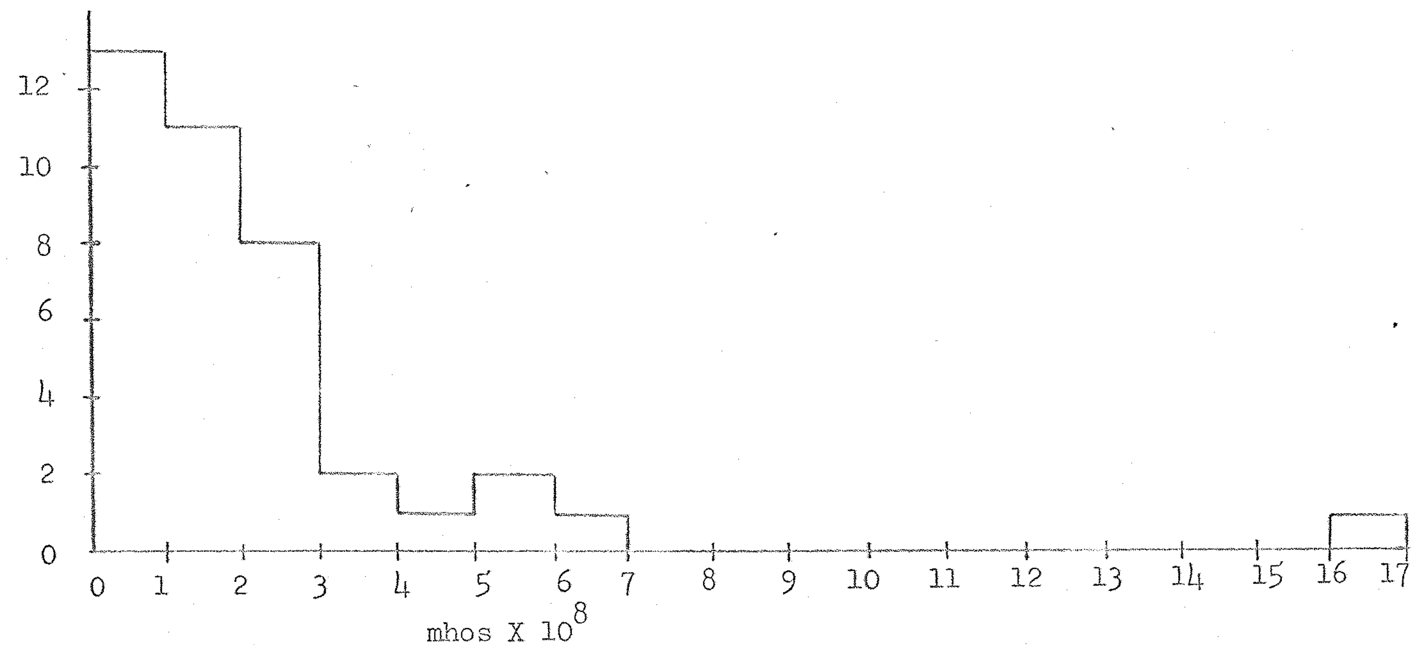
Table of final design.

Group 1.	n = 10.	Control run.	Experimental run.
Group 2.	n = 10.	Experimental run.	Control run.

3.6.1. Data analysis of different transformations. Data for extinction was extracted by reading resistance values (a) and (b) (See previous notation from figures 3.4.). These values were punched onto computer cards. A computer programme was constructed to calculate mean CR+ magnitudes and mean CR- magnitudes during habituation and the three extinction blocks. These results were plotted in a histogram in figure 3.10.

It can be seen that this histogram gives an approximate J-shaped distribution. The data thus required some type of transformation before further analyses could be implemented.

Data was analysed according to the four transformations recommended



<u>Figure 3.10</u> No transformation. Histogram of mean response magnitude to CS- during the total extinction phase.

previously (P130). Transformation (iv) was multiplied by 10^3 before logs were taken in order to remove any negative log values.

Computer programmes were constructed to calculate mean CR+ and CR- magnitudes according to the four different transformation formulae. These programmes were applied to the punched data cards and results plotted in histograms of mean CR+ and mean CR- in habituation and the three extinction blocks.

A chi-square test for goodness of fit determined which transformation produced the nearest approximation to a normal distribution (Ferguson, 1966).

Figures 3.11. to 3.14. show histograms for each data transformation in habituation and the three extinction blocks.

The following table 3.2. gives chi-square values for each histogram's goodness of fit to a normal distribution.

Key for figures 3.11 to 3.14: All scores converted to standard scores.

_______ = Observed score. ------ = Normal score.

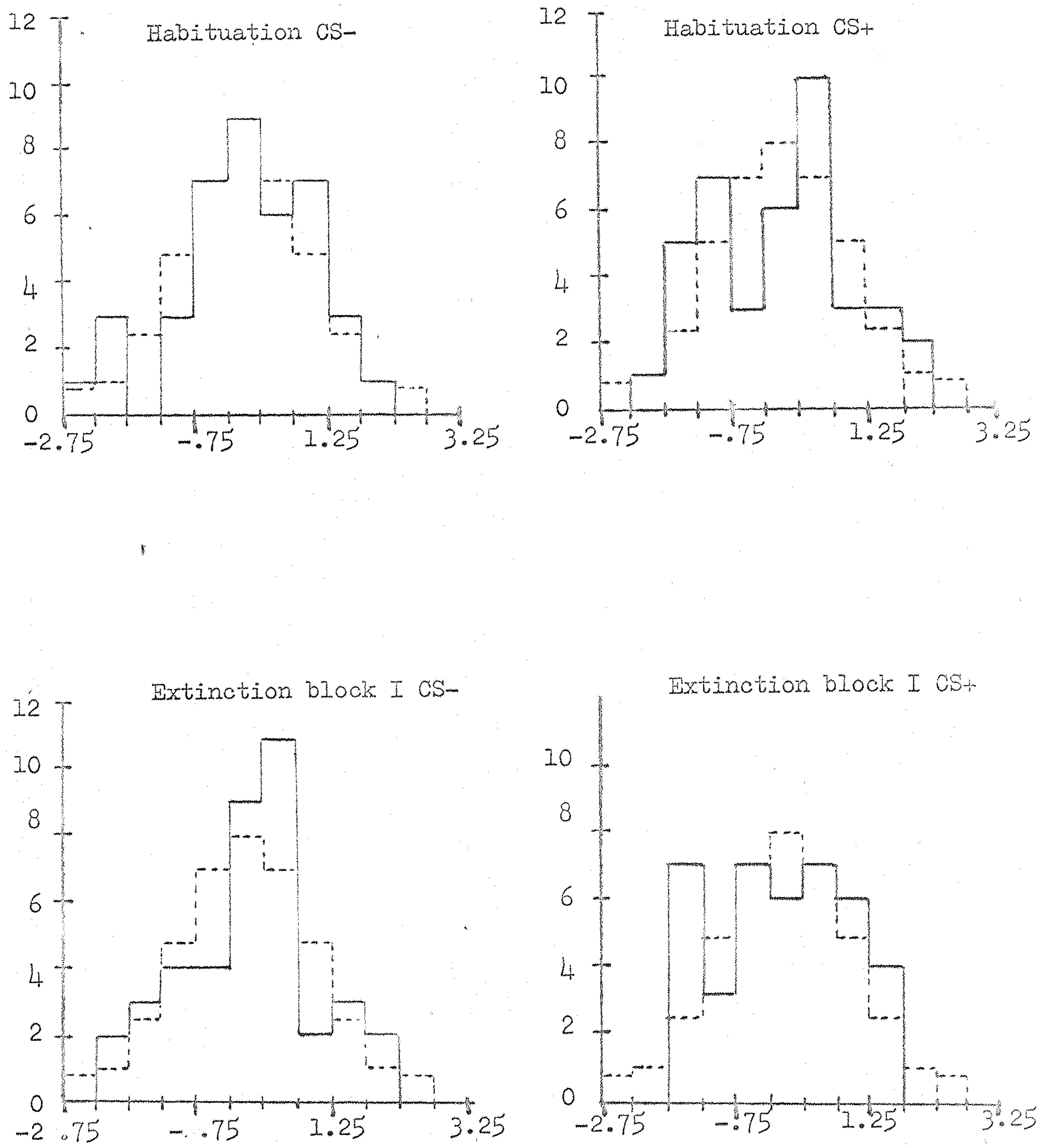


Figure 3.11 Transformation (i) Log of change in conductance

Cont/d.

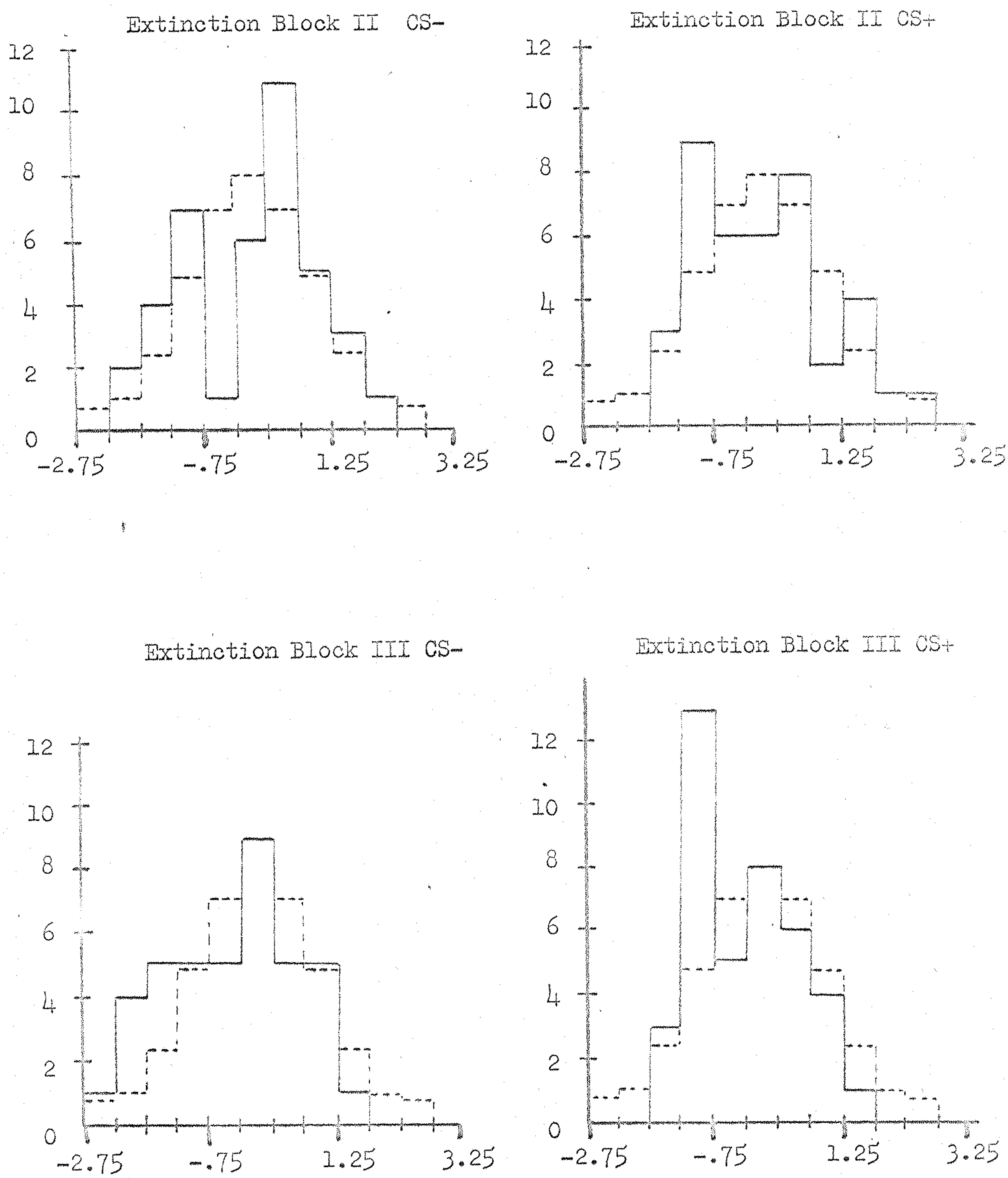
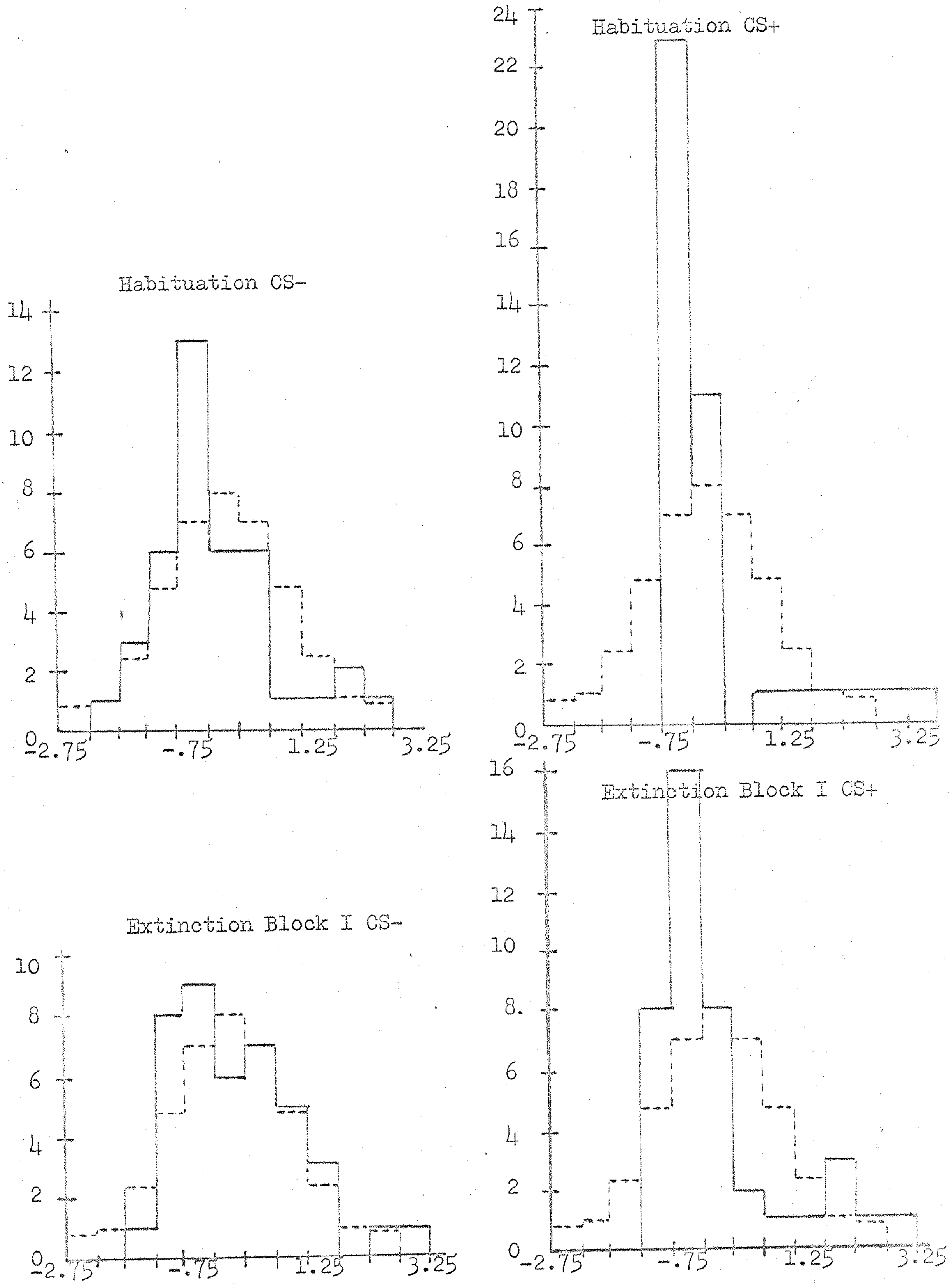


Figure 3.11 Transformation (i) Log of change in conductance



<u>Figure 3.12</u> Transformation (ii) Change in log conductance.

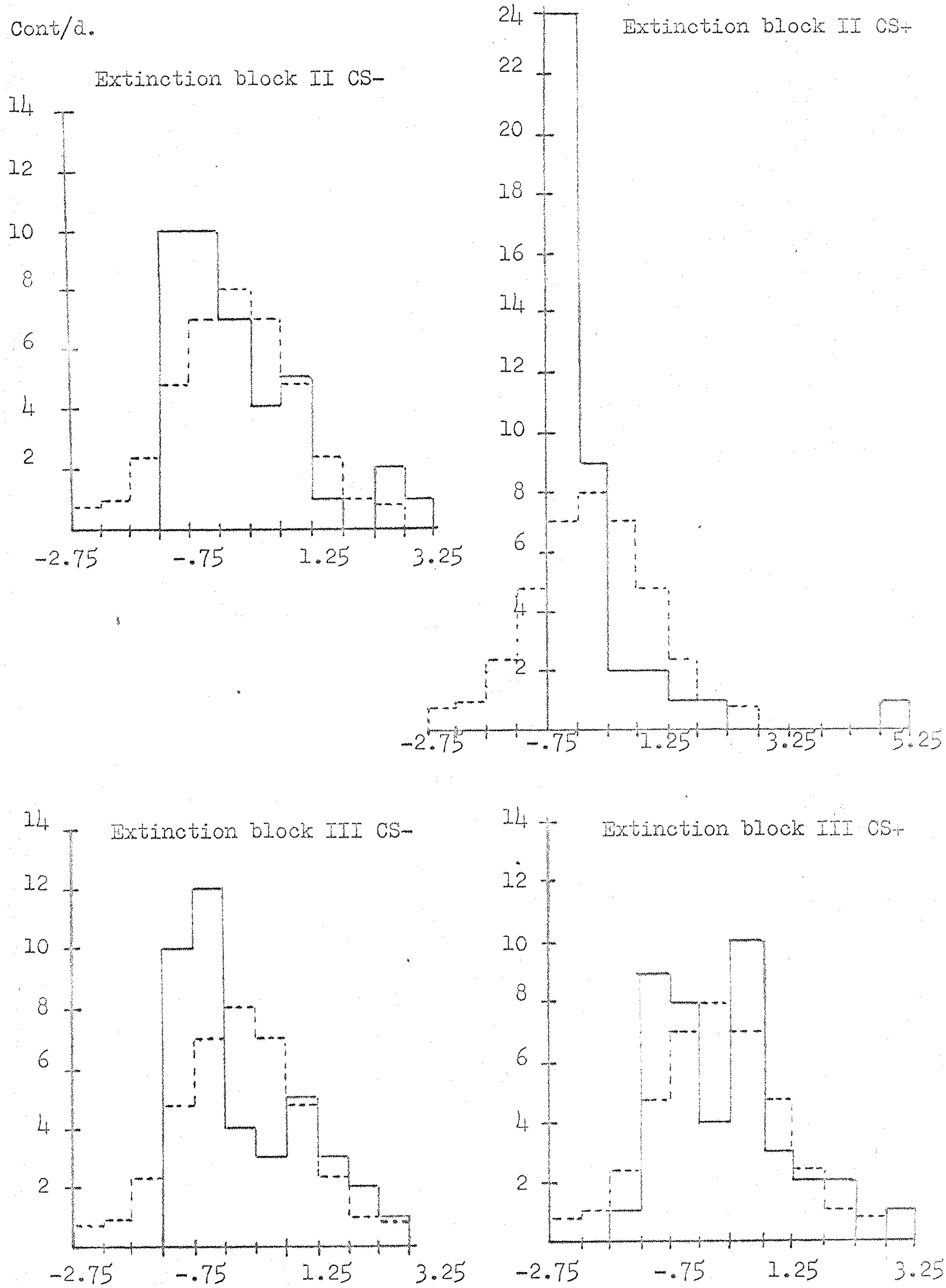


Figure 3.12 Transformation (ii) Change in log conductance

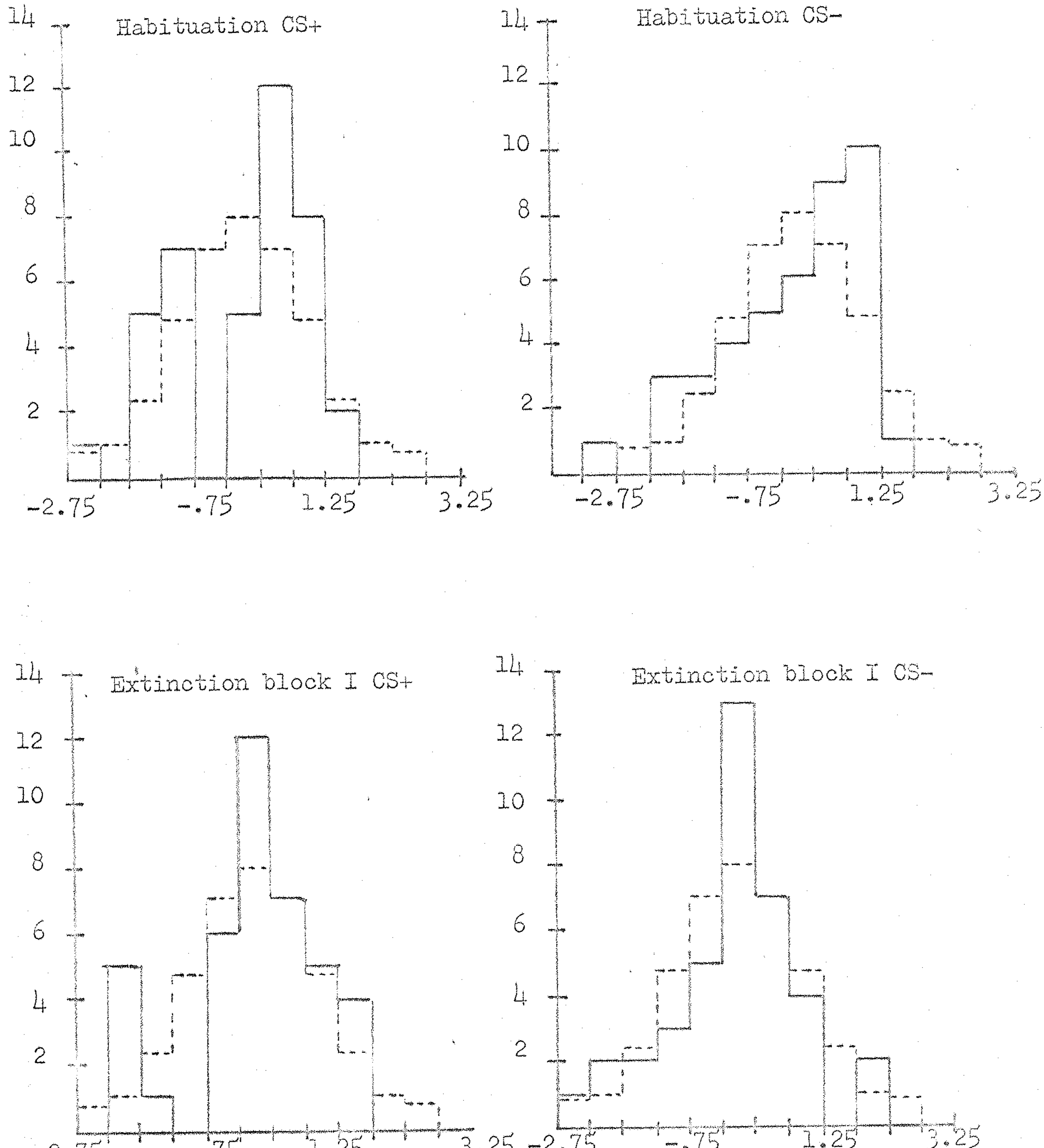


Figure 3.13 Transformation (iii) Conductance change expressed as a proportion of the maximum response

Cont/d.

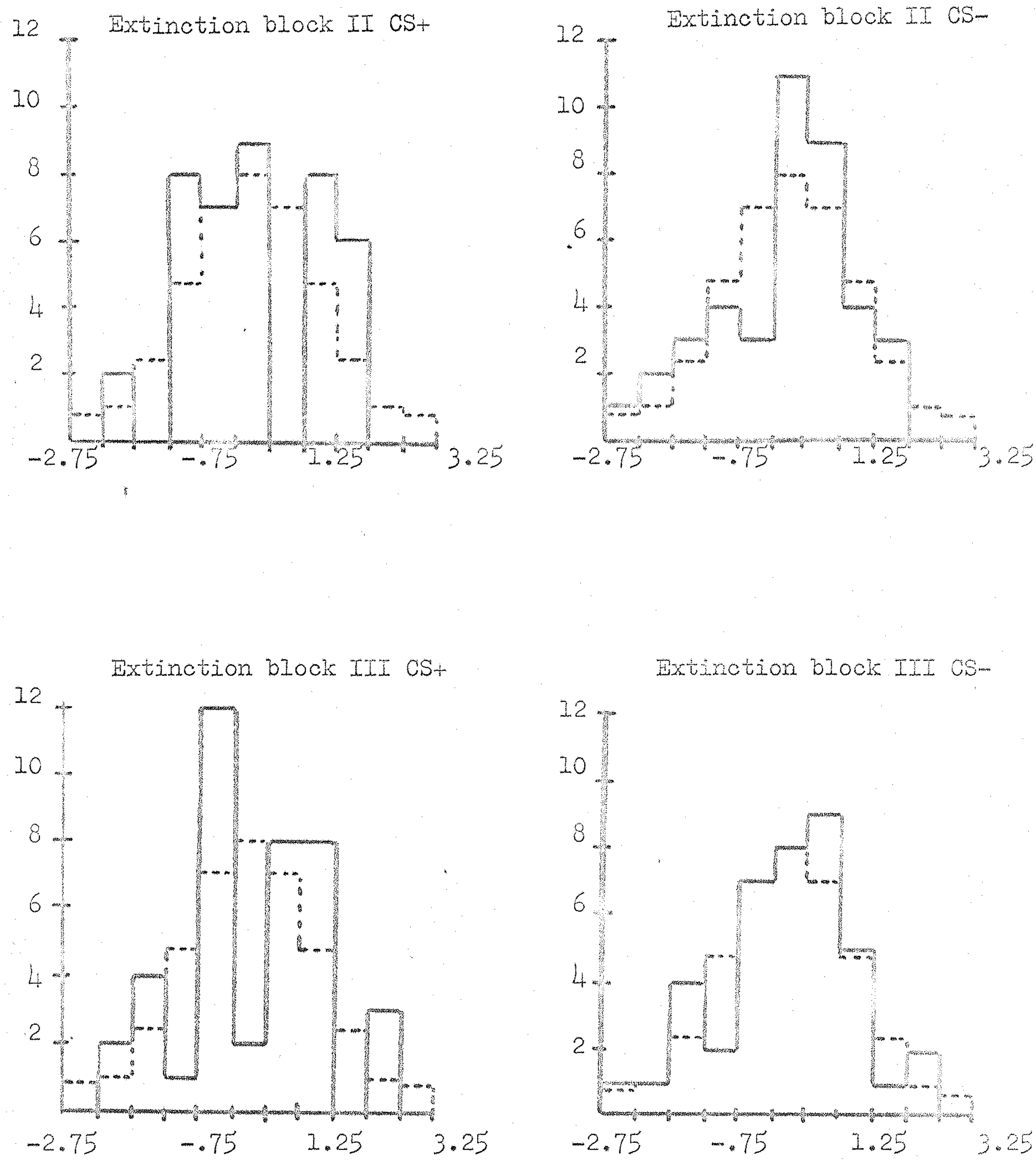


Figure 3.13 Transformation (iii) Conductance change expressed as a proportion of the maximum response

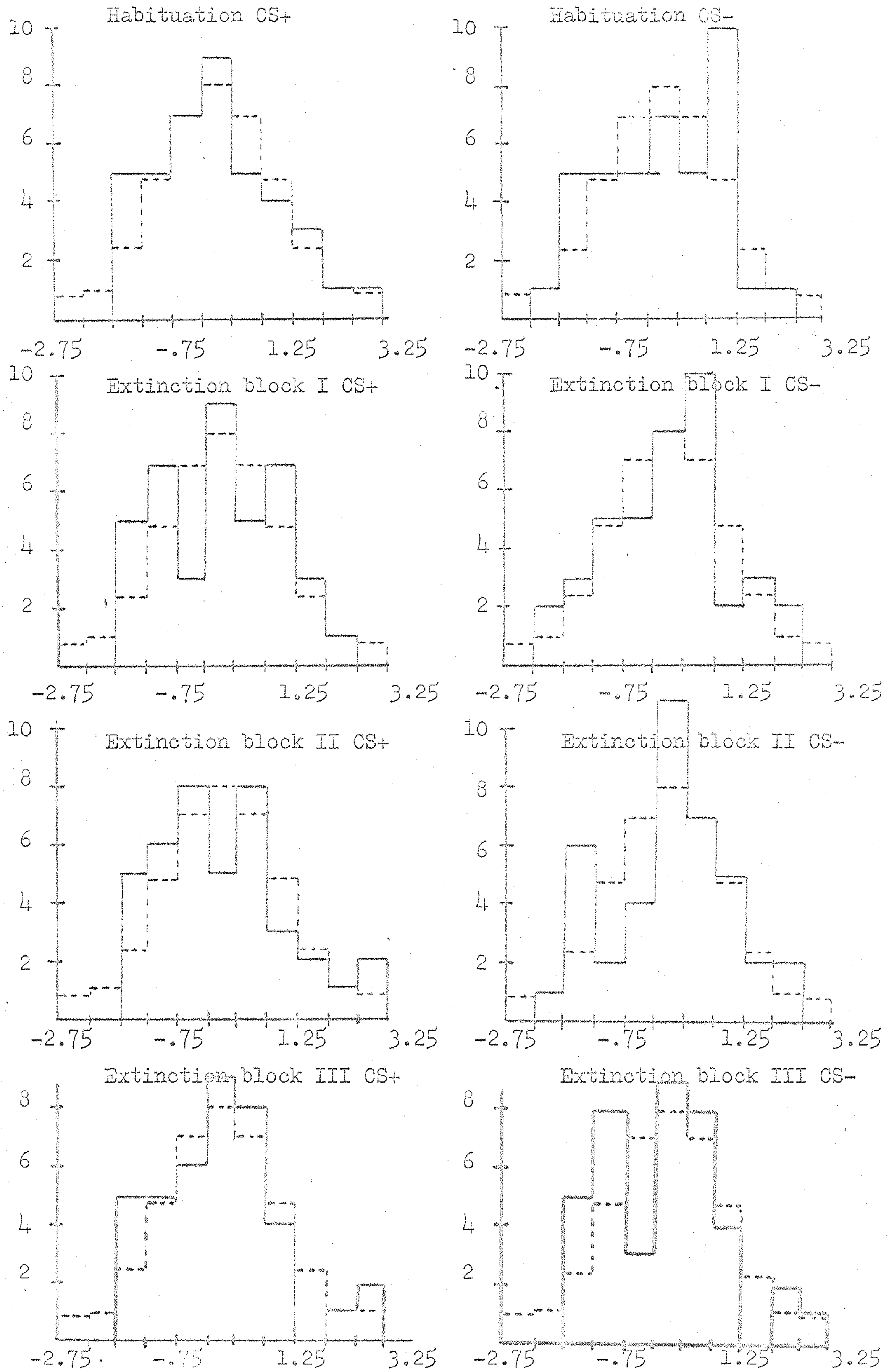


Figure 3.14 Transformation (iv) Log of conductance change expressed as a proportion of the maximum response

TABLE 3.2.

CR magnitude comparisons for each transformation.

Source.	Transformations.			
	(i)	(ii)	(iii)	(iv)
Mean CR+ magnitude, habituation block.	8.24*	62.16	18.62	4.75*
Mean CR- magnitude, habituation block.	9.06*	11.86*	9.95*	10.22*
Mean CR+ magnitude, Extinction block I.	12.45*	29.32	18.66	8.78*
Mean CR- magnitude, Extinction block I.	6.02*	5.92*	10.57*	4.01*
Mean CR+ magnitude, Extinction block II.	9.41*	56.92	19.91	7.67*
Mean CR- magnitude, Extinction block II.	9.84*	15.25	7.51*	7.27*
Mean CR+ magnitude, Extinction block III.	14.04*	19.01	18.33	8.41*
Mean CR- magnitude, Extinction block III.	18.63*	11.61*	4.34*	12.60*

(* = $p < .05$)

Result. From Table 3.2., it can be seen that the only transformation having all its chi-square values with the five per cent significance level, is transformation (iv). i.e. log of the change in conductance expressed first as a proportion of change in conductance of maximum response.

$$\text{Log} \frac{\text{SCR} \quad \frac{1}{b} - \frac{1}{a}}{\text{SCR}_{\text{Max:}} \quad \frac{1}{B} - \frac{1}{A}}$$

Transformation (i) has only one value outside the five per cent level, but this transformation does not take base level or response range into account. It will be recalled (P.30) that possible differences in effective electrode area are taken into account by a range correction. Hence the best method of data transformation is transformation (iv) and all future data will be transformed by this method.

3.6.2. Data analysis for determining differential response measure.

Analyses of Variance were performed comparing mean CR+ magnitude with mean CR- magnitude in experimental runs. (See table 3.3.) CR+ magnitude was significantly greater than CR- magnitude in the first two extinction blocks. The third extinction block exhibited a non-significant trend in the predicted direction. There were also significant group order effects in the first two extinction blocks but there was no significant interaction between group order and CR+/CR- magnitude.

Analyses of Variance were performed comparing mean CR+ magnitude in the experimental run with mean CR- magnitude to one light in the control run. (See table 3.4.) The effect of the experimental CS-UCS pairings was significant in all three extinction blocks. There was also a significant group order effect in the first two extinction blocks, while interaction between group order and experimental/control run was significant in all extinction blocks.

Analyses of Variance compared mean CR- magnitude in experimental and control runs. (See table 3.5.) There were no significant experimental/control effects nor a significant group order effect. However, there was a significant interaction between group order and experimental/control effects. This interaction was analysed by analysis of variance for simple effects (See table 3.6.) Experimental run first compared with both control run first and control run second showed a significant experimental/control effect. Experimental run second compared with either control run showed no significant results.

A graph (figure 3.6..) of mean CR+ and CR- magnitude in experimental run first and mean CR magnitude in control run first, demonstrates the large increase in mean CR+ magnitude with a small decline in mean CR-magnitude, together with a larger decline in the control run mean CR magnitude.

A graph (figure 3.7 .) of mean CR+ magnitude and mean CR- magnitude in experimental run second and mean CR magnitude in control run second, shows the non-significant trend for control run second mean CR magnitude to be greater than experimental run second mean CR+ magnitude but less than experimental run mean CR- magnitude.

TABLE 3.3.

Anova summary tables for differential responding in each block.

Source.	S of S	df	MS	F	p
Block I.					
Between subjects.	11.477	19			
Group order.	4.440	1	4.440	11.359	.01
Subjects within groups.	7.036	18	.391		
Within groups.	4.413	20			
CR+ v. CR-	2.916	1	2.916	40.218	.001
Interaction between group order & CR+ / CR-.	.193	1	.193	2.662	NS
Subjects with groups.	1.304	18	.073		
Block II.					
Between subjects.	11.403	19			
Group order.	2.883	1	2.883	6.092	.025
Subjects within groups.	8.520	18	.473		
Within subjects.	2.101	20	.105		
CR+ v. CR-	1.108	1	1.108	21.055	.001
Interaction between group order & CR+ / CR-.	.046	1	.046	.878	NS
Subjects with groups.	.948	18	.053		

TABLE 3.3. (Cont/d.)

Source.	S of S	df	MS	F	p
Block III.					
Between subjects.	12.718	19			
Group order.	1.005	1	1.005	1.544	NS
Subjects within groups.	11.713	18	.651		
Within subjects	2.098	20	.105		
CR+ v. CR-.	.184	1	.184	1.768	NS
Interaction between group order & CR+ / CR-.	.037	1	.037	.351	NS
Subjects with groups.	1.877	18	.104		

NS = Non-significant.

TABLE 3.4.

Anova summary tables comparing mean CR+ magnitude in experimental and control runs.

Source.	S of S	df	MS	F	p
Block I.					
Between subjects.	7.903	19			
Group order.	1.737	1	1.737	5.070	.05
Subjects within groups.	6.166	18	.343		
Within subjects.	10.018	20	.501		
Exp; v. con:	6.151	1	6.151	46.843	.001
Interaction between group order & Exp; / Con.	1.505	1	1.505	11.462	.01
Subjects with groups.	2.363	18	.131		
Block II.					
Between subjects.	6.627	19			
Group order.	1.115	1	1.115	3.639	.1
Subjects within groups.	5.513	18	.306		
Within subjects.	7.148	20	.357		
Exp; v. Con:	2.114	1	2.114	8.830	.01
Interaction between group order & Exp: / Con:	.724	1	.724	3.061	.1
Subjects with groups.	4.310	18	.239		

TABLE 3.4. (Cont/d.)

Source.	S of S	df	MS	F	p
Block III.					
Between subjects.	9.926	19			
Group order.	.006	1	.006	.011	NS
Subjects within groups.	9.919	18	.551		
Within subjects.	4.759	20	.238		
Exp; v. Con:	.934	1	.934	55.097	.001
Interaction between group order & Exp; / Con:	.775	1	.775	4.570	.05
Subjects with groups.	3.051	18	.170		

TABLE 3.5.

Anova summary table comparing mean CR- magnitude in experimental and control runs.

Source.	S of S	df	MS	F	p
Block I.					
Between subjects.	5.721	19	.301		
Group order.	.752	1	.752	2.724	NS
Subjects within groups.	4.969	18	.276		
Within subjects.	2.005	20	.100	1.390	NS
Exp; v. Con:	.062	1	.062	.860	NS
Interaction between group order & Exp; / Con:	.644	1	.644	8.932	.01
Subjects with groups.	1.299	18	.072		
Block II.					
Between subjects.	6.027	19			
Group order.	.621	1	.621	2.646	NS
Subjects within groups.	5.405	18	.300		
Within subjects.	1.559	20	.078		
Exp; v. Con:	.137	1	.137	2.646	NS
Interaction between group order & Exp; / Con:	.491	1	.491	9.493	.01
Subjects with groups.	.931	18	.052		

TABLE 3.5. (Cont/d.)

Source.	S of S	df	MS	F	p
Block III.					
Between subjects.	6.952	19			
Group order.	.228	1	.228	.611	NS
Subjects within groups.	6.724	18	.374		
Within subjects.	1.813	20			
Exp; v. Con:	.029	1	.029	.407	NS
Interaction between group order & Exp; / Con:	.522	1	.522	7.429	.025
Subjects with groups.	1.263	18	.070		

TABLE 3.6.

Anova summary tables for simple effects on mean CR-magnitude in experimental and control runs.

Source.	S of S	df	MS	F	p
Block I.					
Experimental run second with control run first.					
Between subjects.	.015	1	.015	.081	NS
Within subjects.	3.327	18	.185		
Total.	3.478	19			
Experimental run first with control run second.					
Between subjects.	.557	1	.557	3.184	.1
Within subjects.	3.146	18	.175		
Total.	3.747	19			
Experimental run first with control run first.					
Between subjects.	.627	1	.627	3.414	.1
Within subjects.	3.303	18	.184		
Total.	3.929	19			
Experimental run second with control run second.					
Between subjects.	.189	1	.189	1.148	NS
Within subjects.	2.964	18	.164		
Total.	3.154	19			

TABLE 3.6. (Cont/d.)

Source.	S of S	df	MS	F	p
Block II.					
Experimental run second with control run first.					
Between subjects.	.055	1	.055	.335	NS
Within subjects.	2.935	18	.163		
Total.	2.990	19			
Experimental run first with control run second.					
Between subjects.	.573	1	.573	3.031	.1
Within subjects.	3.402	18	.189		
Total.	3.975	19			
Experimental run first with control run first.					
Between subjects.	.670	1	.670	3.579	.1
Within subjects.	3.371	18	.187		
Total.	4.042	19			
Experimental run second with control run second.					
Between subjects.	.088	1	.088	.531	NS
Within subjects.	2.966	18	.165		
Total.	3.053	19			

TABLE 3.6. (Cont/d.)

Source.	S of S	df	MS	F	p
Block III.					
Experimental run second with control run first.					
Between subjects.	.153	1	.153	.740	NS
Within subjects.	3.722	18	.207		
Total.	3.875	19			
Experimental run first with control run first.					
Between subjects.	.209	1	.209	.852	NS
Within subjects.	4.412	18	.245		
Total.	4.620	19			
Experimental run second with control run second.					
Between subjects.	.048	1	.048	.239	NS
Within subjects.	3.575	18	.199		
Total.	3.623	19			
Experimental run first with control run second.					
Between subjects.	.397	1	.397	1.676	NS
Within subjects.	4.265	18	.237		
Total.	4.662	19			

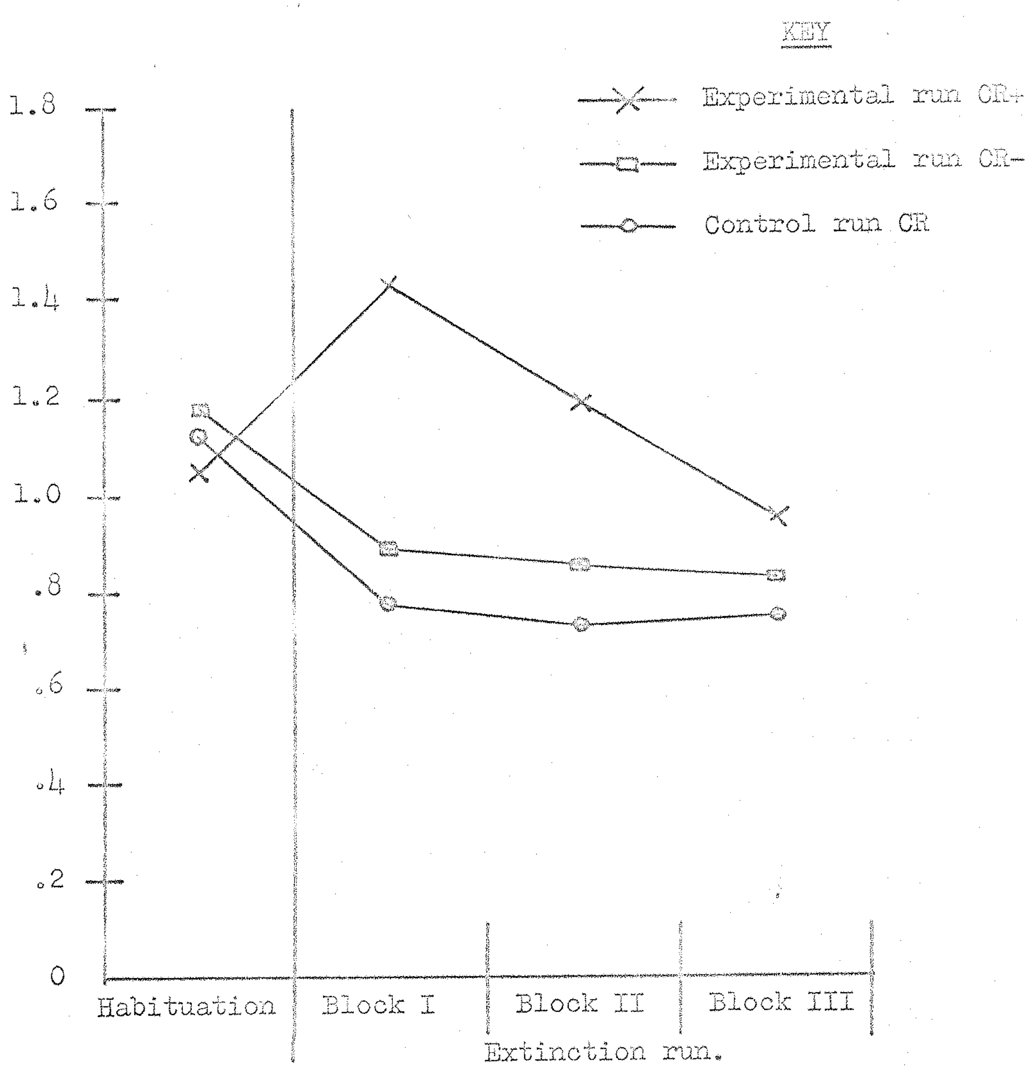


Figure 3.15. Combined experimental and control runs: experimental mean CR+ and mean CR- magnitude and control mean CR magnitude. Each response measured by log change in conductance expressed as a proportion of change in conductance of maximum response X 10^3.

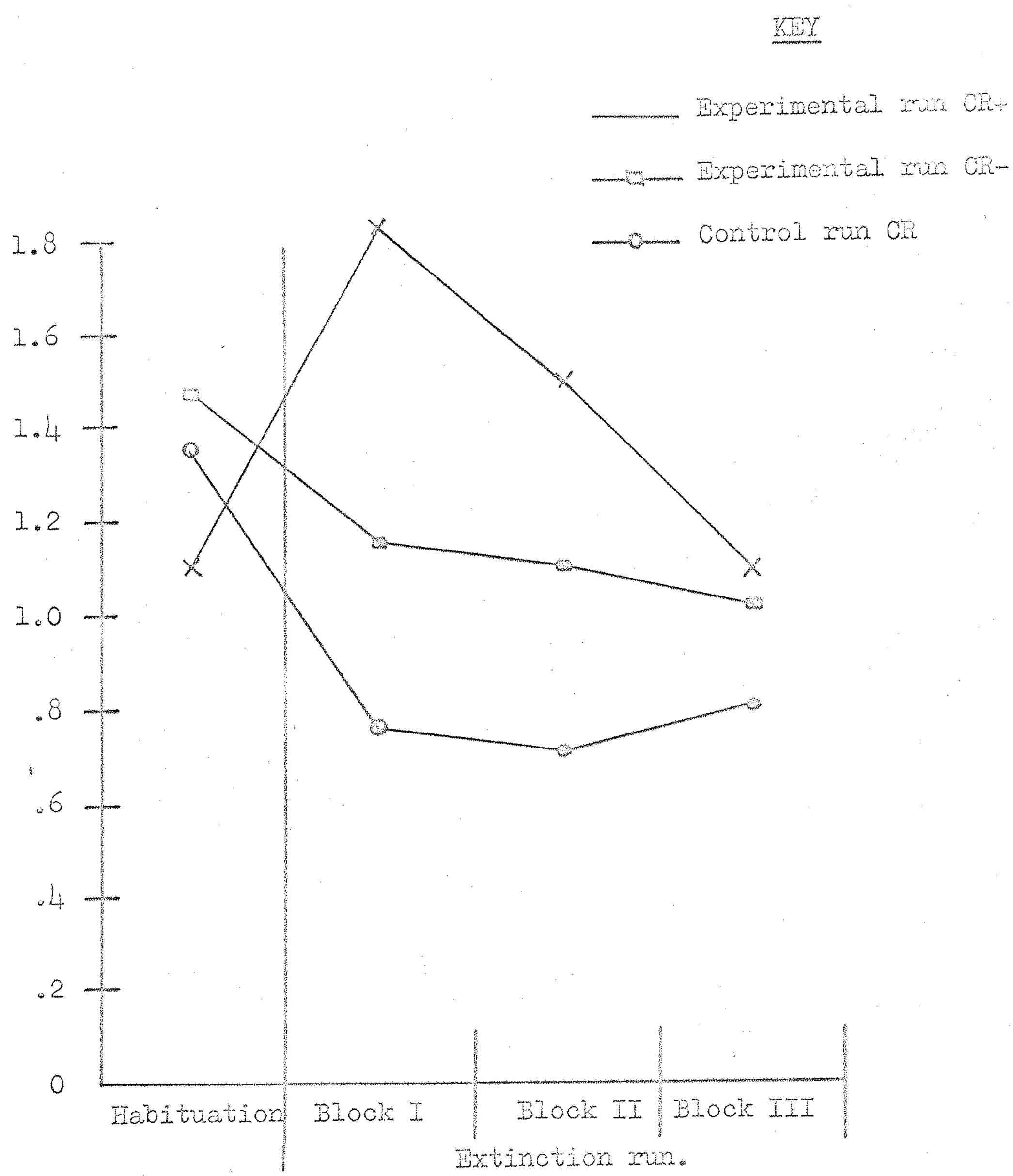


Figure 3.16. First runs for experimental and control: experimental mean CR+ and mean CR- magnitude and control mean CR magnitude. Each response measured by log change in conductance expressed as a proportion of change in conductance of maximum response X 10^3.

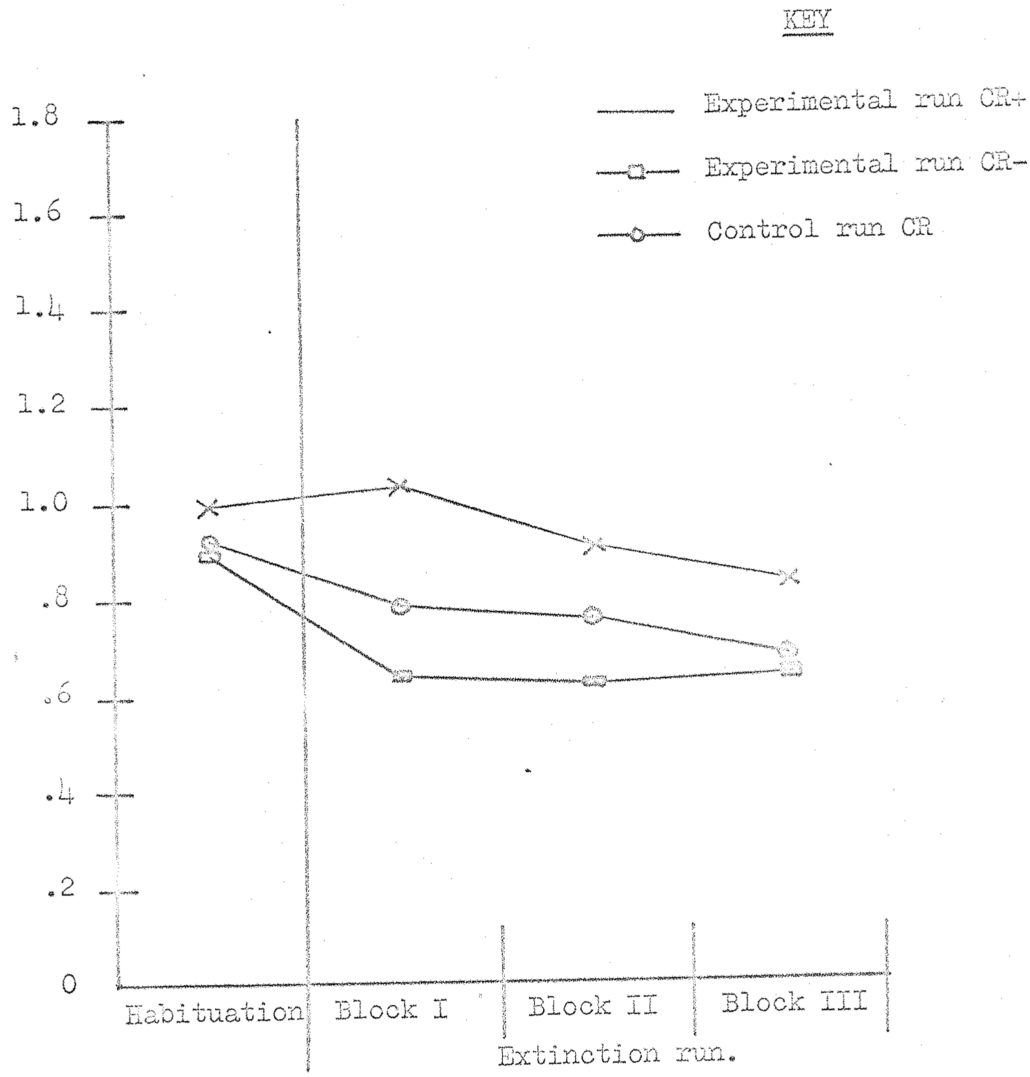


Figure 3.17. Second runs for experimental and control: experimental mean CR+ and mean CR- magnitude and control mean CR magnitude. Each response measured by log change in conductance expressed as a proportion of change in conductance of maximum response X 10^3.

3.7. Conclusion.

The comparison between mean CR+ magnitudes in experimental and control runs (Table 3.3.) shows that experimental subjects respond significantly more to CS+ than control subjects in all three extinction blocks. It can thus be concluded that CS-UCS pairing produces a conditioning effect.

The comparison between mean CR+ magnitude and mean CR- magnitude in experimental runs (Table 3.2.) shows that there is significant differential responding in extinction blocks I and II and a non-significant trend for CR+ magnitude to be greater than CR- magnitude in extinction block III. It can thus be concluded that differential conditioning has occurred and this is significant in the first two extinction blocks but not in the third extinction block.

The experiment aimed to establish what effect CS+ paired with UCS had on CR-. Table 3.4. showed no significant main effects when CR- magnitude in experimental and control runs was compared. However, there was a significant interaction between group order (experimental run first, control run second or control run first, experimental run second) and mean CR- magnitude in experimental and control runs. Analysis of simple effects (Table 3.5.) showed that comparisons between mean CR- magnitude in experimental run first and both control runs were significant in the first two extinction blocks. This suggests that in group order, control run first, experimental run second, there was a dampening affect from the control run on the subsequent experimental run. Subjects were used as their own controls in order to reduce inter-subject variability. However, comparisons between the two groups show that this strategy may have introduced intra-subject variability, i.e. the group order effect. Direct comparisons between the first runs of the two groups show that mean CR- magnitude is influenced by CS+ pairings with

UCS in the first two extinction blocks. Hence it can be concluded that subjects who experience an experimental run only will show an increase in mean CR- magnitude as well as the conditioned increase in mean CR+ magnitude.

Figures 3.15, 3.16, & 3.17 can be compared with pattern (i) or pattern (ii) of the hypothesised extinction course. Extinction cannot be said to follow pattern (iii) since CS-UCS pairings increase CR- as well as CR+ magnitudes. Thus degree of differential responding should not be assessed by regressing CR+ magnitude on CR- magnitude, since this would remove some of the conditioning effect as well as possible variations in activity level.

The other alternative measure of differential responding is simple increase in mean CR+ magnitude minus mean CR- magnitude. Martin & Levey (1969) consider that a measure of conditioning should be independent of initial OR value. Increase in mean CR+ magnitude compared with mean CR- magnitude was tested for independence from initial value, by product moment correlations between mean CR- magnitude in habituation and mean CR+ magnitude minus mean CR- magnitude in extinction. The following correlations were obtained:-

Mean CR- magnitude in habituation with extinction block I increase.
$r = .306$ Not significant.

Mean CR- magnitude in habituation with extinction block II increase.
$r = -.138$ Not significant.

Mean CR- magnitude in habituation with extinction block III increase.
$r = .049$ Not significant.

These non-significant correlations indicate that mean CR magnitude increase is relatively independent of initial mean CR magnitude. This measure was thus considered a satisfactory measure of differential conditioning.

Inspection of individual data using CR increase as the conditioning measure showed some anomalies. In some cases, one extinction block indicated differential responding after a preceding block had indicated lack of differential responding. This phenomenon was thought to be an example of spontaneous CR recovery and hence would confound the first CR extinction measure. A further change was made in the measure of differential responding. When mean CR- magnitude was greater than mean CR+ magnitude, differential responding was scored as zero. If this reversal was followed by positive differential responding in the next extinction blocks, these were also counted as zero. A measure of differential responding throughout the three extinction blocks could then be obtained by summing the increases.

This modified measure of differential responding was tested for independence from initial value by a product moment correlation with mean CR- magnitude in habituation. The correlation was non-significant ($r = .111$) and thus met Martin & Levey's criterion for a measure of conditioning.

It was concluded that this method was most suitable for use in future experiments.

CHAPTER 4.

Assessment of impulsivity.

Throughout Chapter I, constant reference was made to personality. Traits such as anxiety, neuroticism and extraversion were discussed in relation to various experimental phenomena. It was concluded that the aims of this thesis were best served by examining relationships between impulsivity and experimental phenomena such as conditionability. This chapter is divided into two sections: section A discusses personality assessment with particular reference to impulsivity. In section B, an impulsivity scale is constructed and tested for reliability and validity.

Section A.

4.1. Personality assessment.

One way of viewing personality is in terms of traits or types. A personality trait is a continuum along which any individual may differ with respect to other individuals. Traits are identified by observing consistent responses in a variety of situations. The degree to which any individual possesses a trait, is the extent to which a consistent pattern of responding occurs independently of any particular immediate stimulus. (Wright, Taylor, Davies, Sluckin, Lee & Reason, 1970).

A personality type is one of several mutually exclusive types which together account for personality variations within a population. A type can be defined from trait clusters, classification being based on possession of specified traits (Wright et al).

Personality tests can be designed to measure particular source traits (Lykken & Katzenmeyer, 1967) or established tests can be factor analysed and source traits defined from factor item content (Eysenck, 1969). Source traits may be validated by selecting pathological groups (Lykken & Katzenmeyer, 1967) or extreme personality types (Eysenck, 1964) which represent one or both ends of a trait continuum. Other methods of validation rely on correlations with previously established tests (Lykken & Katzenmeyer, 1967, Eysenck, 1964).

4.2. Definition of impulsivity.

The factor analytic literature concerned with personality assessment mentions impulsivity as a source trait (Guilford & Guilford, 1934; Blackburn, 1973), as a first order factor (Cattell, 1957) and as one of several factors defining a type (Eysenck, 1953).

Other types of personality test are said to measure impulsive behaviour directly (Gibson, 1964; Porteus, 1959) or by questionnaire (Lykken & Katzenmeyer, 1967; Zuckerman, Kolin, Price & Zoob, 1964; Kipnis, 1971).

Definitions of impulsivity have tended to vary. However, this literature is comparatively recent and has in some cases, (Guildford, 1959) specified dependence upon Murray's (1938) definition of impulsivity. Since this definition has been available to the above personality researchers, it can be regarded as the basic operational definition.

Murray (1938) defined the impulsive type as one who:-

> "....is usually somewhat restless, quick to move, quick to make up his mind, quick to voice an opinion. He often says the first thing that comes into his head; and does not always consider the future consequences of his conduct".
>
> (Murray, 1938, P.205).

The impulsive type was said to represent one end of a trait continuum from impulsion to deliberation. Impulsion was described as:-

> ".... the tendency to respond (with a motone or verbone) quickly and without reflection. It is rather a coarse variable which includes; 1) short reaction time to social press, 2) quick intuitive behaviour, 3) emotional driveness, 4) lack of forethought, 5) readiness to begin work without a carefully constructed plan".
>
> (Murray, 1938, P.205).

The opposite end of the trait continuum is described as:-

> " 1) Long reaction time to social press, 2) inhibition of initial impulses, 3) hesitation, caution and reflection before action, 4) a long period of planning and organising

before beginning a piece of work. The subject may have obsessional doubts: a 'load' of considerations which he must 'lift' before beginning. He usually experiences difficulty in emergency".

(Murray, 1938, P.205).

It can be seen that Murray's definition emphasises speed of response to the environment and this can be contrasted with psycho-analytic definitions which tend to emphasise lack of self-control.

Psycho-analytic definitions are based on Freudian and neo-Freudian theories rather than experimental measurement. These definitions tend to be derived from hypothetical states of mind. Impulsive behaviour is considered to be a failure of the ego or reality principle to control the id or primary process expression. Primary process activity is generally considered equal in strength between individuals but its dispersion may differ. Ego and super-ego content are both thought to differ quantitatively between individuals, while qualitative differences may be regarded as pathological. Hence lack of self-control by ego or super-ego is synonymous with id impulse expression (Freud, 1970; Brown, 1964).

Fenichel (1946) combined self-control with speed of responding. He distinguished two impulsive types:- the impulse neurotic, who, in the psychoanalytic tradition, is described as one possessing an inefficient ego and the "instinct ridden" character who yields to an impulse before inhibition from the super-ego has time to develop. Thus the "instinct ridden" character's quick response to the environment results in behavioural lack of self control.

It can be seen that impulsivity is a mixture of speed of response to the environment and lack of self-control. When both characteristics are in evidence, then either characteristic could be said to determine the other characteristic. However, a slow response to the environment combined with lack of self-control would not produce Murray's impulsive type, while a fast response to the environment could, in some cases, over-ride self-control assessed from super-ego and ego content. Hence a measure of impulsivity should combine speed of response to the environment with behavioural lack of self-control.

4.3. Measurement of impulsivity.

Personality inventories have been designed to measure a spectrum of personality traits from a number of different scales. Originally, scale item content was selected to measure specific traits, but in some cases, factor analyses suggested changes in scale item content. Thus any single personality trait can be assessed from original scales or from factor analytically derived scales.

Impulsivity scales have been derived from factor analyses of extraversion-introversion items and the clinically based Minnesota Multiphasic Personality Inventory (MMPI).

Other impulsivity scales have been adapted from psychomotor tests and risk taking scales.

4.3.1. Factor analytically derived scales of impulsivity from normal samples. Guildford & Guildford's (1934) factor analysis of extraversion-introversion items produced four main factors, one being an impulsivity factor. A later (1936) analysis had five main factors, four similar to the (1934) factors. Factor R, rhathymia was thought to be closest to the (1934) impulsivity factor and was described as "freedom from care".

Originally, Guildford & Guildford (1934) distinguished thirteen factors, re-analysis (Guildford & Zimmerman, 1956) produced thirteen slightly different factors. Factor R, restraint versus rhathymia, was described as self-restrained versus uncontrolled, serious minded rather than happy-go-lucky and not cheerfully irresponsible. The negative pole of this factor resembled the original (1934) definitions of impulsivity. However, Thurstone (1951) re-analysed Guildford's items and demonstrated a second order factor IV of impulsivity, which had loadings of .6 on Guildford's G (general activity) and .45 on Guildford's R (rhathymia) factors.

Barratt (1965) based his impulsivity scale (BIS) on Thurstone's factor IV. His original subscales were:- speed of cognitive response, lack of impulse control, adventure seeking and risk taking. Revised subscales were:- lack of persistance, social optimism, lack of motor inhibition, aggression-autonomy and action orientation. Barratt (1965) demonstrated that impulsivity subscales were inter-correlated and orthogonal to inter-correlated measures of anxiety. The five BIS subscales correlated with Guildford-Zimmerman factor R, while subscale 3, (lack of motor inhibition) also had a neurotic component, correlating with Guildford-Zimmerman emotional stability (r = -.49) and Thurstone stable scale (r = -.349).

Impulsivity has generally been derived from extraversion-introversion items. One of Cattell's (1965) two second order oblique factors is an extraversion-introversion factor. However, none of his first order factors could be described as an impulsivity factor, although two of these factors do include impulsivity at the trait descriptor level.

Cattell's fifteen first order oblique factors were originally derived from life record data. This was collected by systematic and objective ratings of behaviour by trained observers and descriptors were compared with Allport & Odbert's (1936) list of trait names and successively reduced. Cattell's 16 PF was designed to measure these factors, although second order factors did differ slightly from those previously obtained.

Carrigan (1960) reviewed two orthogonal analyses of Cattell's 16 PF. Karson & Pool (1958) and Mann (1958) found a similar extraversion-introversion factor differing from Cattell's extraversion-introversion factor. Unlike Cattell, they found highest loadings on factor H (parmia), whose original descriptor included impulsive (but no inner tension) versus inhibited, conscientious.

Mann (1958) joint analysed Guildford and Cattell items. One analysis replicated the factor found in the previous analysis, but two other analyses split this cluster giving factor III (social extraversion) and factor IV (lack of self-control). Carrigan concluded that:-

> ".... two or more factors are required to account for the intercorrelations between the E-I variables obtained from the Guildford and Cattell questionnaires. Moreover, the factors show remarkably little overlap,...."
>
> Carrigan (1960, P.337).

She also agreed with Mann's suggestion that:-

> "Factor III corresponds to the American conception of extroversion, with its emphasis on sociability and ease in interpersonal relations, while factor IV corresponds to the European conception of extroversion, with its emphasis on impulsiveness and weak super-ego controls".
>
> Carrigan (1960, P.337).

Eysenck (1969a) describes his factor analysis of behavioural, physical and clinical measures obtained from one thousand soldiers. Orthogonal factors of extraversion and neuroticism were obtained and the Maudsley Personality Inventory (MPI) constructed to measure these factors. The Guildford R-scale was used to index extraversion and the Guildford C-scale (emotional instability) to index neuroticism. Guildford's scales had been considered unsatisfactory, since they were long and repetitive, while some items did not contribute to the scale, and sex differences had not been taken into account. A questionnaire containing all items from Guildford's S-scale (social introversion), C-scale (emotional instability), R-scale (rhathymia), G-scale (general drive for activity), and A-scale (ascendence) and all items from the Maudsley Medical Questionnaire (MMQ) was prepared. The MMQ had previously been constructed to measure neuroticism and successfully differentiated between normal and neurotic soldiers. The final questionnaire was administered to 200 men and 200 women, all British born and over 18 years old.

Item analysis was carried out by taking the 100 men and 100 women obtaining highest C-scores and comparing their replies with the 100 men and 100 women obtaining lowest C-scores. Similarly, the 100 men and 100 women obtaining highest R-scores were compared with the 100 men and 100 women obtaining lowest R-scores. Each item was compared with R and C scales and chi-square values computed separately for men and women. Items not significant beyond the one per cent level for both sexes were discarded. Similarly, items having significant relationships with both scales and items whose content repeated another item, were withdrawn. The final MPI, 24 neuroticism (N) items and 24 extraversion (E) items, were selected from the remaining items. Factor analysis of these 48 items checked item selection adequacy for males and females. Two main factors emerged, although some items did have loadings on both factors. Eysenck considered that these errors balanced out and concluded that:-

> "On the whole the items selected emerge from the factor analysis reasonably well".

Eysenck (1969a,P.83).

Eysenck & Eysenck (1963a, 1969a) considered that sociability and impulsivity were two traits, which by their correlation, defined the extraversion factor. A 66 item questionnaire of extraversion and neuroticism was constructed and factor analysed. Four factors were extracted and rotated graphically, maintaining orthogonality, to an approximation of Thurstone's simple structure solution. Factor I was extraversion and factor II neuroticism, factor III referred to sociability versus impulsivity. Factor IV was ignored, since it only had high loadings on two items concerned with practical jokes.

Factor III loadings were plotted against extraversion loadings giving a clear division into two clusters defined as sociability and impulsivity. Sociability and impulsivity scores taken from the fourteen items with highest loadings on respective factors, correlated.

($r = .468$, $p < .01$). These items added together produced an extraversion scale orthogonal to neuroticism ($r = -.01$). However, there were small significant correlations between neuroticism and sociability ($r = -.133$, $p < .05$) and between neuroticism and impulsivity ($r = .166$, $p < .05$).

Sparrow & Ross (1964) replicated Eysenck & Eysenck's (1963) study. The original MPI items plus an additional twelve items from Eysenck & Eysenck's (1963) scale were used. Sixteen impulsivity and eleven sociability items were common to both studies. These items and twenty items from the Californian Psychological Inventory (CPI) sociability and self-control scales were administered to Australian junior naval recruits, aged 16 years. Factor analysis produced a first N factor and a second E factor. The third factor was impulsivity-sociability (Imp-Soc). Correlations between this Imp-Soc factor loadings and Eysenck & Eysenck's Imp-Soc factor loadings were high ($r = .80$). The sociability cluster contained twelve of Eysenck & Eysenck's sixteen sociability items, while the impulsivity cluster had seven of Eysenck & Eysenck's eleven impulsivity items plus CPI self-control scales (negatively loaded). CPI self-control did, however, load much higher on neuroticism.

Farley (1970) derived EPI impulsivity and sociability scales from Eysenck & Eysenck's (1963) factor analysis of extraversion items. In his total sample, impulsivity correlated with sociability ($r = .39$). Impulsivity correlated significantly with N for English trade apprentices but there was no total sample correlation ($r = .09$). Sociability correlated negatively with N in three groups and the total sample correlation was $r = -.22$ ($p < .05$).

It can be seen that impulsivity scales derived from Guildford's extraversion items are practically independent of neuroticism. Eysenck noted a very small positive correlation between neuroticism and impulsivity and a very small negative correlation between neuroticism and sociability. Sparrow & Ross' replication indicates some negative association between impulsivity and neuroticism, while Farley's study suggests that N is unrelated to impulsivity but negatively correlated with sociability. All studies indicate that factor analysis of extraversion items produces two factors of sociability and impulsivity which are positively correlated. Other studies (Eysenck, Hendrickson & Eysenck, 1969, Howarth & Browne, 1972) have extracted more than two factors from extraversion items and these factor analyses will be discussed later (P.180).

4.3.2. <u>Factor analytically derived scales of impulsivity from clinically based questionnaires.</u> Impulsivity has been measured from the original Minnesota Multiphasic Personality Inventory (MMPI) and from factor analytically derived MMPI scales. The MMPI is a five hundred and fifty item inventory designed to measure personality traits characteristic of disabling psychological abnormality. Hathaway & McKinley (1951) developed nine scales by comparing scores from clinically diagnosed categories with normal sample scores. The psychopathic group is the clinical category whose main diagnostic feature is impulsivity. The psychopath's characteristic profile peaks on hypomania (Ma) and psychopathic deviance (Pd) (Black, 1966). Hence either or both of these scales can be used to measure impulsivity.

Carrigan (1960) reviewed a number of MMPI factor analyses. Most analyses produced bipolar factors with contrasting loadings on Ma and D (depression). She suggested that these bi-polar factors were related to extraversion-introversion.

Kassenbaum, Couch & Slater (1959) derived two second order factors from MMPI items. Factor I was ego-weakness and factor II was extraversion. Extraversion included Ma and an impulsivity scale. These results suggested two types of extraversion; "normal" and "disturbed".

These types were identified by rotating axes through forty-five degrees to yield two fusion factors. Fusion factor A was labelled social withdrawal versus social participation and fusion factor B was labelled impulsivity versus intellectual control. This latter factor contrasted maladjusted extraversion with well adjusted introversion. Its highest loadings were on impulsivity and Ma.

Blackburn (1973) derived an impulsivity scale from an MMPI factor analysis. This scale correlated with a similarly derived anxiety scale ($r = .49$) in a sample of special hospital (Broadmoor) patients and thus may be viewed as comparable with Kassenbaum et al's impulsivity scale.

It can be seen that impulsivity, derived from clinical scales, is associated with neuroticism to a much greater extent than is impulsivity derived from normal extraversion items. It is thus possible that clinically derived impulsivity is closer to psycho-analytic concepts of self-control, while normal impulsivity bears a closer resemblance to Murray's definitions, with their emphasis on speed of response to the environment.

4.3.3. Psychomotor tests of impulsivity. Psychomotor tests of impulsivity measure accuracy and speed of performance.

Two psychomotor tests used to measure impulsivity are the Porteus maze and Gibson's spiral maze.

The Porteus maze test, originally (1959) developed as an intelligence test, was adapted to measure impulsivity. This test consists of a series of mazes which gradually increase in difficulty. The mazes are printed on paper and the subject required to follow the maze with a pencil. Instructions not to lift the pencil, cut corners or cross lines are given. Intelligence is assessed from the most difficult maze successfully traversed. A Q-score is calculated from errors occurring in the first and last thirds of the easier mazes. Errors are counted from number of cut corners, crossed or broken lines and wrong directions taken. The Q-score is said to be a measure of impulsivity, since it reflects rule breaking (Porteus, 1959).

Gibson (1964) developed his spiral maze test (GSM) to improve upon Porteus' Q-score by removing contamination from ability factors. This test consists of one spiral path, a quarter of an inch wide, containing eighth inch diameter obstacles. The subject is instructed to draw a line through the path as quickly as he can, without touching path sides or obstacles. Every fifteen seconds, the subject is reminded to go as quickly as possible. Error score and time taken to complete the maze correlate negatively, so a final score of error with time partialled out can be calculated. This final score was found to correlate with Porteus Q-score ($r = .33$, $p < .001$)

. Both these tests have successfully discriminated delinquent or psychopathic groups from normal controls.

Gibson's test actively encourages speed, so the final score may be closer to Murray's definition of impulsivity, with its emphasis on speed of response to the environment, than to lack of self-control. Porteus considers that his Q-score reflects carelessness and rule breaking, a concept close to lack of self-control. However, Porteus' test has no instructions concerning speed, this may be crucial in impulsivity measurement and suggests that Gibson's test is the superior measure of psychomotor impulsivity.

4.3.4. Risk taking measures of impulsivity. Impulsivity is measured from risk taking scales on the assumption that impulsive individuals actively seek or prefer situations in which fast responses combat environmental dangers.

Impulsivity has been measured by Zuckerman, Kolin, Price & Zoob's (1964) Sensation Seeking Scale (SSS), Lykken & Katzenmeyer's (1967)

Activity Preference Questionnaire (APQ) and Kipnis' (1971) impulsivity scale.

Zuckerman et al's SSS consists of seventy-two item pairs concerned with activities or feelings. The subject is required to choose his preferred activity or indicate the nearest description to his own feelings. Each pair contrasts a stimulating activity or feeling with its converse. The total score indicates degree of preference for stimulating or risky activity.

Lykken's APQ is very similar to Zuckerman et al's SSS. One hundred forced choice item pairs contrast a stimulating activity with an onerous activity. The assumption is that the onerous activity is universally disliked and will only be chosen if the alternative is extremely undesirable. Three subscales are said to measure "social anxiety", "physical anxiety" and "ego-threat"; the combined score measures "total anxiety".

The anxiety label may be a misnomer, since Lykken & Katzenmeyer found that "total anxiety" gave only low, non-significant correlations with Taylor Manifest anxiety, IPAT anxiety and Cattell 16PF anxiety. The negative pole of "total anxiety" is thought to be a measure of impulsivity.

Both Zuckerman et al's SSS and Lykken & Katzenmeyer's APQ have been used to distinguish psychopaths from non-psychopaths (Zuckerman & Link, 1968, Lykken, 1957).

Kipnis' Impulsivity scale was developed from Torrance & Ziller's (1957) risk taking scale. Torrance & Ziller's risk taking scale measured superior performance in dangerous occupations. High scorers tended to dislike accepting orders from superiors and gave self descriptions portraying physically active, aggressive, reckless personalities. Kipnis combined twenty-seven items from this scale with fourteen items concerned with poor relations to authority in childhood and early, persistant interest in exciting activities. The scale was designed to assess impulsivity in students, a criterion being under-achieving grades. High impulsivity scores predicted grades in a high ability group ($p < .01$) but not significantly in a low ability group ($p < .5$).

Zuckerman et al's SSS and Lykken & Katzenmeyer's APQ have mainly been used for within prison comparisons and comparisons between prisoners and normals, while Kipnis' scale was designed for students. Unlike clinically based tests, generally used for prison comparisons, the SSS and APQ items are, on the whole, inoffensive. Their scores should thus be relatively uncontaminated by social desirability response sets compared with MMPI scales which require a "lie" scale to detect this contamination. This advantage may not apply to Kipnis' scale with its inclusion of items concerning poor relations with authority.

SECTION B.

4.4. Construction of an impulsivity scale.

A number of impulsivity scales have been suggested in the previous section. Impulsivity scales, derived from Guildford & Guildford's (1934) original items, and Kipnis' (1971) impulsivity scale have been constructed to measure individual differences in normal samples. Other scales were originally designed to compare abnormal groups, said to manifest impulsivity, with normal groups. The latter scales are thus likely to be biased by maladjustment factors, and in some cases, this bias has been apparent from correlations between impulsivity and neuroticism or anxiety.

Kipnis' impulsivity scale was validated using underachievement as a criterion. Validation was satisfactory only in high intelligence groups, indicating possible contamination by an intelligence factor. This scale was thus considered unsuitable for comparing groups likely to differ in intelligence.

Barratt's impulsivity scale, derived from Guildford's items, was validated using one of Eysenck's (1957) extraversion criteria i.e. eyeblink conditioning (Barratt, 1971). Other scales derived from Guildford's items, namely the MPI and EPI, have measured extraversion and have been validated against extravert and introvert criterion groups (Eysenck & Eysenck, 1964). Factor analysis of extraversion scales derived from Guildford's items have revealed two main factors: impulsivity and sociability (Eysenck & Eysenck, 1963a, 1969a). These factor loadings can be transcribed to EPI items to produce impulsivity and sociability scales. There are evaluative difficulties associated with impulsivity validation from normal criterion groups described as impulsive and non-impulsive, but concurrent validity can be assessed from correlations with other impulsivity tests.

4.4.1. Method of constructing an impulsivity scale from EPI form A.

The Eysenck Personality Inventory (EPI) was designed to improve upon the previously constructed Maudsley Personality Inventory (MPI). The MPI showed a small but persistant correlation between neuroticism (N) and extraversion (E). The EPI was designed to eliminate this correlation and differed from the MPI in the following ways:-

a) The EPI had two different forms, A and B, while the MPI was a single form.

b) All forms have a twenty-four item E-scale and a twenty-four item N-scale but both EPI forms have an additional nine item lie (L) scale.

c) EPI items can only be answered "Yes" or "No", while MPI items can also be answered by the indeterminate "?".

The PEN inventory, used in this research, consists of EPI form A items with an additional twenty-four item P-scale. P is a third second order factor, orthogonal to both E and N and it has been tentatively labelled psychoticism.

Eysenck & Eysenck's (1969a) factor loadings were used to define impulsivity and sociability scales from EPI form A items. Factor loadings from Sparrow & Ross' (1964) replication were not used, since a number of EPI form A items were excluded from their analysis.

EPI form A items were compared with items used by Eysenck & Eysenck. Occasionally, EPI form A item wording differed from Eysenck & Eysenck's item wording. In these cases, item content was compared and relevant loadings considered transferable. Item 80 (See PEN, Appendix I for enumeration) was an exception which had no comparable item in Eysenck & Eysenck's factor analysis. Item 80 was thus given the arbitary designation of sociability, in order to account for all extraversion items in terms of impulsivity or sociability.

Eysenck & Eysenck's (1969a, P 147. Fig.12.1) graph of extraversion factor loadings plotted against sociability-impulsivity factor loadings, was modified for EPI form A items (figure 4.1). All items were numbered from PEN (Appendix I). Items above the zero line defined sociability, while items below zero defined impulsivity.

The finally constructed impulsivity scale consisted of the following eleven items:-

(1), (4), (8), (13), (17), (22), (36), (57), (65), (68) and (88).

The sociability scale consisted of the following thirteen items:-

(25), (29), (33), (40), (44), (48), (53), (62), (73), (75), (76), (80), (83) and (85).

4.4.2. Variability in impulsivity items extracted from EPI form A.

Eysenck, Hendrickson & Eysenck (1969) factor analysed one hundred and eight neuroticism and extraversion items from EPI form A and B. The first solution (unrotated factors) produced six main factors. Factor 5, impulsiveness, had its main loading on PEN items:- (8), (13) and (57). The second solution (Varimax) produced fourteen orthogonal factors. Factor 4, impulsiveness, included PEN items:- (13), (8) and (22). The third solution (Promax) showed twenty-two oblique factors. Factor 4, impulsiveness, included PEN items:- (13), (8), (22) and (1).

Howarth & Browne (1972) factor analysed EPI form A alone. Fifteen orthogonal factors emerged, factor IV, impulsivity loaded on PEN items:- (13), (8) and (22).

It can be seen that only items (8) and (13) are included in all impulsivity factors derived from factor analysis of EPI form A items. Item (22) is included in three of the four impulsivity factors. It was considered that two or possibly three items were too few to constitute an impulsivity scale but these analyses did indicate possible sources of unreliability in the constructed impulsivity scale.

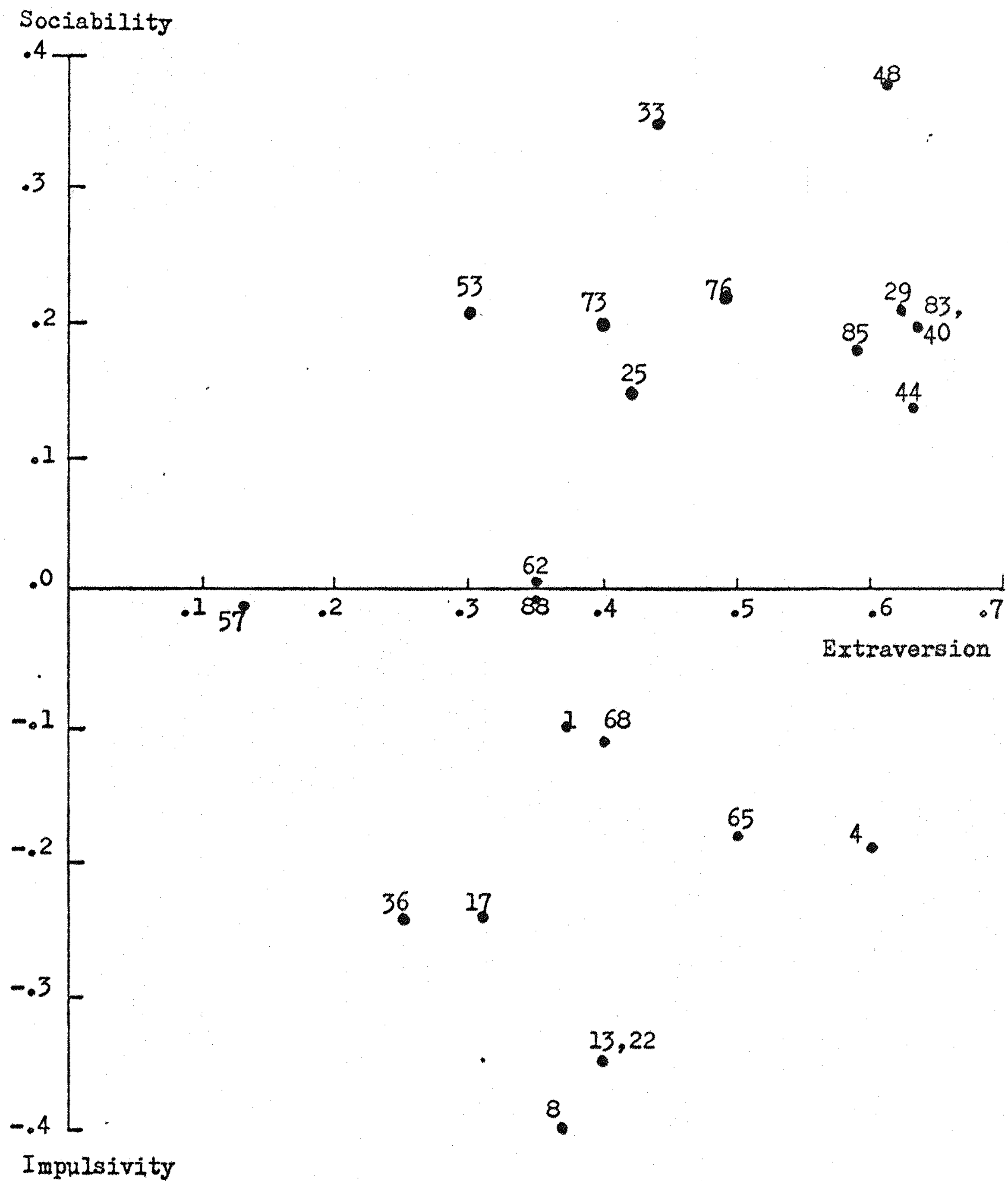


Fig 4.1. Extraversion factor loadings plotted against sociability-impulsivity factor loadings for EPI form A items

Impulsivity and sociability scales from EPI form A items have been used in some studies.

Burgess (1974) used the following items for impulsivity and sociability:-

An eight item impulsivity scale:- Items (1), (4), (8), (13), (17), (22), (36) and (68).

An eleven item sociability scale:- Items (25), (29), (33), (40), (44), (48), (53), (73), (76), (83) and (85).

Eysenck & Levey (1972) used impulsivity and sociability items in their re-analysis of eyeblink conditioning, but they did not specify which items were used. However, items are likely to be those used by Eysenck (1974). She defined her scales from the following items:-

A nine item impulsivity scale:- Items (1), (4), (8), (13), (17), (22), (36), (65) and (68).

A twelve item sociability scale:- Items (19), (25), (29), (33), (40), (44), (48), (53), (73), (76), (83) and (85).

Burgess (1974).

Blackburn (1973) validated his impulsivity and sociability scales using EPI form A items. Impulsivity items were the same as those used by Eysenck, while sociability items were those used by Burgess.

It can be seen that Eysenck's (1974) impulsivity scale includes all items used by Burgess plus item (65), these items are all included in the constructed impulsivity scale together with items (57) and (88). Eysenck's item (19) in her sociability scale is scored as a neuroticism item for personality assessment from EPI form A, exclusion of this item produces Burgess' sociability scale. All Burgess' items are included in the constructed sociability scale plus items (62) and (80). Thus the constructed scales are comparable to previously used impulsivity and sociability scales.

4.5. Reliability of scales derived from EPI form A items.

EPI extraversion and neuroticism scales have been assessed for test-retest and split half-reliability.

The EPI manual cites test-retest reliability for two samples using form A and form B separately. Group X were given a one year interval between tests, while group Y had a nine month interval between tests. Correlations obtained are tabulated below (Table 4.1.).

TABLE 4.1.

Test-retest reliability for E.P.I.

	Sample size.	E form A	E form B	E total.
Group X	92	.82	.85	.88
Group Y	27	.97	.80	.94
		N form A	N form B	N total.
Group X	92	.84	.81	.84
Group Y	27	.88	.91	.92

Eysenck & Eysenck (1964, P.11.)

Split half reliability was calculated by correlating scores obtained from form A with those obtained from form B. Three samples, normals, neurotics and psychotics, showed correlations tabulated below (Table 4.2).

TABLE 4.2.

Split half reliability for E.P.I.

Comparison	Normals	Neurotics	Psychotics
E_A v. E_B	.75	.75	.75
N_A v. N_B	.50	.87	.91

Eysenck & Eysenck (1964, P.11.)

4.5.1. Test of reliability of our constructed impulsivity and sociability scales together with E, N and L reliabilities. Thirty-two students were given EPI form A at the start of their first undergraduate year. They were instructed to complete the form and return it two weeks later. Six months later, these students completed the PEN during an experimental session.

Means and standard deviations for the two test sessions were obtained and tabulated below (Table 4.3).

TABLE 4.3.

Reliability of E.P.I. scales and subscales.

Scale.	First test.		Second test.		Difference.	t.
	Mean	SD	Mean	SD		
Neuroticism	10.66	3.75	10.03	4.97	.63	.573
Extraversion	10.91	4.55	10.66	4.55	.25	.214
Sociability	5.72	2.74	5.89	3.07	-.17	.234
Impulsivity	5.22	2.10	4.98	2.51	.24	.376

A t-test for differences between means demonstrated no significant differences in any scale.

TABLE 4.4.

Test-retest correlations for E.P.I. scales and subscales.

Scale	r
Neuroticism	.845
Extraversion	.820
Sociability	.841
Impulsivity	.634
Lie	.671

Our sample can be considered representative of English students, since means and standard deviations for neuroticism and extraversion are comparable to EPI manual means and standard deviations for English students. Test-retest reliabilities for neuroticism and extraversion are comparable to EPI manual group X reliabilities. Sociability has a similarly high reliability but impulsivity and lie have lower reliabilities. However, the magnitude of the impulsivity and lie correlations is still within the magnitude accepted for split half reliability in the EPI manual.

The similarity between impulsivity and lie scale reliability could indicate a common factor operating on these two scales. Farley (1970) obtained a higher correlation between impulsivity and lie scales ($r = -.41$) than between sociability and lie scales ($r = -.15$) and hence suggested that impulsivity was more susceptible to dissimulation than sociability.

In this study, it is possible that test timing produced a differential need to dissimulate. Students received the first test soon after arrival at University. Insecurity in a new environment could have encouraged dissimulation, while six months later students should be more secure and dissimulate less. Some support for this notion can be derived from our within test correlations. Assuming that a response set operating on two scales increases correlations between these scales, then a reduction in response set would decrease correlations.

Correlations between impulsivity and lie scales were compared for test I and test 2. The correlation was reduced from $r = -.351$ in test I to $r = -.295$ in test 2.

Eysenck (1969b) argues that neuroticism is most susceptible to social desirability response set, if this dissimulation operates more in the first test than the second test, correlations between neuroticism and lie should decrease from test I to test 2.

Correlations between neuroticism and lie scales were compared for test I and test 2. The correlation was reduced from $r = -.417$ in test I to $r = -.230$ in test 2.

It can be seen that some of the comparatively low reliability in impulsivity could possibly be accounted for by test timing, this could have resulted in an increased tendency to dissimulate on the first test.

In future experiments, using impulsivity scales, an effort was made to reduce insecurity by later timing and re-assurance of confidentiality.

4.6. Validity of impulsivity items.

4.6.1. Construct validity of Eysenck's extraversion items. Construct validity of MPI and EPI items was assessed from E and N scores of subjects nominated as extravert, introvert, neurotic and stable. These nominations were aided by the following descriptions of extreme personality types:-

Extravert. "The typical extravert is sociable, likes parties, has many friends, needs to have people to talk to, and does not like reading or studying by himself. He craves excitement, takes chances, often sticks his neck out, acts on the spur of the moment and is generally an impulsive individual. He is fond of practical jokes, always has a ready answer, and generally likes change. He is carefree, easygoing, optimistic, and likes to laugh and be merry. He prefers to keep moving and doing things, tends to be aggressive and to lose his temper quickly. His feelings are not kept under tight control, and he is not always a reliable person."

Introvert. "The introvert is a quiet, retiring sort of person, introspective, fond of books rather than people; he is reserved and distant except to intimate friends. He tends to plan ahead,'looks before he leaps', distrusts the impulse of the moment. He does not like excitement, takes matters of every day life with proper seriousness, and likes a well-ordered mode of life. He keeps his feelings under close control, seldom behaves in an aggressive manner, and does not lose his temper easily. He is reliable, somewhat pessimistic, and places great value on ethical standards."

Neurotic. "High scoring individuals tend to be emotionally over-responsive and to have difficulties in returning to a normal state after emotional experiences. Such individuals frequently complain of vague somatic upsets of a minor kind, such as headaches, digestive troubles, insomnia, backaches etc: and also report many worries, anxieties, and other disagreeable emotional feelings. Such individuals are predisposed to develop neurotic disorders under stress, but such predispositions should not be confused with neurotic breakdown; a person may have high scores in N while yet funcyioning adequately in work, sex, family and social spheres."

Eysenck, (1962a).

Eysenck found that mean E scores for nominated extraverts were 10 points above the population mean, while mean E scores for nominated introverts were 8 points below the population mean. Mean N scores for nominated neurotics were 10 points above the population mean and mean N scores for nominated stables were 5 points below the population mean.

Similarly, Eysenck & Eysenck (1964) validated EPI items using applicants for Mensa as subjects. Although this sample is thus biased towards high intelligence, E and N scales are said to be independent of intelligence, except at very low intelligence levels when comprehension is doubtful. Extraverts' mean E score was 6 points above population mean and introverts' mean E score was 10 points below population mean. Differences between both MPI and EPI scores for nominated groups were all significant.

Eysenck & Eysenck compared the distributions of E scores for nominated extraverts and introverts. The two groups displayed overlapping distributions with a range of 1 to 46 for introverts and a range of 10 to 46 for extraverts. They suggested that this overlap was caused by judge error. A judge could choose two people, one more extraverted than the other, but each judge could use his own criterion for comparison.

Vingoe (1966) compared E scores with subjective ratings of extraversion introversion. Self-rated extraverts and introverts had significantly different E scores.

It can be seen that E scores of nominated extravert and introvert groups give some validation to extraversion items. However, E scores of individual extraverts and introverts do not always agree with their subjective ratings of extraversion and introversion.

4.6.2. <u>Influence of response sets on extraversion items</u>. A general criticism levelled at any self-report questionnaire, is that answers are likely to be affected by acquiescence, dissent or social desirability response sets. These response sets can distort final scores and affect scale validity.

Acquiescence or dissent response set is the subjective tendency to answer predominantly, "Yes" or predominantly, "No", with little regard for item content. Eysenck & Eysenck (1963b) tested extraversion items for these response sets. A 24 item N scale was constructed so that a "Yes" answer indicated neuroticism and a "No" answer indicated stability. Four 8 item extraversion scales were constructed (A, B, C and D), such that a "Yes" answer on scales A and C and a "No" answer on scales B and D indicated extraversion. If acquiescence response set operated, scales A and C would correlate with N, while if dissent response set operated, scales B and D would correlate with N. Correlations obtained were small and non-significant. They were thus able to conclude that these response sets did not operate on extraversion items. One can thus extrapolate from these results to conclude that these response sets do not operate on extraversion subscales such as impulsivity.

Social desirability response set operates when item content influences the subject to give a response which seems most socially desirable or rational to him. Eysenck (1962b) tested MPI items for social desirability response set. The MPI, the acquiescence scale of Jackson-Messick's F scale, MMPI hysteria, psychopathic deviance and psychosthenic scales were administered to subjects. MPI N-scale item content was considered most socially undesirable and hence most vulnerable to social desirability response set. Factor analysis produced a social desirability response set factor but N had no positive loadings on this factor. Eysenck thus concluded that MPI and later EPI scales were not contaminated by this factor.

The EPI includes a "lie" scale to detect response set influences.

Farley (1970) argues that extraversion subscales are differentially effected by social desirability response sets, since his correlation between lie and impulsivity scales was significant ($r = -.41$) and greater than, the non-significant correlation between lie and sociability scales ($r = -.15$). However, our data on impulsivity scale reliability, demonstrate a reduction in correlation between lie and impulsivity scales from the first test to the second test (P. 185). It was concluded that response set influence could be reduced by appropriate test timing and reassurances of confidentiality. Thus our use of impulsivity scales should be relatively uncontaminated by social desirability response sets.

4.6.3. Unitary or dual nature of extraversion. It will be recalled that a wide variety of factor analytic studies derived two main subfactors of impulsivity and sociability from extraversion items (P. 171-173). Eysenck & Eysenck (1969) argue that extraversion, as a second order factor, is composed of correlated subfactors but it is the full extraversion scale which demonstrates predicted correlations with other psychological and physiological phenomena.

Evidence for this assertion was derived from correlations between extraversion item factor loadings and scores from the lemon juice test. Increase in salivation to lemon juice compared with salivation to control stimuli was greater in introverts than in extraverts. The rationale was that introverts are habitually more aroused than extraverts, and hence have lower sensory thresholds and greater reactions to stimuli such as lemon juice. Eysenck & Eysenck obtained extraversion factor loadings from a previous factor analysis of EPI items and 50 other items obtained from five hundred subjects, half men and half women. This study involved forty-five men and forty-eight women. All EPI items having factor loadings of .2 or more on extraversion, correlated with lemon juice test score (r = .15 or more). Eysenck & Eysenck thus concluded that extraversion was a unitary factor. However, closer inspection of the data (Eysenck & Eysenck, 1969, P.152, Fig: 13.1) suggests that their results may not be conclusive evidence of extraversion's unitary nature. Eysenck & Eysenck's figure is divided into two parts; on the right are the high loading-high correlations values and on the left are the low loading-low correlation values. The division approximates a correlation value of .3. Items in the former quadrant, can be compared with sociability-impulsivity loadings obtained from a previous factor analysis of extraversion items using 300 subjects (133 male and 167 female mean age 27.73) (Eysenck & Eysenck, 1969, P.143-146). Eleven extraversion items have correlations with lemon juice test scores, greater than .3. Eight of these items have high factor loadings on sociability and three of these items have high factor loadings on impulsivity. The reverse trend is apparent in the twelve extraversion items having low correlations ($r = .15$ to $.3$) with lemon juice test scores. Eight of these items have factor loadings on impulsivity and the other four have factor loadings on sociability. If extraversion is a unitary factor, one would expect high and low correlations between extraversion items and lemon juice test scores to be equally distributed between sociability and impulsivity items. The lack of equality observed suggests that extraversion may not be a unitary factor.

The lemon juice test has also been criticised on technical grounds. Corcoran (1964) developed the technique used by Eysenck & Eysenck (1969). Use of this technique has tended to replicate relationships between lemon juice salivation and introversion (Corcoran, 1964; Howarth & Skinner, 1969; Casey & McManis, 1971). In the latter study correlation for males was not significant ($r = .19$) but there was a significant correlation for females ($r = .43$, $p < .01$). However, Ramsey (1969) improved the technique and failed to replicate previous results.

It can be seen that evidence for the unitary nature of extraversion is inconclusive. Eysenck & Eysenck's (1969) analysis suggests that sociability items may account for relationships between introversion and lemon juice salivation. Their high correlations have not always been replicated and this has been particularly apparent when salivation measurement has been improved.

Evidence for the dual nature as opposed to the unitary nature of extraversion is more substantial. Eysenck & Levey (1972) re-analysed their data in terms of sociability and impulsivity. Impulsivity accounted for conditionability differences observed between extraverts and introverts, under parameters favourable to introverts. This type of conditioning is closely associated with the main line of Eysenck's (1967) personality theory, hence this re-analysis can be regarded as strong evidence for extraversion's dual nature.

It is possible that lemon juice salivation is related to the appetitive system and a unitary extraversion factor, while eyeblink conditioning may be associated with the aversive system and hence socialisation processes which may, in part, determine impulsivity. This thesis is primarily concerned with aversive conditionability and its relationship to personality. In terms of the above arguments, extraversion is examined with regard to the subfactor of impulsivity.

4.7. Construct validity of our impulsivity scale.

4.7.1. Validation of our impulsivity scale using a psychomotor test.

Gibson's spiral maze (GSM) test was preferred to Porteus' Q-score, since the former was designed to measure psychomotor impulsivity without contamination from ability factors. The GSM also tends to emphasis response speed more than Porteus' Q-score, which tends to measure carelessness and lack of self-control.

Both psychomotor tests have distinguished delinquents from non-delinquents (Gibson, 1965), while Porteus' Q-score has also distinguished psychopaths from non-psychopaths (Schalling & Rosen, 1968). Schalling & Rosen defined psychopaths from the Cleckley criteria which, they emphasise, imply lack of self-control but need not imply strong urges.

Martin & Warde (1971) compared measures of delinquency with GSM scores. Four indices used were:- a) age at first court appearance, b) number of findings of guilt, c) shortest gap between successive unrelated court appearances and d) absconding from training school. GSM error score and index (c) gave the only significant correlation ($r = -.33$, $p < .05$). They also suggested that delinquent/normal differences could be, in part, related to the testing situation. Delinquents were tested at a classifying school and later at training school. The second test showed significantly quicker time scores. This was not regarded as a practice effect, since a control sample, tested for the first time in training school, was quicker than the original classifying school sample. Similar situational effects were observed when re-test samples in different training schools were compared. Different training schools showed significantly different GSM scores, although these samples did not differ in classifying school.

The GSM has also been associated with "naughtiness" ratings of primary school boys (Gibson, 1969). GSM error and time scores classified boys into four types:- quick and careless, slow and careless, quick and accurate, slow and accurate. "Good" boys were mainly quick and accurate, while "naughty" boys fell in both careless groups.

Eysenck (1967) suggested that speed and inaccuracy in psychomotor tests were extravert characteristics. Gibson (1969) compared GSM scores with personality, assessed from the Junior Maudsley Personality Inventory (JMPI) in primary school boys. Psychomotor incompetence (time $scores^2$ + error $scores^2$) replaced the previously recommended corrected error score. Psychomotor incompetence correlated significantly with extraversion for low neuroticism groups only ($p < .05$). However, McDonald & Parker (1971) failed to replicate these results. In normal adolescents, rank order correlations between corrected error score and extraversion were not significant ($r = -.03$) but there was a significant correlation between corrected error score and neuroticism ($r = .37$, $p < .01$). No significant correlations between GSM scores and extraversion were found in either high or low neuroticism groups.

GSM score correlations with other measures of impulsivity are inconclusive. Blackburn (1973) found that only GSM time score correlated with his measure of impulsivity in a sample of special hospital (Broadmoor) patients ($r = -.23$, $p < .05$). There were no significant correlations between GSM scores and his extraversion or anxiety scales.

It can be seen that GSM scores relate to some behavioural indicants of poor socialisation, i.e. delinquency and "naughtiness". One study finds a correlation between psychomotor incompetence and extraversion at low N levels, while another study fails to replicate this result but uses a slightly different GSM measure (corrected error score). Only one study finds that GSM error score correlates with neuroticism. One impulsivity measure correlates with GSM time score but another impulsivity measure was unrelated to GSM scores. However, these studies may be confounded by maladjustment factors. It was thus considered that GSM scores should be a test of impulsivity in normal samples, hence they were used to validate our constructed impulsivity scale.

Method.

Forty-eight male students were administered EPI form A during their first undergraduate year. Subjects were scored for neuroticism and impulsivity, and divided into four groups according to high or low neuroticism and high or low impulsivity. Group means defined the criteria for division. This procedure resulted in uneven groups. However, removal of sixteen subjects with scores on or near the sample's mean for neuroticism or impulsivity, allowed four groups containing eight subjects each to be selected. These thirty-two students were given the GSM, in accordance with manual instructions, as part of an experimental session.

Data analysis.

The correlation between error and time scores was -.507, an order of magnitude similar to that reported by Gibson (1965). A corrected error score was calculated by converting error and time scores to percentiles and regressing error on time scores (method recommended by Gibson, 1965).

Correlations between GSM scores and personality are shown in table 4.5. below:-

TABLE 4.5.

Correlations between G.S.M. scores and E.P.I. scales.

Personality.	GSM score.		
	Time.	Error.	Corrected error.
Neuroticism	.247	-.156	-.053
Extraversion	-.344 ($p < .02$)	.285	.169
Impulsivity	-.105	.360 ($p < .02$)	.363 ($p < .02$)
Sociability	-.409 ($p < .01$)	.085	-.110

The results of analyses of variance for our GSM scores in the four groups divided according to high and low impulsivity and high and low neuroticism scores, are shown in tables 4.6. and 4.7.

TABLE 4.6.

Means and standard deviations for GSM scores in the four personality groups:

GSM scale.	Personality group.			
	H.N, L.I.	H.N, H.I.	L.N, L.I.	L.N, H.I.
Time Mean	56.25	46.25	59.38	31.89
SD	22.00	24.02	19.54	26.18
Error Mean	45.63	63.75	50.63	70.63
SD	21.85	27.87	14.99	21.95
Corrected error.				
Mean	45.00	61.00	46.25	60.12
SD	25.63	30.34	17.87	32.77

TABLE 4.7.

Analysis of variance tables for GSM scores.

GSM time in seconds.

Source.	SS	df	Mean Square.	F	p
Neuroticism	253.12	1	253.12	.478	---
Impulsivity	2812.50	1	2812.50	5.287	.05
Interaction	612.50		612.50	1.152	---
Within cells	14893.75	28	531.92		
Total	18571.87	31			

GSM error score.

Source.	SS	df	Mean Square.	F	p
Neuroticism	282.03	1	282.03	.459	---
Impulsivity	2907.03	1	2907.03	4.7217	.05
Interaction	7.01	1	7.01	.0114	---
Within cells	17203.13	28	614.40		
Total	20399.22	31			

GSM corrected error scores.

Source.	SS	df	Mean Square.	F	p
Neuroticism	.28	1	.28	.000	---
Impulsivity	1785.03	1	1785.03	2.400	---
Interaction	9.03	1	9.03	.010	---
Within cell	20804.37	28	743.01		
Total	22598.71	31			

TABLE 4.8.

Means and standard deviations for impulsivity and neuroticism in the four groups.

Group.		Mean.	Standard deviation.
High N, low I:	N-score.	15.37	2.97
	I-score.	4.00	.92
High N, high I:	N-score.	14.37	1.68
	I-score.	8.12	1.45
Low N, low I:	N-score.	5.62	1.84
	I-score.	4.62	1.92
Low N, high I:	N-score.	9.62	2.19
	I-score.	6.25	1.66

Result:

High impulsivity groups have significantly more errors and are significantly quicker than low impulsivity groups. There is a non-significant trend for corrected error scores to be higher in impulsive groups. There are no significant relationships between GSM scores and neuroticism and no significant interactions between impulsivity and neuroticism with GSM scores.

Conclusion:

The corrected error scores were calculated from time and error scores obtained from this sample and hence may not be comparable with GSM corrected error scores from samples with different ranges. Time scores in this sample are well below those reported in the manual. However, the significant associations between impulsivity and both GSM time and error scores indicate validity for our impulsivity scale.

4.7.2. Validity of our impulsivity scale using risk taking measures of impulsivity. a) Kipnis' impulsivity scale.

The Kipnis impulsivity scale was thought to be a suitable scale for validation, since it was specifically designed to measure impulsivity in students and the sample under test were students.

The validity of Kipnis' impulsivity scale has tended to be restricted to high intelligence groups. Kipnis (1965) found that degree of clinically diagnosed psychopathy correlated with his impulsivity scale (r = .66) when patients had average or high intelligence scores. Within American student samples, impulsivity was related to underachievement and low acceptance of social values in high intelligence groups only (Kipnis, 1971).

Since approximately forty per cent of the American population attend college as opposed to approximately ten per cent of the British population, it was considered that British student samples should be comparable to Kipnis' high intelligence group. Hence use of Kipnis' impulsivity scale should be valid throughout British samples.

Kipnis' impulsivity scale correlates with other scales measuring aspects of extraversion or psychopathy, in American samples:-

MPI E-scale, r = .41

CPI socialisation scale, r = .45

MMPI Ma scale, r = .25

MMPI Pd scale, r = .29

A higher correlation between Kipnis' impulsivity scale and MMPI Pd scale was obtained from a mixed sample of boys from a delinquent home and from an American public school. (r = .53).

Kipnis reports split-half reliability as .84.

<u>Method</u>.

Kipnis' impulsivity scale was anglicized (See Appendix II) in that references to American activities and schools were given their English equivalents. Thirty-two students, selected to remove mean impulsivity and neuroticism scorers, completed Kipnis' impulsivity scale during an experimental session.

Correlations between Kipnis' impulsivity scores and EPI scales were obtained and tabulated below (table 4.9).

TABLE 4.9.

Correlation between Kipnis' impulsivity and EPI scales.

Neuroticism, r = –.048 (NS)	Impulsivity, r = .275 (NS)
Extraversion, r = .475 ($p<.01$)	Sociability, r = .450 ($p<.01$)

Since the sample was selected to exclude mean impulsivity and mean neuroticism scorers, these correlations were considered indicative of trends and further non-parametric analyses were performed.

Three Mann-Whitney U tests were calculated for comparison of Kipnis scores in:- a) two groups defined from high and low EPI scores, b) two groups defined from high and low S scores, and c) two groups defined from high and low E scores. Results are tabulated below (table 4.10).

TABLE 4.10.

Mann-Whitney U scores for Kipnis scores in high and low personality groups.

Impulsivity,	U = 89	(NS)
Sociability,	U = 80	($p<.05$)
Extraversion,	U = 103	(NS)

Result. Correlations indicate that Kipnis score is related to extraversion and sociability, while there is comparatively little relationship with impulsivity. The two significant relationships between Kipnis score and sociability suggest that Kipnis score measures the sociability component of extraversion. The lack of significant U for extraversion could be caused by bias towards impulsivity in the sample selection which eliminated mean I scores. eg; low I combined with high S would produce a mean I score with equal probability of being assigned to the high or low E group.

Conclusion.

Our EPI impulsivity scale has not been validated using Kipnis' impulsivity scale. This need not imply that our EPI scale is a poor measure of impulsivity, since Kipnis' impulsivity scale has a significant relationship with EPI sociability and could thus be a measure of sociability rather than impulsivity. This notion is supported by Kipnis' validity criteria. High impulsivity scorers had more orderly and predictable friendships than low impulsivity scorers.

b) Lykken's Activity Preference Questionnaire (APQ).

The APQ is a hundred paired item, forced choice inventory developed by Lykken & Katzenmeyer (1967) (See Appendix III). "Physical" and "social" anxiety subscales consist of thirty-two item pairs each, while "ego-threat" is made up from sixteen item pairs. The total score from the sum of the three subscales is said to measure anxiety, although it is unrelated to any existing measure of anxiety (See P.176).

"Physical anxiety" pairs contrast a frightening or exciting activity with an onerous activity. e.g. item 43: "Washing a car" or "Driving a car at ninety-five miles per hour".

"Social anxiety" contrasts an awkward social situation with a boring or onerous activity. e.g. item 95:- "Waiting for an overdue bus" or "Meeting a friend on the street and not being able to remember his name".

"Ego-threat" contrasts an embarrassing activity with an onerous or boring activity. e.g. item 15:- "You catch a bad cold on the day before a big party" or "People at a party are telling jokes. You tell a long drawn out story but no one laughs".

In the above examples, endorsement of the first activity scores on anxiety.

The APQ has been validated using primary psychopaths as a criterion group. Lykken (1957) compared primary psychopaths, defined by the Cleckley criteria, with non-psychopathic prisoners. The former group had significantly lower APQ scores than the latter and a group of normal controls. Schacter & Latané (1964) used the APQ to identify psychopathic and non-psychopathic prisoners. Psychopathic groups from Lykken's study and Schacter & Latané's experiment gave significantly poorer avoidance learning than control groups.

Rose (1964) compared mean MMPI profiles of Psychiatric patients scoring in the upper and lower twenty per cent of the APQ. Mean profiles for high scorers indicated an anxious, worried neurotic while mean profiles for low scorers were associated with psychopathic characteristics.

Hauser (1959) administered the APQ to a group of normal college students. APQ score correlated negatively with a self-report measure of a variety of minor legal offences.

It can be seen that APQ scores are negatively associated with psychopathy and one measure of criminality. Since a diagnostic characteristic of psychopathy is impulsivity and criminal behaviour is thought to be a manifestation of behavioural impulsivity, the APQ could be used to validate an impulsivity scale.

Method.

Twenty three post graduates completed the APQ and EPI form A during an experimental session.

Correlations between APQ scores and EPI scores are tabulated below (table 4.11).

TABLE 4.11.

Correlations between APQ scores and EPI scales.

EPI measures.	APQ measures. S.A.	P.A.	Ego-threat.	Total.
Neuroticism	.267	.150	-.060	.219
Extraversion	-.532***	-.105	-.386**	-.516***
Sociability	-.351*	.087	-.415**	-.242
Impulsivity	-.589***	-.313	-.457**	-.616***
Age	-.063	-.395*	-.108	.157

* = $p < .1$, ** = $p < .05$, *** = $p < .01$.

Result.

Impulsivity has the highest correlation with total APQ score. It is also significantly correlated with social anxiety and ego-threat. The lack of significant correlation between impulsivity and physical anxiety could be associated with an age factor, since there was a significant negative correlation between physical anxiety and age.

Conclusion.

Our EPI derived impulsivity scale can be said to have been validated by the APQ.

4.7.3. Validity of our impulsivity scale using clinically based measures of impulsivity. a) The Pd and Ma scales from the MMPI.

It will be recalled (P.173) that a number of MMPI factor analyses produced a bipolar factor with loadings on Ma and D (depression). Carrigan (1960) suggested that this factor was related to extraversion-introversion. Others (Kassenbaum, Couch & Slater, 1959; Blackburn, 1973) have derived an impulsivity scale from MMPI items. Kassenbaum et al found that their second fusion factor, maladjusted extraversion to adjusted introversion, had highest loadings on impulsivity and Ma.

Psychopaths, the group with impulsivity as their diagnostic characteristic, have peak scores on Pd and Ma scales (Black, 1966).

Evidence thus suggests that Ma is closely related to impulsivity while Pd may also have some association with impulsivity.

Hathaway & McKinley (1951) define hypomania (Ma) as marked over-productivity in thought and action. The hypomaniac patient is one who:-

> "....has usually got into trouble because of undertaking too many things. He is active and enthusiastic. Contrary to common expectations he may also be somewhat depressed at times. His activities may interfere with other people through his attempts to reform social practise, his enthusiastic stirring up of projects in which he may lose interest, or his disregard of social conventions. In the latter connection he may get into trouble with the law. A fair percentage of patients diagnosed as psychopathic personality are better called hypomanic."
>
> (Hathaway & McKinley, 1951, P.14).

The psychopathic deviant (Pd) scale measures:-

> "....the similarity to the clinical group who have little deep emotional response, are unable to profit from experience and disregard social mores. These people may be dangerous to themselves and others but are commonly likeable and intelligent. Their most frequent anti-social activities are lying, stealing, alcohol or drug addiction and sexual immorality. They may have short periods of true psychopathic excitement and depression following discovery."
>
> (Hathaway & McKinley, 1951, P.14).

Although peaks on Ma and Pd are characteristic of psychopaths there may also be some interaction with intelligence. Panton (1960) found that prisoners with an IQ over 110 had psychopathic MMPI profiles, while prisoners with average or below average IQ tended to have neurotic or anxious MMPI profiles. Assuming "dropping out" of school is a behavioural indicant of impulsivity in "normal" samples, then similar results were obtained by Roessel (1954). More intelligent high school students with high Pd scores, were more likely to "drop out" than those with low Pd scores. No relationship was found among the less intelligent.

Two types of psychopath have peaks on Ma and Pd; the primary psychopath and the secondary psychopath. The former has average or low anxiety and neuroticism scores while the latter has peaks on anxiety and neuroticism scales. Primary psychopaths fit the Cleckley criteria but secondary psychopaths do not fulfil all the criteria, in particular the lack of anxiety criterion (Hare, 1970). However, both types of psychopaths are said to be impulsive so that Pd and Ma should be measures of impulsivity.

Method.

The full MMPI was considered too time consuming to be used. Since interest centered on the Ma and Pd scales a shortened version of these scales composed. Ma and Pd items were extracted from the MMPI, the number of items in each scale was halved by removing repeated items. The scales were still considered to be too long and repetitive. The remaining items were assigned to categories, on the basis of item content, and a representative number were arbitrarily selected from each category. The final shortened version of MMPI Pd and Ma scales can be seen in Appendix (IV).

The validity of this shortened MMPI scale was tested. Twenty students who had previously completed the full MMPI were given the shortened version. Ma and Pd scores were compared by product moment correlations. Ma scales correlated at r = .73, Pd scales correlated at r = .74. The shortened version was thus considered an acceptable measure of MMPI Ma and Pd scales.

Method.

Forty-eight students completed the shortened version of MMPI Ma and Pd scales together with EPI form A during an experimental session.

Data analysis.

The correlations between EPI scales and the shortened MMPI Pd and

Ma scales is given in table 4.12. below.

TABLE 4.12.

Correlations between MMPI, Pd and Ma scales and EPI scales.

EPI scales	Pd	Ma
Neuroticism	.364**	.181
Extraversion	.188	.384***
Sociability	.089	.240
Impulsivity	.241	.416***

*** = $p < .01$, ** = $p < .02$.

Result.

Impulsivity has the highest significant correlation with Ma. Neuroticism is significantly correlated with Pd.

Conclusion.

Impulsivity had been validated by use of MMPI Ma but not MMPI Pd. This result is consistent with previous MMPI factor analyses which associated impulsivity or extraversion with the Ma scale but not the Pd scale.

The correlation between neuroticism and Pd suggests that Pd may be more closely associated with a maladjustment factor rather than impulsivity, hence the observed lack of correlation does not invalidate our impulsivity scale.

b) A derived impulsivity scale from MMPI items.

Blackburn (1973) derived an impulsivity scale from factor analysis of MMPI items. Previously, Kassenbaum, Couch & Slater (1969) factor analysed MMPI items, producing an impulsivity factor associated with neuroticism and a sociability factor associated with stability. Blackburn's factor analysis showed similar factors which he labelled impulsivity, sociability, anxiety and extraversion. His Revised

Personality Inventory (RPI) was designed to measure these factors (See Appendix V).

Blackburn compared RPI impulsivity and sociability scales with EPI form A impulsivity and sociability scales (items listed on P. 182). Data was collected from a sample of ninety-nine Special Hospital (Broadmoor) patients. Correlations were obtained and tabulated below (Table 4.13).

TABLE 4.13.

Correlations between RPI and EPI scales in Blackburn's thesis.

	EPI Impulsivity.	EPI Sociability.
EPI sociability	.22*	1
RPI impulsivity	.56***	.03
RPI sociability	-.15	.66***
EPI neuroticism	.18	-.41***

* = $p < .05$, ** = $p < .01$, *** = $p < .001$.

It can be seen that Blackburn found EPI impulsivity to be similar to RPI impulsivity in his sample. Generalisation from a clinical sample to a normal sample should be possible if RPI impulsivity is uncontaminated by clinical factors. The RPI was thus used to assess validity of our EPI impulsivity scale in a student sample.

Method.

Twenty first year male psychology students completed EPI form A and Blackburn's RPI during an experimental session.

Data analysis.

Product moment correlations between EPI form A scales and RPI scales were calculated. Correlations are given in table 4.14 below.

TABLE 4.14.

Correlations between RPI and EPI scales in our study.

EPI neuroticism with RPI anxiety.	r = .656 ($p < .01$).
EPI with RPI extraversion.	r = .375 ($p < .2$)
EPI with RPI sociability.	r = .678 ($p < .001$)
EPI with RPI impulsivity.	r = .296 (Not significant).

Result.

EPI impulsivity is the only scale which does not have a significant correlation with the equivalent RPI scale.

Conclusion.

EPI impulsivity has not been validated by use of Blackburn's impulsivity scale in this student sample.

Blackburn's high correlation between the two impulsivity scales could be due to range attenuation in his sample. His sample consisted of patients due for release which may have introduced bias towards the less impulsive patients. This notion is substantiated by the significantly lower impulsivity scores reported for his patient sample compared with a normal control sample, contrary to hypotheses concerning impulsivity, criminality and psychopathy.

It is possible that Blackburn's impulsivity scale measures impulsivity in secondary psychopaths rather than primary psychopaths. RPI impulsivity and RPI anxiety correlated significantly in Blackburn's sample ($r = .53$, $p < .001$). In our student sample, there was a small but non-significant correlation between RPI impulsivity and EPI neuroticism ($r = .258$), this was greater than our correlation between EPI impulsivity and EPI neuroticism ($r = .191$). Blackburn's impulsivity scale thus appears to be contaminated by neuroticism or maladjustment factors.

It can be seen that our low correlation between EPI impulsivity and RPI impulsivity does not necessarily invalidate EPI impulsivity but casts doubt on the validity of RPI impulsivity in normal samples.

4.8. Summary of our EPI impulsivity scale validation.

Table 4.15 summarises result from the validity studies.

TABLE 4.15.

Summary of results from validity studies.

Test.	Result.
GSM	n = 32 students selected from a sample of 48.
Error score.	High impulsivity groups had more errors than low impulsivity groups ($p < .05$).
Time score.	High impulsivity groups were quicker than low impulsivity groups ($p < .05$).
Corrected error score.	No significant differences between high and low impulsivity groups.
Kipnis' Impulsivity scale.	n = 32 students selected from a sample of 48.
Kipnis' impulsivity	No significant difference between high and low EPI impulsivity groups. High EPI sociability groups had higher Kipnis' impulsivity scores than low EPI sociability groups,
APQ scales.	n = 23
Social anxiety.	r = -.589 ($p < .01$).
Physical anxiety.	r = -.313 (Not significant).
Ego-threat.	r = -.457 ($p < .05$).
Total scale.	r = -.616 ($p < .01$).
MMPI Pd & Ma.	n = 48
Pd.	r = .241 (Not significant).
Ma.	r = .416 ($p < .01$).
RPI impulsivity.	n = 20
	r = .296 (Not significant).

It can be seen that our constructed impulsivity scale has been validated by significant relationships with the two main GSM scores, APQ anxiety and the MMPI Ma scale.

Impulsivity was not significantly related to Kipnis' impulsivity scale, MMPI Pd or Blackburn's MMPI derived impulsivity scale.

Kipnis' impulsivity scale showed high correlations with extraversion and sociability and was thus thought to reflect the sociability component of extraversion rather than impulsivity. Hence this lack of association with our impulsivity scale was not considered as evidence of our scale's invalidity.

Both MMPI Pd and Blackburn's impulsivity scale were thought to be contaminated by maladjustment factors. MMPI Pd correlated significantly with EPI neuroticism and Blackburn's impulsivity scale showed a non-significant correlation with neuroticism. However, Blackburn's impulsivity scale had previously demonstrated a correlation with his MMPI derived anxiety scale. Hence non-significant correlations between impulsivity and these measures can be accounted for by influence from neuroticism or anxiety.

It can be seen that our constructed impulsivity scale has been validated when non-controversial measures of impulsivity have been used.

CHAPTER 5.

Experimental test of relationships between personality, conditioning and arousal.

EXPERIMENT II.

This experiment was designed to test relationships between impulsivity and conditionability and to assess the influence of neuroticism on these relationships, in a student sample. It had also been suggested that conditionability was related to arousal (Spence, 1956). Hypotheses concerning relationships between personality and arousal have been similar to those concerning relationships between personality and conditionability (Eysenck, 1957, 1967). Hence relationships between personality and arousal were also examined.

Theoretical relationships between personality, conditionability and arousal were reviewed in Chapter I. Eysenck (1957) postulated a positive relationship between conditionability and introversion. Neuroticism was equated with arousal and said to exaggerate extraversion-introversion differences. Later, Eysenck (1967) suggested that arousal was cortical and related to extraversion-introversion only. Predicted relationships between conditionability and introversion were confined to under-arousing experimental parameters. Over-arousing parameters could reverse the predicted relationship by inducing transmarginal inhibition in introverts and increasing arousal in extraverts.

Spence (1956) postulated a direct relationship between conditionability and arousal. Arousal was equated with anxiety, measured by the Taylor Manifest Anxiety Scale (MAS). MAS anxiety was a dimension lying obliquely to Eysenck's neuroticism and extraversion, such that high anxiety scorers were neurotic introverts and low anxiety scorers were stable extraverts

Gray (1970, 1971a & b) considered that use of special parameters, to demonstrate extravert-introvert conditioning differences, was not sufficient support for a general personality theory. He combined Eysenck's (1957) theory with Spence's (1956) theory. Conditioning was divided into two types: appetitive and aversive. Appetitive conditionability was associated with extraversion and aversive conditionability was associated with introversion. Both types of conditioning were said to be increased by arousal which he equated with neuroticism. Aversive conditioning was considered the mediator of socialisation. Gray predicts that subjects least susceptible to punishment and hence aversive conditioning, are stable extraverts and those most susceptible to punishment are neurotic introverts. Neurotic extraverts and stable introverts were said to lie between these two extremes.

It was thought that a socialisation paradigm should involve aversive CR acquisition for all subjects, by use of a strong UCS, and that individual differences in socialisation efficacy would be related to CR extinction. Extraversion could be divided into sociability and impulsivity. Impulsivity was considered to be associated with lack of socialisation, while sociability might be related to appetitive conditioning (P. 192). Thus impulsivity replaced extraversion in the hypotheses outlined above.

The final hypothesis concerning conditioning and personality was:- decreasing order of conditioning would be neurotic, non-impulsive, stable non-impulsive or neurotic impulsive, stable impulsive.

Arousal has been related both to anxiety (Spence, 1956) and to introversion (Eysenck, 1967, 1970, 1971 a & b). The combined relationship in Gray's hypothesis is specific to aversive system arousal. In apparent contrast to these theories, Claridge (1967) suggested that clinically defined neuroticism in extraverts (hysteria) decreased drive and arousal, while clinically defined neuroticism in introverts increased drive and arousal. Claridge's two arousal system model (P.37) predicts that indices of arousal modulation are directly related to extraversion-introversion, while indices of tonic arousal are related to drive rather than N-scores. Arousal modulation was indicated by cortical arousal measures such as EEG and SAE, while tonic arousal was said to associated with autonomic indices. In this case, electrodermal indices, such as conductance level, stimulus specific reactivity and spontaneous fluctuations are all measures of tonic arousal. However, the applicability of his model to normal samples is controversial. Claridge suggests that normals could cluster around the centre or be scattered along the hysteria-dysthymia diagonal. Hysterics have been found not to have high E scores but to be indistinguishable from normal sample E scores (P. 11). Thus Claridge's latter suggestion, equating normals with the hysteria-dysthymia diagonal, indicates an arousal continuum from low N, high E to high N, low E. i.e. the anxiety diagonal proposed by Gray (1970, 1971 a & b).

Psychopaths have been said to be underaroused (Quay, 1965; Hare, 1970) (See P.281 for full discussion). Research tends to support this hypothesis when primary psychopaths have been considered. Personality theorists (Eysenck, 1971, Gray, 1970) consider the psychopath to be extravert. However, empirical support for this notion is equivocal but there is agreement that impulsivity is a main diagnostic characteric (Hare, 1970). Hence impulsivity was considered a superior index of extraversion.

The resultant hypothesis to be tested was that decreasing order of arousal would be neurotic non-impulsive, stable non-impulsive or neurotic impulsive, stable impulsive.

Eysenck (1967) suggested that high arousal in introverts could induce transmarginal inhibition in response to stress. This should be indicated by variability between arousal measures. Research by Hume (1973) indicates that this variability is apparent at very high and very low arousal levels. Hence variability should be greatest in the two extreme quadrants of the arousal continuum. The resulting hypothesis is that neurotic non-impulsives and stable impulsives will be more variable than stable non-impulsives and neurotic impulsives.

A further measure of arousability is response recovery time. Gellhorn (1967) proposed that pathological anxiety involved malfunction in the reciprocal inhibition mechanism of the hypothalamus. Hence a sympathetic response to stress would have a longer recovery time in anxious patients than in controls. Lader & Mathews (1968) developed this notion by suggesting that panic attacks were caused by inability to recover from previous stimulation before further stimulation was applied. Each response increased arousal by further additions to unrecovered responses. They found that patients suffering from anxiety states had the highest number of spontaneous fluctuations and least rapid response habituation compared with phobic patients and normals.

Longer than normal recovery times in anxious patients were also found by Malmo, Shagass & Davis (1950); Davis, Malmo & Shagass (1954); Malmo & Shagass (1952) and Rubin (1964). Similarly, situational anxiety induced by threat, has been found to increase recovery time (Furedy & Ginsberg, 1973).

These relationships between anxiety and long recovery time suggest that both neuroticism and introversion are related to long recovery times.

The resulting hypothesis was that recovery times would increase in the following order:- neurotic, non-impulsive; stable non-impulsive orneurotic impulsive; stable impulsive.

Final hypotheses tested in experiment II.

a) Conditioning.

Decreasing order of conditioning is neurotic, non-impulsive; stable, non-impulsive or neurotic impulsive; stable impulsive.

b) Arousal.

i) Decreasing order of arousal is neurotic, non-impulsive; stable non-impulsive or neurotic impulsive; stable impulsive.

ii) Neurotic, non-impulsives and stable impulsives will show more variation between arousal measures than stable non-impulsives and neurotic impulsives.

Method.

The sample was drawn from two first year, male, psychology undergraduate groups.

Group I consisted of thirty two subjects, selected from a total of forty-eight students who completed EPI form A at the start of their first undergraduate year. The mean N-score of the forty-eight students was just under 11 and mean I-score was just over 5. Twelve students with N-scores of 11 or I-scores of 5 were eliminated, leaving equal numbers of subjects in each quadrant formed by high and low N and I-scores. These thirty-two subjects underwent the conditioning procedure described in Chapter 3.

Group 2 was drawn from first year male undergraduates in the following year. Fifty-four students completed EPI form A in their first term. The mean N-score was just over 10 and mean I-score just under 5. Twenty students with N-scores of 10 or I-scores of 5 were eliminated and two students with low N and high I scores disappeared. The remaining thirty-two students underwent the conditioning procedure in the following spring term. These thirty-two students were also divided between the four quadrants, but the mean N score was lower than the mean N-score of group 1, resulting in a slightly different quadrant composition.

The two groups were combined and all median N and I scores omitted. i.e. subjects with N-scores of 10 or 11 and I-scores of 5 were excluded. This resulted in unequal quadrants with a total of fifty-one subjects.

The hypotheses were tested in each group and in the combined group.

Hypothesis (a) Conditioning.

Decreasing order of conditioning is neurotic non-impulsive, stable non-impulsive or neurotic impulsive, stable impulsive.

The electrodermal record was analysed as recommended in Chapter 3. Each response to a stimulus light was transformed using the formula:-

$$\text{Log} \quad \frac{\frac{1}{b} - \frac{1}{a}}{\frac{1}{B} - \frac{1}{A}}$$

where a and b = resistance readings at beginning and end of response and A and B = resistance readings at beginning and end of Maximum UCR.

Mean CR- magnitude was substracted from mean CR+ magnitude in each extinction block to give the differential response.

Negative differential responses and positive differential responses occurring in a block after a negative differential response, were scored as zero differential responses.

A total differential responding score was calculated by adding differential responses from each extinction block.

Analyses of variance for differential responding in habituation, in each extinction block and total differential responding score were calculated for each group and for the combined group. This assessed the relationship between impulsivity and differential responding and the effects of neuroticism on differential responding. Analysis of simple effects for combined groups assessed differential responding in each personality quadrant and the degree to which the hypothesis was fulfilled.

A graph for differential responding scores in combined groups for each quadrant was plotted (See Fig. 5.1).

TABLE 5.1.

Group I. Analysis of variance for differential responding in habituation, the three extinction blocks and the total extinction run.

Differential responding in habituation.

Source.	S of S	df	MS	F	p
Neuroticism	.398	1	.398	2.630	---
Impulsivity	.018	1	.018	.116	---
N X I	.031	1	.031	.202	---
Within cells	4.239	28	.151		

Differential responding in extinction block I.

Source.	S of S	df	MS	F	p
Neuroticism	.132	1	.132	.466	---
Impulsivity	.001	1	.001	.003	---
N X I	.326	1	.326	1.155	---
Within cell	7.909	28	.283		

Differential responding in extinction block II.

Source.	S of S	df	MS	F	p
Neuroticism	.074	1	.074	.170	---
Impulsivity	.098	1	.098	.224	---
N X I	.010	1	.010	.023	---
Within cell	12.212	28	.436		

TABLE 5.1. (cont/d)

Differential responding in extinction block III.

Source.	S of S	df	MS	F	p
Neuroticism	.015	1	.015	.055	---
Impulsivity	.046	1	.046	.172	---
N X I	.009	1	.009	.032	---
Within cell	7.525	28	.269		

Differential responding in total extinction phase.

Source.	S of S	df	MS	F	p
Neuroticism	.264	1	.264	.127	---
Impulsivity	.248	1	.248	.120	---
N X I	.581	1	.581	.280	---
Within cell	58.046	28	2.073		

TABLE 5.2.

Group 2. Analysis of variance for differential responding in habituation, the three extinction blocks and the total extinction run.

Differential responding in habituation.

Source.	S of S	df	MS	F	p
Neuroticism	.068	1	.068	.387	---
Impulsivity	.016	1	.016	.090	---
N X I	.076	1	.076	.433	---
Within cells	4.887	28	.175		

Differential responding in extinction block I.

Source.	S of S	df	MS	F	p
Neuroticism	.061	1	.061	.266	---
Impulsivity	.839	1	.839	3.694	.01
N X I	.009	1	.009	.038	---
Within cell	6.358	28	.227		

Differential responding in extinction block II.

Source.	S of S	df	MS	F	p
Neuroticism	.015	1	.015	.079	---
Impulsivity	.585	1	.585	3.053	.01
N X I	.073	1	.073	.378	---
Within cell	5.365	28	.192		

TABLE 5.2. (Cont/d)

Differential responding in extinction block III.

Source.	S of S	df	MS	F	p
Neuroticism	.200	1	.200	1.056	---
Impulsivity	1.091	1	1.091	5.759	.05
N X I	.100	1	.100	.528	---
Within cell	5.304	28	.189		

Differential responding in total extinction phase.

Source.	S of S	df	MS	F	p
Neuroticism	.325	1	.325	.279	---
Impulsivity	7.427	1	7.427	6.368	.05
N X I	.243	1	.243	.208	---
Within cell	32.652	28	1.166		

TABLE 5.3.

Combined group. Analyses of variance for differential responding in habituation, the three extinction blocks and the total extinction phase.

Differential responding in habituation.

Source.	S of S	df	MS	F	p
Neuroticism	.020	1	.020	.150	---
Impulsivity	.003	1	.003	.253	---
N X I	.001	1	.001	.037	---
Within cell	6.308	47			

Differential responding in extinction block I.

Source.	S of S	df	MS	F	p
Neuroticism	.158	1	.158	.696	---
Impulsivity	.424	1	.424	1.866	0.25
N X I	.167	1	.167	.734	---
Within cell	10.686	47	.227		

Differential responding in extinction block II.

Source.	S of S	df	MS	F	p
Neuroticism	.029	1	.029	.091	---
Impulsivity	.875	1	.875	2.700	0.25
N X I	.115	1	.115	.356	---
Within cell	15.219	47	.324		

TABLE 5.3. (Cont/d)

Differential responding in extinction block III.

Source.	S of S	df	MS	F	p
Neuroticism	.006	1	.006	.025	---
Impulsivity	1.878	1	1.878	7.827	0.01
N X I	.054	1	.054	.225	---
Within cell	11.277	47	.240		

Differential responding in total extinction phase.

Source.	S of S	df	MS	F	p
Neuroticism	.877	1	.877	.574	---
Impulsivity	7.190	1	7.190	4.706	0.05
N X I	.494	1	.494	.324	---
Within cell	71.803	47	1.528		

TABLE 5.4.

Analysis of simple effects for combined groups in extinction.

Extinction block I.

Effects of I for high N quadrants:	F = .129	(N.S.)
Effects of I for low N quadrants:	F = 2.468	($p < .25$)
Effects of N for low I quadrants:	F = .001	(N.S.)
Effects of N for high I quadrants:	F = 1.429	($p < .25$)
High N, low I versus low N, high I:	F = 2.422	($p < .25$)
Low N, low I versus high N, high I:	F = .140	(N.S.)

Extinction block II.

Effects of I for high N quadrants:	F = .551	(N.S.)
Effects of I for low N quadrants:	F = 2.504	($p < .25$)
Effects of N for low I quadrants:	F = .042	(N.S.)
Effects of N for high I quadrants:	F = .405	(N.S.)
High N, low I versus low N, high I:	F = 1.902	($p < .25$)
Low N, low I versus high N, high I:	F = .894	(N.S.)

Extinction block III.

Effects of I for high N quadrants:	F = 2.693	($p < .25$)
Effects of I for low N quadrants:	F = 5.358	($p < .05$)
Effects of N for low I quadrants:	F = .053	(N.S.)
Effects of N for high I quadrants:	F = .197	(N.S.)
High N, low I versus low N, high I:	F = 4.346	($p < .05$)
Low N, low I versus high N, high I:	F = 3.497	($p < .1$)

TABLE 5.4. (Cont/d).

Total extinction phase.

Effects of I for high N quadrants:	F = 1.281	(N.S.)
Effects of I for low N quadrants:	F = 3.750	($p < .1$)
Effects of N for low I quadrants:	F = .018	(N.S.)
Effects of N for high I quadrants:	F = .880	(N.S.)
High N, low I versus low N, high I:	F = 4.283	($p < .05$)
Low N, low I versus high N, high I:	F = .996	(N.S.)

N = Neuroticism: I = Impulsivity: NS = Not significant:

TABLE 5.5.

Means and standard deviations for differential responding in the four quadrants.

Group I.	Personality quadrants.			
Habituation.	HN, LI.	HN, HI.	LN, LI.	LN, HI.
n	8	8	8	8
Mean	.119	.011	-.166	-.151
SD	.369	.398	.356	.429
Extinction block I.				
Mean	.949	.757	.619	.831
SD	.482	.497	.582	.559
Extinction block II.				
Mean	.764	.619	.633	.558
SD	.769	.615	.665	.577
Extinction block III.				
Mean	.447	.338	.457	.414
SD	.615	.357	.488	.582
Total extinction phase.				
Mean	2.160	1.714	1.709	1.802
SD	1.574	1.259	1.390	1.516

TABLE 5.5. (Cont/d).

Group 2.				
n	8	8	8	8
Habituation.				
Mean	-.275	-.134	-.091	-.080
SD	.576	.461	.225	.323
Extinction block I.				
Mean	.842	.551	.788	.431
SD	.578	.518	.396	.385
Extinction block II.				
Mean	.544	.178	.492	.317
SD	.496	.231	.538	.421
Extinction block III.				
Mean	.705	.224	.435	.178
SD	.568	.356	.444	.334
Total extinction phase.				
Mean	2.090	.953	1.714	.925
SD	1.250	.709	1.382	.830

TABLE 5.5. (Cont/d).

Combined group.

	HN, LI.	HN, HI.	LN, LI.	LN, HI.
n	13	15	14	9
Habituation.				
Mean	-.072	-.083	-.107	-.130
SD	.354	.422	.309	.366
Extinction block I.				
Mean	.761	.691	.764	.461
SD	.473	.434	.549	.424
Extinction block II.				
Mean	.575	.404	.621	.258
SD	.678	.550	.578	.377
Extinction block III.				
Mean	.625	.300	.511	.212
SD	.595	.349	.447	.330
Total extinction phase.				
Mean	1.961	1.396	1.894	.928
SD	1.481	1.331	1.069	.898

TABLE 5.6.

Means and standard deviations for neuroticism and impulsivity in the four quadrants.

	HN, LI.	HN, HI.	LN, LI.	LN, HI.
Group I.				
Neuroticism				
Mean	15.37	14.37	5.62	9.62
SD	2.97	1.68	1.84	2.19
Impulsivity				
Mean	4.00	8.12	4.62	6.25
SD	.92	1.45	1.92	1.66
Group 2.				
Neuroticism				
Mean	14.00	13.87	8.00	6.75
SD	1.06	2.03	.92	2.43
Impulsivity	3.62	7.37	2.37	7.50
SD	.91	1.40	1.30	1.41
Combined group.				
Neuroticism				
Mean	14.61	14.20	7.28	6.11
SD	2.06	1.85	1.58	2.20
Impulsivity				
Mean	3.53	7.93	2.85	7.66
SD	.77	1.27	1.16	1.41
n	13	15	14	9

H = High: L = Low: N = Neuroticism: I = Impulsivity:

Results for differential responding in the four personality quadrants.

Group 1.

Neither N nor I gave any significant differences in differential responding in any extinction block or total extinction phase.

There was a non-significant trend for the high N, low I (anxiety) quadrant to have higher differential responding scores than the other quadrants, in extinction blocks I and II and total extinction phase.

Group 2.

High and low impulsivity quadrants showed a significant difference in differential responding in all extinction blocks and the total extinction phase.

High and low N scorers were not significantly different, although there was a trend for the high N, low I (anxiety) quadrant to have higher differential responding than the other quadrants in all three extinction blocks and the total extinction phase.

Combined groups.

High and low impulsivity quadrants showed a significant difference in differential responding in extinction block III ($p < .01$) and the total extinction phase ($p < .05$). There was a trend for non-impulsives to show greater differential responding than impulsives, in extinction blocks I and II ($p < .25$).

Analysis of simple effects lends some support to the hypothesis when the total extinction phase is considered.

Mean differential responding scores in each quadrant:-

	Low impulsivity.	High impulsivity.
High neuroticism.	1.961	1.396
Low neuroticism.	1.894	.928

Low I, high N (anxiety) differed significantly from high I, low N (non-anxious) ($p < .05$).

Low impulsivity differed significantly from high impulsivity in low N quadrants only ($p < .1$).

Figure 5.1. summarises these results for the combined groups.

Hypothesis (b) Arousal.

Four arousal indices were used: spontaneous fluctuations, stimulus specific reactivity, basal skin conductance and time taken to recover half the amplitude of a UCR.

Previous research (reviewed P.65-68) suggested that spontaneous fluctuations were the most reliable indicant of arousal and basal level conductance the least reliable of the former three arousal indices. The reliability of half-time recovery is uncertain (See P.215).

Data collation:

i) Spontaneous fluctuations in habituation, acquisition and extinction phases were counted. Analyses of variance for spontaneous fluctuations in each phase for groups 1 and 2 and the combined group were calculated. Results are tabulated in tables 5.7, 5.8 and 5.9.

ii) Stimulus specific reactivity was assessed from the mean CR-magnitude in habituation and in extinction. The data transformation recommended in Chapter 3 (P.146) was used to calculate CR- magnitudes. Analyses of variance for stimulus specific reactivity in habituation and extinction for groups 1 and 2 and the combined group were calculated (See tables 5.10 and 5.11.).

iii) Basal level skin conductance was measured at the start of extinction. Units used were log micro-mhos. Analyses of variance for basal level conductance in groups 1 and 2 and the combined group were calculated (See tables 5.12 and 5.13.)

iv) Response recovery times were taken from UCR recovery. The longest response recovery times occurred after the UCR. Acquisition

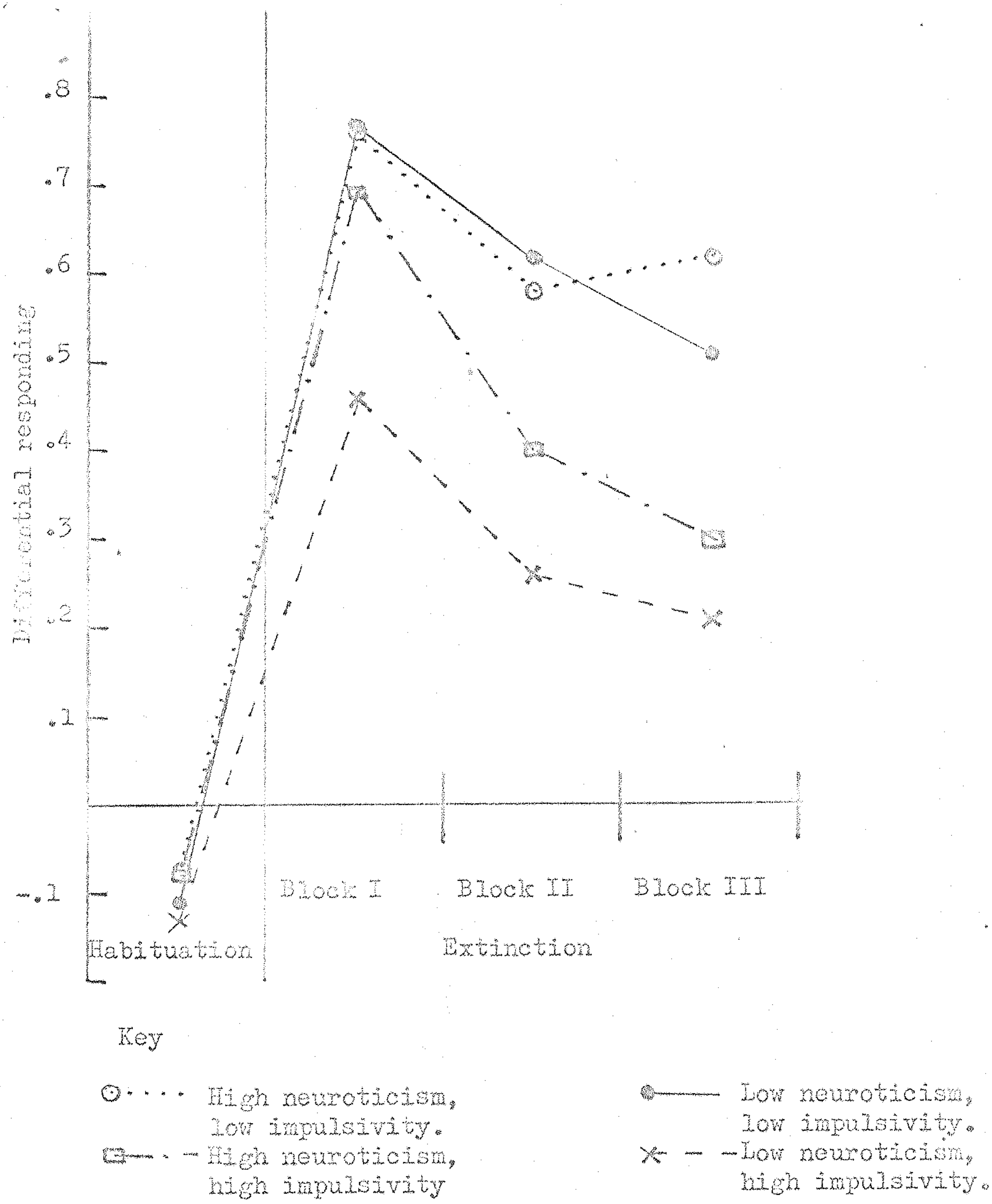


Fig 5.1. Mean differential responding for combined groups in each personality quadrant. Means calculated from individual differential responding, measured by each subjects's mean CR+ - mean CR- for each block. CRs calculated as log change in conductance expressed as a proportion of change in conductance of maximum response. i.e Transformation (iv) (P. 130).

records showed that not all responses returned to base-line, the measure used was thus time taken, to the nearest half second, for the UCR to return to half its amplitude. It will be recalled (P.117) that unreinforced stimuli occurred throughout acquisition; these tended to interfere with UCR recovery. The record was thus inspected to find the maximum UCR without other response interference during recovery. The final half time recovery score was taken from the UCR which met the criteria best.

Analyses of variance were performed on groups 1 and 2 and the combined group (See tables 5.14 and 5.15).

Variation between measures, within quadrants, was assessed by product moment correlations between the three commonly used arousal measures: spontaneous fluctuations, stimulus specific reactivity and basal level (See table 5.16).

TABLE 5.7.

i) Analysis of variance tables for spontaneous fluctuations in habituation, acquisition and extinction.

Group 1.

Habituation.

Source.	S of S	df	MS	F	p
Neuroticism	108.781	1	108.781	.301	---
Impulsivity	9.031	1	9.031	.025	---
N X I	1.531	1	1.531	.004	---
Within cell.	10124.875	28	361.603		

Acquisition.

Source.	S of S	df	MS	F	p
Neuroticism	200.000	1	200.000	.159	---
Impulsivity	630.125	1	630.125	.502	---
N X I	741.125	1	741.125	.590	---
Within cell.	35166.250	28	1255.938		

Extinction.

Source.	S of S	df	MS	F	p
Neuroticism	312.500	1	312.500	.274	---
Impulsivity	496.125	1	496.125	.434	---
N X I	2016.125	1	2016.125	1.765	---
Within cell.	31992.750	28	1142.598		

TABLE 5.7. (Cont/d).

Group 2.

Habituation.

Source.	S of S	df	MS	F	p
Neuroticism	903.125	1	903.125	4.314	0.05
Impulsivity	1275.125	1	1275.125	6.091	0.05
N X I	50.000	1	50.000	.239	---
Within cell.	5861.250	28	209.330		

Acquisition.

Source.	S of S	df	MS	F	p
Neuroticism	1140.031	1	1140.031	.738	---
Impulsivity	3260.281	1	3260.281	2.111	.25
N X I	712.531	1	712.531	.461	---
Within cell.	43244.375	28	1544.442		

Extinction.

Source.	S of S	df	MS	F	p
Neuroticism	3382.531	1	3382.531	2.730	0.25
Impulsivity	2538.381	1.	2538.281	2.049	0.25
N X I	457.531	1	457.531	.369	---
Within cell.	34694.375	28	1239.085		

TABLE 5.7. (Cont/d).

Combined group.

Habituation.

Source.	S of S	df	MS	F	p
Neuroticism	358.391	1	358.391	1.415	0.25
Impulsivity	459.911	1	459.911	1.815	0.25
N X I	120.836	1	120.836	.477	---
Within cell.	11907.606	47	253.353		

Acquisition.

Source.	S of S	df	MS	F	p
Neuroticism	310.204	1	310.204	.292	---
Impulsivity	1124.773	1	1124.773	1.057	---
N X I	648.903	1	648.903	.610	---
Within cell.	50003.414	47	1063.902		

Extinction.

Source.	S of S	df	MS	F	p
Neuroticism	2205.709	1	2205.709	2.778	0.25
Impulsivity	30.650	1	30.650	.039	---
N X I	180.118	1	180.118	.227	---
Within cell.	37320.302	47	794.049		

TABLE 5.8.

Means and standard deviations for spontaneous fluctuations in groups 1 and 2 and combined groups.

Group 1.

	HN, LI.	HN, HI.	LN, LI.	LN, HI.
Habituation.				
Mean	41.625	41.000	45.750	44.250
SD	16.335	24.184	18.752	15.591
Acquisition.				
Mean	71.500	72.250	86.125	67.625
SD	30.336	36.780	43.318	29.568
Extinction.				
Mean	70.250	78.250	92.375	68.625
SD	28.263	27.742	41.840	35.375

Group 2.

Habituation.				
Mean	31.625	21.500	44.750	29.625
SD	11.783	9.914	21.144	12.374
Acquisition.				
Mean	53.750	43.000	75.125	45.500
SD	46.355	27.161	48.702	30.322
Extinction.				
Mean	53.750	43.500	81.875	56.500
SD	41.527	27.841	43.036	24.588

TABLE 5.8. (Cont/d).

Combined groups.

	HN, LI.	HN, HI.	LN, LI.	LN, HI.
Habituation.				
Mean	35.385	32.400	43.929	34.667
SD	14.986	20.677	19.365	14.353
Acquisition.				
Mean	61.769	59.467	74.071	57.222
SD	39.804	35.094	41.951	33.782
Extinction.				
Mean	61.615	63.867	78.857	73.444
SD	35.073	31.048	37.233	33.463

TABLE 5.9.

t-tests to compare high and low I scorers at low N levels for differences in spontaneous fluctuations in combined groups.

Habituation.

	Low I, low N.	High I, low N.
Mean	43.929	34.667
SD	19.365	14.353
$t = 1.230$	$(p < .2)$	

Acquisition

	Low I, low N.	High I, low N.
Mean	74.071	57.222
SD	41.951	33.782
$t = 1.010$	$(p < .2)$	

Extinction

	Low I, low N.	High I, low N.
Mean	78.857	73.444
SD	37.233	33.463
$t = .354$	(Not significant)	

TABLE 5.10.

ii) Analysis of variance tables for stimulus specific reactivity to CS-, in habituation and extinction for groups 1 and 2 and combined groups.

Group 1.

Habituation.

Source.	S of S	df	MS	F	p
Neuroticism	.0014	1	.0014	.0059	---
Impulsivity	.0064	1	.0064	.0270	---
N X I	.0062	1	.0062	.0262	---
Within cell	6.6279	28	.2367		

Extinction.

Source.	S of S	df	MS	F	p
Neuroticism	.1830	1	.1830	.1204	---
Impulsivity	.1176	1	.1176	.0774	---
N X I	.4896	1	.4896	.3222	---
Within cell	42.5419	28	1.5194		

TABLE 5.10. (Cont/d).

Group 2.

Habituation.

Source.	S of S	df	MS	F	p
Neuroticism	.3223	1	.3223	1.2117	---
Impulsivity	.6467	1	.6467	2.4312	---
N X I	.0351	1	.0351	.1320	---
Within cell.	7.4489	28	.2660		

Extinction.

Source.	S of S	df	MS	F	p
Neuroticism	7.7028	1	7.7028	3.5027	0.1
Impulsivity	3.5245	1	3.5245	1.6027	0.25
N X I	.0338	1	.0338	.0154	---
Within cell.	61.5737	28	2.1991		

TABLE 5.10. (Cont/d).

Combined group.

Habituation.

Source.	S of S	df	MS	F	p
Neuroticism	.0920	1	.0920	.3477	---
Impulsivity	.0270	1	.0270	.1021	---
N X I	.0074	1	.0074	.0280	---
Within cell.	12.4348	47			

Extinction.

Source.	S of S	df	MS	F	p
Neuroticism	6.5030	1	6.5030	3.3039	0.1
Impulsivity	.0135	1	.0135	.0069	---
N X I	.0163	1	.0163	.0083	---
Within cell.	92.5116	47	1.9683		

TABLE 5.11.

Means and standard deviations for stimulus specific reactivity in groups 1 and 2 and combined groups.

	HN, LI.	HN, HI.	LN, LI.	LN, HI.
Group 1.				
Habituation.				
Mean	1.332	1.333	1.318	1.374
SD	.436	.498	.466	.540
Extinction.				
Mean	2.114	2.483	2.513	2.387
SD	.878	1.402	1.280	1.305
Group 2.				
Habituation.				
Mean	1.178	.827	1.312	1.094
SD	.453	.302	.722	.496
Extinction.				
Mean	2.101	1.373	3.017	2.419
SD	1.532	1.030	1.744	1.532
Combined group.				
Habituation.				
Mean	1.180	1.109	1.242	1.219
SD	.446	.478	.609	.503
Extinction.				
Mean	2.135	2.038	2.734	2.895
SD	1.256	1.286	1.591	1.480

TABLE 5.12.

iii) Analyses of variance tables for basal levels at start of extinction.

Group 1.

Source.	S of S	df	MS	F	p
Neuroticism	.0001	1	.0001	.0015	---
Impulsivity	.2521	1	.2521	3.8255	0.1
N X I	.0120	1	.0120	.1821	---
Within cell.	1.8456	28	.0659		

Group 2.

Source.	S of S	df	MS	F	p
Neuroticism	.0968	1	.0968	2.3325	0.25
Impulsivity	.0961	1	.0861	2.0747	0.25
N X I	.0171	1	.0171	.4120	---
Within cell.	1.1623	28	.0415		

Combined group.

Source.	S of S	df	MS	F	p
Neuroticism	.0331	1	.0331	.6687	---
Impulsivity	.0012	1	.0012	.0242	---
N X I	.0022	1	.0022	.0444	---
Within cell.	2.3257	47	.0495		

TABLE 5.13.

Means and standard deviations for basal levels in groups 1 and 2 and combined groups.

	HN, LI.	HN, HI.	LN, LI.	LN, HI.
Group 1.				
Mean	4.425	4.564	4.383	4.599
SD	.257	.304	.249	.210
Group 2.				
Mean	4.283	4.325	4.539	4.389
SD	.137	.276	.251	.091
Combined group.				
Mean	4.402	4.455	4.501	4.460
SD	.220	.314	.247	.230

TABLE 5.14.

iv) Analyses of variance tables for $\frac{1}{2}$ time recovery.

Group 1.

Source.	S of S	df	MS	F	p
Neuroticism	.2812	1	.2812	.0158	---
Impulsivity	7.0312	1	7.0312	.3958	---
N X I	11.2813	1	11.2813	.6351	---
Within cell.	497.3750	28	17.7634		

Group 2.

Source.	S of S	df	MS	F	p
Neuroticism	18.0000	1	18.0000	.4540	---
Impulsivity	153.125	1	153.125	3.8617	0.1
N X I	36.125	1	36.125	.9111	---
Within cell.	1110.250	28	39.6518		

Combined group.

Source.	S of S	df	MS	F	p
Neuroticism	.0932	1	.0932	.0037	---
Impulsivity	24.6526	1	24.6526	.9697	---
N X I	35.2666	1	35.2666	1.3871	0.25
Within cell.	1194.9312	47	25.4241		

TABLE 5.15.

Means and standard deviations for ½ time recovery in groups 1 and 2 and combined groups.

Group 1.	HN, LI.	HN, HI.	LN, LI.	LN, HI.
Mean	6.438	4.313	5.438	5.688
SD	3.448	4.766	4.313	4.225
Group 2.				
Mean	5.750	12.250	6.375	8.625
SD	3.454	8.582	5.495	6.545
Combined group.				
Mean	6.385	6.867	5.536	7.889
SD	3.495	5.646	4.551	6.451

TABLE 5.16.

Variations between spontaneous fluctuations, stimulus specific reactivity and basal level in the four quadrants.

Group 1.

	HN, LI.	HN, HI.	LN, LI.	LN, HI.
Spontaneous fluctuations v. reactivity.	.7656	.8588	.2924	.8965
Spontaneous fluctuations v. basal level.	.4001	.5897	-.0519	.7148
Reactivity v. basal level.	.3980	.5530	.3962	.7990

Group 2.

	HN, LI.	HN, HI.	LN, LI.	LN, HI.
Spontaneous fluctuations v. reactivity.	.9633	.9117	.8896	.8915
Spontaneous fluctuations v. basal level.	.4464	.7603	.4796	-.0962
Reactivity v. basal level.	.5284	.7247	.5107	-.0019

TABLE 5.16. (Cont/d).

Combined group.

	HN, LI.	HN, HI.	LN, LI.	LN, HI.
Spontaneous fluctuations v. reactivity.	.8016	.8817	.9016	.8157
Spontaneous fluctuations v. basal level.	.3943	.7405	.2243	.7451
Reactivity v. basal level.	.2756	.6814	.2716	.4592

TABLE 5.17.

Summary of results from experiment II.

Differential responding.

		Hab:	Ext:I	Ext:II	Ext:III	Total Ext:
Group 1.	N	NS	NS	NS	NS	NS
	I	NS	NS	NS	NS	NS
Group 2.	N	NS	NS	NS	NS	NS
	I	NS	$p < .1$	$p < .1$	$p < .05$	$p < .05$
Combined	N	NS	NS	NS	NS	NS
group.	I	NS	$p < .25$	$p < .25$	$p < .01$	$p < .05$

Arousal.

Spontaneous fluctuations.

		Hab:	Acq:	Total Ext:
Group 1.	N	NS	NS	NS
	I	NS	NS	NS
Group 2.	N	$p < .05$	NS	NS
	I	$p < .05$	NS	NS
Combined	N	NS	NS	NS
group.	I	NS	NS	NS

Stimulus specific reactivity.

		Hab:	Total extinction.
Group 1.	N	NS	NS
	I	NS	NS
Group 2.	N	NS	$p < .1$
	I	NS	NS
Combined	N	NS	$p < .1$
group.	I	NS	NS

TABLE 5.17. (Cont/d).

Basal levels.

		Extinction.
Group 1.	N	NS
	I	$p < .1$
Group 2.	N	NS
	I	NS
Combined	N	NS
group.	I	NS

½ time recovery.

Group 1.	N	NS
	I	NS
Group 2.	N	NS
	I	$p < .1$
Combined	N	NS
group.	I	NS

TABLE 5.17. (Cont/d).

Variation between spontaneous fluctuations, stimulus specific reactivity and basal level in the four quadrants.

Group 1.

Decreasing order of variability = Low N, low I. High N, low I. High N, high I. Low N, high I.

Group 2.

Decreasing order of variability = Low N, high I. Low N, low I. High N, low I. High N, high I.

Combined group.

Decreasing order of variability = Low N, low I. High N, low I. Low N, high I. High N, high I.

Key.

Hab: = Habituation run.

Ext:I = Extinction block I:

Ext:II = Extinction block II.

Ext:III = Extinction block III.

Acq: = Acquisition run.

Total Ext: = Total extinction run.

NS = Non-significant.

N = Neuroticism.

I = Impulsivity.

Results for arousal in the four personality quadrants.

i) Spontaneous fluctuations.

Group 1:

There are no significant differences in spontaneous fluctuations in any phase between any of the quadrants.

Group 2:

In habituation, the high impulsive groups have significantly fewer spontaneous fluctuations than the low impulsive groups ($p < .05$). Contrary to the hypothesis, low N groups have significantly more spontaneous fluctuations than high N groups in habituation ($p < .05$).

In acquisition there is a trend for high impulsive groups to have fewer spontaneous fluctuations than low impulsive groups ($p < .25$). This same trend is also apparent in extinction ($p < .25$), together with a trend for low N groups to have more spontaneous fluctuations than high N groups, contrary to the hypothesis ($p < .25$).

Combined group:

There are no significant differences in spontaneous fluctuations in any phase, between any of the quadrants. However, there are some non-significant trends. In habituation, there is a trend for high impulsive groups to have fewer spontaneous fluctuations than low impulsive groups, together with a trend for low neuroticism groups to have fewer spontaneous fluctuations than high neuroticism groups ($p < .25$). The trend for low neuroticism groups to have fewer spontaneous fluctuations than high N groups is also apparent in extinction ($p < .25$).

At low N levels, t-tests show a non-significant trend for high impulsives to have fewer spontaneous fluctuations than low impulsives in habituation and acquisition ($p < .2$). At high N levels there are no consistent trends for differences between high and low impulsives.

It can be seen that there are some significant results and some trends indicating a relationship between impulsivity and few spontaneous fluctuations. These results can probably be accounted for by relationships between spontaneous fluctuations and impulsivity at low N-levels. There are some significant results and non-significant trends indicating contradiction of the hypothesis concerning N and arousal.

ii) Stimulus specific reactivity.

Group 1:

There are no significant differences in stimulus specific reactivity between any of the quadrants.

Group 2:

High N groups have significantly less stimulus specific reactivity than low N groups ($p < .1$) contrary to the hypothesis.

There is a non-significant trend for high impulsive groups to have less reactivity than low impulsive groups.

Combined group:

High N groups had significantly less reactivity than low N groups ($p < .1$).

It can be seen that none of the arousal hypotheses are confirmed, while the only significant result is directly opposite to the predicted hypothesis concerning N.

iii) Basal level.

Group 1:

High I groups have higher basal levels (high arousal) than low I groups ($p < .1$) contrary to the hypothesis.

Group 2:

There are no significant differences between the quadrants. However, there is a trend for high impulsives to have lower basal levels (low arousal) than low impulsives ($p < .25$). There is also a trend for high N scorers to have lower basal levels than low N scorers, contrary to the hypothesis. ($p < .25$).

Combined groups:

There are no significant differences in basal level between the quadrants.

iv) $\frac{1}{2}$ time recovery.

Group 1:

There are no significant differences in $\frac{1}{2}$ time recovery between the quadrants.

Group 2:

High impulsive groups have significantly longer $\frac{1}{2}$ time recovery than low impulsive groups ($p < .1$). Neuroticism has no significant effect.

Combined group:

There are no significant differences in $\frac{1}{2}$ time recovery between the quadrants. However, inspection of mean $\frac{1}{2}$ time recovery in each quadrant shows a tendency for high impulsives to have longer $\frac{1}{2}$ time recovery than low impulsives, while in low impulsives, neuroticism increases $\frac{1}{2}$ time recovery.

Discussion.

Results from differential responding in extinction lend some support to Gray's (1970,1971) modification of Eysenck's (1967) hypothesis. High impulsive quadrants show significantly less differential responding when group 2 and combined groups are considered. The lack of significant results in group 1 could be attributed to the inclusion of six subjects, with medium scores, in the low N, high I quadrant. Removal of these subjects in the combined group analysis can be regarded as an improvement in testing the hypothesis.

Analysis of simple effects for differential responding in combined groups, indicates that N influences differential responding in the direction postulated by Gray. Trends observed in extinction blocks I and

II reach significance in extinction block III and the total extinction phase. Analysis of simple effects showed that most of the relationship between impulsivity and differential responding could be attributed to differences at low N-levels. Comparisons between quadrants representing extremes of Gray's anxiety dimension and anti-social dimension showed significant differences in the predicted direction. Decreasing order of differential responding was:- high N, low I; low N, low I; high N, high I; low N, high I. This is the predicted order, although giving equal weight to N and I, there should have been less difference between the two middle quadrants, while both these quadrants should have differed significantly from the two extreme quadrants. This did not occur since the affect of I was much greater than the affect of N.

Relationships between personality and arousal tend to be non-significant. Only two results out of a possible forty-two reach an acceptable significance level ($p < .05$). However, these results support the hypothesis associating impulsivity with low arousal and contradict the hypothesis associating neuroticism with high arousal. These results were obtained from spontaneous fluctuations in habituation of group 2. The lack of significant differences between the quadrants in extinction suggests that all quadrants habituate to the experimental situation, once extinction begins, while the high N, high I quadrant habituates comparatively rapidly showing this effect in the habituation phase.

The association between high N and low stimulus specific reactivity, at a low level of significance ($p < .1$), during extinction in group 2 and the combined group contradicts the hypothesis associating high N with high arousal. However, this result could be peculiar to student groups, it will be recalled (P.66) that this reversal was previously observed by Sadler, Mefferd & Houck (1971). Claridge (1967) suggests that tonic arousal is associated with drive rather than N-scores. It could thus be argued that students tend to have higher drive than normal samples and hence have higher than normal arousal levels. Claridge associates N scores with maladjustment. Students lacking an appropriate drive level may have more adjustment problems than higher drive students. This could increase N-scores causing an apparent reversal of the hypothesis.

The experimental methodology suggests an alternative explanation for the association between low reactivity and high N scores. It is possible that CR- magnitude is confounded by conditioned response acquisition. In Chapter 3, it was shown that CS-UCS pairings tended to be associated with increased responding to CS- compared with a similar run after unpaired CS and UCS presentations. There is a trend for high N to be associated with greater differential responding in extinction. It will be recalled (Chapter 3. P.132) that conditioned response acquisition was thought to occur in two stages. Stage I increased responding to all stimuli on the same continuum as the CS, while stage 2 increased responding to CS+ but reduced responding to CS-. It could thus be argued that low N is more closely associated with extinction of stage I conditioning, while high N is associated with extinction of stage 2 conditioning. In this case, low N groups would show greater responding to CS- than high N groups. However, if this explanation is correct, one would also expect greater and significant differences in differential responding between high N and low N groups, and an association between high impulsivity and low stimulus specific reactivity. Neither expectation is fulfilled.

Throughout the literature, basal level conductance has been an equivocal arousal measure (See P.68). The only significant result in group I ($p < .1$) indicates that impulsivity is associated with high arousal. Trends in group 2 indicate the opposite and predicted association between basal level and impulsivity ($p < .25$). These contradictions could account for the lack of significant relationships in the combined group. Use of basal level as an arousal index cannot be said to have lent any support to the hypothesis.

Comparing variability of arousal measures, it can be seen that low I is associated with greater variability between arousal indices than high I, when N is high. This could be regarded as support for Eysenck's (1967) notion that high arousal in introverts invokes transmarginal inhibition and hence variation in arousal indices. In the low N quadrants, results from group 1 contradict those from group 2, although taking the combined group there is a trend for low I subjects to be more variable than high I subjects. i.e. a reflection of the result for high N quadrants. This suggests that the student group as a whole, tend towards high arousal. Mean N-scores for our groups are comparable to Eysenck & Eysenck's (1964) mean N score for student groups. However, this N-score is above general population norms. Hence low N scores in student groups may tend to fall within medium ranges for normal samples.

$\frac{1}{2}$ time recovery is not significantly associated with N-scores. In group 2, there is a significant relationship between high impulsivity and long $\frac{1}{2}$ time recovery. In combined groups, mean $\frac{1}{2}$ time recovery is longer in both high I groups than in low I groups but this is not significant. This result is contrary to our hypothesis associating long recovery time with high arousal and lack of impulsivity. It is possible that long recovery time is associated with under rather than over-arousal. Claridge's (1967) two arousal system model suggests that long recovery time is related to impulsivity. The arousal modulation system was said to facilitate and suppress information. Extraversion was associated with low arousal modulation, this combined with high tonic arousal in the active psychosis quadrant, resulted in arousal system imbalance (See figure 1.3. P.37). When arousal system imbalance was caused by inadequate response suppression rather than excessive suppression, active psychosis and impulsivity were implicated. Edelberg (1970) lends further support to this notion. He found that fast recovery time reflected mobilisation for goal directed behaviour. Impulsivity is associated with lack of premeditation or mobilisation for goal directed behaviour, hence long recovery time could be associated with impulsivity.

Since spontaneous fluctuations were considered the most reliable measure of arousal, a product moment correlation between spontaneous fluctuations in extinction and $\frac{1}{2}$ time recovery in the combined group, was calculated. A correlation of $-.58$ ($p < .001$) was obtained. It could thus be concluded that long $\frac{1}{2}$ time recovery was more closely associated with under-arousal than over-arousal.

Conclusion.

Relationships between personality and differential responding showed some support for Gray's (1970,1971) modification of Eysenck's personality theory, when impulsivity was substituted for extraversion.

Relationships between personality and arousal were not very substantial, although there was an indication that spontaneous fluctuations were inversely related to impulsivity. There were also results suggesting that spontaneous fluctuations and stimulus specific reactivity were inversely related to neuroticism, contrary to the hypothesis. The relationship between $\frac{1}{2}$ time recovery and impulsivity contradicted our original hypothesis but this result was thought to be an indication that long recovery times were associated with under-arousal rather than over-arousal. The inverse correlation between spontaneous fluctuations in extinction and $\frac{1}{2}$ time recovery substantiated this notion.

Neuroticism group means were comparable to Eysenck & Eysenck's (1964) student means but both are above normal population means. The impulsivity scale has not been standardised but it is reasonable to suppose that impulsivity may be lower in student groups than normal samples of the same age. Hence results obtained need not be generalisable to other samples.

An improved test of the general hypothesis would have utilised a sample representative of the normal population. The practical difficulties involved in defining and selecting a representative normal sample, and persuading them to be experimental subjects in a University during the working day, were considered insurmountable. An alternative method of taking equipment to an institution would have produced another type of bias.

A further test of this hypothesis involves comparing a student sample with a sample specifically chosen to contain a majority of impulsive persons. At the same time, analysis within the impulsive sample could be compared with the above results.

CHAPTER 6.

Personality, criminality and conditioning.

This chapter gives a brief outline of Eysenck's (1971) criminality theory, since this is an extension of his personality theory and forms a framework within which hypotheses can be formulated and tested.

The literature suggests that Eysenck's hypotheses concerning personality and criminality have not been adequately tested, while studies comparing random criminal groups with controls have not found significant differences in conditionability.

Empirical studies have tended to concentrate on relationships between psychopathy, conditioning and arousal. The controversial relationship between psychopathy, criminality and personality is discussed together with influence from environmental factors. This literature review allows Eysenck's hypotheses concerning criminality, personality, conditioning and arousal to be modified for subsequent testing in Chapter 7.

6.1. Eysenck's theory of criminality.

It will be recalled that Eysenck (1957) considered extraverts to be under-socialised and introverts over-socialised, given comparable environmental pressures (P. 10). Neuroticism was said to exaggerate these differences by acting as a drive on habitual responses. These socialisation and personality differences were said to be accounted for by varying degrees of conditionability.

Eysenck (1970) suggested that criminals were a representative sample of under-socialised individuals, while psychopaths represented a more extreme case of under-socialisation. Hence criminals and psychopaths were said to be neurotic extraverts with low conditioning susceptibility.

Eysenck & Eysenck (1970) modified their criminality theory to include psychosis (P). P was a third personality dimension, orthogonal to E and N. Trait descriptors for P were thought to be characteristic of criminals, while genetic evidence relating criminality to psychosis, suggested that criminals would have high P scores.

Eysenck's theory of criminality results in the following predictions:-

i) Criminals and psychopaths will tend to be extraverted, neurotic and psychotic.

ii) Criminals and psychopaths will tend to have low conditioning susceptibility.

6.1.1. Empirical evidence for Eysenck's hypothesised personality differences between criminals and controls. Passingham (1972) reviewed evidence for higher neuroticism and extraversion in criminal samples than in control samples. Delinquents and controls were compared for extraversion and neuroticism, assessed from the JEPI or MPI, in eight studies. Six of these studies reported significantly higher N scores in delinquents than in controls. The other two studies found no significant differences in N-scores between the groups. Only two of these eight studies reported significantly higher E-scores in delinquents than in controls. Three studies found significantly lower E-scores in delinquents than in controls, while the remaining three studies reported no significant differences between groups. Adult offenders and controls were compared for E and N scores assessed from the MPI, EPI and PI. Twenty of these studies found significantly higher N scores in offenders than in controls. The remaining five studies reported no significant differences between groups. Only seven studies found significantly higher E scores in offenders compared with controls. One study reported significantly lower E scores in offenders compared with controls, while the remaining seventeen studies found no significant differences between groups.

Passingham reviews several predictive studies which tend to support

Eysenck's hypothesis. However, this evidence was equivocal since Eysenck's inventories were not used to assess extraversion and neuroticism.

Passingham's reviewed studies are not strictly comparable, since criminal samples were drawn from different types of institution and samples within institutions varied. However, it can be seen that most studies found significantly higher N-scores in criminals than in controls. No study refuted this hypothesis significantly. The hypothesis concerning higher E scores in criminals than controls was considerably more equivocal.

Eysenck & Eysenck (1970) found that P scores were significantly higher in a prison sample than in any of their three control samples. However, hypotheses concerning N and E scores were not substantiated. Student controls showed significantly higher N scores than prisoners, while industrial apprentices had higher E scores than prisoners.

Eysenck & Eysenck (1971) developed a criminal propensity scale (Cp). Item analysis from their previous (1970) study, showed that forty items from PI were endorsed more often by prisoners than by any of the control groups. These items tended to be certain P and N scale items, together with impulsivity items. N scale items were thought to be of an autonomic type, i.e. they referred to direct manifestations of sympathetic arousal or to introspective interpretations of sympathetic arousal, such as feelings of tenseness, worry or being nervous. These results also suggested that it was the impulsivity aspect of extraversion which was associated with criminality, rather than the sociability factor.

Burgess (1972) considered that comparisons between sample means was not a test of the hypothesis that criminals were both more extravert and more neurotic. No differences between criminals and controls could be observed if some controls were more extravert, while other controls were more neurotic. He compared several prison samples with London transport employees as controls. There were no significant differences in mean E or N scores. However, a quadrant analysis of prison and control samples, showed that prisoners were significantly over-represented in the neurotic extravert quadrant. He thus proposed $(E \times N)^2$ as a measure of criminal propensity, since this measured the diagonal from stable introvert to neurotic extravert.

Burgess' results can be compared with Gray's (1970a) hypothesised anti-social diagonal. Eysenck & Eysenck's (1971) analysis suggests that impulsivity should be substituted for extraversion in prisoner-control comparisons. Hence Eysenck's modified hypothesis can be tested by comparing quadrant composition according to N and impulsivity and by a measure of anti-social behaviour assessed from a combination of neuroticism and impulsivity.

6.1.2. <u>Empirical evidence for Eysenck's conditioning theory of criminality.</u> Passingham (1972) reviewed evidence for Eysenck's conditioning theory of criminality. No significant differences for eyeblink conditioning between prisoners and controls were reported by Field & Brengelman (1961), Field (1960) and West (1963). Some tentative support for the hypothesis was reported by Parke & Walters (1966). They found that alcoholic prisoners showed fewer conditioned avoidance responses than a control group.

Most studies concerning conditioning in prisoners have compared prisoner subgroups. Primary psychopathic prisoners have shown less avoidance learning than neurotic psychopaths (Lykken, 1957, Schmauk, 1970) and less electrodermal conditioning (Lykken, 1957, Hare, 1965; Hare & Quinn, 1971). Evidence relating types of psychopathy to conditionability is reviewed in Section 3 (P. 272).

It can be seen that evidence associating criminality with lack of conditionability is equivocal. Subgroups such as alcoholics cannot be said to test the hypothesis adequately. Observed differences in conditionability, between types of psychopath, are not predicted from Eysenck's theory. The influence of anxiety or neuroticism tends to increase conditioning in psychopaths rather than decreasing conditioning as predicted.

6.1.3. Conclusion to Eysenck's criminality theory. Eysenck hypothesises that criminality is mediated by conditioning and that criminals will tend to be neurotic extraverts. Evidence indicates that criminals may be more neurotic than controls but that aversive conditionability is increased by neuroticism. Hence conditionability differences cannot account for all types of criminality.

Eysenck suggests that psychopaths are less conditionable, less aroused, more extravert and more neurotic than non-psychopaths. These hypotheses are discussed under the following headings:-

6.2. Definitions of psychopathy.

6.3. Psychopathy and conditionability.

6.4. Psychopathy and arousal.

Similar hypotheses apply to psychopaths and criminals, but evidence suggests that both groups share the behavioural characteristic of impulsivity. This notion is discussed under the heading:-

6.5. Psychopathy, criminality and impulsivity.

Eysenck considers criminality as a normally distributed personality trait. Prisoners and psychopaths are said to occupy one extreme of this trait. This notion is discussed under the heading:-

6.6. Prison samples and criminality.

Socialisation and personality differences were said to be related to criminality and psychopathy, provided environmental pressures were constant. The possibility of inequality in environmental pressures is discussed under the following headings:-

6.7. Environmental factors in the etiology of psychopathy and criminality.

6.8. Class differences in criminality and conviction.

6.2. Definitions of psychopathy.

The legal definition of psychopathy from the 1959 Mental Act for England and Wales is:-

> "Psychopathy is a persistant disorder or disability of mind, which results in abnormally or seriously irresponsible conduct on the part of the patient, and requires or is susceptible to medical treatment".

Psychiatric opinion determines the diagnoses for legal purposes within the meaning of the act.

Karpman (1948) argued that if the term psychopath was to have any psychological meaning, anti-social behaviour had to be associated with the individual's character structure. He suggested that evidence of brain damage, organic defect, neurosis or psychosis should eliminate individuals from the anethopathic or main psychopathic category.

Clinical descriptions of psychopathy usually list a number of characteristic traits. One of the most widely used descriptions is that of Cleckley (1955) who listed the following sixteen traits or criteria:-

a) Superficial charm and good "intelligence".

b) Absence of delusions or other signs of irrational thinking.

c) Absence of "nervousness" or psychoneurotic manifestations.

d) Unreliability.

e) Untruthfulness and insincerity.

f) Lack of remorse or shame.

g) Inadequately motivated anti-social behaviour.

h) Poor judgement and failure to learn by experience.

i) Pathologic egocentricity and incapacity for love.

j) General poverty in major affective reactions.

k) Specific loss of insight.

l) Unresponsiveness in general interpersonal relations.

m) Fantastic and uninviting behaviour with drink and sometimes without.

n) Suicide rarely carried out.

o) Sex life trivial, impersonal and poorly integrated.

p) Failure to follow any life plan.

Cleckley's case histories do not always fulfil all the criteria, but criteria (b) and (c) seem to be used most consistently with some or all of the other criteria.

Others have nominated underlying personality traits, from which further characteristics can be derived. Craft (1966) nominated two main traits for defining psychopathy:-

a) Lack of feeling, affection or love for others.

b) Tendency to act on impulse and without forethought.

Other diagnostic traits were determined from these two main traits. McCord & McCord (1964) emphasised lovelessness and guiltlessness, while Foulds (1965) suggested that egocentricity and lack of empathy were the basic characteristics.

6.2.1. Measurement of psychopathy. Psychopathy has been assessed from clinical descriptions, case histories and questionnaire responses. Hare (1970) considered that clinical descriptions defined primary psychopathy. The secondary or neurotic psychopath was equally anti-social but was also severely emotionally disturbed. A third psychopathic category displaying anti-social behaviour was the subcultural delinquent, whose behaviour conformed to a deviant subculture within which his affective responses were normal.

Case history data from delinquent children was analysed by Jenkins (1966). Three clusters emerged analagous to Hare's three psychopathic subtypes.

Questionnaire measures of psychopathy in frequent use are the MMPI, (Hathaway & McKinley, 1951) Quay's Personal Opinion Survey (POS) (Peterson, Quay & Tiffany, 1961) and Lykken's Activity Preference

Questionnaire (Lykken & Katzenmeyer, 1967).

Black (1966) depicts three typical psychopathic MMPI profiles. The first two profiles can be compared with Hare's primary and secondary psychopaths. Both types are high on Psychopathic deviance (Pd) and Hypomania (Ma). Type I is normal on all other scales, while type II is high on other scales, in particular the schizophrenia scale. Type III has peaks on Pd and psychasthenia with a dip on hypomania. Black suggests that this type II is an inadequate psychopath.

Blackburn (1973) isolated four psychopathic types from a factor analysis of MMPI items. Types I and II replicated Black's first two types, while the other two types could be compared with Hare's subcultural type and Black's inadequate type.

Quay (1964) isolated Hare's three types from behaviour ratings and later from the POS (Peterson et al, 1961). The POS has been used to define psychopathic groups in a number of conditioning studies (P.277). However, some doubt has been cast on the validity of POS scales. Becker (1964) showed that the psychopathic (P) and neurotic (N) scales correlated with each other ($r = .43$), while both scales were related in the same direction, to other variables under investigation. Similarly, Finn (1971) found high correlations between (P) and (N) scales and also demonstrated that these scales would not have selected primary and secondary psychopaths defined by the Cleckley criteria. It can thus be seen that the POS has not distinguished reliably between psychopaths, although it may be a general measure of anti-social behaviour.

Lykken's APQ appears to be a measure of primary psychopathy, since it discriminated between primary psychopaths defined by Cleckley's criteria, and a group of psychopaths not fulfilling all the Cleckley criteria. This latter group were closer to normal controls in their mean APQ score. Rose (1964) substantiates this notion. Within a psychiatric sample, high

APQ scorers had an MMPI profile indicative of anxiety neurosis, while low APQ scorers had the MMPI psychopathic profile.

It can be seen that four main types of psychopath have been defined. Among these four, interest has centered on distinctions between primary and secondary psychopaths. Primary psychopathy has been defined from the Cleckley criteria, from MMPI Pd and Ma scores with no other elevated scales, and Lykken's APQ. Quay's POS has been thought to define primary psychopathy but evidence suggests that these scales may be invalid.

6.3. Psychopathy and conditioning.

6.3.1. Aversive classical conditioning. Empirical evidence for the hypothesis that primary psychopaths are less susceptible to aversive classical conditioning is equivocal.

The hypothesis has been tested using eyeblink conditioning. Gendreau & Suboski (1971) compared primary psychopaths, aggressive psychopaths and non-psychopaths, classified from the MMPI, for conditioned eyeblink acquisition. Three different procedures were used; one with facilitory instructions, one with no instructions and one with inhibitory instructions for blinking to the airpuff. Primary and aggressive psychopaths gave fewer responses to both CS+ and CS-, than non-psychopaths. This result was most pronounced in the neutral procedure. Percentage responding to CS+ showed no differences between groups. This latter measure may not be a valid measure of conditioning, since it can result in inflated scores when CS- is low or zero (See P. 131).

Warren & Grant (1955) compared high and low MMPI Pd students for differential eyeblink acquisition. There were no group differences on the first day, but on the second day, low Pd students showed superior conditioning performance. There was also a tendency for high Pd students to be more responsive to both CS+ and CS-, than low Pd students. This difference was significant for CS- ($p<.05$). However, in this sample, Pd scores correlated with MAS anxiety scores ($r = .51$). Increased eyeblink responding has been associated with anxiety (Spence, 1964). Anxiety arousal could be greater on the first day than the second day, so obscuring conditioning differences due to Pd. Increased responding to both CS+ and CS- in high Pd subjects contradicts Gendreau & Suboski's result of decreased responding in primary and aggressive psychopaths compared with non-psychopaths. This may indicate that high Pd scoring students are not comparable to high Pd scoring prisoners, or that Pd scores in this student sample measure secondary psychopathy.

Autonomic conditioning in primary psychopaths and controls has been examined. Lykken (1957) found that primary psychopaths showed less electrodermal conditioning than non-psychopaths (P.78). The mixed group lay between these two extremes but differences did not reach significance. Similarly, Hare (1965b) found that primary psychopaths defined from the Cleckley criteria, gave fewer electrodermal CR+s than non-psychopathic prisoners. Hare & Quinn (1971) monitored several response systems during differential autonomic conditioning. Results from the electrodermal system replicated Hare (1965), in that primary psychopaths gave little evidence of conditioning. However, there were no differences between primary psychopaths and non-psychopaths in the acquisition of differential cardiac and digital vasomotor responses. Neither group acquired differential cephalic vasomotor responses.

Equivocal results for conditioning monitored by heart rate were also obtained by Fenz, Young & Fenz (1973). Primary psychopaths took longer to acquire the bi-phasic conditioned heart rate response (deceleration followed by acceleration) than neurotic psychopaths or controls. However, contrary to the hypothesis, primary psychopaths were more resistant to extinction than controls. This latter result suggests that awareness rather than conditionability is being measured. Kling (1973) found that primary psychopaths were less aware of CS-UCS contingencies than controls, while Fisher (1972) showed that primary psychopaths performed an avoidance task as well as controls, when under threatened shock, but removal of shock threat resulted in performance deterioration for primary psychopaths only.

Apparent contradictions between electrodermal and heart rate conditioning in primary psychopaths may be associated with OR conditioning in primary psychopaths and DR conditioning in controls. Graham & Clifton

(1966) consider that heart rate deceleration is an OR which can be replaced by a DR of heart rate acceleration, when stimulus intensity is sufficiently great. Within this replacement range, heart rate deceleration should habituate rapidly with high stimulus intensities. If the deceleration is not replaced by an acceleration, then it should habituate more slowly at high stimulus intensities. Fenz et al's CR criterion was:-

> "....during any 9 second period, the peak heart rate is to be preceded and followed by lower heart rate scores and in addition the heart rate at second 9 has to be lower than the heart rate at second 8".

A CS occurred at second 7. Inspection of the record for heart rate in beats per minute for the first 7½ seconds of acquisition, shows a pronounced deceleration for all groups, the following acceleration for neurotic psychopaths and controls is higher than any of the preceding heart rate peaks, indicating conditioned DR. However, acceleration for primary psychopaths does not reach the maximum previously attained, indicating a conditioned OR rather than conditioned DR. A similar pattern is also apparent during extinction, neurotic psychopaths show the most unambiguous acceleration. Group differences in basal heart rate during extinction, also tend to indicate that an anxiety mediated response has not been conditioned in primary psychopaths. In primary psychopaths, basal heart rate declined during extinction but in the other two groups basal heart rate increased. It is probable that conditioned anxiety or DRs increase basal level, whereas conditioned ORs should not effect basal level. Hare & Quinn note that cardiac deceleration increased markedly over trials suggesting that stimulus intensities were not sufficiently great to replace the OR with a DR.

It can be seen that eyeblink conditioning studies have not tested the hypothesis adequately. In autonomic conditioning studies, lack of electrodermal conditioning appears to be associated with primary psychopathy.

However, other autonomic response systems have shown equivocal results, suggesting that primary psychopaths may be susceptible to OR conditioning but not anxiety mediated or DR conditioning.

6.3.2. Avoidance conditioning. Lykken's (1955) experiment originally supported the hypothesis that primary psychopaths were deficient in avoidance learning. He compared primary psychopaths, mixed psychopaths and controls for avoidance learning during a manifest task. The manifest task was a complex mental maze. The subject was required to choose one of four levers, the correct choice produced a green light to indicate that the next point could be traversed. If an incorrect lever was pushed, an error was noted and the subject chose another lever. The avoidance task was superimposed upon the manifest task. Certain errors were punished by electric shock which could be avoided by appropriate lever selection. All groups learned the manifest task equally well. Controls learned to avoid shocks but primary psychopaths gave little evidence of any avoidance. The mixed group lay between these two extremes.

Schacter & Latané (1964) replicated Lykken's experiment and substantiated his results.

Persons & Bruning (1966) considered that their study refuted Lykken's results. Psychopathic prisoners, non-psychopathic prisoners and controls were compared for active avoidance learning. The task was to draw lines within specified dimensions while blindfold. Subjects were informed of their errors and given contingent electric shocks. Psychopaths acquired the response most rapidly, non-psychopathic prisoners least rapidly and college students fell between these two extremes.

Reconciliation between these results can be achieved by considering awareness differences. The importance of information concerning CS-UCS contingencies on subsequent avoidance learning was illustrated by Fisher (1972). Psychopathic and non-psychopathic prisoners were compared for four different avoidance learning procedures. Subjects watched a model operate a Lykken task and flinch when shocked. The four procedures were:-

a) Subject received high shock when model received shock.

b) Subject received low shock when model received shock.

c) Subject was not shocked, but was told he would receive shock later.

d) Subject was not given any shock, but was told to learn all he could about the task while watching the model, since he would be questioned on it later.

Following this procedure, subjects were tested for performance on the Lykken task. All subjects performed best after procedures (b) and (d). There were no acquisition differences between groups but when shock was discontinued, performance of primary psychopaths deteriorated, while controls continued to improve. Performance of primary psychopaths was thus contingent upon threatened punishment.

Lykken's results and their replications can be explained in terms of awareness differences between primary psychopaths and non-psychopaths. Primary psychopaths, being less aware of the contingencies, display less conditioning. Fisher's study indicates that all his subjects were aware of CS-UCS contingencies before performing the Lykken task, hence no differences between groups were observed. In Persons & Bruning's study, all subjects were aware of CS-UCS contingencies, hence no differences would be expected. However, the superiority of primary psychopaths could be due to anxiety arousal in control groups causing performance decrement.

Schmauk's (1971) results suggest that observed avoidance learning or awareness differences, between primary psychopaths and controls, depend upon type of punishment. Primary psychopaths displayed less avoidance learning than controls when punishment was physical (shock) or social (experimenter saying "wrong"). However, under tangible punishment (loss of money), primary psychopaths increased avoidance learning to equal that of the controls. Schmauk concluded that primary psychopaths were not deficient in avoidance learning when punishment was appropriate to their value system. However, monetary loss, in this experimental context, need not be regarded as punishment. The experimenter gave the subjects some money, then during the experiment removed money in association with certain stimuli, the final outcome was a greater or lesser reward. This situation could thus be perceived as maximising final reward, rather than a series of non-rewards, and hence related to appetitive conditioning rather than aversive conditioning.

It can be seen that differences between primary psychopaths and controls in acquisition of avoidance learning, could be due to awareness differences. These may, in turn, depend upon susceptibility to punishment. When punishment was physical or social, primary psychopaths were deficient in avoidance learning. When avoidance learning had been achieved and punishment discontinued, primary psychopaths extinguished quickly.

6.3.3. <u>Appetitive operant conditioning.</u> There is no unequivocal evidence for differences between primary psychopaths and controls for appetitive operant conditioning.

A number of studies have defined psychopathic and neurotic groups from Quay's Personal Opinion Survey (POS). However, the validity of this scale has been questioned (Becker, 1964; Finn, 1971).

Johns & Quay (1962) compared psychopathic and neurotic groups defined from the POS, for operant responses to pronouns "I" and "We" using Taffel's Technique. Controls with no conditioning were used for comparison. Neurotic groups differed significantly between experimental and control procedures, while psychopathic groups showed no differences in operant level.

Johns & Quay's study was replicated by Quay & Hunt (1965). High P, low N and low P, high N groups, defined from the POS, were compared for operant conditioning differences. There were no differences between groups. However, conditioning was negatively associated with MPI E-scores and not associated with MPI N-scores.

Persons & Persons (1965) criticised the conditioning methodology used in both the above studies. They noted that both experimental and control psychopathic groups in Johns & Quay's study, had a higher operant level than either of the neurotic groups. They concluded that the failure to observe differences between psychopathic groups, was due to a ceiling effect, in that psychopaths had a natural tendency to use "I" and "We" more often than other pronouns.

Gutierrez & Eisenman (1971) compared neurotic and psychopathic delinquents for three procedures using Taffel's technique, with reinforcement to the pronoun "They". The three procedures were:-

a) Positive reinforcement with experimenter saying "Good".

b) A non-verbal, meaningful buzzer. i.e. buzzer with experimenter saying "Good".

c) Non-verbal reinforcement by the buzzer with no meaning attached.

Neurotics conditioned more under treatment (a) than under treatment (b) but neither treatment showed significantly more conditioning than psychopaths. Under treatment (c), N-scores correlated positively with conditioning and P-scores correlated negatively with conditioning ($p < .01$).

All the above studies are of doubtful validity, since Quay's POS may be defining primary psychopathy inaccurately.

Bernard & Eisenman (1967) compared female prisoners with student nurses, for operant conditioning using Taffel's technique with reinforcement to the pronoun "I". Prisoners conditioned better than nurses using either money or social praise as reinforcement. However, this study could be contaminated by the ceiling effect observed by Persons & Persons (1965).

Steele (1970) compared psychopathic and normal prisoners, defined from Gilberstadt & Duker's criteria, on an operant task. There were no differences between groups. These criteria may not take anxiety in account, hence results may not be applicable to primary psychopathy.

Kling's (1973) study suggests that primary psychopaths are deficient in both appetitive and aversive operant conditioning. However, these results can be explained in terms of slower awareness of reinforcement contingencies in primary psychopaths. Kling compared primary and neurotic psychopaths using Taffel's technique with appetitive and aversive reinforcement. Primary and neurotic psychopaths were defined by MMPI Pd and Ma scales and the State Trait Anxiety Inventory (STAI). Four types of reinforcement were used:-

a) Material reward. Subject given five cents.

b) Material punishment. Subject had five cents removed from a starting pile of forty cents.

c) Verbal reward. Experimenter said "Good".

d) Verbal punishment. Experimenter said "Not so good".

Material reinforcement increased reinforcement contingency awareness for both appetitive and aversive procedures. However, primary psychopaths were less aware (48%) than neurotic psychopaths (75%). Aware subjects increased their performance, while unaware subjects remained unchanged. Aware neurotic psychopaths increased their performance more than aware primary psychopaths under all procedures. However, conditioning performance may still depend upon differential awareness between groups, rather than poor conditionability in primary psychopaths. Kling does not mention the method for awareness assessment, but it is usual to assess awareness at the end of an experimental session. This gives no indication of the time at which awareness occurs. It is possible that primary psychopaths become aware later in the session than neurotic psychopaths, in which case, they receive fewer conditioning trials than neurotic psychopaths. Hence primary psychopaths have a final inferior conditioning performance.

It can be seen that there is no satisfactory evidence for appetitive conditioning differences between primary psychopaths and controls. Taffel's technique, reinforcing "I" and "We", may be contaminated by ceiling effects. The validity of the POS has been questioned. Finally, onset of reinforcement contingency awareness may be slower in primary psychopaths and hence account for observed differences. The hypothesis cannot be said to have been adequately tested.

6.4. Psychopathy and arousal.

Most theories concerning psychopathy and arousal, consider the psychopaths to be relatively under-aroused (Quay, 1965; Hare, 1970; Eysenck, 1967; Gray, 1970, 1971 a & b). However, Schacter & Latané (1964) suggest that psychopaths may be over-aroused and hence fail to differentiate between emotional states. Some reconciliation between these theories can be achieved by considering responsiveness to aversive stimuli rather than arousal. McCord & McCord (1964) regarded the psychopath's inability to control impulses as an indication of physiological over-responsiveness, which does not necessarily imply that the psychopath is normally over-aroused. Normal under-arousal may be associated with lack of anticipation of emotional situations. When an emotional situation occurs, there is no time to check impulses and consequent over-reaction (Sutker, 1970).

Quay (1965) considered that psychopaths were pathologically under-aroused. Impulsivity, a need for excitement and the inability to tolerate boredom were said to be related to the psychopath's drive to maintain an optimal arousal level. Hare (1970) argued that psychopaths normally reduced sensory input, resulting in cortical under-arousal and sensory deprivation. The psychopath's propensity for "exciting" or frightening activities was regarded as an effort to achieve optimal arousal level.

Eysenck (1967) associated under-arousal with extraversion. Psychopaths were said to be extreme extraverts, hence they were extremely under-aroused.

The influence of neuroticism on arousal is controversial. It will be recalled (P.262) that Eysenck's psychopaths were neurotic extraverts but neuroticism has been thought to increase arousal (Spence, 1956; Gray, 1970a). Eysenck considered that neuroticism influenced arousal in so far as it contributed to drive state. Drive state was equated with overall activation to which emotional upset could contribute. Emotional upset was associated with high N-scores, resulting in a higher drive in high N-scorers than in low N-scorers. Eysenck reported Furneaux's (1961) results of neuroticism/extraversion interactions on body sway suggestibility. Stable introverts and neurotic extraverts had low suggestibility, while stable extraverts and neurotic introverts had high suggestibility. Eysenck suggested that identical stimuli produced differential motivation in extraverts and introverts. The extravert's high drive was directed towards people, which involved him in interpersonal interactions with the experimenter, making him less suggestible. This suggests that task performance may be inferior in Eysenck's psychopaths (high E, high N) but arousal could be high and directed towards the experimenter. Arousal could thus be affected by presence or absence of the experimenter or other people in the experimental situation. Colquhoun & Corcoran (1964) demonstrated the affects of other people on performance of extraverts and introverts. Extraverts performed better than introverts in a group situation, while introverts performed better than extraverts when isolated. Most empirical evidence concerns isolated experimental situations, which should not activate a neurotic extravert's drive towards interpersonal interaction. Hence reported arousal should be lower in extraverts, regardless of neuroticism. In introverts, neuroticism may increase arousal by increasing task oriented drive.

It can be seen that Eysenck's theory leads to the prediction that primary and secondary psychopaths and criminals will be less aroused in an isolated experimental situation than controls.

Gray (1970, 1971 a & b) argued that neuroticism increased both appetitive and aversive arousability and this arousability was related to conditionability in the two systems. He considered that anti-social behaviour was associated with high neuroticism and extraversion because extraverts were more susceptible to reward than introverts and neuroticism increased this susceptibility. Considering the aversive system only, aversive arousal was thought to parallel aversive conditionability differences. i.e. decreasing order of arousal would be neurotic introvert, stable introvert or neurotic extravert, stable extravert. Assuming that psychopaths are extravert, primary psychopaths would be less aroused than secondary psychopaths, while both types of psychopath would be less aroused than neurotic introverts.

In contrast to under-arousal theories of psychopathy, Schacter & Latané (1971) considered some psychopaths to be over-aroused. They suggested that chronic physiological over-reactivity was equivalent to no reactivity. If reactions to all classes of stimuli (neutral and emotional) were similar, then physiological changes which normals associated with emotion, would not be differentiated from changes associated with neutral stimuli. Adrenaline was said to increase avoidance learning in psychopaths by intensifying emotional reactions to aversive stimuli. It was thought that a marked increase in activation would be perceived as an emotional state, while lesser increases would pass unnoticed.

6.4.1. Psychopathy and autonomic arousal indices. The following empirical evidence indicates some support for under-arousal in primary psychopaths, when electrodermal indices are considered. However, heart rate measures have suggested that primary psychopaths may be over-aroused.

6.4.1.1. Electrodermal indices of arousal:- Four main indices of electrodermal arousal have been used to compare primary psychopaths and controls. These are:

a) Spontaneous electrodermal activity.

b) Stimulus specific responses.

c) Basal level skin conductance or resistance.

d) Habituation of electrodermal ORs.

Crider & Lunn (1971) review a number of studies reporting positive correlations between spontaneous fluctuations and OR habituation. They thus consider that both measures are alternative indices of "electrodermal lability". In contrast, neo-Pavlovian theory equates OR habituation with CR extinction. Both measures being used as indices of dynamism in inhibition (P. 59). Comparisons between primary psychopaths and controls for OR habituation could thus be equated with conditionability differences.

a) Spontaneous electrodermal activity has generally been found to be lower in primary psychopaths and controls. Significant differences between primary psychopaths and non-psychopathic offenders have been reported by Lippert & Senter (1963), Schalling, Linberg, Levander & Dahlin (1973) and Hare & Quinn (1971). Fox & Lippert (1963) found that anti-social psychopaths had less spontaneous activity than inadequate psychopaths. Hare (1968) reported a non-significant trend for primary psychopaths to have less spontaneous activity than non-psychopathic offenders. Cauthen (1972) found no differences between high and low MMPI Pd and Ma scoring students. However, student scores need not be generalisable to prison populations and anxiety was not taken into account.

Schacter (1971) cites two early studies of spontaneous electrodermal activity in delinquent subgroups as support for his over-arousal theory of psychopathy. However, it can be argued that he identifies the wrong group as psychopathic. Landis (1932) studied electrodermal activity in delinquents undergoing a stressful situation. Subjects having marked emotional reactions (i.e. frightened, angry, tearful) gave fewer spontaneous electrodermal responses than non-emotional subjects. Similarly, Jones (1950) found that subjects rated highly for emotional expressiveness, had significantly less electrodermal activity than subjects rated as low for emotional expressiveness. Schacter equates psychopathy with non-emotional subjects. However, Jones' low reactive subjects were described as:-

> "easily excited, irritable, impulsive and to behave in ways that seem somewhat irresponsible to adults".

(Schacter, 1971, P.172). This description appears to resemble clinical descriptions of psychopathy (P.268-269). High reactives were described as:-

> "calm, deliberate, good-natured and said to have greater constancy of mood"

(Schacter, 1971, P.173). Schacter considers the description of high reactives indicates emotional flatness, said to characterise some psychopaths. Cleckley's (1955) descriptions indicate that psychopaths react expressively but the "feeling" component is lacking. Electrodermal activity could be compared with the feeling component.

b) Stimulus specific responses have tended to be smaller in primary psychopaths than in controls. Borkovec (1970) found that psychopathic delinquents were initially less responsive than non-psychopathic delinquents. Gendreau & Suboski (1971) noted reduced responding to CS+ and CS- in primary psychopaths classified from the MMPI. Generalising from students with high MMPI Pd scores to psychopaths, Warren & Grant (1955) reported that high Pd students gave more responses to CS- than low Pd students. However, this generalisation may be invalid and the result could be contaminated by anxiety, since they also noted that Pd correlated with MAS anxiety ($r = .51$).

c) Basal level skin conductance or its reciprocal, skin resistance, have not demonstrated consistent differences between primary psychopaths and controls.

Lippert & Senter (1966); Parker, Syndulko, Maltzman, Jes & Ziskind (1973) report no differences in basal level conductance between primary psychopaths and other offenders. Similarly, Fox & Lippert (1963) found no differences in basal level between anti-social and inadequate psychopaths. Cauthen (1972) reported no differences between students scoring high and low on MMPI Pd and Ma scales. However, this latter study need not be generalisable to prison populations and may be contaminated by anxiety.

Other studies have obtained contradictory results. Lykken (1955) reports significantly lower basal skin resistance (i.e. higher arousal) in primary psychopaths than controls. He ascribes this effect to seasonal differences in testing. Normals were tested during mid-summer heat and controls during the winter. Steele (1971) replicated these results, in so far as psychopaths, defined from Gilberstadt & Duker's criteria, had higher basal level skin conductance than controls. However, these criteria of psychopathy may not take anxiety into account. In contrast to these studies, Schalling et al (1973) and Hare & Quinn (1971) report lower basal level skin conductance in primary psychopaths than in controls.

It will be recalled (P.68) that basal level skin conductance measures were thought to be contaminated by factors unassociated with arousal. These factors may have influenced the above results.

d) Habituation of electrodermal ORs has been found to be faster in psychopaths than controls, even when anxiety differences have been taken into account. Borkovec (1970) found that psychopaths habituated to moderate intensity tones, faster than controls. However, psychopaths started at a lower level of reactivity, hence leaving less time for adaptation comparable to that of controls. Cauthen (1972) found that students' MMPI Pd scores correlated positively with speed of habituation of electrodermal responses to light flashes. However, this result may not necessarily be generalisable to prison samples.

It can be seen that there is some evidence indicating under-arousal in primary psychopaths compared with controls, when spontaneous fluctuations, stimulus specific reactivity and OR habituation in the electrodermal system have been monitored. Basal level skin conductance or resistance has not shown consistent results.

6.4.1.2. Heart rate indices of arousal:- Comparisons between primary psychopaths and controls for heart rate differences at rest are inconclusive. Schacter & Latané (1964); Hare (1968); Valins (1967); report non-significant trends for primary psychopaths to have higher heart rates than controls. Fenz et al (1973) found no differences in resting heart rate, between primary psychopaths and controls.

Schacter & Latané demonstrated that adrenaline injections increased heart rate significantly in primary psychopaths and also improved avoidance learning. In controls, there was a slight increase in heart rate, followed by a return to slightly raised normal levels. These results were replicated by Dinitz, Goldman, Allen & Lindner (1973). Valins (1963) reported similar heart rate increases in primary psychopaths during stressful situations.

Valins (1967) showed that primary psychopaths (students defined from Lykken's APQ and an irritability and nervousness scale) increased heart rate by 2.8 beats per minute during electric shock anticipation. There were no significant differences at shock reception. When stimulus intensity was varied, primary psychopaths showed heart rate acceleration at lower stimulus intensities than non-psychopaths. Warnings for stronger stimuli, produced heart rate deceleration for non-psychopaths but heart rate acceleration for psychopaths. Valins interpreted these results in terms of Lacey et al's (1963) theory, which associated heart rate acceleration with cortical inhibition and withdrawal from the environment, while heart rate deceleration was associated with increased sensitivity to the environment. However, Hahn (1973) reviewed evidence for Lacey et al's theory and concluded that support was unsatisfactory.

Chase, Graham & Graham (1968) found that heart rate accelerative or decelerative responses to warning stimuli were determined by expected energy required for the response to a stimulus. Heart rate responses were divided into three phases. Initially, there was heart rate deceleration. When the required response to a stimulus was a button push, a further heart rate deceleration occurred, but when the required response was exercise, there was heart rate acceleration. Immediately preceding the "go" signal there was heart rate deceleration. Similar results were reported by Malcuit (1973). When electric shock could be avoided by an active response, warnings produced heart rate acceleration. In a passive procedure and after error information there was heart rate deceleration.

Valins results can be explained by considering OR habituation in primary psychopaths and their preference for energy expenditure. Electrodermal evidence suggests that ORs habituate faster in primary psychopaths. The decelerative components of tri- or bi- phasic heart rate responses would thus be expected to habituate in primary psychopaths, leaving heart rate acceleration. Primary psychopaths have been said to act without thinking (Cleckley, 1955; McCord & McCord, 1964; Craft, 1966). Hence a warning of aversive stimulation given to primary psychopaths, may activate a preference for energy expenditure, startle or active avoidance rather than passive acceptance. Thus heart rate acceleration rather than deceleration will be observed in primary psychopaths.

It can be seen that heart rate responses are difficult to interpret in terms of aversive emotional arousal. Heart rate changes may assess arousal but the scale is non-linear. An OR increases arousal but heart rate decreases, while expectations of energy output and DRs cause heart rate acceleration. Adrenaline injections and stress situations suggest that arousal increases in primary psychopaths, together with improved performance. On the whole, evidence suggests that primary psychopaths are originally under-aroused and experimental manipulation can increase arousal to normal levels.

6.4.2. <u>Electrodermal indices of arousal increase during anticipation of aversive stimulation.</u> There is evidence to suggest that primary psychopaths show less increase in electrodermal arousal than non-psychopaths, during anticipation of aversive stimulation. Hare (1970) found that controls showed a greater increase in skin conductance, sooner than psychopaths, while anticipating electric shock. Steele (1971) replicated this experiment but found no differences between psychopaths and non-psychopaths defined from Gilberstadt & Dukers' criteria. The definition in the latter experiment may mean that anxiety was not taken into account.

Lippert & Senter (1966) compared twenty-one primary psychopathic delinquents with twenty-one non-psychopathic delinquents for response to shock threat. There were no differences in basal level conductance but twelve of the non-psychopaths displayed conductance increase under shock threat. None of the psychopaths displayed this increase.

Schalling & Levander (1967) reported that primary psychopaths showed less electrodermal activity during stress anticipation than non-psychopaths. Similarly, Schmauk (1970) found that controls showed greater autonomic anticipation than primary psychopaths, when punishment was physical or social. All groups had greater autonomic anticipation under the shock procedure than under social or tangible punishment procedures. Under tangible punishment (money loss) primary psychopaths increased their autonomic anticipation but this did not differ from autonomic anticipation of controls. However, it was previously considered (P.277) that money loss could be perceived as appetitive conditioning rather than aversive conditioning.

It can be seen that primary psychopaths show less arousal increase under aversive stimulus anticipation than controls, provided the stimulus is physical or social rather than loss of money.

6.4.3. <u>Pain tolerance and pain threshold.</u> Eysenck (1967) associated low arousal with high sensory thresholds and greater pain tolerance. Similarly, Gray (1970, 1971 a & b) related low arousal to insensitivity to punishment. Hypotheses concerning arousal should thus be transferable to pain tolerance and pain threshold.

Evidence suggests that primary psychopaths are capable of tolerating more pain than controls when motivation is sufficient.

Hare (1965 a & b) and Hare & Quinn (1970) found no differences between primary psychopaths and controls for electric shock tolerance. Similarly, Finn (1971) found no differences between these groups for pain tolerance in the cold pressor test. Schacter & Latané (1964) reported no differences between primary psychopaths and controls, for painfulness ratings of a standard electric shock. However, there is some support for the hypothesis that primary psychopaths have higher pain threshold and greater shock tolerance than controls, when the relevant personality groups are compared. Schalling & Levander (1964) showed that high anxiety prone delinquents had lower pain thresholds than low anxiety delinquents. Schalling (1971) also investigated two types of pain threshold and pain tolerance in relation to personality variables in students. High pain thresholds and tolerance for continuously increasing electrical stimulation was related to extraversion. High pain thresholds and tolerance levels for discontinuous electric shocks was related to extraversion and neuroticism.

A further study compared primary psychopaths for pain tolerance, with the addition of incentives for accepting pain (Hare & Thorvaldson, 1971).

In this case, primary psychopaths tolerated significantly more pain than non-psychopaths.

It can be seen that personality groups associated with primary psychopathy have greater pain tolerance and higher pain thresholds than other groups, while primary psychopaths will tolerate more pain than non-psychopaths when motivation is sufficient.

6.4.4. Conclusion to relationships between psychopathy and arousal. Most of the empirical evidence supports under-arousal theories of psychopathy. Electrodermal measures of arousal under normal and resting conditions, indicate that primary psychopaths are less aroused than controls. The evidence is most substantial when spontaneous fluctuations have been used to measure arousal. Stimulus specific reactivity and OR habituation also indicate low arousal in primary psychopaths. Resting levels of skin conductance have not shown any consistent differences between the groups. During stress anticipation, electrodermal activity and basal levels have shown greater increases in controls than in primary psychopaths.

Heart rate data has revealed no significant group differences at normal or resting levels of arousal. In contrast to electrodermal data, heart rate in primary psychopaths has tended to increase during stress anticipation, while heart rate of controls had decreased. These results were thought to reflect faster OR (heart rate deceleration) habituation and a propensity for energy expenditure in primary psychopaths, rather than increased emotional or anxiety arousal.

The primary psychopath's heart rate increase after adrenaline injections and stress could indicate an increase in emotional or anxiety arousal, since avoidance performance improved. This suggests that primary psychopaths are normally deficient in anxiety arousal.

Higher pain thresholds and greater pain tolerance seem to be associated with primary psychopathy, provided motivation is sufficient.

Hence under-arousal in primary psychopaths is suggested.

It can be seen that the evidence tends to support Gray's personality theory, in that neuroticism or anxiety is an important variable in determining extravert arousal differences. Only primary psychopaths (high E, low N) show under-arousal. Eysenck's psychopaths and criminals (high E, high N) do not differ from controls.

6.5. Psychopathy, Criminality and impulsivity.

Eysenck's (1970) theory of criminality suggests that psychopaths are one extreme of a dimension from criminal to socialised behaviour. Non-psychopathic criminals could be said to lie between psychopaths and normals. This notion is contended by Craft (1966) who considers criminals and psychopaths as separate but overlapping groups. However, an increase in disorderly behaviour, on the part of the psychopath, increases likelihood of conviction. Similarly, Black (1966) distinguishes psychopaths from the repeatedly convicted, the two groups are said to form overlapping distributions. Thus criminals and psychopaths share factors such as disorderly behaviour, which contribute to their likelihood of incarceration, but there is no reason to predict quantitative differences between these groups in personality traits, criminality or other related factors.

Eysenck & Eysenck (1971) consider that empirical evidence indicating no differences between prisoners and normals in extraversion scores, could be due to low sociability scores in prisoners. They argue that many sociability items are not relevant to prison life, hence E-scores are deflated. They found that impulsivity items but not sociability items, did differentiate between prisoners and controls. It can be argued that impulsivity items are primarily concerned with under-socialised behaviour, while sociability items are related to use of learned social skills. The previous experiment II, tested the hypothesis that impulsivity was related to aversive conditionability and some support for this hypothesis was found. Hence Eysenck's criminality theory should have impulsivity substituted for extraversion.

Definitions of psychopathy indicate that impulsivity is one of the more important diagnostic traits (Hare, 1970). Psychopaths should thus have higher scores on impulsivity tests than controls.

These hypotheses, that psychopaths and criminals should be more impulsive than normals, need not be reversable. i.e. impulsive individuals need not be psychopathic or criminal. It is likely that other variables interact with impulsivity to result in psychopathic or criminal behaviour. Hence, observed differences on impulsivity tests need not reflect impulsivity differences alone. Some tests may contain a greater proportion of the impulsivity variable than others.

Most impulsivity tests have been validated by comparing psychopaths or criminals with controls.

Validity tests of our impulsivity scale, derived from EPI items, indicated that EPI impulsivity was associated with psychomotor impulsivity, since high impulsivity scorers took less time and made more errors on the GSM, than low impulsivity scorers. EPI impulsivity also correlated with APQ scores and MMPI Ma scores.

The GSM was originally validated by comparing delinquents and controls (Gibson, 1965) and from "naughtiness" ratings in normal school children. Lykken's APQ was validated by comparing primary psychopaths and non-psychopathic prisoners (Lykken & Katzenmeyer, 1967). Within a psychiatric sample, high APQ scorers had an MMPI profile indicative of anxiety neurosis, while low APQ scorers had the MMPI psychopathic profile (Rose, 1964). In college students, APQ scores correlated negatively with a self-report measure of minor legal offences (Hauser, 1959).

It can be seen that both the GSM and APQ differentiated between criminal or psychopathic groups and controls. In normal samples, both tests correlated with mild forms of deviance.

Psychopaths have been defined from peak scores on MMPI Pd and Ma scales (Black, 1966; Blackburn, 1973). Similarly, Hare (1969) compared mean MMPI profiles for thirty psychopathic and thirty non-psychopathic criminals, and found that MMPI Ma and Pd scores differentiated the groups best. Our test of EPI impulsivity validity, using MMPI Ma and Pd scales, showed that EPI impulsivity was significantly associated with Ma but not Pd scores. Pd correlated significantly with neuroticism, indicating contamination from this factor in normal samples. This suggests that the relationship between impulsivity and Pd is confined to prison or special hospital samples. Further support for contamination of clinically derived impulsivity scales, from maladjustment factors, can be drawn from use of Blackburn's impulsivity scale. This scale was derived from an analysis of MMPI items in a special hospital (Broadmoor) sample. Within that sample, Blackburn's impulsivity scale correlated with EPI impulsivity, while in our student sample the correlation between our EPI impulsivity scale and Blackburn's impulsivity scale was not significant.

It can be seen that differences between psychopaths and controls are apparent on both Ma and Pd scales of the MMPI but only Ma could be regarded as an alternative measure of impulsivity. Pd is contaminated by other factors. Other impulsivity tests, GSM and APQ, have discriminated criminals and psychopaths from normals and have been associated with our EPI impulsivity scale. Hence our EPI impulsivity scale should discriminate psychopaths and criminals from controls.

6.6. <u>Prison samples and criminality.</u>

In order to assess characteristics of criminals, a criminal sample must be compared with a non-criminal sample. The following discussion suggests that there is comparatively little overlap in degree of criminality, when prisoners convicted for serious offences are compared with the unconvicted.

6.6.1. <u>Degree of criminality as a personality trait.</u> Degree of criminality regarded as a normally distributed personality trait is a hypothetical construct. It may be useful to consider types represented by extremes of this distribution. It can then be argued that certain specified groups will have a mean degree of criminality nearer one extreme than the other.

There have been various attempts to assess both degree of criminality and its converse, degree of honesty. Assessments of criminality within criminal samples tend to confound seriousness and frequency of crime (Green, 1961). i.e. Within extremes for either frequency or seriousness, a persistant shop lifter and first offender for burglary can be equated in a middle range of criminality.

Hood & Sparks (1970) suggest that offenders should be classified by reference to their criminal career, rather than single offences. They review literature pertaining to type of criminal career and conclude that homogenous criminal careers are comparatively rare. Studies based on arrest records tend to exaggerate homogeneity through police practice of arresting on the basis of previous convictions (Roebuck, 1965). Where more stringent offence criteria are used, there is little evidence of stable offence style (Robin, 1963). Hood & Sparks reviewed studies of sexual offenders (Radzinowicz, 1957), violent criminals (McClintock, 1961), robbers (McClintock & Gibson, 1961) and offenders convicted for fraud (Hadden, 1967). The highest percentages for specialists were robbers and defrauders (16%), while 12% of the defrauders had begun their criminal careers with other offences and specialised in fraud as they matured.

Studies attempting to measure degree of honesty have experienced similar difficulties in quantification. Hartshorne & May's (1930) "Character Education Enquiry" was originally considered unsatisfactory, since correlations between "honesty" tests were low. However, Eysenck (1970) regarded honesty as a quality predictable from one situation to another, while dishonesty tended to be; "unintegrated, unstable and unpredictable".

Eysenck (1970, P.30).

Eysenck also suggested that Hartshorne & May's low correlations could be attributed to the subject's youth, since similar tests with adults showed greater consistency.

Dishonesty, characterised by unpredictability in different situations, can be compared with uneven moral development. Brown (1965) divides moral development into moral knowledge, moral feeling and moral conduct. Moral knowledge, he associates with cognitive learning and moral feeling with classical conditioning. These two factors, together with imitation, identification and operant conditioning, determine moral conduct. He considers that maturity is manifested by integration of these factors.

Crime can be compared with lack of moral development or uneven moral development. Where all components of moral development are lacking, heterogenious criminal careers could be expected. Where moral feeling is lacking, either through inherent insusceptibility to aversive classical conditioning or through lack of conditioning experience, integration of cognitive learning and operant conditioning could determine homogenous criminal careers and increased specialisation with maturity.

It can be seen that degree of criminality cannot be regarded as one simple normally distributed personality trait. However, consideration of groups postulated as extreme types on this hypothetical trait, should allow discrimination on one or more contributing factors.

6.6.2. Crime in prison and non-prison samples. There is relatively little difficulty in defining a group with a high degree of criminality. However, the opposite pole, a group of honest people may be harder to define.

Green's (1961) study of sentencing procedure in Philadelphia showed that a prison sentence was most highly associated with offence seriousness and number of previous convictions. Considering grave offences only, 70% were given prison sentences over twelve months, while only 11% were not imprisoned at all. Hood & Sparks reviewed English studies, which tend to concentrate on less serious offences but the data obtained is comparable to Green's results. It can thus be assumed that long prison sentences are given for the most serious crimes. The reverse hypothesis, that serious crimes receive prison sentences cannot be substantiated (Hood & Sparks, 1970, P.144 and 153).

The likelihood of imprisonment for crimes known to the police can be fairly accurately estimated. However, there has been considerable controversy concerning the number of crimes unknown to the police. Attempts to estimate this "dark number" have been derived from two sources:- victimisation and self-report studies. Victimisation studies assess the volume and nature of all criminal acts committed within some specified locality and time period. Self-report studies estimate the number of people who commit criminal acts and the frequency with which they do so. Both types of study indicate that a large number of crimes are not reported to the police (Hood & Sparks, 1970).

Walker (1971) reports a victimisation study carried out on ten thousand households in the USA. Police were notified in approximately 60% of the serious cases. He also notes that 40% of robberies committed in England and Wales from 1950 to 1968 were cleared up. Burglary and robbery combined had an acquittal rate of 40%. 51.4% of persons found guilty in higher courts were sentenced to imprisonment. Higher courts tend to deal with the more serious offences, hence likelihood of imprisonment for a serious offence can be estimated at 50%. Table I summarises these percentages to obtain an estimate of the likelihood of imprisonment for commission of a serious offence.

TABLE 6.1.

Serious crime shrinkage from commission to prison.

Stage.	% continuing at each stage.	% of total crime.
Police notification.	60%	60%
Police arrest.	40%	24%
Found guilty.	60%	14.4%
Imprisoned.	50%	7.2%

The above table suggests that any criminal sample defined from the criterion of having received a prison sentence, contains approximately ten per cent of all persons committing a similar serious offence.

This method of estimating imprisonment is based on a single offence and does not take number of previous convictions or offences into account. Previous offences known to the police increase likelihood of arrest and imprisonment (Hood & Sparks, 1970). Hence increased criminality, defined from seriousness and frequency of crimes committed, increases likelihood of imprisonment.

Victimisation studies cannot estimate the proportion of hidden crime committed by any one individual or the proportion of the general population who commit crimes. However, self-report studies help to clarify these issues. Self-report studies tend to concentrate on school children, hence the generalisability of these results to adult crime is controversial.

Hood & Sparks cite Wallenstein & Wyle (1947) as one of the few self-report studies of adult crime. Questionnaires for self-reported crime were obtained from 1,800 men and women in New York State. 64% admitted committing a felony. However, considering robbery and burglary as examples of serious offences which could result in imprisonment, only 11% to 17% of the men could be regarded as serious offenders. Subject's ages were not mentioned but self-reported crime from the age of sixteen years was requested.

Hood & Sparks cite a Scandinavian self-report study of entrants to the armed forces and three American studies of self-reported crime in schoolboys. All studies indicated that only 2% had been involved in serious crime or could be classified as persistent offenders. Similar results were obtained in an English study (Belson, 1968). Belson also indicated that boys caught by the police, were those most heavily involved in stealing, although about the same percentage of heavy stealers had never been caught.

It can be seen that prison samples contain individuals with a high degree of criminality, assessed from seriousness and frequency of crime committed. "Dark number" studies suggest that a high percentage of crimes committed are unknown to the police. The only adult self-report study indicates that 11% to 17% of the adult population commit serious crimes. Delinquency studies, sampling a shorter time period, suggest that 2% of the population commit serious crimes, while only half the number committing serious crimes are convicted. The normal unconvicted population could thus be regarded as containing 2% to 17% of persons equal in criminality to a prison sample. Normal and prison samples can thus be compared along a dimension of criminality.

6.7. Environmental factors in the etiology of psychopathy and criminality.

This study is concerned with individual differences in personality and physiological function which may be associated with criminality. Hence possible environmental factors in the etiology of criminality should be reduced. Environmental influences are suggested in the following discussion.

Eysenck (1970) ascribes psychopathy to an inherited lack of aversive conditionability. However, there is evidence to suggest that some forms of psychopathy have environmental origins.

Bender (1947) summarises the viewpoint that psychopathy is caused by parental deprivation, she says:

> "Emotional deprivation in the infantile period due to a serious break in parent-child relationships, for example the child who spent a considerable time in infancy or childhood in an institution without any affectional ties, or a child who has been transferred from one foster home to another with critical breaks in the continuity of affectional patterns.... the defect is in the ability to form relationships, to identify themselves with others, and consequently, in conceptualisation of intellectual, emotional and social problems".
>
> Bender (1947, P.362).

There is some evidence in favour of this viewpoint. Goldfarb (1955) compared two groups of children reared in institutions. One group was placed in homes before they were three years old, while the other group was placed in homes after three years of age. Both groups had emotional problems, but the second group were unable to keep to rules, lacked guilt, envied affection and were unable to form lasting relationships. They also had low IQ and poor speech. This type of emotional disturbance may be related to family separation rather than institutional care. Lewis (1954) examined five hundred deprived children admitted into care and found that only five, of the nineteen affectionless characters, had suffered prolonged separation from their families. Rutter (1971) reviewed a large number of studies on maternal deprivation and concluded that deviant behaviour in institutional children was greater than in normal children, but less than deviant behaviour of children from the most disturbed homes.

Further studies substantiate Rutter's conclusion. Oltman & Friedman (1967) found that 50% of their psychopaths had suffered parental loss, but 34% of their non-psychopaths had also had parental loss. However, 28% of the psychopaths had separated parents compared with only 7% of the non-psychopaths. Similarly, Douglas, Ross & Simpson (1968) noted that homes broken by divorce or separation rather than death, showed an association with delinquency. Wardle (1961) not only associated delinquency with the child from a broken home, but also the parent from a broken home. Pressure from a criminal parent did not add to the risk of delinquency if adverse family relationships were taken into account (West, 1967).

Robins (1966) found that most of the psychopaths in her survey, had fathers who were psychopathic or alcoholic. Separation from these fathers did not lessen the chances of the child becoming psychopathic. McCord & McCord (1964) observed that anti-social behaviour was related to inconsistent discipline, which could be expected from psychopathic or alcoholic fathers. However, Wiggins (1968) suggested that inconsistent discipline could be related to the child's lack of response to normal discipline. This evidence suggests that a psychopathic child may inherit his personality from a psychopathic parent. Both child and parent may be irresponsible, which could increase marital disharmony and subsequent likelihood of divorce or separation.

It can be seen that a poor environment may be associated with psychopathic or criminal tendencies but this does not exclude inherited factors. Since the contribution of environmental factors is controversial, these should be reduced as much as possible, when comparing psychopathic or criminal samples with controls.

6.8. Class differences in criminality and conviction.

Some sociological factors may influence likelihood of conviction. These factors are suggested in the following discussion and should be taken into account when selecting the criminal sample.

Hood & Sparks (1970, Fig:2.4. P.56) show that the lower working class have a considerably higher delinquency rate than other classes. They consider that the class distribution of adult offenders is much the same. There is evidence to suggest that the delinquency figures do not reflect class differences in criminal behaviour alone, but do reflect class differences in criminal behaviour, likelihood of arrest and likelihood of conviction.

Porterfield (1946) compared offences reported by three hundred and thirty seven students at Texan Christian University with those reported by over two thousand children charged at Fort Worth juvenile court. The delinquencies of both groups were equally serious. Hood & Sparks review a number of other American studies showing a similar lack of correlation between reported delinquencies and social class. However, class differences in type of crime committed have been found. Arnold (1965) noted that middle class reported serious and destructive offences, while working class reported using alcohol, narcotics, fighting and assault. Gold (1966) replicated these results but showed that official records exaggerated the status difference in delinquency. The ratio of working class to middle class should have been 1.5 to 1, instead of 5 to 1 on the official records.

Subcultural factors such as Miller's (1958) "toughness" value system, prevalent in certain lower class street corner groups, may effect likelihood of arrest. Hood & Sparks (1970) described the characteristics of individuals most likely to be arrested:

"According to Piliavin and Briar the most important cue is the way the

> boy responds to the police. If he confesses quickly, appears penitent and anxious he will be classified as a 'victim of circumstance' or 'salvagable' and consequently dealt with informally. If, on the other hand, the offender's demeanour is hostile, lacking in respect and unco-operative he is likely to get himself defined as someone who 'doesn't respect the law". ....Piliavin and Briar's study shows that of the 21 youths in their study who were classified as unco-operative 14 were arrested compared to only two of the 45 who were co-operative".
>
> (Hood & Sparks, 1970, P.78).

The above description suggests that subcultural factors determine arrest or informal admonishment. However, there is evidence to suggest that lower status boys are more frequently delinquent and commit more serious offences. Belson (1968) found that boys caught by the police, were those most heavily involved in stealing, although about the same percentage of heavy stealers had never been caught. Heavy stealers tended to have fathers in the lower occupational levels, while the greater proportion of those caught had unskilled fathers. Most of the heavy stealers were educated in Secondary Modern and Comprehensive schools. The proportion of public and Grammar school boys was about half that from other schools and of these boys, only a quarter got caught by the police.

It can be seen that there is a bias towards arresting lower status criminals or delinquents but criminal behaviour is more prevalent in lower status groups than other groups. Comparisons between prisoners and controls, for individual determinants of criminal behaviour, should thus endeavour to reduce class bias by concentrating on higher status prisoners.

6.9. Conclusion to Chapter 6.

Hypotheses derived from Eysenck's criminality theory have not been adequately tested. However, there is a related body of literature concerned with psychopathy, rather than criminality, and its relationship to physiological measures. Definitions of psychopathy have varied but questionnaires have isolated several types. Type I has been equated with Cleckley's non-anxious psychopath and designated primary psychopathy, while type II is the neurotic or secondary psychopath.

There is empirical evidence suggesting that primary psychopathy is associated with lack of aversive conditionability, when electrodermal responses are considered. Other autonomic systems and eyeblink conditioning have shown equivocal results. Primary psychopaths have displayed comparative lack of avoidance conditioning, but this result may have been confounded by awareness. Appetitive conditioning has not shown any consistent relationships with psychopathy.

Evidence relating primary psychopathy to arousal is controversial, but tends to parallel results from aversive conditioning studies. Primary psychopathy has been associated with electrodermal indices of low arousal, but heart rate indices of high arousal. This latter result was thought to reflect an association between heart rate and preference for physical energy expenditure, rather than emotional arousal. Other evidence supports the notion of under-arousal in primary psychopaths. Electrodermal indices of aversive stimulus anticipation were less in primary psychopaths than controls, the primary psychopath's pain tolerance was greater than controls, provided motivation was adequate.

Eysenck's criminality theory suggests that psychopaths are extreme criminals, hence high neuroticism and extraversion said to be characteristic of criminals, are exaggerated in the psychopath. This notion is controversial but there is theoretical agreement that psychopaths and criminals share the personality trait of impulsivity. However, primary psychopaths are non-anxious and would thus be low N-scores, while the neurotic or secondary psychopath would be closer to Eysenck's concept of psychopathy and criminality.

Test of Eysenck's criminality theory require comparing a sample of highly criminal individuals with a sample containing relatively few criminals. It is argued that criminals convicted for serious crimes compared with an unconvicted sample meet this criterion.

Eysenck's criminality theory is concerned with individual differences in personality and underlying physiological factors, hence environmental influences should be reduced to a minimum when comparing criminal and non-criminal samples. It was suggested that deprived or broken homes could contribute to criminality, while lower class status could bias conviction. The criminal sample should thus be selected to reduce these factors by eliminating subjects with poor home backgrounds and attempting to obtain relatively high status prisoners.

Eysenck's hypotheses and their modifications can be tested by comparing personality and physiological variables in a selected prison sample and controls. Within the prison sample relationships between these variables can be determined and compared with results obtained for student samples in Chapter 5. Specific hypotheses to be tested are enumerated in Chapter 7 (P. 311).

CHAPTER 7.

This chapter reports a comparison of psychological and physiological factors in a selected prison sample and a student sample, together with relationships between psychological and physiological factors within the prison sample.

EXPERIMENT III.

General Introduction.

Attempts to select groups containing a majority of impulsive persons, have been based on the notion that crime is one manifestation of impulsive behaviour. Interest has centered upon prison samples and psychopaths within prison samples.

Eysenck's (1957) personality theory associated psychopathy and criminality with high scores on extraversion and neuroticism. Later, Eysenck & Eysenck (1971) suggested that impulsivity should be substituted for extraversion when considering prison samples. They also included psychosis as a determinant of criminality. This psychosis (P) factor was said to be orthogonal to both extraversion (E) and neuroticism (N). However, Eysenck (1957) did stipulate that personality and criminality differences associated with lack of conditionability, were only applicable when socialisation and environmental pressures were equal. Trasler (1973) considered that one causal factor in criminality was inefficient socialisation. Neither Eysenck nor Trasler are clear about the affects of inefficient socialisation on personality. Franks (1956) suggested that introverted criminals had conditioned to an undesirable environment. However, Little (1963) was unable to substantiate this notion. There is thus a possibility that inefficient socialisation affects personality.

Previously, (P.301-303) it was concluded that criminality was associated with homes broken by divorce or separation. Individuals from these homes are likely to have suffered from poor and inefficient socialisation. It will be recalled (P.304-305) that lower status groups were over-represented in prison samples. Some bias was introduced by preference for convicting lower status groups. However, lower status groups did tend to commit more crime than other groups. Trasler (1973) associates inefficient socialisation with lower status groups. Hence personality and conditioning theories of crime may not be applicable to randomly selected prison samples. This study attempted to eliminate these confounding factors by selecting prisoners with stable family backgrounds, from higher status groups.

Theoretically, the selected prison sample should contain a majority of impulsive persons (P.293-295). Thus Eysenck's theories and their modifications can be tested by comparing this prison sample with a student sample on relevant personality and physiological measures. At the same time, the generality of relationships between personality and physiological factors can be assessed by comparing within prison sample relationships with those observed in Experiment II.

Method.

Sample selection concentrated on aspects of social background said to be associated with use of efficient socialisation techniques. i.e. unexceptional, stable, normal satisfactory family backgrounds.

H.M. Prison, Leyhill was chosen as the institution which could provide the largest sample satisfying the family background criteria. Forty-eight subjects were selected from the total inmate population, to satisfy the following criteria for family background:-

a) No irregularity of background reported in prison records. Cases for rejection included instances of suggested family breakup or disharmony, absence of one or both parents (including war evacuation) during childhood. Under ten years old defined childhood.

b) No information from the assistant governor indicating the subject's unsuitability.

c) No subjective report of an unhappy childhood.

This last criterion was ascertained from the following three questions concerning the subject's childhood:-

i) Did you live with both parents, until you were 10 years old (at least) ?

ii) Do you feel that you were, in general, treated rather badly by either or both parents, up to the age of 10 years?

iii) Which of the terms below best describe your feelings about your homelife as a child? (Up to the age of 10 years).

Unhappy. Not bad. Pleasant. Happy.

Subjects were eliminated if they reported separation from their parents, if they considered they were badly treated or if they did not describe their background as "pleasant" or "happy".

Subjects were run in pairs. One subject was given the conditioning procedure, while the other subject completed personality inventories.

The conditioning procedure was described previously (P.112-118). Two adjacent rooms used were as similar as possible to the University experimental rooms. However, the darkened experimental room was not sound attenuated and there was no means of observing the subject.

Personality inventories used were:-

a) The Eysenck Personality Inventory including the P scale. (See Appendix I).

b) A shortened version of MMPI psychopathic deviant (Pd) scale and hypomania (Ma) scale. (See Appendix IV).

These experiments in H.M. Prison, Leyhill were carried out with Dr. T. D. McComb. Selection of prisoners and conditioning were completed under his guidance, as part of a Home Office project reported in 1970.

The above experiment was replicated in the University using a further fifty students as subjects. Subjects were obtained by advertising in the Student Bulletin, offering 50 pence for an hour's participation in a psychological experiment. Subjects underwent the conditioning procedure, previously described (P.112-118) followed by completion of the PEN, the shortened version of Ma and Pd scales and the form for subjective criteria of happy childhood. Two subjects were eliminated who did not describe their childhood as "happy" or "pleasant". These students were thus comparable to the selected prison sample.

The two groups were compared for differences in personality and physiological measures and within prison sample relationships were compared with those obtained in Experiment II.

Hypotheses concerning personality and physiological measures are discussed separately, together with data analyses and results.

The order of presentation is listed below:-

7.1. Personality differences between prisoners and students.

7.1.1. Prisoners have higher impulsivity, neuroticism, psychoticism and criminal propensity scores than students.

7.1.2. Prisoners have higher combined neuroticism and low impulsivity scores than students.

7.1.3. Prisoners display more active psychosis than students, assessed from a combination of psychoticism and impulsivity scores.

7.1.4. Prisoners have higher MMPI Pd and Ma scores than students.

7.1.5. Discussion of personality differences between prisoners and students.

7.2. Physiological differences between prison and student samples.

7.2.1. The prison sample display less differential responding to an aversive CS during extinction than the student sample.

7.2.2. The prison sample are less aroused and display longer recovery times than the student sample.

7.2.3. Variability between arousal measures is higher in prisoners than students.

7.2.4. Discussion of physiological differences between prison and student samples.

7.3. Relationships between personality and extinction of an aversive differential CR within the prison sample.

7.3.1. High impulsivity, neuroticism, psychoticism and criminal propensity are associated with lack of differential responding.

7.3.2. Combined impulsivity and low neuroticism scores are associated with lack of differential responding.

7.3.3. Combined impulsivity and psychoticism are associated with lack of differential responding.

7.3.4. High MMPI Pd and Ma scores are associated with lack of differential responding.

7.3.5. Discussion of relationships between personality and extinction of an aversive differential CR within the prison sample.

7.4. Relationships between personality and arousal within the prison sample.

7.4.1. High impulsivity, neuroticism, psychoticism and criminal propensity are associated with under-arousal in the prison sample.

7.4.2. Combined impulsivity and low neuroticism are associated with low arousal in the prison sample.

7.4.3. Combined impulsivity and psychoticism are associated with low arousal in the prison sample.

7.4.4. High MMPI Pd and Ma scores are associated with low arousal in the prison sample.

7.4.5. Arousal is lower in prison samples than student samples, when it is assessed from variability between arousal indices in the four personality quadrants, defined from neuroticism and impulsivity corrected for age.

7.4.6. Discussion of relationships between personality and arousal within the prison sample.

7.1. Personality differences between prison and student samples.

7.1.1. Prisoners have higher impulsivity, neuroticism, psychoticism and criminal propensity scores than students.

Eysenck (1957) associated criminality with high scores on extraversion (E) and neuroticism (N). Later, Eysenck & Eysenck (1970, 1971) added psychoticism and criminal propensity to personality correlates of criminality.

Eysenck & Eysenck (1971) found that extraversion scores did not discriminate an unselected prison sample from controls. Item analysis suggested that impulsivity, rather than extraversion discriminated the groups. Impulsivity was thus substituted for extraversion in tests of Eysenck's hypotheses.

Eysenck & Eysenck (1971) also developed a criminal propensity scale (Cp) from PEN items which discriminated prisoners from controls. This scale included impulsivity, neuroticism and psychoticism items.

Eysenck specifies equal environmental pressures for fulfilment of his hypotheses. The selection procedure for this prison sample should have reduced environmental and socialisation differences to a minimum. Students were also checked for stable backgrounds by the same subjective criteria form.

Eysenck's hypotheses were tested by comparing sample means for impulsivity, neuroticism, psychoticism and criminal propensity. Samples were also compared for impulsivity with an age correction.

Data summary and calculation:

TABLE 7.1.

Comparison of impulsivity (I), neuroticism (N), psychoticism (P) and criminal propensity (Cp) scores in the prison and student samples.

	I	N	P	Cp
Prisoners.				
Mean	5.71	7.04	3.81	9.32
SD	2.48	5.02	1.98	4.91
Students.				
Mean	5.31	9.95	4.03	9.31
SD	2.18	4.19	2.23	4.39
Difference.	.40	-2.91	.22	.01
t.	.00	-3.08	-.68	.01
Significance.	----	.01	----	----

It can be seen that only neuroticism scores differentiate the groups and this is in the direction opposite to Eysenck's hypothesis.

The hypothesis concerning impulsivity was re-examined. There is some evidence to suggest that impulsivity may decline with age. Black (1971) compared types of Special Hospital (Broadmoor) patients for MMPI scores. Psychopaths scored high on Pd and Ma scales. However, re-test over a period of years, showed that Ma scores declined with age, while Pd remained at the same high level. Validity tests for our impulsivity scale, using Pd and Ma showed that impulsivity was associated significantly with Ma scores only. Similarly, Eysenck & Eysenck's (1969b) analysis of extraversion scores by age group, shows a decline in E-scores with age. This decline could be attributed to the impulsivity component of extraversion.

The samples were compared for age, table 7.2. below:-

TABLE 7.2.

Age differences in prison and student samples.

	Mean	SD
Prisoners:-	35.63	9.57
Students:-	19.79	2.03

$t = 11.22$. ($p < .001$)

Figure 7.1. shows histograms of age distributions in prison and student samples. It can be seen that there is a nearly normal distribution of age in prisoners but a skewed distribution of age in students.

The correlation between age and impulsivity in prisoners = -.464. Correlations within the student sample were considered invalid, since the distribution was skewed and the range limited. This suggests that impulsivity is inversely associated with age.

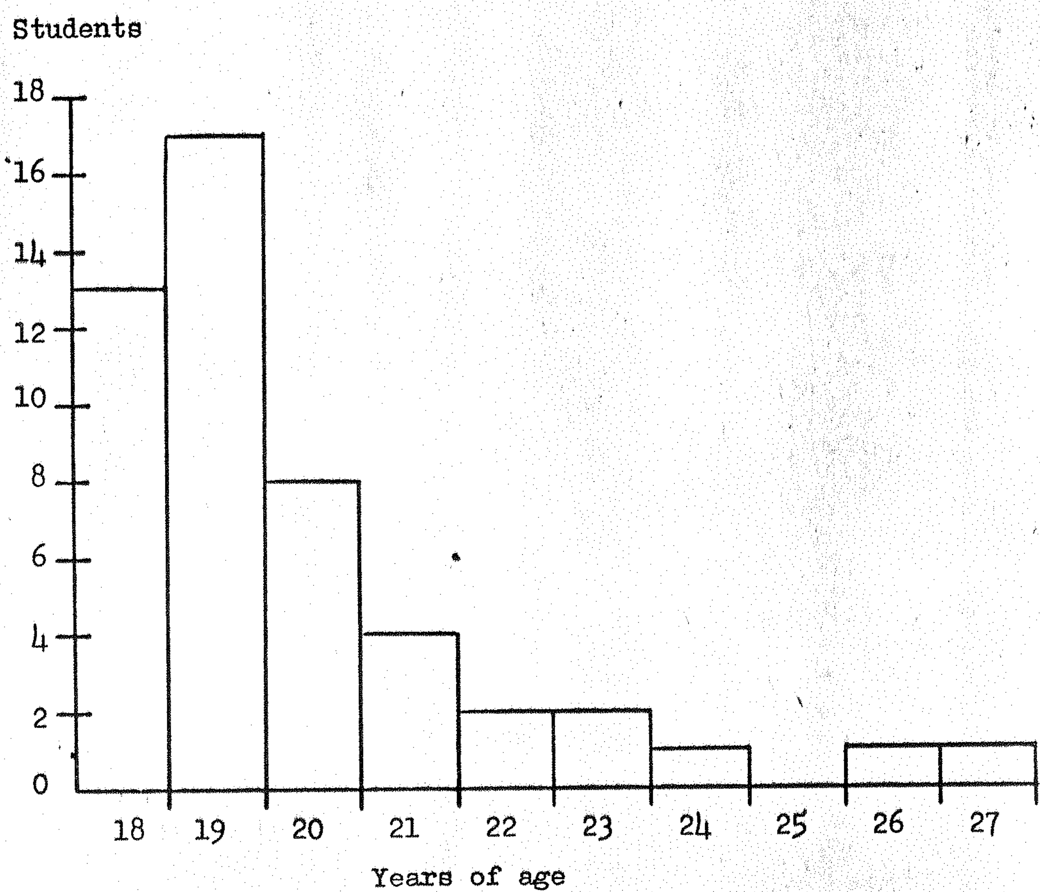
Two types of comparison between prisoners and students for impulsivity allowed age to be taken into account:-

a) The two samples were combined and the correlation between age and impulsivity calculated ($r = -.154$). Standard scores for age and impulsivity were calculated, in order to find predicted I score from age. Differences between predicted I and observed I were compared between the two samples, giving the following results:-

	Mean	SD
Prisoners:-	.2686	.9746
Students:-	-.1689	.9483

$t = 2.2265$. Significant beyond the .05 level.

b) Prisoners under 27 years old were compared for I scores with students, whose maximum age was 27 years.



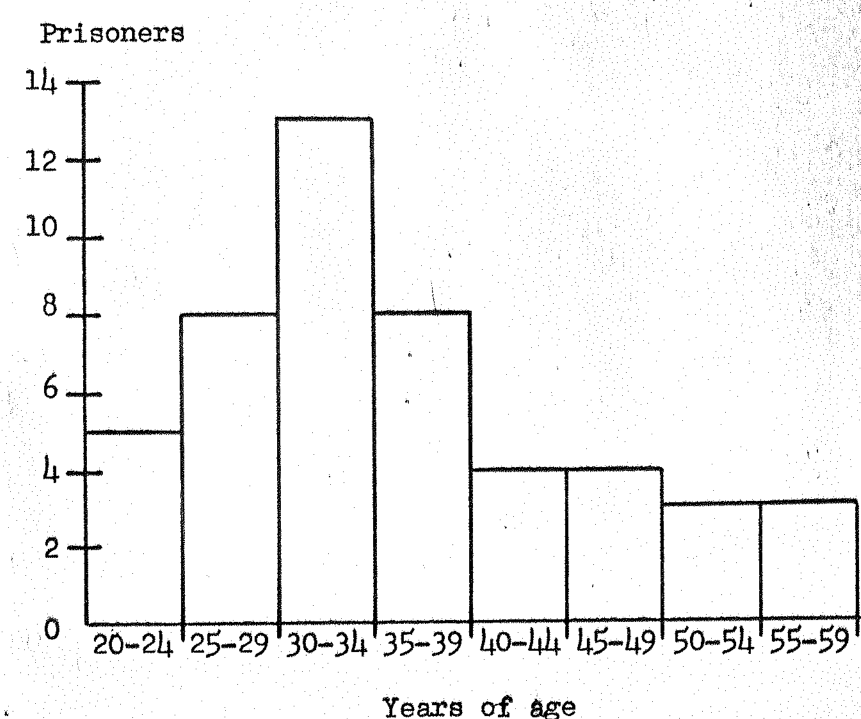


Figure 7.1 Histograms of age distribution frequencies in the prisoner and student samples

	n	Mean	SD
Prisoners:-	9	7.44	1.81
Students:-	48	5.31	2.18

t = 2.758 Significant beyond the .05 level.

Result.

There were no significant differences between the samples in I-scores, P-scores or Cp scores. N-scores were significantly lower in prisoners compared with students, contrary to Eysenck's hypothesis. A correlation between impulsivity and age in the prison sample, suggested that impulsivity should be corrected for age. When impulsivity was corrected for age, either by a regression analysis or by eliminating prisoners older than the oldest student, impulsivity was higher in prisoners than students.

7.1.2. Prisoners have higher combined neuroticism and impulsivity scores than students. In contrast to Eysenck's criminality theory, evidence previously reviewed (P.272-275) suggested that primary psychopaths (high extraversion, low neuroticism) may lack aversive conditionability, while there was no evidence to indicate that Eysenck's psychopaths (high extraversion, high neuroticism) differed from normals in aversive conditionability. Substituting impulsivity for extraversion in Experiment II substantiated this notion, in so far as the low N, high impulsivity group displayed least differential responding in aversive CR extinction. If Eysenck's hypothesis, that criminals are less conditionable than controls, is correct, then these results suggest that criminals and psychopaths are stable extraverts, providing environmental pressures are constant. The resulting hypothesis is that criminals will have higher impulsivity scores combined with lower neuroticism scores than students.

The hypothesis was tested by comparing sample frequencies in quadrants defined from impulsivity and neuroticism (See table 7.3 & 7.4).

Data summary and calculation:

Comparison of impulsivity (I) neuroticism (N) and impulsivity/ neuroticism interactions in our selected prison sample and students.

The previous calculation showed that prisoners had significantly ($p < .05$) lower N-scores than students but there were no differences in impulsivity scores. However, impulsivity corrected for age was higher in prisoners than students.

Burgess (1972) considered that quadrant analysis for neuroticism and extraversion scores was a better test of Eysenck's hypothesis, than comparisons between mean scores (P.264-265). Substituting impulsivity for extraversion, prison and student samples were compared for quadrant composition in Table 7.3. below.

TABLE 7.3.

Frequency and contingency tables for prison and student samples in quadrants defined from neuroticism and impulsivity scores.

Combined mean N-score = 8.49. Combined mean I-score = 5.51.

Group.	Observed frequency.		Expected frequency.		total.
	Students	Prisoners.	Students	Prisoners.	
LI, LN.	13	14	13.5	13.5	27
LI, HN.	13	10	11.5	11.5	23
HI, LN.	7	16	11.5	11.5	23
HI, HN.	15	8	11.5	11.5	23
Totals.	48	48	48	48	96

Chi-square = 6.07, Not significant.

Group.	Observed frequency.		Expected frequency.		total.
	Students	Prisoners.	Students	Prisoners.	
LI, HN.	13	10	10.00	13.00	23
HI, LN.	7	16	10.00	13.00	23
Totals.	20	26	20	26	46

Chi-square = 3.184, $(p < .1)$.

A further quadrant analysis comparing prison and student samples was calculated from quadrants defined by neuroticism and impulsivity corrected for age. See table 7.4. below.

TABLE 7.4.

Frequency and contingency tables for prison and student samples in quadrants defined from neuroticism scores and impulsivity scores corrected for age.

Group.	Observed frequency.		Expected frequency.		total.
	Students	Prisoners.	Students	Prisoners.	
LI, LN.	13	13	13	13	26
LI, HN.	16	7	11.5	11.5	23
HI, LN.	7	17	12	12	24
HI, HN.	12	11	11.5	11.5	23
Totals.	48	48	48	48	96

Chi-square = 7.730, df = 3, $p < .01$.

Group.	Observed frequency.		Expected frequency.		total.
	Students	Prisoners.	Students	Prisoners.	
LI, HN.	16	7	11.26	11.74	23
HI, LN.	7	17	11.74	12.26	24
Totals.	23	24	23	23	47

Chi-square = 7.653, df = 1, $p < .01$.

Result.

Quadrant distribution on the basis of N and I scores shows a non-significant tendency for prisoners to be over-represented in the high I, low N quadrant. When I scores are corrected for age, quadrant distribution is significantly different in prisoners and students ($p < .01$). Differences are most obvious when low I, high N and high I, low N quadrants are compared. These quadrants can be regarded as representing extremes of Gray's (1970, 1971 a & b) anxiety dimension. Direct comparisons between these quadrants, indicate a trend for more prisoners to fall within the high I, low N quadrant and more students to fall within the low I, high N quadrant ($p < .1$). When I scores are corrected for age, this difference reaches significance ($p < .01$).

7.1.3. <u>Prisoners display more active psychosis than students, assessed from a combination of psychoticism and impulsivity scores.</u> Eysenck & Eysenck (1971) suggest that criminality is associated with psychosis (P) and predict that prisoners will have higher P scores than controls. Claridge's (1967) personality theory was summarised by psychotic and neurotic diagonals, superimposed on a horizontal extraversion dimension. (P.37). Impulsivity and psychopathy were placed on the extravert side of the psychotic diagonal. Criminality should thus be associated with a combination of impulsivity and psychosis.

Eysenck's P scale could be regarded as a measure of Claridge's psychotic dimension, while our impulsivity scale should discriminate between active and passive psychosis.

Data summary and calculation:

Calculation 7.1.1. showed no differences between prisoners and students in impulsivity or psychoticism scores. However, impulsivity corrected for age was higher in the prison sample.

A quadrant analysis for impulsivity and psychoticism allows impulsivity/psychoticism interactions to be taken into account.

Samples were compared for quadrant composition in table 7.5 below.

TABLE 7.5.

Frequency and contingency tables for prison and student samples in quadrants defined from psychoticism and impulsivity scores.

Group.	Observed frequency.		Expected frequency.		total.
	Students	Prisoners.	Students	Prisoners.	
LI, LP.	16	14	15	15	30
LI, HP.	10	9	9.5	9.5	19
HI, LP.	8	9	8.5	8.5	17
HI, HP.	14	16	15	15	30
Totals.	48	48	48	48	96

Chi-square = .378, Not significant.

Group.	Observed frequency.		Expected frequency.		total.
	Students	Prisoners.	Students	Prisoners.	
LI, LP.	16	14	15	15	30
HI, HP.	14	16	15	15	30
Totals.	30	30	30	30	60

Chi-square = .267. df = 1. Not significant.

A further quadrant analysis comparing prison and student samples was calculated from quadrants defined by psychoticism and impulsivity corrected for age. See table 7.6 below.

TABLE 7.6.

Frequency and contingency tables for prison and student samples in quadrants defined from psychoticism scores and impulsivity scores corrected for age.

Group.	Observed frequency.		Expected frequency.		total.
	Students	Prisoners.	Students	Prisoners.	
LI, LP.	16	12	14	14	28
LI, HP.	13	7	10	10	20
HI, LP.	8	11	9.5	9.5	19
HI, HP.	11	18	14.5	14.5	29
Totals.	48	48	48	48	96

Chi-square = 5.678, df = 3, $p < .2$.

Group.	Observed frequency.		Expected frequency.		total.
	Students	Prisoners.	Students	Prisoners.	
LI, LP.	16	12	13.3	14.7	28
HI, HP.	11	18	13.7	15.3	29
Totals.	27	30	27	30	57

Chi-square = 2.03, df = 1, $p < .2$.

Result.

Quadrant distribution on the basis of P and I scores does not differ significantly between prisoners and students. When I scores are corrected for age, there is a non-significant trend ($p < .2$) for different quadrant composition in prisoners and students.

Frequency comparisons between quadrants representing extremes of the active psychosis dimension, show a non-significant trend ($p < .2$) for prisoners to be over-represented in the active psychosis quadrant, and students to be over-represented in the passive non-psychotic quadrant.

7.1.4. Prisoners have higher MMPI Pd and Ma scores than students.
Psychopaths have been distinguished from other groups by their high scores on MMPI Pd and Ma scales (Black, 1966). Since Eysenck considers that psychopaths represent one pole of a criminality continuum, prisoners should have higher scores than students on MMPI Pd and Ma scales.

Data summary and calculation:

Comparison of psychopathic deviant (Pd) and hypomania (Ma) scores in a prison sample and students.

Means and standard deviations for Ma and Pd scores in prison and student samples were compared by t-tests. Results are tabulated in table 7.6 below.

TABLE 7.7.

Ma and Pd scores in student and prison samples.

	Students.	Prisoners.
Pd scores.		
Mean	11.31	10.47
SD	3.298	3.055
Difference = -.84,	t = -1.117,	Not significant.
Ma scores.		
Mean	12.05	11.85
SD	2.630	2.919
Difference = -.20,	t = -.354,	Not significant.

Result.

Pd and Ma scores do not differentiate prison groups from students.

7.1.5. Discussion of personality differences between prison and student samples. There were no differences between the samples in impulsivity scores. However, the prison sample was significantly older than students and within the prison sample, impulsivity was inversely correlated with age. This inverse correlation between impulsivity and age, suggested that impulsivity in the prison sample, should be corrected for age. Corrected impulsivity scores did show the hypothesised difference between prisoners and students. However, it could be argued, that the resulting difference was attributed to the age difference alone. A further comparison between students and prisoners within the student age range, showed that these prisoners were significantly more impulsive than students. Hence, there is some support for Eysenck's modified hypothesis, that prisoners are more impulsive than students.

Our student/prisoner differences in I-scores could suggest that high impulsivity mitigates against selection as a student and that it is the student sample rather than the prison sample which differs from population norms. However, some support for the notion that it is our prisoners rather than the students which differ from the norm can be obtained from E-score comparisons.

Eysenck & Eysenck's (1970) control group of married men with similar age and social class to our prison group have significantly lower E-scores than our prisoners ($p < .001$). While E-scores for our prisoners (Mean = 12.79, SD = 4.48) are comparable to E-scores in Eysenck's prisoners (Mean = 12.75, SD = 3.52). Using Eysenck & Eysenck's (1971) table of percentage of keyed answers for control and prison groups: mean percentage of I-score answers for married men = 49.08 and mean percentage of I-score answers for prisoners = 54.38. In so far as Eysenck's prisoners can be compared with our prisoners, then I-scores can be considered greater in prisoners than the normal population.

It can be seen that our I-score differences between prisoners and students need not necessarily indicate that prisoners have higher I-scores than the normal population but indirect evidence suggests that there is some limited support for this notion.

Neuroticism scores were significantly lower in the prison sample than in students. However, our student N-scores are similar to student norms which are higher than population norms (Eysenck & Eysenck, 1964). Our prisoner N-scores are significantly ($p<.001$) lower than Eysenck & Eysenck's (1970) prisoner N-scores but do not differ significantly from Eysenck & Eysenck's (1970) married men of equivalent age and social class to our prison sample. Hence differences observed in N-scores between our prisoners and students can be attributed to high N-scores in students rather than low N-scores of prisoners.

The difference in N-scores between our prison sample and other prison samples must be attributed to our selection procedure. Environmental determants of criminal behaviour were reduced to study possible inherited determants. Previous discussion of sociological (P.298-300 & 304-305) and environmental factors (P.301-304) suggested that there were important determants in our random prison sample. It could be argued that adverse environmental factors are associated with high N-scores. Hence the prevalence of high N-scores in other random prison samples could be environmentaly other than inherentaly determined and may not necessarily be associated with underlying physiological factors.

Our results suggest that N-score is not necessarily associated with physiological correlates of criminality.

The analysis combining neuroticism and impulsivity showed a trend for prisoners to be over-represented in the low N, high I quadrant ($p<.1$). This over-representation was increased to a significant level when impulsivity was corrected for age ($p<.05$). This quadrant can be compared with traits associated with primary psychopathy (P.268-271). Thus this sample may be biased towards primary psychopathy rather than any other type of psychopathy.

The criminal propensity scale is composed from impulsivity, neuroticism and psychoticism items which discriminated unselected prisoners from controls (Eysenck & Eysenck, 1970; 1971). Comparisons for Cp between the samples, should thus be similar to those obtained from these scales considered separately. Impulsivity and psychoticism should not contribute to any difference, but the significant difference in neuroticism should be reflected in a significant difference in criminal propensity. The fact that there were no significant differences in criminal propensity between groups, suggests that N items which discriminated between Eysenck & Eysenck's samples, may have been endorsed more often in our criminal sample than other N items. Hence cancelling out the unpredicted lower N scores in our prison sample. i.e. Our prison sample may have scored higher on N items which discriminated Eysenck & Eysenck's samples but lower on other N items.

Active psychosis, assessed from P and I scores, had a non-significant tendency to be over-represented in the prison sample when I was corrected for age. This result could reflect age differences between the samples and the unusually high P scores in our student sample. This hypothesis was thus not adequately tested.

Psychopathic deviance (Pd) and Hypomania (Ma) scores did not discriminate the groups. Ma may be contaminated by age differences between samples. Previously, (P.206) it was shown that Ma correlated significantly with our impulsivity scale. Black (1971) indicated that Ma in psychopaths declined with age, while our impulsivity scale showed a significant inverse correlation with age in the prison sample. The fact that Ma did not discriminate the samples could thus be attributed to age differences.

Black (1971) found that Pd did not decline with age in psychopaths. Hence lack of differences in Pd between the samples could not be attributed to age. The Pd scale contains items which indicate departure from conventional norms and attitudes. It will be recalled (P.297) that studies of honesty, related dishonesty to variability between tests of honesty, while honesty was characterised by high integrated scores on honesty tests. Brown (1965) suggests that integration of moral feeling, moral knowledge and moral conduct are associated with maturity. Kohlberg's (1968) test of mature moral judgement classifies the population into six moral stages. Stages 3 and 4 reflect conventional attitudes found in the majority of the population. Stages 1 and 2 are immature stages, prevalent in delinquent samples, while stages 5 and 6 are mature stages, representing an integrated value system, which could depart from conventional norms. Attainment of stages 5 and 6 required at least average intelligence. Thus Pd scores may be higher in both prison and student samples, but causes may differ. In prisoners, departure from conventional norms may be associated with an unintegrated moral system manifested by stage 1 and 2 thinking. On the other hand, students may be more likely to have attained stage 5 and 6 thinking, resulting in departure from conventional norms. Alternatively, a few students with stage 5 and 6 thinking could change student attitudes from conventional population attitudes to conventional student attitudes. This explanation could account for lack of observed differences in Pd between prisoners and students.

7.2. Physiological differences between prison and student samples.

7.2.1. The prison sample display less differential responding to an aversive CS during extinction, than the student sample.

Experiment II tested the modified version of Eysenck's hypothesis associating lack of conditionability with impulsivity. Evidence indicated that impulsivity was related to rapid extinction of a differential aversive conditioned response. This relationship was significant in low neuroticism groups only, thus lending some support to Gray's (1970a;1971 a & b) modification to Eysenck's theory, when impulsivity is substituted for extraversion.

A further test of Eysenck's hypothesis and its modifications was suggested. A student sample could be compared with a sample of people known to have committed impulsive acts. Precedent suggested that criminal and psychopathic samples met this criterion. Relationships between psychopathy, criminality and impulsivity were reviewed in Chapter 6, (Section 5). It was concluded that our impulsivity scale was closely related to scales known to have distinguished psychopaths from non-psychopaths, and criminals from controls.

The choice of a criminal sample allowed Eysenck's theory of criminality to be considered. This theory stated that criminals were deficient in conditionability compared with controls, provided environmental pressures were constant. The prisoner and student group were selected to reduce this difference in environmental pressures.

The resultant hypothesis, that the selected prison sample should be less conditionable than students, was based on the premises outlined above:- a) This prison group should contain more impulsive persons than a control group and hence show less conditionability than a control group. b) This prison group should show comparative lack of conditionability since they fulfilled Eysenck's proviso to his theory of criminality.

Data summary and calculation:

Comparison of differential responding to an aversive CS during extinction, in prison and student samples.

The distribution of differential responding in prisoners was skewed, hence non-parametric statistics were used to compare the samples.

TABLE 7.8.

Frequency tables of differential responding in the three extinction blocks for prisoners and students.

	Observed frequency.		Expected frequency.		total.
	Students.	Prisoners.	Students.	Prisoners.	
Ext: I.					
Con:	41	27	34	34	68
Non-Con:	7	21	14	14	28
	Chi-square = 9.882.		$p < .01$.		
Ext: II.					
Con:	31	16	23.5	23.5	47
Non-Con:	17	32	24.5	24.5	49
	Chi-square = 9.379.		$p < .01$.		
Ext: III.					
Con:	21	7	14	14	28
Non-Con:	27	41	34	34	68
	Chi-square = 6.965.		$p < .01$.		

Result.

Significantly more students than prisoners display differential responding to the aversive CS, in all three extinction blocks. These results are depicted in figure 7.2.

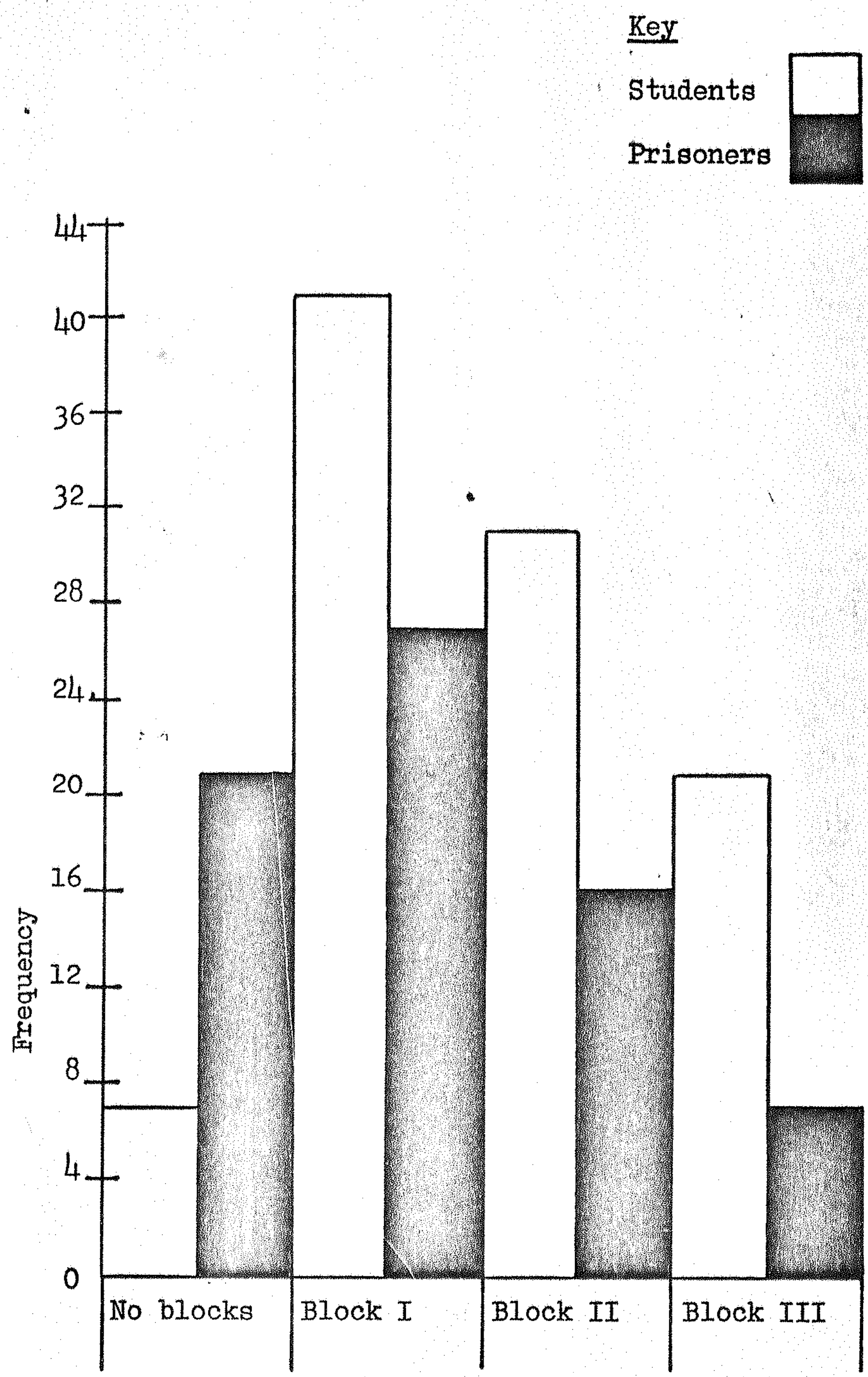


Figure 7.2 Differential responding displayed in each block by students and prisoners

7.2.2. <u>The prison sample are less aroused and display longer recovery times than the student sample.</u> Experiment II showed that relationships between personality and arousal indices were equivocal. There were some indications that low arousal was associated with impulsivity and neuroticism. This latter result was thought to be peculiar to student groups, since assessment of variability between arousal indices suggested that students were more highly aroused than the normal population. Arousal measured by spontaneous fluctuations was considered the most satisfactory arousal index. Long $\frac{1}{2}$ time recovery had originally been thought to index arousal. However, long $\frac{1}{2}$ time recovery showed a significant negative correlation with spontaneous fluctuations in extinction ($r = -.58$, $p < .001$), suggesting that it was a measure of low arousal rather than high arousal. This notion was substantiated by reference to Claridge's (1967) two arousal system model of personality. Considering long recovery time as an indication of arousal system imbalance, the inadequate response suppression associated with active psychosis was implicated (P.37). Relationships between personality and arousal were thus considered to have been inadequately tested. A comparison between a student group and an impulsive group was thought to be an improved test of hypotheses concerning arousal and personality.

Research, previously reviewed (P.281-292) suggested that primary psychopaths were under-aroused. This result could be generalisable to normals in the same personality quadrant i.e. stable extraverts. Criminality theories agree that criminals are extravert, but disagree when neuroticism is considered. Eysenck considers that extraversion is associated with low arousal, hence criminals should be under-aroused.

Prisoners should have longer recovery times than students for two reasons:- a) If the prison group represents an impulsive group, then our previously observed association between long recovery time and impulsivity, should result in longer recovery times for prisoners. b) If Claridge's active psychosis is associated with criminal behaviour, then prisoners should have longer recovery times than students.

The hypotheses were tested by the following comparisons:-

i) Spontaneous fluctuations in prisoner and student samples. (Table 7.9.)

ii) Stimulus specific reactivity in prisoner and student samples. (Table 7.10.).

iii) Basal level skin conductance in prisoner and student samples. (Table 7.11.).

iv) $\frac{1}{2}$ time recovery in prisoner and student samples. (Table 7.12.).

Data summary and calculation:

Comparison of arousal indices and $\frac{1}{2}$ time recovery in prison and student samples.

i) Spontaneous fluctuations in prison and student samples.

TABLE 7.9.

Number of spontaneous fluctuations in habituation, acquisition and extinction.

Habituation.

	Students	Prisoners.
Mean	39.10	34.65
SD	13.44	13.65

t = 1.081. Not significant.

Acquisition.

	Students	Prisoners
Mean	62.52	61.23
SD	29.50	32.93

t = -.2024. Not significant.

Extinction.

	Students	Prisoners
Mean	66.02	72.54
SD	33.12	31.68

t = .9410. Not significant.

ii) Stimulus specific reactivity in prison and student samples.

TABLE 7.10.

Magnitude of response to CS- in habituation and extinction.

Habituation.

	Students	Prisoners.
Mean	1.303	1.111
SD	.485	.457

$t = 1.9907$. $p < .1$.

Extinction.

	Students	Prisoners.
Mean	2.665	1.884
SD	1.201	1.091

$t = 3.3333$. $p < .01$.

---

iii) Basal level skin conductance in prison and student samples.

TABLE 7.11.

Log basal level skin conductance in mhos x 10^4 measured at extinction onset.

	Students	Prisoners.
Mean	4.349	4.309
SD	.197	.208

$t = .941$. Not significant.

---

iv) $\frac{1}{2}$ time recovery in prison and student samples.

TABLE 7.12.

Time taken to recover half the maximum response to aversive stimulation (UCS).

	Students.	Prisoners.
Mean	6.729	10.604
SD	4.843	6.417

$t = 3.3394$. $p < .01$.

Result.

Arousal, indicated by stimulus specific reactivity and short recovery time, is significantly lower in the prison sample than the student sample. However, arousal measured by spontaneous fluctuations and basal level shows no differences between the samples.

7.2.3. Variability between arousal measures is higher in prisoners, than students. Hume (1973) suggested that high and low arousal was associated with more variability between arousal measures than medium arousal (P.215). Experiment II showed that the hypothesised low arousal group (stable impulsive) did not have comparatively greater variability between arousal indices. This suggested that students could be more highly aroused than the general population.

Eysenck suggests that psychopaths and criminals are less aroused than the normal population. Hence our prison sample should show greater variability between arousal indices than the student sample.

The hypothesis was tested by comparing correlations between spontaneous fluctuations, stimulus specific responding and basal level in prison and student samples. (See table 7.13).

Data summary and calculation:-

TABLE 7.13.

Variation between arousal measures in prison and student samples.

	Students	Prisoners.
Spontaneous fluctuations v. stimulus specific responding.	.8386	.8157
Spontaneous fluctuations v. basal level.	.0130	.2905
Stimulus specific responding v. basal level.	.1514	.2319

Result.

There are no differences in variability between arousal measures in prison and students groups.

7.2.4. Discussion of physiological differences between prison and student samples. The hypothesis concerning differences in aversive differential responding in extinction was extremely well confirmed. Prisoners displayed significantly less evidence of differential responding in all three extinction blocks than students ($p < .01$). However, arousal differences between the samples were equivocal. There were no significant differences between the samples in spontaneous fluctuations but stimulus specific responding did show the hypothesised arousal differences.

Gray (1970; 1971 a & b) suggests that aversive system arousal is associated with aversive conditionability. However, the difference in aversive conditionability between our samples, cannot be attributed to arousal differences, since the most reliable arousal measure, spontaneous fluctuations, did not discriminate the groups. Complete lack of differential responding could indicate a decline in attention to CS+ and CS-, comparable to avoidance performance deterioration in primary psychopaths after removal of shock threat (Fisher, 1972).

The alternative explanation, that some prisoners did not acquire a differential response is not tenable. Inspection of acquisition records, showed characteristic multiple responses to CS-UCS pairings (figure 3.6, P.126) and CS with UCS omission (figure 3.4, P.126). Hence the relational learning component of conditioning can be regarded as comparable for both samples.

The difference in aversive differential responding between the groups could be exaggerated by decreased attention in prison samples. Consideration of masking task effects on differential responding suggested that decline in performance was associated with a distraction - attention dimension (P.96, Grant, 1973; Ross & Nelson, 1973). Experiment I indicated that both CS+ and CS- were increased by the conditioning procedure. Hence distraction combined with conditioning may be evidenced by increased responding to CS+ and CS-, with little discrimination.

Responding to CS- or stimulus specific responding has been regarded as an arousal measure (Crider & Lunn, 1971). However, if attention is divided, then stimulus specific responding may indicate the proportion of arousal concentrated on CS-s, rather than the total arousal level. The observed lack of sample differences in spontaneous fluctuations, basal level and arousal index variability suggests that there are no differences between the samples in total arousal. The significant difference between prisoners and students in stimulus specific responding, could indicate that the proportion of total arousal concentrated on CSs-, is less in prisoners than students.

$\frac{1}{2}$ Time recovery was significantly longer in prisoners than students. Results from Experiment II suggested that this measure indicated low arousal, since it correlated with spontaneous fluctuations ($r = -.580$). However, in this experiment, spontaneous fluctuations did not discriminate between the groups, while within the prison sample, the correlation with ½ time recovery was lower than that previously obtained ($r = -.340$). This suggests that ½ time recovery may be associated with abnormality other than low arousal, which is specific to prisoners.

7.3. Relationships between personality and extinction of an aversive differential conditioned response within the prison sample.

7.3.1. High impulsivity, neuroticism, psychoticism and criminal propensity are associated with lack of differential responding during extinction, in the prison sample. Eysenck's (1957) criminality theory states that criminals are neurotic extraverts and lack conditionability. Later Eysenck & Eysenck (1970; 1971) suggested that impulsivity should be substituted for extraversion and that psychoticism and criminal propensity were also associated with criminality. Hence, aversive conditionability should be inversely related to impulsivity, neuroticism, psychoticism and criminal propensity.

It will be recalled (P.331) that a comparatively large number of prisoners showed lack of differential responding in extinction:-

In extinction block I, 21 prisoners showed no differential responding. In extinction block II, 32 prisoners showed no differential responding and in extinction block III, 40 prisoners showed no differential responding. This indicates a progressive departure from the normal distribution over extinction blocks. Hence parametric statistics were unsuitable for use with raw differential responding scores. However, personality scores were normally distributed. Parametric statistics could thus be used to indicate differences in personality between groups defined by differential responding in the three extinction blocks.

Data summary and calculation:

Analyses of variance were calculated for personality scores in the four groups, defined from evidence of differential responding in the three extinction blocks.

TABLE 7.14.

Analysis of variance tables for personality variables in the four differential responding groups.

Impulsivity.

Source.	SS	df	MS	F	Significance.
Between groups.	13.019	3	4.3380	.6991	----
Within groups.	272.851	44	6.2011		
Total.	285.870	47			

	Mean I.	SD	n
Non-conditioners.	6.0	2.10	21
Block I only.	6.18	3.28	11
Block I and II.	5.00	1.94	9
All blocks.	4.93	2.81	7

Neuroticism.

Source.	SS	df	MS	F	Significance.
Between groups.	77.252	3	25.780	1.025	----
Within groups.	1105.165	44	25.117		
Total.	1182.417	47			

	Mean N.	SD	n
Non-conditioners.	8.00	5.621	21
Block I only.	5.55	3.297	11
Blocks I and II.	5.56	4.304	9
All blocks.	8.43	6.002	7

Psychoticism.

Source.	SS	df	MS	F	Significance.
Between groups.	7.466	3	2.488	.600	---
Within groups.	182.284	44	4.142		
Total.	188.750	47			

	Mean P.	SD	n
Non-conditioners.	4.310	2.472	21
Block I only.	3.546	1.753	11
Blocks I and II.	3.388	1.054	9
All blocks.	3.714	1.799	7

Criminal propensity.

Source.	SS	df	MS	F	Significance.
Between groups.	53.613	3	17.871	.730	---
Within groups.	1081.466	44	24.578		
Total.	1135.079	47			

	Mean Cp.	SD	n
Non-conditioners.	9.905	5.039	21
Block I only.	8.546	3.503	11
Blocks I and II.	7.500	3.964	9
All blocks.	9.688	7.116	7

Impulsivity corrected for age.

Source.	SS	df	MS	F	Significance.
Between groups.	5.138	3	1.712	1.900	.25
Within groups.	39.670	44	.901		
Total.	44.808	47			

	Mean Ic	SD	n
Non-conditioners.	.417	.852	21
Block I only.	.520	1.252	11
Blocks I and II.	-.241	.721	9
All blocks.	-.230	.940	7

Results.

Impulsivity, neuroticism, psychoticism and criminal propensity are not significantly associated with differential responding to an aversive CS extinction. However, there is a tendency for mean impulsivity scores to decline with increased differential responding in the three extinction blocks. This tendency increases when impulsivity is corrected for age.

7.3.2. Combined impulsivity and neuroticism scores are associated with lack of conditionability.

Experiment II showed that the high impulsive, low neuroticism quadrant gave least evidence of differential responding, compared with other personality quadrants. If results from student samples are generalisable to prison samples, then high impulsivity, and low neuroticism should be associated with lack of conditionability in this prison sample.

The hypothesis was tested by comparing frequencies of conditioning and non-conditioning, assessed from differential responding, in each personality quadrant for the three extinction blocks.

Data analysis and calculation:

TABLE 7.15.

Frequency tables for prisoners' differential responding in the three extinction blocks, according to personality quadrants defined from mean impulsivity and neuroticism scores of prisoner and students sample combined.

Extinction block I.

	Observed frequency.		Expected frequency.		total.
	Con:	Non-con:	Con:	Non-con:	
LI, LN.	10	4	7.875	6.125	14
HI, LN.	7	9	9.000	7.000	16
LI, HN.	6	4	5.625	4.375	10
HI, HN.	4	4	4.500	3.500	8
	27	21	27	21	48
	Chi-square = 2.704.		Not significant.		
HI, LN.	7	9	8	8	16
LI, HN.	6	4	5	5	10
	13	13	13	13	26
	Chi-squared = .65.		Not significant.		

Extinction block II.

	Observed frequency.		Expected frequency.		total.
	Con:	Non-con:	Con:	Non-con:	
LI, LN.	6	8	4.667	9.333	14
HI, LN.	3	13	5.333	10.667	16
LI, HN.	5	5	3.333	6.667	10
HI, HN.	2	6	2.667	5.333	8
	16	32	16	32	48

Chi-squared = 2.350. Not significant.

HI, LN.	3	13	4.92	11.08	16
LI, HN.	5	5	3.08	6.92	10
	8	18	8	18	26

Chi-squared = 2.809. $(p < .1)$.

Extinction block III.

	Observed frequency.		Expected frequency.		total.
	Con:	Non-con:	Con:	Non-con:	
LI, LN.	2	12	2.041	11.958	14
HI, LN.	0	16	2.333	13.667	16
LI, HN.	3	7	1.458	8.541	10
HI, HN.	2	6	1.167	6.833	8
	7	41	7	41	48

Chi-squared = 5.107. Not significant.

HI, LN.	0	16	1.85	14.15	16
LI, HN.	3	7	1.15	8.85	10
	3	23	3	23	26

Chi-squared = 5.453. $(p < .025)$.

TABLE 7.16.

Frequency tables for prisoners' differential responding in the three extinction blocks, according to personality quadrants defined from mean impulsivity, corrected for age, and neuroticism scores of prisoner and student samples combined.

Extinction block I.

	Observed frequency.		Expected frequency.		total.
	Con:	Non-con:	Con:	Non-con:	
LI, LN.	8	5	7.31	5.69	13
HI, LN.	9	8	9.56	7.44	17
LI, HN.	5	2	3.94	3.06	7
HI, HN.	5	6	6.19	4.81	11
	27	21	27	21	48

Chi-squared = 1.396. Not significant.

H.I, LN.	9	8	9.92	7.08	17
L.I, HN.	5	2	4.08	2.92	7
	14	10	14	10	24

Chi-squared = .700. Not significant.

Extinction block II.

	Observed frequency.		Expected frequency.		total.
	Con:	Non-con:	Con:	Non-con:	
LI, LN.	6	7	4.33	8.67	13
HI, LN.	3	14	5.67	11.33	17
LI, HN.	4	3	2.33	4.67	7
HI, HN.	3	8	3.67	7.33	11
	16	32	16	32	48

Chi-squared = 4.827. Not significant.

H.I, LN.	3	14	4.96	12.04	17
L.I, HN.	4	3	2.04	4.96	7
	7	17	7	17	24

Chi-squared = 3.057. ($p < .1$).

Extinction block III.

	Observed frequency.		Expected frequency.		total.
	Con:	Non-con:	Con:	Non-con:	
LI, LN.	2	11	1.90	11.10	13
HI, LN.	0	17	2.48	14.52	17
LI, HN.	2	5	1.02	5.98	7
HI, HN.	3	8	1.60	9.40	11
	7	41	7	41	48

Chi-squared = 5.442. Not significant.

HI, LN.	0	17	1.42	15.58	17
LI, HN.	2	5	.58	6.42	7
	2	22	2	22	24

Chi-squared = 5.339 ($p < .025$).

Con: = Conditioners. Non-con: = Non-conditioners.

I = Impulsivity. N = Neuroticism.

Result.

When quadrants formed from either N and I scores or N and I scores corrected for age are considered, there are no significant differences in between conditioners and non-conditioners in the three extinction blocks. However, comparing the two quadrants representing Gray's anxiety dimension, suggests that CR extinction is faster in the high I, low N quadrant than the low I, high N quadrant.

Extinction block II shows a non-significant trend for the high I, low N quadrant to have a greater proportion of non-conditioners than the low I, high N quadrant ($p < .1$) and in extinction block III this result reaches a significant level ($p < .025$).

7.3.3. Combined impulsivity and psychoticism scores are associated with lack of conditionability.

Eysenck & Eysenck's (1970) list of traits associated with criminality can be compared with Claridge's behavioural characteristics of active psychotics. If Eysenck's P scale measures Claridge's psychotic dimension, and our impulsivity assesses impulsivity said to be characteristic of active psychosis, then high P, high I prisoners should, through the association with criminality, be less conditionable than prisoners in other quadrants.

Data summary and calculation:

Impulsivity/psychoticism quadrants were defined from combined mean prisoner/student score for P and I corrected for age. Chi-square comparisons of differential responding frequency in the three extinction blocks were calculated.

TABLE 7.17.

Frequency tables for prisoner's differential responding in the three extinction blocks, according to personality quadrants defined from mean impulsivity, corrected for age, and psychoticism scores of prisoner and student samples combined.

Extinction block I.

	Observed frequency.		Expected frequency.		total.
	Con:	Non-con:	Con	Non-con:	
LP, LI.	9	3	6.75	5.25	12
LP, HI.	6	5	6.19	4.81	11
HP, LI.	5	2	3.94	3.06	7
HP, HI.	7	11	10.13	7.87	18
	27	21	27	21	48

Chi-square = 4.5916. df = 3, $p < .3$.

	Observed frequency.		Expected frequency.		total.
	Con:	Non-con:	Con:	Non-con:	
LP, LI.	9	3	6.4	5.6	12
HP, HI.	7	11	9.6	8.4	18
	16	14	16	14	30

Chi-square = 3.7721. df = 1, $p < .1$.

Extinction block II.

	Observed frequency.		Expected frequency.		total.
	Con:	Non-con:	Con:	Non-con:	
LP, LI.	7	5	4	8	12
LP, HI.	3	8	3.67	7.33	11
HP, LI.	2	5	2.33	4.67	7
HP, HI.	4	14	6	12	18
Total	16	32	16	32	48

Chi-square = 4.6285. df = 3, $p < .3$.

	Observed frequency.		Expected frequency.		total.
	Con:	Non-con:	Con:	Non-con:	
LP, LI.	7	5	4.4	7.6	12
HP, HI.	4	14	6.6	11.4	18
	11	19	11	19	30

Chi-square = 4.0428 df = 1, $p < .05$.

Extinction block III.

	Observed frequency.		Expected frequency.		total.
	Con:	Non-con:	Con:	Non-con:	
LP, LI.	3	9	1.75	10.25	12
LP, HI.	1	10	1.60	9.40	11
HP, LI.	1	6	1.02	5.98	7
HP, HI.	2	16	2.63	15.37	18
	7	41	7	41	48

Chi-square = 1.4855. df = 3. Not significant.

	Observed frequency.		Expected frequency.		total.
	Con:	Non-con:	Con:	Non-con:	
LP, LI.	3	9	2	10	12
HP, HI.	2	16	3	15	18
	5	25	5	25	30

Chi-square = 1.100. df = 1. $p < .3$.

Result.

The first two extinction blocks show a trend for quadrants, defined from psychoticism and impulsivity scores corrected for age, to differ. In extinction block I, high P, high I contains more non-conditioners than conditioners. All three other quadrants show the reverse trend. In extinction block II, high P, high I has the greater proportion of non-conditioners to conditioners, while only low P, low I has more conditioners than non-conditioners. Low P, low I and high P, high I in extinction blocks I and II, differed significantly ($p < .1$, $p < .05$ respectively). There were no significant differences between quadrants in extinction block III.

7.3.4. High MMPI Pd and Ma scores are associated with lack of conditionability in a prison sample. Psychopaths have high Pd and Ma scores (Black, 1966). Eysenck associates psychopathy with criminality and lack of conditionability. Hence high Pd and Ma scores should be associated with lack of conditionability.

Data summary and calculation:

Analyses of variance for Pd and Ma scores were calculated, for the differential responding groups.

TABLE 7.18.

Analysis of variance tables for Ma and Pd in

the four differential responding groups.

Hypomania (Ma).

Source.	SS	df	MS	F	Significance.
Between groups.	17.325	3	5.775	.667	---
Within groups.	380.754	44	8.653		
Total.	398.079	47			

	Mean Ma	SD	n
Non-conditioners.	12.476	4.472	21
Block I only.	11.636	3.828	11
Blocks I and II.	11.222	3.308	9
All blocks.	11.071	2.588	7

Psychopathic deviance (Pd).

Source.	SS	df	MS	F	Significance.
Between groups.	124.385	3	41.461	5.017	$p < .01$.
Within groups.	363.610	44	8.263		
Total.	487.995	47			

	Mean Pd	SD	n
Non-conditioners.	11.357	3.147	21
Block I only.	11.273	2.936	11
Blocks I and II.	9.222	2.237	9
All blocks.	10.000	3.366	7

Result.

Hypomania (Ma) is not significantly associated with aversive conditionability. However, psychopathic deviance (Pd) is significantly associated with lack of aversive conditionability ($p < .01$).

7.3.5. Discussion of relationships between personality and aversive conditionability within the prison sample. None of Eysenck's personality variables, considered alone, was significantly associated with differential responding in extinction. However, there was a tendency for mean I scores to decline with differential responding in none, one, two or three extinction blocks. This tendency does offer some tentative support to the hypothesis that extinction of an aversive CR is inversely related to impulsivity.

When all neuroticism/impulsivity quadrants are compared for differential responding in the three extinction blocks, there are no significant differences. However, the high I, low N, quadrant has proportionally more non-conditioners than the other quadrants. When this quadrant is compared with the low I, high N quadrant, this proportional difference reaches significance in extinction block III. This result does suggest some tentative support for Gray's (1970, 1971 a & b) hypothesis, in so far as the low anxiety quadrant extinguishes CRs faster than the other quadrants. The homogeneity of the other three quadrants could be associated with the significantly lower N scores in this prison sample compared with students. High N scoring prisoners were defined from the combined student/prisoner mean N score but this could still leave a majority of middle range N scorers to represent high N in prisoners.

P scores alone were not significantly different in the four groups defined from differential responding in none, one, two or three extinction blocks. However, mean P scores were highest in the group displaying no evidence of differential responding in extinction. Considering quadrants defined from P and I scores corrected for age, the high P, high I quadrant contained the highest ratio of non-conditioners to conditioners in extinction blocks I and II. The high P, high I quadrant was significantly different from the low P, low I quadrant in extinction block II ($p < .05$) and there was a non-significant trend in extinction block I ($p < .1$).

Claridge's personality model (P.37) suggests that primary psychopaths are active psychotics with personality traits associated with psychoticism (P) and impulsivity (I) (i.e. the high P, high I quadrant). Results indicate that the high P, high I quadrant contains more individuals, whose evidence of conditioning ceases after extinction onset information has been given, than other quadrants. They can thus be compared with Fisher's (1972) deterioration of active avoidance conditioning in primary psychopaths, after extinction onset information has been given (P.273).

The lack of significant differences in P/I quadrants for extinction block III, could be due to CR extinction in other quadrants, rather than any change in differential responding of high P, high I prisoners.

MMPI Ma scores were not significantly associated with conditionability. However, these scores may be confounded by age, since Black (1971) noted that Ma declined with age in psychopaths and there was a negative correlation between Ma and age in this sample ($r = -.283$).

MMPI Pd scores were significantly associated with differential responding. It will be recalled (P. 328) that high Pd scores in prisoners and students were thought to be influenced by different factors. It was suggested that Pd in prisoners was related to criminality, whereas Pd in students might reflect unconventional attitudes with no relationship to criminality.

Pd scores in prisoners may assess a dimension similar to P and impulsivity combined. Pd correlated with I ($r = .456$) and P ($r = .359$).

Pd may thus be an alternative measure of Claridge's active psychosis, with similar relationships to conditionability.

7.4. Relationships between personality and arousal within the prison sample.

7.4.1. High impulsivity, neuroticism, psychoticism and criminal propensity are associated with under-arousal in a prison sample.

Eysenck (1957) considered that under-arousal was associated with psychopathy. Psychopaths and criminals were said to be neurotic extraverts. Substituting impulsivity for extraversion in a prison sample results in the hypothesis that criminals will be impulsive and neurotic. Eysenck & Eysenck (1970,1971) added psychoticism and criminal propensity to traits associated with criminality. Hence impulsivity, neuroticism, psychoticism and criminal propensity should be related to low arousal, through their associations with criminality.

Data summary and calculation:

Product moment correlations between arousal measures and personality measures were calculated. It will be recalled (P.316) that impulsivity correlated with age in this prison sample (r = -.464). Partial correlations with impulsivity corrected for age and all arousal measures were calculated. The resultant R value is listed with correlations in Table 7.19. below.

TABLE 7.19.

Correlations between personality and arousal measures.

i) Spontaneous fluctuations.

	Hab:	Acq:	Ext:I	Ext:II	Ext:III
Impulsivity	-.362***	-.293**	-.262*	-.310**	-.183
Age	-.080	-.109	-.191	-.231	-.262*
Impulsivity with age.	-.452***	-.390***	-.403***	-.484****	-.356**
Neuroticism	-.274*	-.053	-.074	-.035	.076
Psychoticism	-.335**	-.252*	-.183	-.255*	-.179
Criminal propensity.	-.326**	-.168	-.165	-.205	-.021

ii) Stimulus specific responding.

	Hab:	Ext:
Impulsivity	-.176	-.332**
Age	-.213	-.221
Impulsivity with age.	-.318**	-.503****
Neuroticism	-.148	-.088
Psychoticism	-.399***	-.211
Criminal propensity.	-.132	-.205

iii) Basal level skin conductance.

Impulsivity	-.083
Age	-.178
Impulsivity with age.	-.190
Neuroticism	-.068
Psychoticism	-.124
Criminal propensity.	-.105

iv) ½ Time recovery.

Impulsivity	.181
Impulsivity with age.	.209
Neuroticism	.294**
Psychoticism	.307**
Criminal propensity.	.250*

* = $p < .1$, ** = $p < .05$, *** = $p < .01$, **** = $p < .001$.

Result.

Impulsivity is inversely associated with arousal assessed from spontaneous fluctuations and stimulus specific responding. This association is increased when impulsivity is corrected for age.

There are some significant inverse correlations between psychoticism and arousal, assessed from spontaneous fluctuations and stimulus specific responding ($p < .001$ to $p < .1$). There is also one trend indicating an inverse correlation between neuroticism and spontaneous fluctuations in habituation ($p < .1$).

There are no significant correlations between basal level and any of the personality measures considered.

$\frac{1}{2}$ Time recovery is positively correlated with neuroticism and psychoticism ($p < .05$) and there is a trend for a positive correlation between $\frac{1}{2}$ time recovery and criminal propensity ($p < .1$).

7.4.2. Combined high impulsivity and low neuroticism are associated with low arousal in a prison sample. Research reviewed previously, (P.281-292) suggested that low arousal was associated with primary psychopathy. Primary psychopaths were said to be stable extraverts or impulsives. If personality variables are related to low arousal in primary psychopaths, then low arousal in other samples should be associated with stable extraversion or impulsivity. Experiment II showed some trends for impulsivity to be associated with low arousal, assessed from spontaneous fluctuations. The inverse correlation between neuroticism and arousal, suggested that students might be comparatively over-aroused compared with the general population. The hypothesis was thus considered to have been inadequately tested in the student sample.

The hypothesis was re-tested in the prison sample, using an impulsivity by neuroticism analysis of variance for each arousal measure.

Data summary and calculation:

TABLE 7.20.

Analyses of variance tables for impulsivity corrected for age and neuroticism effects on each arousal measure.

i) Spontaneous fluctuations.

Habituation.

Source.	SS	df	MS	F	Significance.
Neuroticism	630.949	1	630.949	3.672	.1
Impulsivity	55.547	1	55.547	.323	---
N X I	534.619	1	533.619	3.111	---
Within cell.	7559.865	44	171.815		

	LN, LIc.	LN, HIc.	HN, LIc.	HN, HIc.
n	13	17	7	11
Mean	42.307	33.098	27.714	32.454
SD	12.795	9.390	9.877	18.970

Acquisition.

Source.	SS	df	MS	F	Significance.
Neuroticism	1.245	1	1.245	.001	---
Impulsivity	274.336	1	274.336	.238	---
N X I	1.787	1	1.787	.001	---
Within cell.	50664.196	44	1151.459		

	LN, LIc.	LN, HIc.	HN, LIc.	HN, HIc.
n	13	17	7	11
Mean	64.076	59.470	76.857	58.727
SD	27.539	29.889	29.896	46.904

TABLE 7.20 (Cont/d).

Extinction.

Source.	SS	df	MS	F	Significance.
Neuroticism	7.9	1	7.9	.007	---
Impulsivity	690.420	1	690.420	.657	---
N X I	23.101	1	23.101	.021	---
Within cell.	46269.573	44	1050.217		

	LN, LIc.	LN, HIc.	HN, LIc.	HN, HIc.
n	13	17	7	11
Mean	77.461	68.058	76.857	76.363
SD	21.026	38.316	29.896	34.713

ii) Stimulus specific responding.

Habituation.

Source.	SS	df	MS	F	Significance.
Neuroticism	.601	1	.601	2.960	.1
Impulsivity	.01	1	.01	.049	---
N X I	.371	1	.371	1.827	---
Within cell.	8.972	44	.203		

	LN, LIc.	LN, HIc.	HN, LIc.	HN, HIc.
n	13	17	7	11
Mean	1.277	1.116	.854	1.069
SD	.441	.406	.351	.569

TABLE 7.20 (Cont/d).

Extinction.

Source.	SS	df	MS	F	Significance.
Neuroticism	.120	1	.120	.100	---
Impulsivity	3.234	1	3.234	2.713	---
N X I	.174	1	.174	.145	---
Within cell.	52.469	44	1.192		

	LN, LIc.	LN, HIc.	HN, LIc.	HN, HIc.
n	13	17	7	11
Mean	2.179	1.762	2.200	1.528
SD	.953	.917	.921	1.516

iii) Basal level skin conductance.

Source.	SS	df	MS	F	Significance.
Neuroticism	.010	1	.010	.227	---
Impulsivity	.021	1	.021	.477	---
N X I	.021	1	.021	.477	---
Within cell.	1.968	44	.044		

	LN, LIc.	LN, HIc.	HN, LIc.	HN, HIc.
n	13	17	7	11
Mean	4.320	4.314	4.232	4.337
SD	.219	.181	.228	.234

TABLE 7.20 (Cont/d).

iv) ½ time recovery.

Source.					
Neuroticism	145.626	1	145.626	3.526	.1
Impulsivity	24.533	1	24.533	.594	---
N X I	43.373	1	43.373	1.050	---
Within cell.	1817.238	44	41.300		

	LN, LIc.	LN, HIc.	HN, LIc.	HN, HIc.
n	13	17	7	11
Mean	7.214	10.705	12.857	12.363
SD	6.191	7.320	5.209	5.954

Result.

Neuroticism and impulsivity combined are not significantly associated with any arousal measure. However, arousal in habituation, measured by spontaneous fluctuations and stimulus specific responding, shows trends for an inverse association with neuroticism ($p < .1$). Similarly ½ time recovery is longer at high N levels ($p < .1$).

7.4.3. Combined impulsivity and psychoticism is associated with low arousal in a prison sample. The hypothesis is derived from Eysenck's criminality theory. Psychopathy and criminality are said to be associated with low arousal. Criminals were thought to be more psychotic and more impulsive than non-criminals. Hence high I and high P should be associated with low arousal.

Data analysis and calculation:

Two by two analyses of variance were calculated for affects of psychoticism and impulsivity corrected for age, on each arousal measure. Quadrants were defined from mean P scores and impulsivity corrected for age in the combined prisoner and student group.

TABLE 7.21.

Analysis of variance tables for impulsivity corrected for age and psychoticism effects on each arousal measure.

i) Spontaneous fluctuations.

Habituation.

Source.	SS	df	MS	F	Significance.
Psychoticism	387.993	1	387.993	2.2673	.25
Impulsivity	456.064	1	456.064	2.6651	.25
P X I	180.245	1	180.245	1.0533	---
Within cell.	7529.264	44	171.120		

	LP, LIc.	LP, HIc.	HP, LIc.	HP, HIc.
n	12	11	7	18
Mean	43.250	32.636	33.142	30.722
SD	11.631	16.500	15.941	10.271

Acquisition.

Source.	SS	df	MS	F	Significance.
Psychoticism	5.578	1	5.578	.004	---
Impulsivity	1097.567	1	1097.567	.970	---
P X I	70.598	1	70.598	.062	---
Within cell.	49754.432	44	1130.782		

	LP, LIc.	LP, HIc.	HP, LIc.	HP, HIc.
n	12	11	7	18
Mean	66.000	58.454	69.285	56.611
SD	26.305	50.411	27.849	26.652

TABLE 7.21 (Cont/d).

Extinction.

Source.	SS	df	MS	F	Significance.
Psychoticism	122.315	1	122.315	.1166	---
Impulsivity	753.184	1	753.184	.7181	---
P X I	73.994	1	73.994	.0705	---
Within cell.	46148.250	44	1048.824		

	LP, LIc.	LP, HIc.	HP, LIc.	HP, HIc.
n	12	11	7	18
Mean	77.750	72.000	77.000	66.000
SD	21.372	49.703	29.586	25.631

ii) Stimulus specific responding.

Habituation.

Source.	SS	df	MS	F	Significance.
Psychoticism	.7130	1	.7130	3.5632	.1
Impulsivity	.0944	1	.0944	.4717	---
P X I	.0558	1	.0558	.2788	---
Within cell.	8.8087	44	.2001		

	LP, LIc.	LP, HIc.	HP, LIc.	HP, HIc.
n	12	11	7	18
Mean	1.3291	1.1627	.9985	.9777
SD	.3253	.4813	.5495	.4547

TABLE 7.21 (Cont/d).

Extinction.

Source.	SS	df	MS	F	Significance.
Psychoticism	.0085	1	.0085	.0069	---
Impulsivity	1.7503	1	1.7503	1.4334	---
P X I	.3569	1	.3569	.3086	---
Within cell.	53.7246	44	1.2210		

	LP, LIc.	LP, HIc.	HP, LIc.	HP, HIc.
n	12	11	7	18
Mean	2.0436	1.8277	2.2599	1.6684
SD	.9460	1.5992	.8186	.9166

iii) Basal level.

Source.	SS	df	MS	F	Significance.
Psychoticism	.0139	1	.0139	.3151	---
Impulsivity	.0193	1	.0193	.4376	---
P X I	.0472	44	.0441		

	LP, LIc.	LP, HIc.	HP, LIc.	HP, HIc.
n	12	11	7	18
Mean	4.3750	4.2654	4.2714	4.2966
SD	.1983	.3103	.2147	.1259

TABLE 7.21 (Cont/d).

iv) $\frac{1}{2}$ time recovery.

Source.					
Psychoticism	9.0576	1	9.0576	.2361	---
Impulsivity	169.2737	1	169.2737	4.4135	.05
P X I	40.3573	1	40.3573	1.0522	---
Within cell.	1687.5473	44	38.3532		

	LP, LIc.	LP, HIc.	HP, LIc.	HP, HIc.
n	12	11	7	18
Mean	7.000	12.9090	9.8571	11.8888
SD	4.1995	7.0207	6.4142	6.6588

Result.

Considering spontaneous fluctuations in habituation, there is a non-significant trend ($p < .25$) for low arousal to be associated with high P and high I. There is a trend for stimulus specific responding to be lower in the high P groups but there is no relationship with impulsivity.

Basal level shows no significant effects or trends for either psychoticism or impulsivity.

$\frac{1}{2}$ time recovery is significantly longer in high impulsivity groups ($p < .05$) but there is no significant affect from psychoticism.

7.4.4. High MMPI Pd and Ma scores are associated with low arousal in a prison sample. Psychopaths were characterised by high MMPI Pd and Ma scores (Black, 1966). Eysenck (1957) equated psychopathy with low arousal and the anti-social pole of criminality dimension. Hence high Pd and Ma scores should be associated with low arousal.

Data summary and calculation:

Product moment correlations between Pd and Ma scores with arousal measures were calculated. There was a high correlation between Pd and Ma (r = .546). Ma and Pd were combined by calculating the multiple correlation coefficient between these measures are arousal indices. All correlations are listed in Table 7.22 below.

TABLE 7.22.

Correlations between Ma and Pd with arousal measures.

i) Spontaneous fluctuations.

	Hab:	Acq:	Ext:I.	Ext:II.	Ext:III.
Ma	-.332**	-.232	-.176	-.203	-.074
Pd	-.392***	-.239	-.214	-.205	-.136
Ma and Pd.	-.417****	-.268	-.225	-.232	-.131

ii) Stimulus specific responding.

	Hab:	Ext:
Ma	-.367**	-.169
Pd	-.172	-.237
Ma and Pd	-.369****	-.242

iii) Basal level skin conductance.

Ma	.224
Pd	.235
Ma and Pd	.261

Result.

Arousal assessed from spontaneous fluctuations and stimulus specific responding is significantly associated with Ma and Pd combined, in habituation but not extinction.

Ma and Pd separately are both associated significantly with spontaneous fluctuations in habituation, but only Ma and not Pd is significantly associated with stimulus specific responding in habituation.

Neither basal level nor $\frac{1}{2}$ time recovery are significantly associated with Ma or Pd.

7.4.5. Arousal is lower in prison samples than student samples, when it is assessed from variability between arousal indices in the four personality quadrants defined by high and low neuroticism and high and low impulsivity corrected for age. In experiment II, variability between arousal measures in the four personality quadrants, defined from impulsivity and neuroticism, suggested that students were over-aroused as a group. Stable impulsives did not show the hypothesised increased variation between arousal measures. It was thus suggested that, if prisoners were less aroused than students, there would be greater variability between arousal measures in the stable impulsive quadrant in the prison sample compared with the students sample.

Data summary and calculation:

Prisoners were divided into four quadrants based on N and I scores, above and below the mean. Within quadrant correlations were calculated for spontaneous fluctuations, stimulus specific responding and basal levels. These are tabulated below in Table 7.23.

TABLE 7.23.

Correlations between arousal measures in the four personality quadrants.

	HN, LI.	HN, HI.	LN, LI.	LN, HI.
Spontaneous fluctuations v. stimulus specific responding.	.7935	.8855	.6767	.8746
Spontaneous fluctuations v. basal level.	.3983	.5607	.1691	.3559
Stimulus specific responding v. basal level.	.2630	.6549	-.2207	.4470

Result.

Both high impulsivity groups have less variability than the low impulsivity groups.

7.4.6. Discussion of relationships between personality and arousal within the prison sample. Considering Eysenck's personality dimensions separately it can be seen that impulsivity and impulsivity corrected for age show the most consistent relationship with low arousal. It could be argued that the increase in the relationship between impulsivity and low arousal, when an age correction is applied, is attributable to a decline in arousal with age. However, inverse correlations between arousal indices and age were generally low, the highest correlation being between spontaneous fluctuations in extinction block III and age ($r = -.262$, $p < .1$). It can thus be concluded that the hypothesis associating low arousal with impulsivity is supported, while an age correction increases this relationship.

Previously, it was noted that spontaneous fluctuations did not distinguish prisoners from students, although the groups were significantly different when compared for stimulus specific responding. Both these measures were correlated and associated with impulsivity in prisoners. It was suggested that stimulus specific responding indicated the proportion of total arousal (indicated by spontaneous fluctuations) concentrated on CS-s. It could be argued that a low proportion of total arousal concentrated on CS-s, indicates high distraction on Ross & Nelson's distraction-attention dimension. High distraction may be related to impulsivity, since by definition (P. 167) impulsivity is the tendency to respond quickly and without reflection. This suggests that energy is directed into the impulsive act without regard to cues associated with possible punishment. In our conditioning procedure, subjects were instructed to perform the driving task. CSs were directly above the moving track. Lack of attention to CSs could thus be compared with lack of reflection during response.

Neuroticism tended to be inversely correlated with arousal, the highest correlation being between N and spontaneous fluctuations in habituation ($p < .1$). Arousal in quadrants defined from impulsivity corrected for age and neuroticism did not show any significant effects, but trends indicated that neuroticism was inversely associated with arousal in habituation measured from spontaneous fluctuations and stimulus specific responding. $\frac{1}{2}$ time recovery also suggested that N was associated with I on arousal ($p < .1$). These trends support Eysenck's hypothesis concerning neuroticism in extraverts and replicates the trend observed in experiment II. However, this result is contrary to most research reviewed in Chapter I (P.65-67).

Eysenck's P score also showed inverse correlations with low arousal. The highest correlation was between P and stimulus specific responding in habituation. P is said to measure psychotic tendencies, while Silverman's (1966) review of attention in schizophrenia suggests that psychosis is related to the inability to attend selectively. The high inverse correlation between P and stimulus specific responding at the start of the experiment could thus indicate a deficiency in attention at high P levels. The reduced correlation between P and stimulus specific responding in extinction, could result from low P scorers habituating to the same low response level, rather than any change in high P scorers' response.

The combined analysis of P/I interactions shows a trend for total arousal, assessed from spontaneous fluctuations, to be associated with low I and low P. Considering stimulus specific responding in habituation, there is a significant effect for P scores only. This suggests that total arousal at experiment onset is associated with low impulsivity, while the proportion of arousal concentrated on CSs is associated with P scores.

Claridge's (1967) two arousal system model suggested that active psychosis might be represented by high P and high I scores. However, active psychosis represented the low arousal modulation, high tonic arousal quadrant. Tonic arousal was said to be indicated by autonomic measures. In this experiment, the two most reliable autonomic arousal measures, spontaneous fluctuations and stimulus specific responding, were both inversely associated with psychoticism and impulsivity. Hence Claridge's model was not supported. On the other hand, if stimulus specific responding indicates lack of attention to CSs, then this index can be regarded as equivalent to insufficient arousal modulation, which Claridge does associate with active psychosis. Claridge's model may thus still have explanatory value if his two arousal systems are considered as hypothetical rather than measureable.

Criminal propensity and arousal assessed from spontaneous fluctuations or stimulus specific responding was only significantly correlated for spontaneous fluctuations in habituation ($p < .05$). Since criminal propensity is composed from I, P and N items, this result could be regarded as reflecting correlations between these scales and arousal. The lack of other significant correlations could be attributed to a greater influence from N items rather than I or P items in the total Cp scale.

Psychopathic deviance and hypomania combined were significantly inversely correlated with spontaneous fluctuations and stimulus specific responding in habituation but not extinction. In so far as these scales measure psychopathy in prison samples, psychopathy is associated with low arousal before any experimental procedure occurs. Since N scores were lower in the prison sample than the student sample, high Pd and Ma scores suggest the influence of primary rather than secondary psychopathy. These results can thus be regarded as consistent with experimental evidence relating primary psychopathy to low arousal (P.281-289).

There is also the possibility that high Pd and Ma are related to Eysenck's concept of psychoticism in criminals. Correlations between Pd and Ma combined with arousal measures are similar to correlations between P and arousal measures within the prison sample, while P correlated with Pd ($r = .359$) and Ma ($r = .378$).

Basal level showed no significant correlation with any personality measure within the prison sample. This can be regarded as a further indication of the unreliability of basal level as an arousal measure discussed on P.68.

Variability between arousal indices gave no indication that this sample differed from students, either by direct comparison, or by comparison between correlations within personality quadrants defined from neuroticism and impulsivity corrected for age. This result confirms the lack of difference in arousal between the samples when spontaneous fluctuations are considered.

½ Time recovery was a controversial arousal measure. Originally, (P. 215) long recovery time was thought to indicate high arousal. However, the correlation between ½ time recovery and spontaneous fluctuations in Experiment II suggested that long recovery time was associated with low arousal. Furthermore, one significant result (Table 5.15) suggested that long recovery time might be associated with impulsivity. This result was not replicated significantly in this experiment when correlations between ½ time recovery and impulsivity or impulsivity corrected for age were considered. However, the P/I quadrant analysis, with quadrants defined by position with respect to mean P and mean I corrected for age from prisoner and student samples combined, showed a significant effect for I with an age correction ($p < .05$). There is thus some indication that impulsivity corrected for age in prisoners compared with students, is associated with long recovery time.

Claridge (1967) considered that active psychosis was associated with arousal system imbalance on the extravert side. It can be argued that long recovery time results from insufficient arousal modulation compared with tonic arousal. This would occur in the active psychosis quadrant.

Descriptions of active psychosis resembled Eysenck's list of traits associated with criminality. Hence Eysenck's P and I scales were thought to indicate active psychosis. A non-significant trend for high P, high I to be over-represented in the prison sample compared with the student sample lent some support to this notion. If long recovery time does indicate Claridge's active psychosis, then the significant difference in recovery time between prisoners and students supports the hypothesis that prisoners display active psychosis.

Analysis of $\frac{1}{2}$ time recovery in quadrants defined from P and I showed a significant effect for I corrected for age only. The lack of effect for P could be attributed to the unusually high P scores in this student sample. The correlation within the prison sample, between P and $\frac{1}{2}$ time recovery was significant ($r = .307$, $p < .05$).

It can be seen that an association between $\frac{1}{2}$ time recovery and both impulsivity corrected for age and psychoticism is indicated. This suggests that longer recovery time in prisoners than students may be connected with Claridge's concept of active psychosis.

The significant correlation between long $\frac{1}{2}$ time recovery and neuroticism is difficult to reconcile with the above results and Claridge's (1973) notion that low N scores indicate psychosis. However, there is a significant correlation between N and P in the prison sample ($r = .330$, $p < .05$). Hence high N scores in these prisoners may be associated with difficulties in adjusting to psychosis, rather than neurosis alone. The correlation between N and $\frac{1}{2}$ time recovery could thus be a reflection of that obtained between P and $\frac{1}{2}$ time recovery.

3.5. Summary of results.

TABLE 7.24.

Prisoner/student comparisons.

Personality measures:-	Prisoners.	Students.	p.
Impulsivity	+	–	---
Impulsivity corrected for age	+	–	.05
Neuroticism	–	+	.05
Psychoticism	–	+	---
Criminal propensity	+	–	---
Anxiety. N X I	–	+	.1
Anxiety. N X Ic	–	+	.01
Active psychosis. P X I	+	–	.2
Psychopathic deviance	–	+	---
Hypomania	–	+	---

Physiological measures.	Prisoners.	Students.	p.
Differential responding:-			
Extinction block I.	–	+	.01
Extinction block II.	–	+	.01
Extinction block III.	–	+	.01
Spontaneous fluctuations:-			
Habituation.	–	+	---
Acquisition.	–	+	---
Extinction.	+	–	---
Stimulus specific responding:-			
Habituation.	–	+	.1
Extinction.	–	+	.01
Basal level.	–	+	---
$\frac{1}{2}$ time recovery.	+	–	.01

TABLE 7.25.

Relationships between personality and physiological measures within the prison sample.

Differential responding in extinction:-

Personality measure.	F	p
Impulsivity	.699	---
Impulsivity corrected for age	1.900	.25
Neuroticism	1.025	---
Psychoticism	.600	---
Criminal propensity	.730	---

TABLE 7.25 (Cont/d).

Personality measure.		Chi-square.	p
Anxiety N X I	Block I.	2.704	---
	Block II.	2.350	---
	Block III.	5.1075	---
High N, low I v.			
Low N, high I.	Block I.	.650	---
		.2809	---
		.453	---
Anxiety N X Ic	Block I.	1.396	---
	Block II.	4.827	---
	Block III.	5.442	---
High N, low Ic v.			
Low N, high Ic.	Block I.	.700	---
	Block II.	3.057	.1
	Block III.	5.339	.025
Active psychosis	Block I.	4.592	---
P X Ic	Block II.	4.629	---
	Block III.	1.486	---
High P, high I v.			
Low P, low Ic.	Block I.	3.772	.1
	Block II.	4.043	.05
	Block III.	1.100	---
		F	
Hypomania		.667	---
Psychopathic deviance		5.017	.01

TABLE 7.25 (Cont/d).

Arousal.

Correlations between personality and arousal measures.

	I	Ic	N	P	Cp	Pd	Ma	Pd & Ma.	Age.
SF.Hab:	-.362***	-.452***	-.274*	-.335**	-.326**	-.392***	-.332**	-.417***	-.080
SF.Acq:	-.293**	-.390***	.053	-.252*	-.168	-.239	-.232	-.268	-.109
SF.Ext:I.	-.262	-.404***	-.074	-.183	-.165	-.214	-.176	-.225	-.191
SF.Ext:II.	-.310**	-.484****	.035	-.255*	-.205	-.205	-.203	-.232	-.231
SF.Ext:III.	-.183	-.356**	-.076	-.179	-.021	-.136	-.074	-.131	-.262*
SSR.Hab:	-.178	-.318**	-.148	-.399***	-.132	-.172	-.362**	-.369**	-.213
SSR.Ext:	-.332**	-.503****	-.088	-.211	-.205	-.237	-.169	-.242	-.221
BL:	-.083	-.190	-.068	-.124	-.105	-.050	-.182	-.191	-.178
½TR:	.181	.209	.294**	.307**	.250*	.235	.224	.261	.016

TABLE 7.25 (Cont/d).

Arousal.

Anxiety. N X I analyses.

Arousal index. F values for:	N	I	N X I
SF.Hab:	3.672*	.323	3.111
SF.Acq:	.001	.2385	.001
SF.Ext:	.007	.657	.021
SSR.Hab:	2.960*	.049	1.827
SSR.Ext:	.100	2.713	.145
BL.	.227	.477	.477
½TR.	3.526*	.594	1.050

Active psychosis. P X I analyses.

Arousal index. F values for:			
SF.Hab:	2.2673 ($p < .25$)	2.6651 ($p < .25$)	1.0533
SF.Acq:	.004	.970	.062
SF.Ext:	.1166	.7181	.0705
SSR.Hab:	3.5632*	.4717	.2788
SSR.Ext:	.0069	1.4334	.3086
BL.	.3151	.4376	1.0702
½TR.	.2361	4.4135**	1.0522

Notation:-

I = Impulsivity. Ic = Impulsivity corrected for age.

N = Neuroticism. P = Psychoticism. Cp = Criminal propensity.

Pd = Psychopathic deviance. Ma = Hypomania.

SF.Hab: = Spontaneous fluctuations in habituation.

SF.Acq: = Spontaneous fluctuations in acquisition.

SF.Ext: = Spontaneous fluctuations in extinction.

SSR.Hab: = Stimulus specific responding in habituation.

SSR.Ext: = Stimulus specific responding in extinction.

BL. = Basal level in log conductance.

$\frac{1}{2}$TR. = Half time recovery from maximum response.

* = $p < .1$, ** = $p < .05$, *** = $p < .01$, **** = $p < .001$.

7.6. Further research.

The research design would have been improved if prisoners were matched with a control group for age, intelligence and social class. Our selection procedure did result in prisoners from higher status groups than a random prison sample. It also tended to bias the sample towards higher than average intelligence, assessed roughly from attainment of academic qualifications e.g. degrees and A-levels. However, age of samples was significantly different.

The other uncontrolled variable was institutionalisation. Most studies of institutionalisation effects have been concerned with children (Jones, 1975). Detrimental effects can be attributed to emotional deprivation during the formative years. In this study, care was taken to reduce adverse environmental effects in childhood. Hence institutional effects of adult detention without childhood deprivation are relatively unknown. Examination of this effect would require another institutional sample with subjects matched for age on admittance and number of institutional years. Mental hospitals could supply this type of sample but the mental disturbance and drug effects would make comparison difficult. However, hospitals catering for severe accident cases might provide a comparable sample, provided brain damage and congenital defect were excluded. A history of previous accidents could be obtained to assess accident proneness. Highly accident prone individuals should be excluded, since Eysenck (1970) considered that these people had personality similarities with criminals. Ideally, the samples should be matched for age, I.Q. and social class.

Accurate assessment of prisoner's social class presents difficulties. Prison records do not supply all required information, while the prisoner's own account may be biased. Ego needs may tend to increase social status by distortion of either parent's or prisoner's occupation. In some cases, "company director" was the prisoner's last occupation. The size of the company and its function were unspecified, causing difficulty in classification of status.

The possibility that differential and stimulus specific responding differences between prisoners and students were associated with easy distractability, could be tested by manipulating attention. The subject could undergo our conditioning procedure, followed by a further modified extinction phase. The modified extinction phase would consist of CS lights of two second duration, interspersed with a few CS lights of three second duration. Attention to CSs would be increased by instructing the subject to press a foot pedal every time a CS longer than two seconds occurred. Interruption between extinction phases, to give instructions, should result in spontaneous CR recovery. Hence differential and stimulus specific responding in the two extinction phases could be compared. Influence from a distraction-attention dimension would be implicated if either differential or stimulus specific responding increased in the second extinction phase.

Further tests of distraction-attention influences would be to compare prisoners and students for performance on vigilance tasks. The high psychoticism, high impulsivity quadrant could also be compared with other quadrants. Less vigilance in prisoners and high P, high I quadrants would indicate greater distractability in these groups than in normals. Hence supporting the notion that a distraction-attention dimension could account for the low differential and stimulus specific responding in these groups.

7.7. Conclusion.

Relationships between conditioning, personality and criminality have been assessed with reference to Eysenck's personality and criminality theories. The Eysenckian framework suggested that arousal was a closely related dimension, hence analyses included arousal measures in relation to personality and criminality.

In experiment II, students, selected for extreme neuroticism (N) and impulsivity (I) scores, indicated that impulsivity was significantly associated with lack of differential responding in CR extinction. This result supported Eysenck's hypothesis concerning extraversion and conditionability, since previous literature had suggested that impulsivity should be substituted for extraversion in the Eysenckian model. In prisoners, selected for good home backgrounds, there was a non-significant trend for high I scores to be associated with lack of differential responding in extinction.

Neuroticism/impulsivity analyses showed that, in both students and prisoners, the low N, high I quadrant displayed least differential responding. This quadrant was compared with the high N, low I quadrant to assess differential responding between groups representing either end of Gray's (1970, 1971 a & b) anxiety dimension. Both student and prisoner comparisons gave significant differences for extinction block III, while extinction blocks II and I showed decreasingly non-significant trends in the predicted direction.

The similarity of N/I quadrant analyses within the selected students and prisoners was surprising when considered in the light of group comparisons for N/I and differential responding in extinction. Differential responding was considerably less in prisoners compared with students, but raw I scores did not differ significantly. However, prisoners were significantly older than students, hence I scores corrected for age did differentiate the groups. It was suggested that this age correction was appropriate, since impulsivity was thought to decline with age. Support for this notion was obtained from Black (1971) who noted that Ma declined with age in psychopaths and Ma correlated with our impulsivity scale (P.205). Similarly, a comparison of I scores between the 9 prisoners, within the student age range, and students, showed that these prisoners had significantly higher I scores than students.

Prisoners had significantly lower N scores than students, this together with their higher corrected I scores, tended to bias the prisoners towards high I, low N, comparable to personality characteristics of primary psychopaths. Despite this bias, the non-significant trend for N to increase differential responding, was apparent in both selected students and prisoners.

It can be seen that the main hypothesis associating impulsivity with lack of differential responding in extinction has received some support in both experiments II and III. There was also some support for Gray's modification to Eysenck's hypothesis. There were significant differences in differential responding along the anxiety diagonal but the influence of N alone was not significant, although trends were in the predicted direction.

In prisoners, mean N showed a non-significant increase from differential responding in block I only to differential responding in all blocks but the latter mean was comparable to that obtained for the comparatively large (n = 21) no differential responding group. Hence relationships between N and differential responding could only be said to be comparable in students and prisoners when the no differential responding group was excluded. Entire lack of differential responding was significantly more prevalent in prisoners than students (Figure 7.2. P.331). This latter result may thus be related to other personality characteristics associated with criminality.

Experiment III included a number of additional personality measures thought to be associated with criminality. It will be recalled (P.264) that Eysenck & Eysenck (1970) suggested psychosis (P) as an additional personality dimension distinguishing prisoners from controls. No hypotheses concerning relationships between P and conditionability were formulated. Our results suggest that a combination of P and I might be associated with complete lack of differential responding in prisoners. The high P, high I quadrant displayed less differential responding in extinction blocks I and II than the low P, low I quadrant. There were no differences in extinction block III.

It was thought that P had similarities with MMPI Pd when prisoners but not students were concerned. Within the prison sample, Pd scores were significantly associated with lack of differential responding in extinction.

Considering both experiments II and III, it can be seen that lack of differential responding is associated most strongly with impulsivity, while there are some trends indicating that neuroticism increases conditionability. The resultant order of conditioning tends to support Gray's modification to Eysenck's hypothesis. A further complicating factor was apparent within the prison sample. Hypothesised differences in differential responding were greater than expected. It was suggested that the association between differential responding and active psychosis measured either by P and I combined or by Pd could account for this excessively reduced conditionability in prisoners. This result was not considered generalisable to students.

Measures of arousal were included since Eysenck's hypotheses concerning arousal and personality were similar to hypothesised relationships between conditioning and personality. Similarly, Gray equated aversive system arousability with aversive conditionability. The electrodermal system has been thought to monitor sympathetic arousal and hence be closely associated with the aversive system. It was thus hypothesised that electrodermal arousal would increase along the anxiety dimension (high I, low N to low I, high N).

Experiment II N/I analyses for measures of electrodermal arousal were generally non-significant. There were a few trends indicating that arousal measured by spontaneous fluctuations or stimulus specific reactivity was associated with lack of impulsivity. Experiment III showed that the most valid measure of arousal, spontaneous fluctuations, did not distinguish prisoners from students. However, within the prison sample, there were three out of a possible five significant inverse correlations between spontaneous fluctuations and impulsivity. Stimulus specific responding was significantly lower in prisoners than students and also correlated inversely with impulsivity. These differing results for the two arousal indices raise the possibility that spontaneous fluctuations measures general activation, while stimulus specific responding assesses a proportion of this activation associated with the aversive system.

The above explanation is not entirely satisfactory, since our prison sample has similarities to primary psychopaths who have been found to display fewer spontaneous fluctuations and less stimulus specific responding than controls (P.283-285).

Trends in experiment II indicated that both spontaneous fluctuations and stimulus specific responding were inversely associated with neuroticism, contrary to the hypothesis. This result was thought to be peculiar to student groups (P.214-215). However, prisoners also showed this trend when spontaneous fluctuations in habituation were considered. It is possible that these results have different causal factors in students and prisoners. In prisoners, N correlated with P, suggesting that some high N scores could be caused by an underlying psychosis rather than pure neurosis. Psychosis had a significant inverse correlation with both spontaneous fluctuations and stimulus specific responding in habituation.

Basal level was not significantly associated with any arousal measure in experiment II or III. This result could be expected from previous literature concerned with psychopathy (P.285-286) and personality (P.67-68) in relation to arousal.

Variability between arousal measures did not differentiate prisoners from students, while quadrant comparisons were similar in the two groups, low I quadrant being more variable than high I quadrants. Hence the previous suggestion (P.246), that the student pattern of variability indicated higher arousal in students than other groups, was considered invalid.

In experiment II there was a trend suggesting that impulsivity might be associated with long ½ time recovery. This trend was also apparent in prisoners, reaching significance in the P/I quadrant analysis. Prisoners had significantly longer recovery times than students and long recovery time was significantly associated with both N and P. Hence recovery time may be more closely associated with abnormality indicated by N and P in prisoners rather than impulsivity.

It can be seen that relationships between arousal, personality and criminality are complex. Arousal tends to be inversely associated with impulsivity in students and strongly associated with both impulsivity and psychoticism in prisoners. The association between arousal and impulsivity supports Eysenck's hypothesis but the lack of difference in spontaneous fluctuations for prisoners and students was not predicted. If prisoners are regarded as an impulsive group, then the inverse association between arousal and neuroticism can be regarded as support for Eysenck's hypothesis that N decreases arousal in extraverts. However, differential responding tended to be positively associated with neuroticism, contradicting the hypothesis that N exaggerates extravert-introvert differences. Eysenck's hypotheses concerning N must thus be regarded as unsubstantiated.

REFERENCES

AL-ISSA, I. The effect of attitudinal factors on the relationship between conditioning and personality. British Journal of Social and Clinical Psychology, 1964, 3, 113-119.

ALLPORT, G. W. & ODBERT, H. S. Trait names, a psycho-lexical study. Psychological Monographs, 1936, 47, 171. Cited by VERNON, P. E. Personality Assessment: A Critical Survey, Frame & London: Methuen, 1964, 196.

ARNOLD, W. R. Continuities in research: scaling delinquent behaviour. Social Problems, 1965, 13, 59-66. Cited by HOOD, R. & SPARKS, R. Key Issues in Criminology, London: Weidenfeld & Nicholson, 1970, 55.

BADIA, P. & DEFRAN, R. H. Orienting responses and GSR conditioning: a dilemma. Psychological Review, 1970, 77, 171-181.

BAER, P. E. & FUHRER, M. J. Unexpected effects of masking: differential EDR conditioning without relational learning. Psychophysiology, 1973, 10, 95-99.

BARR, R. F. & McCONAGHY, N. A general factor of conditionability: a study of galvanic skin responses and penile responses. Behaviour Research and Therapy, 1972, 10, 215-227.

BARRATT, E. S. Factor analysis of some psychometric measures of impulsiveness and anxiety. Psychological Reports, 1965, 16, 547-554.

BARRATT, E. S. Psychophysiological correlates of classical differential eyelid conditioning among subjects selected on the basis of impulsivity and anxiety. Biological Psychiatry, 1971, 3, 339-346.

BEAM, J. C. Serial learning and conditioning under real-life stress. Journal of Abnormal and Social Psychology, 1955, 51, 543-551.

BECK, E. C. & DOTY, R. W. Conditioned flexion reflexes acquired during combined catalepsy and de-efferentation. Journal of Comparative and Physiological Psychology, 1957, 50, 211-216.

BECKER, P. W. Correlates of psychopathic and neurotic delinquency within a federal reformatory population. Unpublished Master's Thesis, Ohio University, 1964. Cited by PERSONS, R. W. & PERSONS, C. E. Some experimental support for psychopathic theory: a critique. Psychological Reports, 1965, 16, 745.

BECKER, W. C. Cortical inhibition and extraversion-introversion. Journal of Abnormal and Social Psychology, 1960, 61, 52-66.

BECKER, W. C. & MATTESON, H. H. GSR conditioning, anxiety and extraversion. Journal of Abnormal and Social Psychology, 1961, 62, 427-430.

BELSON, W. A. The extent of stealing by London boys and some of its origins. Reprint Series of the Survey Research Centre, London School of Economics, J. Section, Aug: 1968.

BENDER, L. Psychopathic behaviour disorders in children. In LINDNER, K. M. & SELIGER, R. V. (Eds). Handbook of Correctional Psychology, Philosophical Library, 1947. Cited by MAHER, B. Experimental psychopathology. In DODWELL, P. C. (Ed). New Horizons in Psychology 2. London, Reading & Fakenham: Penguin, 1972, 151.

BENJAMIN, L. S. Statistical treatment of the law of initial values (LIV) in autonomic research: a review and recommendation. Psychosomatic Medicine, 1963, XXV, 556-566.

BERITOFF, J. S. Neural Mechanism of Higher Vertebrate Behaviour, Boston: Little Brown, 1965.

BERNARD, J. L. & EISENMAN, R. Verbal conditioning in sociopaths with social and monetary reinforcement. Journal of Personality and Social Psychology, 1967, 6, 203-206.

BINDRA, D., PATERSON, A. L. & STRZSLECKI, J. On the relation between anxiety and conditioning. Canadian Journal of Psychology, 1955, 9, 1-9.

BLACK, D. A. Appendix on psychological methods of assessment. In CRAFT, M. (Ed). Psychopathic Disorders and their Assessment, Oxford: Pergamon, 1966, 227-305.

BLACK, D. A. Research at Broadmoor. Seminar at the Psychology Department, Southampton University, Southampton, 1971.

BLACKBURN, R. A study of impulsivity in abnormal offenders. Unpublished Ph.D. thesis, Southampton University, 1973.

BORKOVEC, T.D. Autonomic reactivity to sensory stimulation in psychopathic and normal juvenile delinquents. Journal of Consulting and Clinical Psychology, 1970, 35, 217-222.

BOWEN, K. S. Heart rate and GSR concomitants of vigilance and arousal. Canadian Journal of Psychology, 1971, 25, 175-184.

BRADLEY, P. B. The central action of certain drugs in relation to the reticular formation of the brain. In JASPER, H. H., PROCTOR, L. D., KNIGHTON, R. S., NOSHAY, W. C & COSTELLO, R. T. Reticular Formation of the Brain, Boston: Little Brown, 1958, 123-149.

BREBNER, J. M. An experimental investigation of the relationship between conditioning and introversion-extraversion in normal subjects. Unpublished Master's thesis, University of Aberdeen, 1957. Cited by EYSENCK, H. J. Extraversion and the acquisition of eyeblink and GSR conditioned responses. Psychological Bulletin, 1965, 63, 260. Cited by McPHERSON, F. M. Comment on Eysenck's account of some Aberdeen studies of introversion-extraversion and eyeblink conditioning. British Journal of Psychology, 1965, 56, 483.

BRIDGER, W. H. & MANDEL, I. J. A comparison of GSR fear responses produced by threat and electric shock. Journal of Psychiatric Research, 1964, 2, 31-40.

BRIDGER, W. H. & MANDEL, I. J. Abolition of the PRE by instructions in GSR conditioning. Journal of Experimental Psychology, 1965, 69, 476-482.

BROADHURST, A & GLASS, A. A relationship of personality measures to the alpha rhythm of the electroencephelogram. British Journal of Psychiatry, 1969, 115, 199-204.

BROADHURST, D. E. A reformulation of the Yerkes-Dodson law. The British Journal of Mathematical and Statistical Psychology, 1959, 18, 145-157.

BROCKWAY, A. L., GLESER G., WINOKER, G. & ULETT, G. A. The use of a control population in neuropsychiatric research (psychiatric psychological and EEG evaluation of a heterogenous sample). American Journal of Psychiatry, 1954, 111, 248-262.

BROWN, J. A. C. Freud and the Post-Freudians, London, Fakenham & Reading: Penguin, 1964.

BROWN, R. Social Psychology, New York: Macmillan, 1965.

BULL, R. H. C. The reliability of the galvanic skin response. Paper read at the Annual Conference of the British Psychological Society, University of Nottingham, April 1972.

BUNDE, D. C., GRANT, D. A. & FROST, M. R. Differential eyelid conditioning to stimuli that express a response-related command or convey reinforcement-related information. Journal of Verbal Learning and Verbal Behaviour, 1970, 9, 346-355.

BURDICK, J. A. Autonomic lability and neuroticism. Journal of Psychosomatic Research, 1966, 9, 339-342.

BURGESS, P. K. Eysenck's theory of criminality: a new approach. British Journal of Criminology, 1972, 12, 74-82.

BURGESS, P. K. Personal Communication, 1974.

CADORET, R. J. Relationship between autonomic response patterns and conditioned learning. Perceptual and Motor Skills, 1963, 16, 67-85.

CARRIGAN, P. M. Extraversion-introversion as a dimension of personality: a reappraisal. Psychological Bulletin, 1960, 57, 329-360.

CASEY, J. & McMANIS, D. L. Salivary response to lemon juice as a measure of introversion in children. Perceptual and Motor Skills, 1971, 33, 1059-1065.

CASTELLOW, W. A. Relationships between the spiral after-effect and extraversion, neuroticism, sex and induced arousal. Dissertation Abstracts International, 1972, 32, 7287-7288.

CATTELL, R. B. Personality and Motivation Structure and Measurement, London: George G. Harrap, 1957.

CATTELL, R. B. The Scientific Analysis of Personality, Harmondsworth: Penguin, 1965.

CAUTHEN, N. R. Personality correlates of arousal. Dissertation Abstracts International, 1973, 33, 3298.

CHASE, W. G., GRAHAM, F. K. & GRAHAM, D. T. Components of HR response in anticipation of reaction time and exercise tasks. Journal of Experimental Psychology, 1968, 76, 642-648.

CHATTERJEE, B. B. & ERIKSEN, C. W. Conditioning and generalisation of GSR as a function of awareness. Journal of Abnormal and Social Psychology. 1960, 60, 396-403.

CHATTERJEE, B. B. & ERIKSEN, C. W. Cognitive factors in heart rate conditioning. Journal of Experimental Psychology, 1962, 64, 272-279.

CLARIDGE, G. S. The excitation-inhibition balance in neurotics. In EYSENCK, H.J. (Ed). Experiments in Personality. Vol:II, London: Routledge & Kegan Paul, 1960, 107-154.

CLARIDGE, G. S. Personality and Arousal: a Psychophysiological Study of Psychiatric Disorder, Oxford & London: Pergamon, 1967.

CLARIDGE, G. S. A nervous typological analysis of personality variation in normal twins. Chap: 6. In CLARIDGE, G. S., CANTOR, S. & HUME, W. I. (Eds). Personality Differences and Biological Variations: A Study of Twins, Oxford: Pergamon, 1973, 132-148.

CLARIDGE, G. S. & HERRINGTON, R. N. An EEG correlate of the Archimedes spiral after-effect and its relationship to personality. Behaviour Research & Therapy, 1963, 1, 217-229.

CLECKLEY, H. The Mask of Sanity, St. Louis: Mosley, 1955.

CLUM, G. A. A correlational analysis of the relationship between personality and perceptual variables and discriminant GSR conditioning. Journal of Clinical Psychology, 1969, 25, 33-35.

COLES, M. G., GALE, A. & KLINE, P. Personality and habituation of the orienting reaction: tonic and response measures of electrodermal activity. Psychophysiology, 1971, 8, 54-63.

COLQUHOUN, W. P. & CORCORAN, D. W. J. The effects of time of day and social isolation on the relationship between temperament and performance. British Journal of Social and Clinical Psychology, 1964, 3, 226-231.

CORCORAN, D. W. J. The relation between introversion and salivation. American Journal of Psychology, 1964, 77, 298-300.

COURTS, F. A. Relation between muscular tension and performance. Psychological Bulletin, 1942, 39, 347-367.

COWAN, C. O. Cognitive process, anxiety, extraversion and GSR responsiveness in classical differential GSR conditioning. Dissertation Abstracts, 1968, 28, 5201.

CRAFT, M. The meaning of the term 'psychopath'. In CRAFT, M. (Ed). Psychopathic Disorders and their assessment, Oxford: Pergamon, 1966, 1-31.

CRIDER, A. & LUNN, R. Electrodermal lability as a personality dimension. Journal of Experimental Research in Personality, 1971, 5, 145-150.

CUTROW, R. J., PARKS, A., LUCAS. P. & THOMAS, K. The objective use of multiple physiological indices in the detection of deception. Psychophysiology, 1972, 9, 578-588.

DAMODOR, V. N. & MURTHY, H. N. Spiral after-effect and introversion-extraversion. Transactions of All-India Institute of Mental Health, 1967, 7, 79-84. In Psychological Abstracts, 1969, 43, 113000.

DAS, J. P. An experimental study of the relation between hypnosis, conditioning and reactive inhibition. Unpublished Ph.D. thesis, University of London, 1957. Cited by EYSENCK, H. J. Extraversion and the acquisition of eyeblink and GSR conditioned responses. Psychological Bulletin, 1965, 63, 260-261.

DAVIDSON, P. O., PAYNE, R. W. & SLOANE, R. B. Introversion, neuroticism and conditioning. Journal of Abnormal and Social Psychology, 1964, 68, 136-143.

DAVIDSON, P. O., PAYNE, R. W. & SLOANE, R. B. Cortical inhibition, drive level and conditioning. Journal of Abnormal Psychology, 1966, 71, 310-314.

DAVIS, F. H., MALMO, R. B. & SHAGASS, C. Electromyographic reaction to strong auditory stimulation in psychiatric patients. Canadian Journal of Psychology, 1954, 8, 177-186.

DAWSON, M. E. Can classical conditioning occur without contingency learning? A review and evaluation of the evidence. Psychophysiology, 1973, 10, 82-86.

DAWSON, M. E. & BIFERNO, M. A. Concurrent measurement of awareness and electrodermal classical conditioning. Paper presented at the twelfth Annual Meeting of the Society for Psychophysiological Research, Boston, Nov: 1972.

DAWSON, M. E. & FUREDY, J. J. The role of relational awareness in human autonomic discrimination classical conditioning. Paper presented at the thirteenth Annual Meeting of the Society for Psychophysiological Research, Galveston, Oct: 1973.

DAWSON, M. E. & GRINGS, W. W. Comparison of classical conditioning and relational learning. Journal of Experimental Psychology, 1968, 76, 227-231.

DAWSON, M. E. & REARDON, P. Effects of facilitory and inhibitory sets on GSR conditioning and extinction. Journal of Experimental Psychology, 1969, 82, 462-466.

DAWSON, M. E. & REARDON, P. Construct validity of recall and recognition post conditioning measures of awareness. Journal of Experimental Psychology, 1973, 98, 308-315.

DELGADO, J. M. R., ROBERTS, W. W. & MILNER, N. E. Learning motivated by electrical stimulation of the brain. American Journal of Physiology, 1954, 179, 587-593.

DINITZ, S., GOLDMAN, H., ALLEN, H. E. & LINDNER, L. A. Psychopathy and autonomic responsivity: A note on the importance of diagnosis. Journal of Abnormal Psychology, 1973, 82, 533-534.

DODGE, D. W. Contrasts and similarities in the orienting responses of extraverts and introverts as indicated by long and short term vasoconstrictive reactions to auditory signals and monotones. Dissertation Abstracts International, 1966, 27, 301.

DOTY, R. W. & GIURGEA, C. Conditioned reflexes established by coupling electrical excitations of two cortical areas. In LANDAUER, T. K. (Ed). Readings in Physiological Psychology: The Bodily Basis of Behaviour, New York: McGraw-Hill, 1967, 403-417.

DOUGLAS, J. W. B., ROSS, J. M. & SIMPSON, H. R. All our Future: A Longitudinal Study of Secondary Education, Peter Davies, 1968. Cited by RUTTER, M. Maternal Deprivation Re-assessed, Harmondsworth: Penguin, 1971, 63-64.

DUFFY, E. Activation and Behaviour, New York: Wiley, 1962.

DYKMAN, R. A., MACK, R. L. & ACKERMAN, P. T. The evaluation of autonomic and motor components of the nonavoidance conditioned response in the dog. Psychophysiology, 1965, 1, 209-230.

EASON, R. G. & DUDLEY, L. M. Physiological and behavioural indicants of activation. Psychophysiology, 1970, 223-232.

EDELBERG, B. S. Electrical properties of the skin. In BROWN, C. C. Methods in Psychophysiology, Baltimore: Williams & Wilkins, 1967.

EDELBERG, R. The information content of the recovery limb of the electrodermal response. Psychophysiology, 1970, 6, 527-539.

ERIKSEN, C. W. Discrimination and learning without awareness: a methodological survey and evaluation. Psychological Review, 1960, 67, 279-300.

ESTES, W. K. Learning. In DODWELL, P. C. (Ed). New Horizons in Psychology 2, Harmondsworth: Penguin, 1972, 15-35.

EYSENCK, H. J. Dimensions of Personality, London: Routledge & Kegan Paul, 1947.

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

EYSENCK, H. J. The Dynamics of Anxiety and Hysteria, London: Routledge & Kegan Paul, 1957.

EYSENCK, H. J. Personality and verbal conditioning. Psychological Reports, 1959, 5, 570.

EYSENCK, H. J. Response set, authoritarianism and personality questionnaires. British Journal of Social and Clinical Psychology, 1962, 1, 20-24. (I)

EYSENCK, H. J. Extraversion and the acquisition of eyeblink and GSR conditioned responses. Psychological Bulletin, 1965, 63, 258-270.

EYSENCK, H. J. Biological Bases of Personality, Springfield: Charles C. Thomas, 1967.

EYSENCK, H. J. The origin and construction of the MPI. In EYSENCK, H. J. & EYSENCK, S. B. G. (Eds). Personality Structure and Measurement, London: Routledge & Kegan Paul, 1969, 63-83. (a)

EYSENCK, H. J. The validity of the MPI - negative validity. Chap:10 in EYSENCK, H. J. & EYSENCK, S. B. G. (Eds). Personality Structure and Measurement, London: Routledge & Kegan Paul, 1969, 97-117. (b)

EYSENCK, H. J. Crime and Personality, London: Paladin, 1970.

EYSENCK, H. J. & EYSENCK, S. B. G. Manual for the Eysenck personality inventory, Sandiego Educational Test Service, London: University of London Press, 1964.

EYSENCK, H. J. & EYSENCK, S. B. G. The unitary nature of extraversion. In EYSENCK, H. J. & EYSENCK, S. B. G. (Eds). Personality Structure and Measurement, London: Routledge & Kegan Paul, 1969, 150-154. (a)

EYSENCK, H. J., HENDRICKSON, A. & EYSENCK, S. B. G. The orthogonality of personality structure. Chap: 14. In EYSENCK, H. J. & EYSENCK, S. B. G. (Eds). Personality Structure and Measurement, London: Routledge & Kegan Paul, 1969, 155-170.

EYSENCK, H. J. & LEVEY, A. Conditioning introversion-extraversion and the strength of the nervous system. In NEBYLITSYN, V. D. & GRAY, J. A. (Eds). Biological Bases of Individual Behaviour, New York & London: Academic Press, 1972, 206-220.

EYSENCK, H. J. & WILLETT, R. A. Introduction. In EYSENCK, H. J. (Ed). Experiments in Motivation, Oxford: Pergamon, 1964, 3-11.

EYSENCK, S. B. G. The validity of a personality questionnaire as determined by the method of nominated groups. Life Sciences, 1962, 4, 13-15. (2)

EYSENCK, S. B. G. & EYSENCK, H. J. On the dual nature of extraversion. British Journal of Social and Clinical Psychology, 1963, 2, 46-55.

EYSENCK, S. B. G. & EYSENCK, H. J. Acquiescence response set in personality questionnaires. Life Sciences, 1963, 2, 144-147.

EYSENCK, S. B. G. & EYSENCK, H. J. Salivary response to lemon juice as a measure of introversion. Perceptual and Motor Skills, 1967, 24, 1047-1053.

EYSENCK, S. B. G. & EYSENCK, H. J. The dual nature of extraversion. In EYSENCK, H. J. & EYSENCK, S. B. G. (Eds). Personality Structure and Measurement, London: Routledge & Kegan Paul, 1969, 141-149. (b)

EYSENCK, S. B. G. & EYSENCK, H. J. Scores on three personality variables as a function of age, sex and social class. British Journal of Social and Clinical Psychology, 1969, 8, 69-76. (c)

EYSENCK, S. B. G. & EYSENCK, H. J. Crime and personality: an empirical study of the three factor theory. British Journal of Criminology, 1970, 10, 225-239.

EYSENCK, S. B. G. & EYSENCK, H. J. Crime and personality: item analysis of questionnaire responses. British Journal of Criminology, 1971, 11, 49 -62.

FARBER, I. E., SPENCE, K. W. & BECHTOLDT, H. P. Emotionality, introversion-extraversion, and conditioning. Paper presented at the Midwestern Psychological Association, Chicago, 1957. Cited by EYSENCK, H. J. Extraversion and the acquisition of eyeblink and GSR conditioned responses. Psychological Bulletin, 1965, 63, 260.

FARLEY, F. H. Further investigation of the two personae of extraversion. British Journal of Social and Clinical Psychology, 1970, 9, 377-379.

FENICHEL, O. The psycho-analytic theory of neurosis, London: Routledge & Kegan Paul, 1946.

FENTON, G. W. & SCOTTON, L. Personality and the alpha rhythm. British Journal of Psychiatry, 1967, 113, 1283-1289.

FENZ, W. D., YOUNG, M. J. & FENZ, H. G. Differences in the modulation of cardiac activity between psychopaths and controls. Paper presented at the Annual Meeting of the Society for Research in Psychophysiology, Galveston, 1973.

FERÉ, C. Note sur les modifications de la resistance electrique sous l'influence des excitations sensorielles et des emotions, 1888. Cited by McCLEARY, R. A. The nature of the galvanic skin response. Psychological Bulletin, 1950, 47, 99 & 102.

FERGUSON, G. A. Statistical Analysis in Psychology and Education, New York: McGraw-Hill, 1966.

FIELD, J. G. Report to the prison commission of an investigation into the personality of recidivists. Unpublished Manuscript, 1960. Cited by PASSINGHAM, R. E. Crime and personality: a review of Eysenck's theory. In NEBYLITSYN, V. D. & GRAY, J. A. (Eds). Biological Bases of Individual Behaviour, New York & London: Academic Press, 1972, 351 & 356.

FIELD, J. G. & BRENGELMAN, J. C. Eyelid conditioning and three personality parameters. Journal of Abnormal and Social Psychology, 1961, 63, 517-523.

FINKENSIEPER, H. O., SYSTERMAN, J. J. & TIMNER, L. M. Conditioning of eyelid movements in psychiatric patients. Psychiatrica, Neurologia, Neurochirurgia, 1970, 73, 437-440. Abstract No: 1295 in Psychological Abstracts, 1972, 48, 146.

FINN, J. A. Reactions to pain in psychopathic criminals. Dissertation Abstracts International, 1972, 32, 4209-4210.

FISHER, R. H. Vicarious avoidance learning in the psychopath. Dissertation Abstracts International, 1972, 32, 6644.

FOULDS, G. A. The logical impossibility of using hysterics and dysthymics as criterion groups in the study of introversion and extraversion. British Journal of Psychology, 1961, 52, 385-387.

FOULDS, G. A. Personality and Personal Illness, London: Tavistock, 1965.

FOX, R. & LIPPERT, W. Spontaneous GSR and anxiety level in sociopathic delinquents. Journal of Consulting Psychology, 1963, 27, 368.

FRANKS, C. M. Conditioning and personality: a study of normal and neurotic subjects. Journal of Abnormal and Social Psychology, 1956, 52, 143-150. (a)

FRANKS, C. M. Recidivism, psychopathy and personality. British Journal of Delinquency, 1956, VI, 192-201. (b)

FRANKS, C. M. Personality factors and the rate of conditioning. British Journal of Psychology, 1957, 48, 119-126.

FRANKS, C. M. Personality and eyeblink conditioning seven years later. Acta Psychologica, 1963, 21, 295-312.

FRANKS, C. M. & LEIGH, D. The theoretical and experimental application of conditioning model to a consideration of bronchial asthma in man. Journal of Psychosomatic Research, 1959, 4, 88-98.

FREEMAN, G. L. The optimal locus of anticipatory tension in muscular work. Journal of Experimental Psychology, 1937, 21, 554-608. Cited by GRAY, J. A. Pavlov's Typology, Oxford: Pergamon, 1964, P.319.

FREEMAN, G. L. The energetics of Human Behaviour, Ithaca: Cornell University Press, 1948. Cited by GRAY, J. A. Pavlov's Typology, Oxford: Pergamon, 1964, 308.

FRENCH, J. W. A comparison of finger tremor with the galvanic skin reflex and pulse. Journal of Experimental Psychology, 1944, 34, 494-505.

FREUD, S. Two Short Accounts of Psycho-analysis, translated and edited by J. STRACHEY. Harmondsworth: Penguin, 1970.

FUHRER, M. J. & BAER, P. E. Cognitive processes in differential GSR conditioning: effects of a masking task. American Journal of Psychology, 1969, 82, 168-180.

FUREDY, J. J. & GINSBERG, S. Effects of varying signaling and intensity of shock on an unconfounded and novel electrodermal autonomic index in a variable and long interval classical trace conditioning paradigm. Psychophysiology, 1973, 10, 328-334.

FURNEAUX, W. D. Neuroticism, extraversion, drive and suggestibility. International Journal of Clinical Experimental Hypnosis, 1961, 9, 195-214. Cited by EYSENCK, H. J. Biological Bases of Personality, Springfield: Charles C. Thomas, 1967, 182.

FUSTER, J. M. Effects of stimulation of brain stem on tachistoscopic perception. Science, 1958, 127, 150. Cited by GRAY, J. A. in Pavlov's Typology, Oxford: Pergamon, 1964, 310.

GALE, A., COLES, M. & BLAYDON, J. Extraversion-introversion and the EEG. British Journal of Psychology, 1969, 60, 209-223.

GALE, A., COLES, M., KLINE, P. & PENFOLD, V. Extraversion, introversion, neuroticism and the EEG: basal and response measures during habituation of the orienting response. British Journal of Psychology, 1971, 62, 533-543.

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

GELLHORN, E. Principles of Autonomic-Somatic Integrations, Minneapolis: University of Minnesota Press, 1967.

GELLHORN, E. & LOOFBOURROW, G. N. Emotions and Emotional Disorders. A Neurophysiological Study, New York & London: Harper & Row, 1963.

GENDREAU, P. & SUBOSKI, M. D. Classical discrimination eyelid conditioning in primary psychopaths. Journal of Abnormal Psychology, 1971, 77, 242-246.

GIBSON, H. B. The spiral maze: a psychomotor test with implications for the study of delinquency. British Journal of Psychology, 1964, 55, 219-225.

GIBSON, H. B. Manual of the Gibson Spiral Maze, London: University of London Press, 1965.

GIBSON, H. B. The Gibson spiral maze test: retest data in relation to behavioural disturbance, personality and physical measures. British Journal of Psychology, 1969, 60, 523-528.

GLINER, J. A., HARLEY, J. P. & BADIA, P. Elicitation and habituation of the orienting response as a function of instructions, order of stimulus presentations and omission. Journal of Experimental Psychology, 1971, 89, 414-416.

GOLD, M. Undetected delinquent behaviour. Journal of Research in Crime and Delinquency, 1966, 3, 27-46.

GOLDFARB, W. Emotional and intellectual consequences of psychological deprivation in infancy: a revaluation. In HOCH, P. H. & ZUBIN, J. (Eds). Psychopathology of Childhood, 1955. Cited by RUTTER, M. Maternal Deprivation Reassessed, Harmondsworth: Penguin, 1971, 102.

GOTTLOBER, A. B. The relationship between brain potentials and personality. Journal of Experimental Psychology, 1938, 22, 67-74. Cited by FENTON, G. W. & SCOTTON, L. Personality and the alpha rhythm. British Journal of Psychiatry, 1967, 113, 1283-1289.

GRAHAM, F. K. & CLIFTON, R. K. Heart rate change as a component of the orienting response. Psychological Bulletin, 1966, 65, 305-320.

GRANGER, G. W. Night vision and psychiatric disorders. Journal of Mental Science, 1957, 103, 48-79.

GRANT, D. A. Cognitive factors in eyelid conditioning. Psychophysiology, 1973, 10, 75-81.

GRAY, J. A. Pavlov's Typology, Oxford: Pergamon, 1964.

GRAY, J. A. Strength of the nervous system, introversion-extraversion, conditionability and arousal. Behaviour Research and Therapy, 1967, 5, 151-169.

GRAY, J. A. The psychophysiological basis of introversion-extraversion. Behaviour Research & Therapy, 1970, 8, 249-266.

GRAY, J. A. Causal theories of personality and how to test them. Paper presented at the third Banff Conference on Theoretical Psychology, 1971. (a)

GRAY, J. A. The Psychology of Fear and Stress, London: Weidenfeld & Nicholson, 1971. (b)

GREEN, E. Judicial Attitudes in Sentencing, London: Macmillan, 1961. Cited by HOOD, R. & SPARKS, R. Key Issues in Criminology, London: Weidenfeld & Nicholson, 1970, 146.

GUILDFORD, J. P. Personality, New York: McGraw-Hill, 1959.

GUILDFORD, J. P. & GUILDFORD, R. B. An analysis of the factors in a typical test of introversion-extraversion. Journal of Abnormal and Social Psychology, 1934, 28, 377-399. Cited by CARRIGAN, P. M. Extraversion-introversion as a dimension of personality: a reappraisal. Psychological Bulletin, 1960, 57, 331.

GUILDFORD, J. P. & GUILDFORD, R. B. Personality factors, S, E and M and their measurement. Journal of Psychology, 1936, 2, 109-127. Cited by CARRIGAN, P. M. Extraversion-introversion as a dimension of personality: a reappraisal. Psychological Bulletin, 1960, 57, 331.

GUILDFORD, J. P. & ZIMMERMAN, W. S. Fourteen dimensions of temperament. Psychological Monographs, 1956, 70, 417.

GUTIERREZ, M. J. & EISENMAN, R. Verbal conditioning of neurotic and psychopathic delinquents using verbal and non-verbal reinforcers. Psychological Reports, 1971, 29, 7-10.

HADDEN, T. B. The development and administration of the English law of criminal fraud. Unpublished Ph.D. thesis, University of Cambridge, 1967. Cited by HOOD, R. & SPARKS, R. Key Issues in Criminology, London: Weidenfeld & Nicholson, 1970, 138.

HAHN, W. W. Attention and heart rate: a critical appraisal of the hypothesis of Lacey & Lacey. Psychological Bulletin, 1973, 79, 59-70.

HALBERSTAM, J. L. Some personality correlates of conditioning, generalisation and extinction. Psychosomatic Medicine, 1961, 23, 67-76.

HALMIOVÁ, O. & UHERIK, A. A note on the criteria of dynamism of the nervous processes. In NEBYLITSYN, V. D. & GRAY, J. A. Biological Bases of Individual Behaviour, New York & London: Academic Press, 1972.

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

HARE, R. D. Acquisition and generalisation of a conditioned fear response in psychopathic and non-psychopathic criminals. *Journal of Psychology*, 1965, 59, 367-370. (b)

HARE, R. D. Psychopathy, autonomic functioning, and the orienting response. *Journal of Abnormal Psychology, Monograph Supplement*, 1968, 73, 1-24.

HARE, R. D. An MMPI comparison of psychopathic and non-psychopathic criminals. *Unpublished Data*, 1969. Cited by HARE, R. D. *Psychopathy: Theory and Research*, New York: Wiley, 1970, 15.

HARE, R. D. *Psychopathy: Theory and Research*, New York: Wiley, 1970.

HARE, R. D. & QUINN, M. J. Psychopathy and autonomic conditioning. *Journal of Abnormal Psychology*, 1971, 77, 223-235.

HARE, R. D. & THORVALDSON, S. A. Psychopathy and response to electrical stimulation. *Journal of Abnormal Psychology*, 1970, 76, 370-374.

HARTMAN, T. F. & GRANT, D. A. Effects of pattern of reinforcement and verbal information on acquisition, extinction and spontaneous recovery of the eyelid CR. *Journal of Experimental Psychology*, 1962, 63, 217-226.

HARTSHORNE, H. & MAY, M. A. *Character Education Enquiry*, 1920. Cited by EYSENCK, H. J. *Crime and personality*, London: Paladin, 1970, 23-32.

HASLAM, D. R. Individual differences in pain threshold and level of arousal. *British Journal of Psychology*, 1967, 58, 139-142.

HATHAWAY, S. R. & McKINLEY, J. C. *Manual for the Minnesota Multiphasic Personality Inventory*, New York: The Psychological Corporation, 1951.

HAUSER, K. The relationship between normal anxiety and minor crimes. *Unpublished study, University of Minnesota*, 1959. Cited by LYKKEN, D. T. & KATZENMEYER, C. G. Manual for the activity preference questionnaire (APQ). *Reports from research laboratories of the department of psychiatry, University of Minnesota*, 1967, 27.

HEBB, D. O. Drives and the CNS (conceptual nervous system). *Psychological Review*, 1955, 62, 243-245.

HILGARD, E. R. & CAMPBELL, A. A. The course of acquisition and retention of conditioned responses in man. *Journal of Experimental Psychology*, 1936, 19, 227-247. Cited by MARTIN, I. & LEVEY, A. B., *The Genesis of the Classical Conditioned Response*, London: Pergamon, 1969.

HILGARD, E. R. & HUMPHREYS, L. G. The effect of supporting and antagonistic instructions on conditioned discrimination. *Journal of Experimental Psychology*, 1938, 22, 291-304. (a)

HILGARD, E. R. & HUMPHREYS, L. G. The retention of conditioned discrimination in man. *Journal of General Psychology*, 1938, 19, 111-125. Cited by GRANT, D. A. Cognitive factors in eyelid conditioning. *Psychophysiology*, 1973, 10, 76. (b)

HOLLAND, H. C. International Series of Monographs in Experimental Psychology: II. The Spiral After-effect, Oxford: Pergamon, 1966.

HOOD, R. & SPARKS, R. Key Issues in Criminology, London: Weidenfeld & Nicholson, 1970.

HOWARTH, E. & BROWNE, J. A. An item factor analysis of the Eysenck personality inventory. British Journal of Social and Clinical Psychology, 1972, 11, 162-174.

HOWARTH, E. & SKINNER, N. F. Salivation as a physiological indicator of introversion. Journal of Psychology, 1969, 73, 223-228.

HOWARTH, T. B. & MEARES, R. A. The relevance of the neurophysiological concepts of excitation and inhibition to clinical psychiatry. Australia and New Zealand Journal of Psychiatry, 1973, 7, 114-120.

HULL, C. L. Principles of Behaviour, New York: Appleton-Century-Crofts, 1943.

HUME, W. I. Physiological measures in twins. In CLARIDGE, G., CANTOR, S & HUME, W. I. (Eds). Personality Differences and Biological Variations: A Study of Twins, Oxford: Pergamon, 1973, 87-114.

HUMPHREYS, L. G. Measures of strength of conditioned eyelid responses. Journal of General Psychology, 1943, 29, 101-111. Cited by MARTIN I. & LEVEY, A. B. The Genesis of the Classical Conditioned Response. London: Pergamon, 1969, 57-58.

HURLOCK, E. B. The value of praise and reproof as incentives for children. Archives of Psychology, NY, 1924, 11, 71. Cited by LAZARUS, R. S., DEESE, J. & OSLER, S. J. The effects of stress upon psychological performance. Psychological Bulletin, 1952, 49, 302.

INGHAM, J. & ROBINSON, J. O. Personality in the diagnosis of hysteria. British Journal of Psychology, 1964, 55, 276-284.

IPPOLITOV, F. V. Interanalyser differences in the sensitivity-strength parameter for vision, hearing and cutaneous modalities. In NEBYLITSYN, V. D. & GRAY, J. A. Biological Bases of Individual Behaviour, New York & London: Academic Press, 1972, 43-61.

JAWANDA, J. S. Age, sex and personality variables in verbal conditioning and its modification by drugs. Unpublished Ph.D. thesis, Punjab University, 1966. Cited by EYSENCK, H. J. Biological Bases of Personality, Springfield: Charles C. Thomas, 1967, 123-125.

JENKINS, R. L. Psychiatric syndromes in children and their relation to family background. American Journal of Orthopsychiatry, 1966, 36, 450-457.

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.

JONES, H. E. The study of patterns of emotional expression. In REYMERT, M. L. (Ed). Feelings and Emotions, New York: McGraw-Hill, 1950. Cited by SCHACTER, S. Emotion, Obesity and Crime, New York & London: Academic Press, 1971, 172.

JONES, K. Opening the Door. A study of New Policies for the Mentally Handicapped, London & Boston: Routledge & Kegan Paul, 1975.

JUNG, C. G. Psychological Types, translated by BAYNES, H. G. and revised by HULL, R. F. C. London: Routledge & Kegan Paul, 1921.

KARPMAN, B The myth of the psychopathic personality. American Journal of Psychiatry, 1948, 104, 523-534.

KARSON, S. & POOL, K. B. Second-order factors in personality measurement. Journal of Consulting Psychology, 1958, 22, 299-303.

KASSENBAUM, G. G., COUCH, A. S. & SLATER, P. E. The factorial dimensions of the MMPI. Journal of Consulting Psychology, 1959, 23, 226-236.

KIMMEL, H. D. Further analysis of GSR conditioning: a reply to Stewart, Stern, Winokur and Fredman. Psychological Review, 1964, 71, 160-166.

KIMMEL, H. D. & PENNYPACKER, H. S. Differential GSR conditioning as a function of the CS-UCS interval. Journal of Experimental Psychology, 1963, 65, 559-563.

KIPNIS, D. Intelligence as a modifier of the behaviour of character disorders. Journal of Applied Psychology, 1965, 49, 237-242.

KIPNIS, D. Character Structure and Impulsiveness, New York & London: Academic Press, 1971.

KLING, J. K. The effects of verbal and material reward and punishment in the verbal conditioning of primary and secondary psychopaths. Dissertation Abstracts International, 1973, 33, 3311.

KNOTT, J. R. & TRAVIS, L. E. A note on the relationship between duration and amplitude of cortical potentials. Journal of Psychology, 1937, 3, 169-172. Cited by GALE, A., COLES, M. & BLAYDON, J. Extraversion-introversion and the EEG. British Journal of Psychology, 1969, 60, 210.

KNOWLES, J. B. & KRASNER, L. Extraversion and duration of the Archimedes spiral after-effect. Perceptual and Motor Skills, 1965, 20, 997-1000.

KOHLBERG, L. Stage and sequence: the cognitive-development approach to socialisation. In GOSLING, D. A. (Ed). Handbook of Socialisation Theory and Research, Chicago: Rand McNally, 1968, 347-480.

KOROTKIN, I. I. A method of investigating eye-blink conditioned reflexes in man. Fiziol. Zh. SSSE, 1949, 30, 467-472. Cited by KULYUTKIN, Yu.N., ZYRYANOVA, N. G. & SUKHOBSKAYA, G. S. The influence of neurodynamic factors on individual characteristics of problem solving. In NEBYLITSYN, V. D. & GRAY, J. A. (Eds). Biological Bases of Individual Behaviour, New York & London: Academic Press, 1972, 335.

KRISTJANSSON, M. & BROWN, R. I. Instruction effects and relation between extraversion and the spiral after-effect. Perceptual and Motor Skills, 1973, 36, 1323-1326.

KULYUTKIN, Yu.N., ZYRYANOVA, N. G. & SUKHOBSKAYA, G. S. Influence of neurodynamic factors on individual characteristics of problem solving. In NEBYLITSYN, V. D. & GRAY, J. A. Biological Bases of Individual Behaviour, New York & London: Academic Press, 1972, 334-341.

LACEY, J. I. Somatic response patterning and stress: some revisions of activation theory. In APPLEY, M. H. & TRUMBULL, R. (Eds). Psychological Stress: Issues in Research, New York: Appleton-Century-Crofts, 1967, 14-42.

LACEY, J. I., KAGAN, J., LACEY, B. C. & MOSS, H. A. The visceral level: situational determinants and behavioural correlates of autonomic response patterns. In KNAPP, P. H. (Ed). Expression of the Emotions in Man, New York: International University Press, 1963, 161-196.

LACEY, J. I. & SMITH, R. L. Conditioning and generalisation of unconscious anxiety. Science, 1954, 120, 1045-1052.

LADER, M. H. Pneumatic plethysmography. In VENABLES, P. & MARTIN, I. Manual of Psychophysiological Methods, New York: Wiley, 1967, 159-183.

LADER, M. H. The unit of quantification of the GSR. Journal of Psychosomatic Research, 1970, 14, 109-110.

LADER, M. H. & MATHEWS, A. M. A physiological model of phobic anxiety and desensitization. Behaviour Research and Therapy, 1968, 6, 411-421.

LADER, M. H. & MONTAGU, J. D. The psycho-galvanic reflex: a pharmocological study of the peripheral mechanism. Journal of Neurosurgery and Psychiatry, 1962, 25, 126-133.

LANDIS, C. An attempt to measure emotional traits in juvenile delinquency. In LASHLEY, K. S., STONE, C. P., DARROW, C. W., LANDIS, C & HEATH, L. L. Studies in the Dynamics of Behaviour, Chicago: University of Chicago Press, 1932. Cited by SCHACTER, S. Emotion, Obesity and Crime, New York & London: Academic Press, 1971, 171.

LAUNGANI, D. Personality and verbal conditioning. Psychological Reports, 1968, 23, 1134.

LAZARUS, R. S., DEESE, J. & OSLER, S. J. The effects of psychological stress upon performance. Psychological Bulletin, 1952, 49, 293-317.

LAZARUS, R. S. & ERIKSEN, C. W. Psychological stress and its personality correlates: part I. The effect of failure stress upon skilled performance. Journal of Experimental Psychology, 1952, 43, 100-105.

LEARMONTH, G. J., ACKERLY, W. & KAPLAN, M. Relationships between palmar skin potential during stress and personality variables. Psychosomatic Medicine, 1959, 21, 150-157.

LEVY, P. & LANG, P. J. Activation, control and the spiral after-movement. Journal of Personality and Social Psychology, 1966, 3, 105-112.

LEWIS, H. Deprived Children, Oxford: Oxford University Press, 1954. Cited by RUTTER, M. Maternal Deprivation Re-assessed, Harmondsworth: Penguin, 1971, 100.

LINDSLEY, D. B. Psychophysiology and motivation. In JONES, M. R. (Ed). Nebraska Symposium on Motivation, Lincoln: University of Nebraska Press, 1957, 44-105.

LIPPERT, W. W. & SENTER, R. J. Electrodermal responses in the sociopath. Psychonomic Science, 1966, 4, 25-26.

LIPPOLD, O. C. J. Electromyography. In VENABLES, P. & MARTIN, I. (Eds). Manual of Psychophysiological Methods, New York: Wiley, 1967.

LITTLE, A. Professor Eysenck's theory of crime: an empirical test on adolescent offenders. British Journal of Criminology, 1963, 4, 152-163.

LOCKHART, R. A. & GRINGS, W. W. Comments on 'An analysis of GSR conditioning'. Psychological Review, 1963, 70, 562-564.

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

LOVIBOND, S. H. Personality and conditioning. Progress in Experimental Personality Research, 1964, 1, 115-148.

LYKKEN, D. T. A study of anxiety in the sociopathic personality. Unpublished doctoral dissertation, University of Minnesota, 1955.

LYKKEN, D. T. A study of anxiety in the sociopathic personality. Journal of Abnormal and Social Psychology, 1957, 55, 6-10.

LYKKEN, D. T. Range correction applied to heart rate and GSR data. Psychophysiology, 1972, 9, 373-379.

LYKKEN, D. T. & KATZENMEYER, C. G. Manual for the activity preference questionnaire (APQ). Reports from Research Laboratories of the Department of Psychiatry, University of Minnesota, 1967.

LYKKEN, D. T., ROSE R., LUTHER, B. & MALEY, M. Correcting psychophysiological measures for individual differences in range. Psychological Bulletin, 1966, 66, 481-484.

LYKKEN, D. T. & VENABLES, P. H. Direct measurement of skin conductance: a proposal for standardisation. Psychophysiology, 1971, 8, 656-672.

MACLEAN, P. D. Studies on limbic system (visceral brain) and their bearing on psychosomatic problems. In WITTKOWER, E. D. & CLEGHORN, R. A. (Eds). Recent Development in Psychosomatic Medicine, Philadelphia: Lippincott, 1954, 101-125.

MAGOUN, H. W. The Waking Brain, Springfield: Charles C. Thomas, 1963.

MAHER, B. Experimental psychopathology. In DODWELL, P. C. (Ed). New Horizons in Psychology 2, Harmondsworth: Penguin, 1972, 148-167.

MALCUIT, G. Cardiac responses in aversive situation with and without avoidance possibilities. Psychophysiology, 1973, 10, 295-306.

MALMO, R. B. Activation: a neuropsychological dimension. Psychological Review, 1959, 66, 367-386.

MALMO, R. B. & BELANGER, D. Related physiological and behavioural changes: what are their determinants? In Sleep and Altered States of Consciousness, Association for Research in Nervous Mental Diseases 45, Baltimore: Williams & Wilkins, 1967, 228-318.

MALMO, R. B. & SHAGASS, C. Studies of blood pressure in psychiatric patients under stress. Psychosomatic Medicine, 1952, 14, 82-93.

MALMO, R. B., SHAGASS, C. & DAVIS, F. H. A method for the investigation of somatic response mechanisms in psychoneurosis. Science, 1950, 112, 325-328.

MALTZMAN, I. Theoretical conceptions of semantic conditioning and generalisation. In DIXON, T. R. & HORTON, D. L. (Eds). Verbal Behaviour and General Behaviour Theory, Englewood Cliffs: Prentice-Hall, 1968.

MALTZMAN, I. & RASKIN, D. C. Effects of individual differences in the orienting reflex on conditioning and complex processes. Journal of Experimental Research in Personality, 1965, 1, 1-16.

MANDEL, S. L. & GOODSTEIN, L. D. Awareness and intertrial activity in verbal conditioning. Psychological Reports, 1969, 25, 455-460.

MANGAN, G. L. Studies of the relationship between neo-Pavlovian properties of higher nervous activity and western personality dimensions: II. The relation of mobility to perceptual flexibility. Behaviour Research and Therapy, 1967, 2, 117-123.

MANGAN, G. L. The relationship of strength-sensitivity of the visual system to extraversion. In NEBYLITSYN, V. D. & GRAY, J. A. Biological Bases of Individual Behaviour, New York & London: Academic Press, 1972, 254-261.

MANGAN, G. L. & FARMER, R. G. Studies of the relationship between neo-Pavlovian properties of higher nervous activity and western personality dimensions: I. The relationship of nervous system strength and sensitivity to extraversion. Journal of Experimental Research in Personality, 1967, 2, 101-106.

MANGAN, G. L. & O'GORMAN, J. G. Initial amplitude and rate of habituation of orienting reaction in relation to extraversion and neuroticism. Journal of Experimental Research in Personality, 1969, 3, 275-282.

MANN, R. D. The relationship between personality characteristics and individual performance in small groups. Unpublished Doctoral Dissertation, University of Michigan, 1958. Cited by CARRIGAN, P. M. Extraversion-introversion as a dimension of personality: a reappraisal. Psychological Bulletin, 1960, 57, 337.

MARGERISON, I. H., ST: JOHN-LOE, P. & BINNIE, C. D. Electroencephalography. In VENABLES, P. & MARTIN, I. (Eds). Manual of Psychophysiological Methods, New York: Wiley, 1967, 351-402.

MARTENS, R. & LANDERS, D. M. Motor performance under stress: a test of the inverted-U hypothesis. Journal of Personality and Social Psychology, 1970, 16, 29-37.

MARTIN, D. N. & WARDE, S. The performance of approved school boys on the Gibson spiral maze. British Journal of Psychology, 1971, 62, 551-555.

MARTIN, I. Variations in skin resistance and their relationship to GSR conditioning. Journal of Mental Science, 1960, 106, 281-287.

MARTIN, I. & LEVEY, A. B. The Genesis of the Classical Conditioned Response, London: Pergamon, 1969.

MARTON, M. L. The theory of individual differences in neo-behaviourism and in the typology of higher nervous activity. In NEBYLITSYN, V. D. & GRAY, J. A. (Eds). Biological Bases of Individual Behaviour. New York & London: Academic Press, 1972, 221-235.

MARTON, M. L. & URBAN, Ya. An electroencephalographic investigation of individual differences in the processes of conditioning. Proceedings of the eighteenth International Congress for Experimental Psychology, Moscow, 1966, 106-109. Cited by GRAY, J. A. Strength of the nervous system, introversion-extraversion, conditionability and arousal. Behaviour Research and Therapy, 1967, 5, 162.

MATARAZZO, J. D., ULETT, G. A. & SASLOW, G. Human maze performance as a function of increasing levels of anxiety. Journal of General Psychology, 1955, 53, 79-95.

MATARAZZO, R. & MATARAZZO, J. D. Anxiety level and pursuit-meter performance. Journal of Consulting Psychology, 1956, 20, 70.

McCLEARY, R. A. The nature of the galvanic skin response. Psychological Bulletin, 1950, 47, 97-117.

McCLEARY, R. A. & MOORE, R. Y. Subcortical Mechanisms of Behaviour: The Psychological Functions of Primitive Parts of the Brain, New York & London: Basic Books, 1965.

McCLINTOCK, E. H. Crimes of Violence, London: Macmillan, 1961. Cited by HOOD, R. & SPARKS, R. Key Issues in Criminology, London: Weidenfeld & Nicholson, 1970, 138.

McCLINTOCK, F. H. & GIBSON, E. Robbery in London, London: Macmillan, 1961. Cited by HOOD, R. & SPARKS, R. Key Issues in Criminology, London: Weidenfeld & Nicholson, 1970, 138.

McCOMB, T. D. Punishment, arousal conditioning and social learning: an experimental and methodological study. Unpublished Ph.D. thesis, University of Southampton, 1970.

McCORD, W. & McCORD, J. The Psychopath: An Essay on the Criminal Mind, New York: Van Nostrand, 1964.

McDONELL, C. R. & INGLIS, J. Verbal conditioning and personality. Psychological Reports, 1962, 10, 374.

McDONELL, K. G. & PARKER, A. D. Gibson spiral maze and MPI scores: a comparison using normal adolescent subjects. British Journal of Social and Clinical Psychology, 1971, 10, 191-192.

McPHERSON, F. M. Comment on Eysenck's account of some Aberdeen studies of introversion-extraversion and eyeblink conditioning. British Journal of Psychology, 1965, 56, 483-484.

MEDNICK, M. T. Mediated generalisation and the incubation effect as a function of Manifest Anxiety. Journal of Abnormal and Social Psychology, 1957, 55, 315-321.

MILLER, M. Changes in the response to electric shock produced by varying muscular conditions. Journal of Experimental Psychology, 1926, 9, 26-44. Cited by GRAY, J. A. Pavlov's Typology, Oxford: Pergamon, 1964, 308.

MILLER, W. B. Lower class culture as a generating milieu of gang delinquency. Journal of Social Issues, 1958, 14, 5-19.

MOHAN, J. & CLAIRE, C. Personality and verbal conditioning. Manas: A Journal of Scientific Psychology, 1968, 15, 87-93. No: 10726 in Psychological Abstracts, 1969, 43, 1054.

MONTAGU, J. D. & COLES, E. M. Mechanism and measurement of the galvanic skin response. Psychological Bulletin, 1966, 65, 261-279.

MONTGOMERY, D. D. Personality correlates of response tendencies during habituation of the galvanic skin response. Dissertation Abstracts International, 1972, 32, 6690-6691.

MONTUORI, J. J. The effects of stress and anxiety on verbal conditioning in children. Dissertation Abstracts International, 1972, 32, 7319.

MORGAN, C. T. Physiological Psychology, New York: McGraw-Hill, 1965.

MORGENSON, D. F. & MARTIN, I. The orienting response as a predictor of autonomic conditioning. Journal of Experimental Research in Personality, 1968, 3, 89-98.

MORGENSON, D. F. & MARTIN, I. Personalitv. awareness and autonomic conditioning. Psychophysiology, 1969, 5, 536-547.

MORIEARTY, S. E. Classical aversive conditioning with repeated and single CS-UCS pairings. Dissertation Abstracts International, 1972, 33, 2818.

MORUZZI, G. & MAGOUN, H. W. Brain stem reticular formation and activation of the EEG. Electroencephalography and Clinical Neurophysiology, 1949, 1, 455-473.

MOWRER, O. H. Preparatory set (expectancy) - a determinant in motivation and learning. Psychological Review, 1938, 95, 62-91.

MOWRER, O. H. On the dual nature of learning. - A reinterpretation of 'conditioning' and 'problem solving. Harvard Educational Review, 1947, 17, 102-148. Cited by MOWRER, O. H. Learning theory and Behaviour, London: Wiley, 1960, 63-91.

MOWRER, O. H. Learning theory and Behaviour, London: Wiley, 1960.

MURRAY, H. A. Explorations in Personality, New York: Oxford University Press, 1938.

NEBYLITSYN, V. D. An investigation of the connection between sensitivity and strength of the nervous system. In GRAY, J. A. (Ed). Pavlov's Typology, Oxford: Pergamon, 1964, 402-445.

NEBYLITSYN, V. D. Fundamental properties of the human nervous system. Akad: Pedagog: Nauk: RSFSR. Moscow, 1966. Cited by GRAY, J. A. Strength of the nervous system, introversion-extraversion, conditioning and arousal. Behaviour Research and Therapy, 1967, 5, 151-169.

NELSON, M. N. The effects of extraneous tasks, interstimulus interval, and stimulus rise-time on human differential eyelid conditioning. Unpublished Master's thesis. University of Wisconsin, 1971. Cited by ROSS, L. E. & NELSON, M. N. The role of awareness in differential conditioning. Psychophysiology, 1973, 10, 92.

NICHOLSON, J. N. & GRAY, J. A. Peak shift, behavioural contrast and stimulus generalisation as related to personality and development in children. British Journal of Psychology, 1972, 63, 47-62.

OLDS, J. & MILNER, P. Positive reinforcement produced by electrical stimulation of septal area and other regions of rat brain. Journal of Comparative and Physiological Psychology, 1954, 47, 419-427.

OLTMAN, J. & FRIEDMAN, S. Parental deprivation in psychiatric conditions. Diseases of the Nervous System, 1967, 28, 298-303.

OSWALD, I. Sleeping and Waking: Physiology and Psychology, Amsterdam: Elsevier, 1962.

OTIS, G. D. & MARTIN, R. B. Interaction of extraversion and anxiety in an instrumental avoidance task. Journal of Experimental Research in Personality, 1968, 3, 57-59.

PANTON, J. H. MMPI code configurations as related to measures of intelligence among a state prison population. Journal of Social Psychology, 1960, 51, 403-407.

PAPEZ, J. V. A proposed mechanism of emotion. Archives of Neurology and Psychiatry, 1937, 38, 725-743. Cited by EYSENCK, H. J. Biological Bases of Personality, Springfield: Charles C. Thomas, 1967, 234.

PARKE, R. D. & WALTERS, R. H. Alcoholism, avoidance learning and emotional responsiveness. British Journal of Social and Clinical Psychology, 1966, 5, 276-289.

PARKER, D. A., SYNDULKO, K., MALTZMAN, I., JES, R. & ZISKIND, E. Orienting and habituation in sociopathic and normal subjects. Paper presented at the thirteenth Annual Meeting of the Society for Psychophysiological Research, Galveston, 1973.

PASSINGHAM, R. E. Crime and personality: a review of Eysenck's theory. In NEBYLITSYN, V. D. & GRAY, J. A. (Eds). Biological Bases of Individual Behaviour, New York & London: Academic Press, 1972, 302-371.

PAVLOV, I. P. The pharmacology of conditioned reflexes as a method for their study. Dissertation summary by NIKIFOROVSKII, P. M. St: St: Pertersburg, 1910. Cited by TEPLOV, B. M. Problems in the study of general types of higher nervous activity in man and animals. In GRAY, J. A. (Ed). Pavlov's Typology, Oxford: Pergamon, 1964, 7.

PAVLOV, I. P. Conditioned Reflexes. An Investigation of the Physiological Activity of the Cerebral Cortex, ANTREP, G. V. (Trans: & Ed). Oxford University Press, 1927.

PAVLOV, I. P. Trial excursion of a physiologist in the field of psychiatry. Archives Internationales de Pharmacodynamie et de Therapy, 1930. In HORSLEY GANTT, W. (Trans: & Ed). In Lectures on Conditioned Reflexes. Vol: II. London: Lawrence & Wishart, 1941, 39-43.

PAVLOV, I. P. Experimental Neuroses, 1931. In GANTT, W. H. (Trans: & Ed). Lectures on Conditioned Reflexes. Vol: II, London: Lawrence & Wishart, 1941, 73-74.

PAVLOV, I. P. General types of animal and human higher nervous activity. Latest Reports on Physiology and Pathology of higher nervous activity. Third edition. Moscow, 1935, 5-41. In GIBBONS, J. (Ed). BELSKY, S. (Trans). Selected Works, Moscow: Foreign Languages Publishing House, 1955, 313-342. (a)

PAVLOV, I. P. Types of higher nervous activity, their relationship to neurosis and psychoses and the physiological mechanisms of neurotic and psychotic symptoms. Paper read at the Plenary Session of the Second International Congress of Neurologists. London, July, 1935. In BELSKY, S. (Trans) & GIBBONS, J. (Ed). Selected Works, Moscow: Foreign Languages Publishing House, 1955, 481-486. (b)

PAVLOV, I. P. General Types, 1935. In GIBBONS, J. (Ed) & BELSKY, S. (Trans). Selected Works, Moscow: Foreign Languages Publishing House, 1955, 317-318. (c)

PERRY, L. E., GRANT, D. A. & SCHARTZ, M. Differential eyelid conditioning with grammaticality of a noun phrase as the discriminandum. Paper presented at the Meeting of the Psychonomic Society. St: Louis, 1971. Cited by GRANT, D. A. Cognitive factors in eyelid conditioning. Psychophysiology, 1973, 10, 77.

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

PERSONS, R. W. & PERSONS, C. E. Some experimental support for psychopathic theory: a critique. Psychological Reports, 1965, 16, 745-749.

PETERSON, D. R., QUAY, H. C. & TIFFANY, T. L. Personality factors related to juvenile delinquency. Child Development, 1961, 32, 355-372.

PETRIE, A. Individuality in pain and suffering: the reducer and augmenter. <u>University of Chicago Press, Chicago</u>, 1967. Cited by EYSENCK, H. J. <u>Biological Bases of Personality</u>, Springfield: Charles C. Thomas, 1967, 138.

PETROVA, M. K. A laboratory investigation of the strength of the nervous system in a dog of the sanguine type. <u>Trudy fiziol: Labor: I. P. PAVLOVA.</u> Cited by TEPLOV, B. M. Problems in the study of general type of higher nervous activity in man and animals. In GRAY, J. A. (Ed). <u>Pavlov's Typology</u>, Oxford: Pergamon, 1964, 15.

PIERS, E. V. & KIRCHNER E. P. Eyelid conditioning and personality: positive results from nonpartisans. <u>Journal of Abnormal Psychology</u>, 1969, 74, 336-339.

PINNEO, L. R. Effects of induced muscular tension during tracking on level of activation and on performance. <u>Journal of Experimental Psychology</u>, 1961, 62, 523-531.

PORTERFIELD, A. <u>Youth in Trouble</u>, New Pottisnam Foundation, Austin Texas, 1946. Cited by HOOD, R. & SPARKS, R. <u>Key Issues in Criminology</u>, London: Weidenfeld & Nicholson, 1970, 55.

PORTEUS, S. D. <u>The Maze Test and Clinical Psychology</u>, Palo Alto: Pacific Books, 1959.

PUROHIT, A. P. Personality variables, sex differences, GSR responsiveness and GSR conditioning. <u>Journal of Experimental Research in Personality</u>, 1966, 1, 166-173.

PUTNEY, R. T. Conditioned alpha blocking re-examined with the measurement of individual wave amplitudes. <u>Electroencephalography and Clinical Neurophysiology</u>, 1973, 34, 485-493.

QUAY, H. C. Personality dimensions in delinquent males as inferred from the factor analysis of behaviour ratings. <u>Journal of Research in Crime and Delinquency</u>, 1964, 1, 33-37.

QUAY, H. C. Psychopathic personality as pathological stimulation seeking. <u>American Journal of Psychiatry</u>, 1965, 122, 180-183.

QUAY, H. C. & HUNT, W. A. Psychopathy, neuroticism and verbal conditioning: a replication and extension. <u>Journal of Consulting Psychology</u>, 1965, 29, 283.

RADZINOWICZ, L. Sexual offences. <u>A Report of the Cambridge Department of Criminal Science</u>, London: Macmillan, 1961. Cited by HOOD, R. & SPARKS, R. <u>Key Issues in Criminology</u>, London: Weidenfeld & Nicholson, 1970, 138.

RAMSAY, R. W. Salivary response and introversion-extraversion. <u>Acta Psychologia, Amsterdam</u>, 1969, 29, 181-187.

RAZRAN, G. H. S. Conditioned responses: an experimental study and theoretical analysis. <u>Archives of Psychology</u>, 1935, 191, 1-24. Cited by WILLETT, R. A. Measures of learning and conditioning. In EYSENCK, H. J. (Ed). <u>Experiments in Personality, Vol: II. Psychodiagnostics and Psychodynamics</u>, London: Routledge & Kegan Paul, 1960, 167.

RAZRAN, G. H. S. Conditioning and perception. Psychological Review, 1955, 62, 83-95.

REASON, J. Unpublished data. In HOLLAND, H. C. International Series of Monographs in Experimental Psychology: II. The Spiral After-effect, Oxford: Pergamon, 1966, 42-43.

RESCORLA, R. A. & SOLOMON, R. L. Two process learning theory: relationships between Pavlovian conditioning and instrumental learning. Psychological Review, 1967, 74, 151-182.

ROBACK, H. Psychology of Character, London: Kegan Paul, 1931.

ROBIN, G. T. Gang member typology: its extent, sequence and typology. Journal of Criminal Law, Criminology and Political Science, 1963, 55, 59. Cited by HOOD, R. & SPARKS, R. Key Issues in Criminology, London: Weidenfeld & Nicholson, 1970, 138.

ROBINS, L. N. Deviant Children Grown Up, Baltimore: Williams & Wilkins, 1966. Cited by HARE, R. D. Psychopathy: Theory and Research, New York: Wiley, 1970, 100.

ROEBUCK, J. Criminal Typology, Springfield: Charles C. Thomas, 1965. Cited by HOOD, R. & SPARKS, R. Key Issues in Criminology, London: Weidenfeld & Nicholson, 1970, 129.

ROESSEL, F. P. Minnesota Multiphasic Personality Inventory results for high school dropouts and graduates. Dissertation Abstracts, 1954, 14, 942-943.

ROSE, R. J. Preliminary study of three indicants of arousal: measurement, inter-relationships and clinical correlates. Unpublished Doctor's thesis, University of Minnesota, 1964. Cited by LYKKEN, D. I. & KATZENMEYER, C. G. Manual for the activity preference questionnaire (APQ). Reports from Research Laboratories of the Department of Psychiatry, University of Minnesota, 1967, 49.

ROSS, L. E. & NELSON, M. N. The role of awareness in differential conditioning. Psychophysiology, 1973, 10, 91-94.

ROUTTENBERG, A. Hippocampal correlates of consummatory and observed behaviour. Physiology and Behaviour, 1968, 3, 533-535.

ROUTTENBURG, A. Current status of the two-arousal hypothesis. Paper presented at the International Congress of Psychology, London, July, 1969.

ROZHDESTVENSKAYA, V. I. The strength of the nervous system as shown in the ability of nerve cells to endure protracted concentrated excitation. In GRAY, J. A. (Ed). Pavlov's Typology, Oxford: Pergamon, 1964, 367-378.

ROZHDESTVENSKAYA, V. I., NEBYLITSYN, V. D., BORISOVA, M. N. & YERMOLAYEVA-TOMINA, L. B. A comparative study of a number of indices of strength of the nervous system in man. Vop: Psikhol, 1960, 5, 41-56. Cited by MANGAN, G. L. The relationship of strength-sensitivity of the visual system to extracersion. In NEBYLITSYN, V. D. & GRAY, J. A. (Eds). Biological Bases of Individual Behaviour, New York & London: Academic Press, 1972, 257.

RUBIN, L. S. Autonomic dysfunction in neurotic behaviour. Archives of General Psychiatry, 1965, 12, 572-585. Cited by MARTIN, B. Anxiety and Neurotic Disorders, New York: Wiley, 1971, 34.

RUTTER, M. Maternal Deprivation Reassessed, Harmondsworth: Penguin, 1971.

SADLER, T. G. & MEFFERD, R. B. The interaction of extraversion and neuroticism in human operant behaviour. Journal of Experimental Research in Personality, 1971, 5, 278-285.

SADLER, T. G., MEFFERD, R. B. & HOUCK, R. L. The interaction of extraversion and neuroticism in orienting response habituation. Psychophysiology, 1971, 8, 312-318.

SAMUELS, I. Reticular mechanisms and behaviour. Psychological Bulletin, 1959, 56, 1-25.

SAVAGE, R. D. Electro-cerebral activity, extraversion and neuroticism. British Journal of Psychiatry, 1964, 110, 98-100.

SCHACTER, S. Emotion, Obesity and Crime, London & New York: Academic Press, 1971.

SCHACTER, S. & LATANÉ, B. Crime, cognition and the autonomic nervous system. In JONES, M. R. (Ed). Nebraska Symposium on Motivation, Lincoln: University of Nebraska, 1964, 221-273.

SCHALLING, D. Tolerance for experimentally induced pain as related to personality. Scandinavian Journal of Psychology, 1971, 12, 271-281.

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

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. No: 238, 1967.

SCHALLING, D., LINBERG, L., LEVANDER, S. E. & DAHLIN, Y. Spontaneous autonomic activity as related to psychopathy. Biological Psychology, 1973, 1, 83-97.

SCHALLING, D. & ROSEN, A. S. Porteus maze differences between psychopathic and non-psychopathic criminals. British Journal of Social and Clinical Psychology, 1968, 7, 224-228.

SCHLOSBERG, H. & KLING, J. W. The relationship between 'tension' and efficiency. Perceptual and Motor Skills, 1959, 9, 395-397.

SCHMAUK, F. J. Punishment, arousal and avoidance learning in sociopaths. Journal of Abnormal Psychology, 1970, 76, 325-335.

SHAGASS, C. & KERENYI, A. B. Neurophysiologic studies of personality. Journal of Nervous and Mental Disease, 1958, 126, 141-147.

SIDDLE, D. A., MORRISH, R. B., WHITE, K. D. & MANGAN, G. L. Relation of visual sensitivity to extraversion. Journal of Experimental Research in Personality, 1969, 3, 264-267.

SIDIS, B. & NELSON, L. The nature and causation of the galvanic phenomena. Psychological Review. 1910, 17, 98-146. Cited by McCLEARY, R. A. The nature of the galvanic skin response. Psychological Bulletin, 1950, 47, 97-117, 100.

SILVERMAN, J. The problem of attention in research and theory in schizophrenia. In BAKAN, P. (Ed). Attention: An Enduring Problem on Psychology, Princetown: Van Nostrand, 1966, 134-178.

SMITH, S. L. The effect of personality and drugs on auditory threshold when risk taking factors are controlled, 1967. Cited by GRAY, J. A. Strength of the nervous system, introversion-extraversion, conditionability and arousal. Behaviour Research and Therapy, 1967, 5, 151-169, 157.

SOMMER, C. L., 1902. Cited by McCLEARY, R. A. The nature of the galvanic skin response. Psychological Bulletin, 1950, 47, 100.

SPARROW, N. H. & ROSS, J. The dual nature of extraversion: a replication. Australian Journal of Psychology, 1964, 16, 214-218.

SPENCE, K. W. Behaviour and Conditioning, New Haven: Yale University Press, 1956. (a)

SPENCE, K. W. Anxiety (drive) level and performance in eyelid conditioning. Psychological Bulletin, 1964, 61, 129-139.

SPENCE, K. W. & SPENCE, J. T. Relation of eyelid conditioning to manifest anxiety, extraversion and rigidity. Journal of Abnormal and Social Psychology, 1964, 68, 144-149.

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

STEELE, R. E. An examination of positive and negative reinforcement in classical and operant conditioning paradigms in the primary psychopath. Dissertation Abstracts International, 1971, 31, 5643.

STENNETT, R. G. The relationship of performance level to level of arousal. Journal of Experimental Psychology, 1957, 54, 54-61.

STEWART, M. A., STERN, J. A., WINOKUR, G. & FREDMAN, S. An analysis of GSR conditioning. Psychological Review, 1961, 68, 60-67.

STRELAU, J. The general and partial nervous system types - data and theory. In NEBYLITSYN, V. D. & GRAY, J. A. Biological Bases of Individual Behaviour, New York & London: Academic Press, 1972, 62-71.

SURWILLO, W. W. The relation of amplitude of alpha rhythm to heart rate. Psychophysiology, 1965, 1, 247-252.

SUTKER, P. B. Vicarious conditioning and sociopathy. Journal of Abnormal Psychology, 1970, 76, 380-386.

SWEETBAUM, H. A. Comparison of the effects of introversion-extraversion and anxiety on conditioning. Journal of Abnormal and Social Psychology, 1963, 66, 249-254.

SYMON, S. M. An investigation of the relationship between conditioning and introversion-extraversion in normal students. Unpublished Master's Thesis, University of Aberdeen, 1958. Cited by EYSENCK, H. J. Extraversion and the acquisition of eyeblink and GSR conditioned responses. Psychological Bulletin, 1965, 63, 260. Cited by McPHERSON, F. M. Comment on Eysenck's account of some Aberdeen studies of introversion-extraversion and eyeblink conditioning. British Journal of Psychology, 1965, 56, 483.

TAFFEL, C. Anxiety and the conditioning of verbal behaviour. Journal of Abnormal and Social Psychology, 1955, 51, 496-501.

TARCHANOFF, J. Uber die galvanischen erscheinungen an der haut des menschen bei reizung der sinner organe und bei verschiedenen formen der psychischen tatigkeit, 1890. Cited by McCLEARY, R. A. The nature of the galvanic skin response. Psychological Bulletin, 1950, 47, 99.

TAYLOR, S. P. & EPSTEIN, S. The measurement of autonomic arousal. Psychosomatic Medicine, 1967, 29, 514-525.

TEPLOV, B. M. Problems in the study of general types of higher nervous activity in man and animals. In GRAY, J. A. (Ed). Pavlov's Typology, Oxford: Pergamon, 1964, 3-153.

THAYER, R. E. Activation states as assessed by verbal report and four psychophysiological variables. Psychophysiology, 1970, 7, 86-94.

THOMPSON, L. W. & OBRIST, W. D. EEG correlates of verbal learning and overlearning. Electroencephalography and Clinical Neurophysiology, 1964, 16, 332-342.

THURSTONE, L. L. The dimensions of temperament. Psychometrika, 1951, 16, 11-20.

TORRANCE, E. P. & ZILLER, R. C. Risk and life experience: development of a scale for measuring risk taking tendencies. United States Air Force, Washington Air Defence Centre, Technical Report No: 5, 1957, 1-23. Cited by KIPNIS, D. Character Structure and Impulsiveness, New York & London: Academic Press, 1971, 13.

TRASLER, G. B. The Explanation of Criminality, London: Routledge & Kegan Paul, 1962.

TRASLER, G. B. Criminal behaviour. In EYSENCK, H. J. Handbook of Abnormal Psychology 2nd. edition, London: Pitman, 1973.

UHERIK, A. Sleep deprivation, some electrophysiological indicators and personality traits. Studia Psychologia, 1971, 13, 214-221.

ULETT, G. A., GLESER, G., WINOKUR, G. & LAWLER, A. The EEG and reaction to photic stimulation as an index of anxiety proneness.. Electroencephalography and Clinical Neurophysiology, 1953, 5, 23-32.

UPADHYAYA, S. & MURTHY, H. N. Conditionability as related to introversion-extraversion and not to neuroticism. Transactions of All-India Institute of Mental Health, 1970, 10, 117-125. Abstract No: 1310 Psychological Abstracts, 1972, 48, 148.

VALINS, S. Psychopathy and physiological reactivity under stress. Unpublished Master's Thesis. Columbia University, 1963. Cited by VALINS, S. Emotionality and autonomic reactivity. Journal of Experimental Research in Personality, 1967, 2, 41.

VALINS, S. Emotionally and autonomic reactivity. Journal of Experimental Research in Personality, 1967, 2, 41-48.

VENABLES, P. H. & CHRISTIE, M. J. Mechanism, instrumentation, recording techniques and quantification of responses. In PROKASY, W. F. & RASKIN, D. C. (Eds). Electrodermal Activity in Psychological Research, New York & London: Academic Press, 1973, 1-124.

VINGOE, F. J. Validity of the Eysenck extraversion scale as determined by self-ratings in normals. British Journal of Social and Clinical Psychology, 1966, 5, 89-91.

VOGEL, M. D. The relation of personality factors to GSR conditioning of alcoholics: an exploratory study. Canadian Journal of Psychology, 1960, 14, 275-280.

VOGEL, M. D. GSR conditioning and personality factors in alcoholics and normals. Journal of Abnormal and Social Psychology, 1961, 63, 417-421.

WALKER, N. Crime, Courts and Figures: An Introduction to Criminal Statistics, Harmondsworth: Penguin, 1971.

WALLENSTEIN, J. S. & WYLE, C. L. Our law abiding law breakers. National Probation, 1947, (Mar: - Apr:), 107-112. Cited by HOOD, R. & SPARKS, R. Key Issues in Criminology, London: Weidenfeld & Nicholson, 1970, 47-48.

WARDLE, C. J. Two generations of broken homes in the genesis of conduct and behaviour disorders in childhood. British Medical Journal, 1961, 2, 349-354.

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

WHITE, K. D. & MANGAN, G. L. Strength of the nervous system as a function of personality type and level of arousal. Behaviour Research and Therapy, 1972, 10, 139-146.

WHITE, K. D., MANGAN, G. L., MORRISH, R. B. & SIDDLE, D. A. The relation of visual after-images to extraversion and neuroticism. Journal of Experimental Research in Personality, 1969, 3, 268-274.

WIELAND, W. F., STEIN, M. & HAMILTON, C. L. Intensity of the unconditioned stimulus as a factor in conditioning out of awareness. Psychosomatic Medicine, 1963, 25, 124-132.

WIGGINS, J. Inconsistent socialisation. Psychological Reports, 1968, 23, 303-336.

WIKLER, A. Pharmacologic dissociation of behaviour and EEG 'sleep patterns' in dogs: morphine, N-allyl-normorphine and atropine. Proceedings of the Society for Experimental Biological Medicine, 1952, 79, 261-265. Cited by LACEY, J. I. Somatic response patterning and stress: some revisions of activation theory. In APPLEY, M. H. & TRUMBULL, R. Psychological Stress: Issues in Research, New York: Appleton-Century-Crofts. 1967, 14-42.

WILDER, J. The law of initial values in neurology and psychiatry. Facts and problems. Journal of Nervous and Mental Diseases, 1956, 125, 73.

WILLETT, R. A. Measures of learning and conditioning. In EYSENCK, H. J. Experiments in Personality. Vol: 11. Psychodiagnostics and Psychodynamics, London: Routledge & Kegan Paul, 1960, 157-192.

WILSON, G. D. Reversal of differential GSR conditioning by instructions. Journal of Experimental Psychology, 1968, 76, 491-493. (a)

WILSON, G. D. Personality, GSR conditioning and response to i instructional set. Psychological Reports, 1968, 22, 618. (b)

WILSON, R. A., FUHRER, M. J. & BAER, P. E. Differential conditioning of electrodermal responses: effects of performing a masking task during the interstimulus and intertrial intervals. Paper presented at the Meeting of the Society for Psychophysiological Research. St: Louis, 1971.

WINTER, K., BROADHURST, A. & GLASS, A. Neuroticism, extraversion and EEG amplitude. Journal of Experimental Research in Personality, 1972, 6, 44-51.

WRIGHT, D. S., TAYLOR, A., DAVIES, D. R., SLUCKIN, W., LEES, S. G. M. & REASON, J. T. Introducing Psychology: An Experimental Approach, Harmondsworth: Penguin, 1970.

ZHOROV, P. A. & YERMOLAYEVA-TOMINA, L. B. Concerning the relation between extraversion and strength of the nervous system. In NEBYLITSYN, V. D. & GRAY, J. A. (Eds). Biological Bases of Individual Behaviour, New York & London: Academic Press, 1972, 262-268.

ZIENER, A. R. & SCHNELL, A. M. Individual differences in orienting, conditionability and skin resistance responsivity. Psychophysiology, 1971, 8, 612-622.

ZUCKERMAN, M., KOLIN, E. A., PRICE, L. & ZOOB, I. Development of a sensation-seeking scale. Journal of Consulting Psychology, 1964, 28, 477-482.

ZUCKERMAN, M. & LINK, K. Construct validity for the sensation-seeking scale. Journal of Consulting and Clinical Psychology, 1968, 32, 420-426.

APPENDICES

APPENDIX I.

Eysenck's Personality Inventory including (P).

NAME____________________ AGE__________ SEX__________

INSTRUCTIONS.

Please answer each question by putting a circle around the "YES" or the "NO" following the question. There are no right or wrong answers, and no trick questions. Work quickly and do not think too long about the exact meaning of the question.

REMEMBER TO ANSWER EACH QUESTION.

1.	Do you often long for excitement?	YES	NO
2.	Do you often need understanding friends to cheer you up?	YES	NO
3.	Do most things taste the same to you?	YES	NO
4.	Are you usually carefree?	YES	NO
5.	Do you enjoy hurting people you love?	YES	NO
6.	Do you find it very hard to take no for an answer?	YES	NO
7.	Do you generally feel well?	YES	NO
8.	Do you stop and think things over before doing anything?	YES	NO
9.	If you say you will do something do you always keep your promise, no matter how inconvenient it may be to do so?	YES	NO
10.	Have you had more trouble than most?	YES	NO
11.	Does your mood often go up and down?	YES	NO
12.	Do you worry a lot about catching illnesses?	YES	NO
13.	Do you generally do and say things quickly without stopping to think?	YES	NO
14.	Do you sometimes like teasing animals?	YES	NO
15.	Do you ever feel "just miserable" for no good reason?	YES	NO

16. Are there people who wish to harm you? YES NO

17. Would you do almost anything for a dare? YES NO

18. Do you let your dreams warn or guide you? YES NO

19. Do you suddenly feel shy when you want to talk to an attractive stranger? YES NO

20. Once in a while do you lose your temper and get angry? YES NO

21. Did you love your mother? YES NO

22. Do you often do things on the spur of the moment? YES NO

23. Is there someone else who is to blame for most of your problems? YES NO

24. Do you often worry about things you should not have said or done? YES NO

25. Generally do you prefer reading to meeting people? YES NO

26. Would you have done better if people had not put difficulties in your way? YES NO

27. Are your feelings rather easily hurt? YES NO

28. Would it upset you a lot to see a child or animal suffer? YES NO

29. Do you like going out a lot? YES NO

30. Do you occasionally have thoughts and ideas that you would not like other people to know about? YES NO

31. Are you sometimes bubbling over with energy and sometimes very sluggish? YES NO

32. Do people generally seem to take offence easily? YES NO

33. Do you prefer to have few but special friends? YES NO

34. Do you daydream a lot? YES NO

35. Would you take drugs which may have strange or dangerous effects? YES NO

36. When people shout at you, do you shout back? YES NO

37. Was your father a good person? YES NO

38. Are you often troubled about feelings of guilt? YES NO

39. Are all your habits good and desirable ones? YES NO

40. Can you usually let yourself go and enjoy yourself a lot at a gay party? YES NO

41. Are you usually very unlucky? YES NO

42. Would you call yourself tense or "highly-strung? YES NO

43. Would you feel very sorry for an animal caught in a trap? YES NO

44. Do other people think of you as being very lively? YES NO

45. When you are in a crowd, do you worry about catching germs? YES NO

46. After you have done something important, do you often come away feeling you could have done better? YES NO

47. Do your friendships break up easily without it being your fault? YES NO

48. Are you mostly quiet when you are with other people? YES NO

49. Do you sometimes gossip? YES NO

50. Do you care a lot about what others think of you? YES NO

51. Do ideas run through your head so that you cannot sleep? YES NO

52. Was your mother a good person? YES NO

53. If there is something you want to know about, would you rather look it up in a book than talk to someone about it? YES NO

54. Do you very often just sit and do nothing? YES NO

55. Do you get palpitations or thumping on your heart? YES NO

56. Do people tell you a lot of lies? YES NO

57. Do you like the kind of work that you need to pay close attention to? YES NO

58. Do you think some people try to avoid you? YES NO

59. Do you get attacks of shaking or trembling? YES NO

60. Would you always declare EVERYTHING at the customs, even if you knew that you could never be found out? YES NO

61. Do good manners and personal cleanliness matter much to you? YES NO

62. Do you hate being with a crowd who play jokes on one another? YES NO

63. When things go wrong is it usually your own fault? YES NO

64. Are you an irritable person? YES NO

65. Do you like doing things in which you have to act quickly? YES NO

66. Do a lot of different thoughts often come into your mind when you are trying to talk to someone? YES NO

67. Do you worry about awful things that might happen? YES NO

68. Are you slow and unhurried in the way you move? YES NO

69. Have you ever been late for an appointment or work? YES NO

70. When people are friendly do you wonder whether they really mean it? YES NO

71. Do you have many nightmares? YES NO

72. Do you normally speak rather loudly? YES NO

73. Do you like talking to people so much that you never miss a chance of talking to a stranger? YES NO

74. Are you troubled by aches and pains? YES NO

75. Do you generally understand why people feel the way they do? YES NO

76. Would you be very unhappy if you could not see lots of people most of the time? YES NO

77. Would you call yourself a nervous person? YES NO

78. Of all the people you know, are there some whom you definitely do not like? YES NO

79. Do you try not to be rude to people? YES NO

80. Would you say that you were fairly self-confident? YES NO

81. Are you easily hurt when people find fault with you or your work? YES NO

82. Before taking decisions, do you generally ask someone's advice? YES NO

83. Do you find it hard to really enjoy yourself at a lively party? YES NO

84. Are you troubled with feelings of inferiority? YES NO

85. Can you easily get some life into a rather dull party? YES NO

86. Do you sometimes talk about things you know nothing about? YES NO

87. Do you worry about your health? YES NO

88. Do you like playing pranks on others? YES NO

89. Do you suffer from sleeplessness? YES NO

APPENDIX II.

Kinsey' Impulsivity Scale.

1-8. When you were a boy, did you engage in the following activities fairly often? (Answer each item separately using the following key):

(1) Yes

(2) No

1. Football
2. Diving
3. Tobogganing
4. Softball or rounders
5. Hunting or shooting
6. Poker or Brag
7. Driving a motorcycle
8. Taking care of pets

9-20. Do you remember doing the following things as a child before you were 15? (Answer each item separately using the following key):

(1) Yes

(2) No

9. Playing with snakes
10. Being interested in sex
11. Being afraid of the dark
12. Arguing with parents and teachers fairly often about your rights
13. Reading a great deal
14. Smoking
15. Playing cricket
16. Doing cruel things
17. Going on picnics with the family
18. Playing truant
19. Eating only certain foods
20. Showing a bad temper when angry

21-31. Within the last year have you engaged in the following activities fairly often? (Answer each item separately using the following key):

(1) Yes

(2) No

21. Swimming

22. Diving

23. Poker or Brag

24. Bowling

25. Car rallying or scrambling

26. Bridge

27. Black Jack

28. Golf

29. Drinking parties

30. Snooker

31. Tennis

32-36. Had you done the following things before you were eighteen? (Answer each item separately using the following key):

(1) Yes

(2) No

32. Hiked over 20 miles

33. Learned to swim moderately well or better

34. Learned to handle a boat moderately well or better

35. Learned to climb mountains moderately well or better

36. Learned to skate.

37-43. How old were you when you first did the things listed in items 37-43? (Answer each item separately using the following key):

(1) 14 or younger

(2) 15 to 16

(3) 17 to 20

(4) 21 or older

(5) Not yet

37. Meeting girls by picking them up

38. Taking an overnight trip away from home without your family

39. Dancing

40. Drinking beer

41. Drinking spirits

42. Hitchhiking

43. Going to the library once a week or more

44. How much do you enjoy rough sports like football, boxing, wrestling, hockey?

(1) Very much

(2) Some

(3) Very little

(4) Not at all

45. In junior school (up to 11 years) how many times a year were you sent to the principal for fooling around in class?

(1) Usually not sent

(2) Once or twice

(3) Three or four times

(4) Fairly often

46. As a boy, how frequently did you take a dare?

(1) Almost always

(2) Usually

(3) Sometimes and sometimes not

(4) Almost never

(5) Never

47. In secondary school (11-15 years), how frequently were you punished for bad conduct in school?

(1) Once or twice a week

(2) Almost every week

(3) Almost every month

(4) Once every year or so

(5) Rarely or never

48. How frequently has the thought entered your mind that other people dislike you or something about you?

(1) Very often

(2) Pretty regular

(3) Occasionally

(4) Once or twice

(5) Never

49. In school (over 16 years) did you help other students with their studies?

(1) Other students asked me for help with their studies

(2) Other students expected me to have ideas about what to do and how to do it

(3) Teachers asked me to explain things to other students

(4) I sought opportunities to help other students understand things

(5) I rarely helped others with their studies

50. When you are with a group of friends deciding what to do for the evening, what do you usually do?

(1) Make a suggestion and try to get the others to accept it

(2) Make a suggestion and let it go at that

(3) Wait for others to make suggestions and express your opinion about their suggestions

(4) Say nothing and go along with the others

(5) Leave the group if you do not like the decision

51. Regardless of your income, have you managed to save anything?

(1) I have managed to save money

(2) I have never saved money

(3) I have sometimes spent more than I earned

52. When you have a little extra money, which of the following do you prefer to do?

(1) Try my luck at poker, dice or brag

(2) Get a good meal

(3) Go on a date or take my wife out

(4) Call relative or family when away from home

(5) Save it

53-56. How often do you like to do the following when you have a free evening? (Answer each item separately using the following key):

(1) As often as I can

(2) Fairly often

(3) Occasionally

(4) Rarely

53. Go to public dances

54. Go to parties with a date or wife

55. Go out with friends and stir up excitement

56. Go to the cinema

APPENDIX III.

ACTIVITY PREFERENCE QUESTIONNAIRE.

Form A.

DIRECTIONS

Read Carefully

One way of understanding a person better is by studying the kinds of activities or experiences he likes or enjoys. This test employs the similar approach of studying the pattern of your dislikes. In each of the items on the following pages -- and in the sample item below -- two activities or experiences are described which most people would consider at least mildly unpleasant. Some of them are very unpleasant indeed. In some instances, you will find that similar things have actually happened to you; in the others, you can at least imagine what they would be like.

Your task is to try to imagine yourself in each of the two situations and then, pretending that either one or the other had to happen to you, to decide which one you would prefer -- which of the two you would take as the 'lesser of evils'.

SAMPLE ITEM.

(T) Having to work late one night. (F) Being run over by a train.

In this case there isn't much doubt that, if one of these things had to happen to you, you would prefer the alternative on the left (working late at night) as the lesser evil than the one on the right (being run over by a train). Therefore you would make a pencil mark in the left-hand box (the one marked with a T) on the answer sheet. DO NOT MAKE ANY MARKS ON THE TEST BOOKLET. If you would prefer the activity or experience listed on the right -- if you think that one would be less unpleasant than the other alternative -- fill in the right-hand box (the one marked with an F) on the answer sheet.

Answer every item on the test. Work rapidly but consider both alternatives in each item carefully. Imagine how you would feel about each alternative, decide which of the two would seem <u>least</u> unpleasant, and mark your answer sheet accordingly.

– – – <u>Remember:</u> Indicate the alternative that you would <u>prefer.</u> – – –

1. (T) Being interviewed for a job.
   (F) Mowing the lawn.
2. (T) Sitting through a dull movie for the second time because the person you're with hasn't seen it.
   (F) Turning on a light switch when your hand is wet and you might get a shock.
3. (T) In the midst of traffic your horn sticks and begins to blow continuously.
   (F) In school having to give a report in front of the class.
4. (T) Your group takes up a collection to buy a sick member a gift. You discover later that your donation was much smaller than any others.
   (F) On doctor's orders, you can eat nothing for two weeks but a liquid dietary product.
5. (T) Take a roller coaster ride.
   (F) Wash three storm windows on each side.
6. (T) Copy four pages of a dictionary.
   (F) Belching in church during prayer.
7. (T) Painting a large greenhouse.
   (F) Shoveling the pavements after a snowstorm.
8. (T) Attempting to beat a railway train at a crossing.
   (F) Spraining your ankle so that you have to have a cast put on it.
9. (T) Cleaning out a basement.
   (F) Going to a party where no one knows you.
10. (T) Getting caught at something.
    (F) Having your empty car smashed by a runaway lorry.
11. (T) Having to get out of bed an hour earlier than usual.
    (F) You pass someone on the street and say, "Hi, Charley" and then realise it isn't Charley.

12. (T) Watching an operation.

(F) Your favourite hat is lost or stolen.

13. (T) Accidentally dialling a wrong number twice in succession.

(F) Giving a loud, uncontrollable sneeze during a quiet moment at the symphony.

14. (T) Walking a mile when it's 15 degrees below zero.

(F) Being near where a volcano erupts.

15. (T) People at a party are telling jokes. You tell a long drawn-out story but no one laughs.

(F) You catch a bad cold the day before a big party.

16. (T) Hitting your thumb while hammering a nail.

(F) After eating in a restaurant, you find that you can't pay the bill.

17. (T) Taking down the Christmas tree and cleaning up after it.

(F) Jumping down 15 feet into soft earth.

18. (T) Whitewashing a long board fence.

(F) Washing 20 storm windows on both sides.

19. (T) It is the first day in a new class. The teacher asks each person to stand up and tell about himself.

(F) Sweep the floor.

20. (T) You must walk around all day on a blistered foot.

(F) Sleeping out on a camping trip in an area where rattlesnakes have been reported.

21. (T) Several people push ahead of you in line but you can't bring yourself to say anything.

(F) Wanting to go out some night and not having any money.

22. (T) Going to the morgue to identify an acquaintance who has been killed in an accident.

(F) Letting a large but harmless spider run up your arm.

23. (T) Breaking your shoelace while getting dressed.

(F) Your dog has torn up the neighbour's newspaper and you have to go over and apologize.

24. (T) Find a big cockroach under your pillow.

(F) Getting stuck in traffic when you're in a hurry.

25. (T) After a school exam, names and grades are posted on the wall. Yours is at the bottom of the list.

(F) You find you must clean up the floor where someone has vomited.

26. (T) Having to run until your throat is sore and there's a pain in your side.

(F) Help push a stalled car on a winter morning.

27. (T) Getting ready to watch something important on television and having the set fail.

(F) Upsetting a glass of milk on a neighbour's carpet.

28. (T) Finding a wrecked car in the ditch with three occupants unconcious and bleeding.

(F) You go on a two-week ocean cruise and are seasick the entire time.

29. (T) You find that you must cancel your vacation.

(F) You are arguing with friends and get so frustrated and upset that you choke up and your eyes fill with tears.

30. (T) Having your date at a dance leave without you.

(F) Sitting through a long lecture with a runny nose and no handkerchief.

31. (T) Asking someone to pay you money that he owes you.

(F) Sleeping one night on the floor.

32. (T) Balancing along the top of a picket fence.

(F) Walking up four flights of stairs.

33. (T) Having to stay in bed with the flu and a sick headache.

(F) Having your hands shake and your mouth go dry as you try to talk in front of a group.

34. (T) Having to spend half a day in a closet.

(F) You overhear a friend say something sarcastic about your parents.

35. (T) Dispose of a dead mouse from a mousetrap.

(F) Being caught in a thunderstorm.

36. (T) Being wheeled into the operating room to have your appendix removed.

(F) A doctor examined a sore in your throat and you are waiting to find out whether it's cancer.

37. (T) You are on stage in the school play and realise that you have forgotten your lines.

(F) You return to your car parked downtown to find you left the lights on so that the battery is dead.

38. (T) Standing in a long line for something.

(F) Being given an electric shock as part of a medical experiment.

39. (T) Having your hair cut by an inexperienced barber.

(F) You slip in mud and get your new spring clothes soaked and dirty.

40. (T) Put on a shirt or a blouse and find a button missing.

(F) Having to ask where the bathroom is at a party.

41. (T) You're in a bank and suddenly three masked men with guns come in and make everyone raise their hands.

(F) Sitting through a two-hour concert of bad music.

42. (T) Counting the beans needed to fill a four-quart sweet jar.

(F) At a high school picnic, they choose up sides for baseball and you are the last one picked.

43. (T) Washing a car.

(F) Driving a car at 95 miles an hour.

44. (T) Having to ask the person behind you at the cinema to stop kicking the seat.

(F) Watching a long headache-pill commercial on T.V.

45. (T) You are paddling a canoe across a large Canadian lake and a storm blows up.

(F) Stumbling into an electric fan.

46. (T) You have taken a neighbour's child to the circus and realise you have lost him in the crowd.

(F) While on vacation your car breaks down and you have to wait in a small town while parts are sent for.

47. (T) You must scrub the kitchen floor on hands and knees.

(F) You must make a speech to 100 people.

48. (T) Having your car swing into a skid on an icy corner.

(F) Having to walk five miles for petrol.

49. (T) Having your empty car smashed by a runaway lorry.

(F) Having your grocery bag break and spill on a crowded street.

50. (T) You go to a party and find that you're the only one who dressed up.

(F). Wet mopping the floor of a hospital corridor.

51. (T) You're at summer camp and must do 30 minutes stiff calesthanics each morning before breakfast.

(F) You row out in a boat to bring in the dead body of a drowning victim.

52. (T) Digging a big rubbish pit.

(F) A high pressure sales clerk bullies you into buying the higher-priced pair of shoes that you didn't really want.

53. (T) Having the doctor stick a needle in your arm for an injection.

(F) Falling out of a boat.

54. (T) Losing your wallet to a pickpocket.

(F) Having someone say loudly to you at a party, "Why don't you go home? Nobody wants you here."

55. (T) Being chased by a huge and angry bull.

(F) Spending a month in bed.

56. (T) Introducing yourself to a total stranger.

(F) Having to stand up on the bus.

57. (T) Cleaning up your house after floodwaters have left it filled with mud and silt.

(F) Making a parachute jump.

58. (T) Being a dishwasher in a restaurant for one week.

(F) You get a chance to be interviewed on TV to advertise a charity drive but you become tongue-tied and make a poor showing.

59. (T) Finding that you have been short-changed and having to return to the store to ask for the rest.

(F) Sandpapering a wooden chair to get it ready for re-painting.

60. (T) Spending a week with nothing to eat but bread and water.

(F) Going to hospital to have a minor operation.

61. (T) Running out of petrol in the middle of a crowded downtown intersection.

(F) Waiting in line for two hours to pay a parking ticket.

62. (T) Having to give up eating desserts.

(F) Swimming in very rough ocean water.

63. (T) Just sitting around with nothing to do on a Sunday afternoon.

(F) Cutting out the spoiled parts of a bushel of potatoes.

64. (T) You must wash out a dozen of someone else's dirty handkerchiefs by hand.

(F) Walking into a room full of people, you stumble on a footstool and sprawl on the floor.

65. (T) Having someone get mad and tell you off.

(F) Playing cards with people who are more skilled than you are and then making a dumb mistake.

66. (T) Being caught on a sandbank by the rising tide.

(F) Being stranded in an off-shore lighthouse for a week by high tides.

67. (T) Being sick in your stomach for 24 hours.

(F) Finding out you've overslept and missed an important appointment.

68. (T) You are introduced to a girl (man) who is so attractive and poised that you become very shy and awkward.

(F) You must find where someone else parked your car in a big lot at the state fair.

69. (T) Being in a flood.

(F) Carrying a ton of coal from the backyard into the basement.

70. (T) Spilling paint all over your shoes.

(F) Discovering your feet are dirty when you undress for a medical examination.

71. (T) Having a gabby old woman sit down next to you on the bus.

(F) Catching a bad cold the day before a big party.

72. (T) Having to walk half a mile through a soaking rain without a coat.

(F) Walking near a whirling plane propeller.

73. (T) You agree to supervise a child's birthday party but the children won't mind you and race around out of control.

(F) Spending the evening with some boring people.

74. (T) Laughing at something not meant to be funny.

(F) Clean up the popcorn and candy wrappers in the neighbourhood movie theatre.

75. (T) Walking around all day in tight, uncomfortable shoes.

(F) Finding yourself in the midst of a fighting mob.

76. (T) You have spent all day preparing for a picnic but it rains just as you start to eat.

(F) You overhear someone comment on how strangely you are dressed.

77. (T) Being threatened by a much bigger and more powerful person.

(F) You're caught in a speed trap driving through a small town and must wait for an hour to pay a $20 fine.

78. (T) Lick stamps for 1,000 letters.

(F) Watch someone make a fool of himself on a television quiz programme.

79. (T) You are given an IQ test in front of a college class as a demonstration.

(F) Having to go down to the courthouse to renew your driver's license.

80. (T) Cleaning up the living room after the plaster has all fallen down.

(F) Standing on the very top rung of a ladder in order to wash a second floor window.

81. (T) You are broke and have to borrow for a meal.

(F) You must distribute 1,000 handbills in letter boxes from door to door.

82. (T) Having a bad head cold.

(F) Having your employer get mad about mistakes in your work.

83. (T) Looking for something in an attic storeroom on a stifling hot day.

(F) Going into a dark cellar where there may be rats.

84. (T) "Having it out" with someone.

(F) Sitting from midnight to 4.00 a.m. in a railway station waiting for your train.

85. (T) Walking barefoot in a room where some glass has been broken.

(F) Walking barefoot across a burning hot sandy beach.

86. (T) Coming home hungry and having to eat a cold supper.

(F) Stumbling in a crowded bus and dropping your load of packages.

87. (T) Coming out of a movie in your summer shoes to find it's snowed a foot deep.

(F) Getting out of a warm bed in a room so cold that you can see your breath.

88. (T) Sorting out a bucketful of nuts and bolts.

(F) While flying home from a trip you get airsick and have to dash down the aisle to the wash-room.

89. (T) Taking a long ride in a taxi and then finding you don't have enough money for the trip.

(F) Getting paint in your hair.

90. (T) While dining at home, you spill a very hot cup of coffee in your lap.

(F) You go with your date to a party but she (he) slips away later and goes home with someone else.

91. (T) Waiting in a dentist's office to have a tooth out.

(F) Having an earache.

92. (T) Having to go out to a party with a large red pimple on the end of your nose.

(F) Loosing a book that you borrowed from a teacher and which can't be replaced.

93. (T) Your family, along with three others, must spend a month underground testing a fall-out shelter.

(F) You want to join a social club, but the members vote not to let you in.

94. (T) Out in the middle of a frozen lake, you realise that the ice is unsafe.

(F) You find that vandals have slashed all four tyres on your car.

95. (T) Waiting for an overdue bus.

(F) Meeting a friend on the street and not being able to remember his name.

96. (T) You're in the back seat of a driverless car which suddenly starts rolling downhill.

(F) Giving blood for the blood bank.

97. (T) You go to the beach with some friends and realise that they all have a better build (figure) than you do.

(F) Washing ten storm windows on both sides.

98. (T) Run a steam presser in a laundry for a week.

(F) Being caught in a blizzard.

99. (T) Being asked for a contribution when you haven't any money.

(F) Untying a hard knot in your shoelace.

100. (T) Having to "go out" with a visiting relative.

(F) Banging your head on a cabinet door.

APPENDIX IV.

Our shortened MMPI version for Ma and Pa.

Instructions:- Read each statement and decide whether it is true or false as applied to you. Then make a cross in the appropriate column. Try not to leave any blank spaces.

	TRUE	FALSE
1. At times I feel that I can make my mind up with unusually great ease.		
2. I like to talk about sex.		
3. I wish I were not so shy.		
4. I am always disgusted with the law when a criminal is freed through the arguments of a smart lawyer.		
5. I am neither gaining nor losing weight.		
6. At times my thoughts have raced ahead faster than I could speak them.		
7. I have had very strange and peculiar experiences.		
8. I do not mind being made fun of.		
9. Some people are so bossy that I feel like doing the opposite of what they request, even though I know they are right.		
10. I know who is responsible for most of my troubles.		
11. It makes me impatient to have people ask my advice or otherwise interrupt me when I am working on something important.		
12. No one seems to understand me.		
13. If people had not had it in for me I would have been much more successful.		
14. I am easily downed in an argument.		
15. My hardest battles are with myself.		

TRUE FALSE

16. When I was a child, I belonged to a crowd or gang that tried to stick together through thick and thin.

17. When in a group of people I have trouble thinking of the right things to talk about.

18. I sweat very easily even on cool days.

19. My speech is the same as always (not faster or slower, or slurring; no hoarseness.)

20. There is very little love and companionship in my family as compared to other homes.

21. During one period when I was a youngster I engaged in petty thievery.

22. I have very few fears compared to my friends.

23. What others think of me does not bother me.

24. I have been inspired to a programme of life based on duty which I have since carefully followed.

25. I have at times stood in the way of people who were trying to do something, not because it amounted to much but because of the principle of the thing.

26. I find it hard to keep my mind on a task or job.

27. It makes me uncomfortable to put on a stunt at a party even if others are doing the same thing.

28. A person should try to understand his dreams and be guided by or take warning from them.

29. I feel I have often been punished without cause.

30. I have met problems so full of possibilities that I have been unable to make up my mind about them.

31. I am happy most of the time.

32. It is not hard for me to ask help from my friends even though I cannot return the favour.

33. I have periods of such great restlessness that I cannot sit long in a chair.

34. At times I have a strong urge to do something harmful or shocking.

35. My daily life is full of things that keep me interested.

36. I am against giving money to beggars.

37. My parents have often objected to the kind of people I went around with.

38. I have never done anything dangerous for the thrill of it.

39. At times I have very much wanted to leave home.

40. Much of the time I feel as if I have done something wrong or evil.

41. I have often had to take orders from someone who did not know as much as I did.

42. I don't blame anyone trying to grab everything he can get in this world.

43. I have been disappointed in love.

44. I believe women ought to have as much sexual freedom as men.

45. I have never been in trouble because of my sex behaviour.

46. Sometimes, when I am not feeling well, I am cross.

47. I have not lived the right kind of life.

48. I work under a great deal of tension.

49. In school I was sometimes sent to the principal for bad behaviour.

APPENDIX V.

Blackburn's Revised Personality Inventory 1970

1. Sometimes I have the same dream over and over.
2. I have sometimes stayed away from another person because I feared doing or saying something that I might regret afterwards.
3. I am in just as good physical health as most of my friends.
4. When in a group of people I have trouble thinking of the right things to talk about.
5. I feel that I have often been punished without cause.
6. I like dramatics.
7. I get mad easily and then get over it soon.
8. I can remember "playing sick" to get out of something.
9. I seem to be about as capable and smart as most others around me.
10. I easily become impatient with people.
11. I feel anxiety about something or someone almost all the time.
12. Once in a while I feel hate towards members of my family whom I usually love.
13. I enjoy many different kinds of play and recreation.
14. I like to let people know where I stand on things.
15. I am often said to be hot headed.
16. At times I feel like picking a fist fight with someone.
17. I have often found people jealous of my good ideas just because they had not thought of them first.
18. If I could get into a movie without paying and be sure I was not seen I would probably do it.
19. Whenever possible I avoid being in a crowd.
20. I do many things which I regret afterwards.
21. I like to flirt.
22. I like parties and socials.

23. I worry quite a bit over possible misfortunes.

24. I liked school.

25. I feel tired a good deal of the time.

26. In a group of people I would not be embarrassed to start a discussion or give an opinion about something I know well.

27. I am fascinated by fire.

28. I am bothered by people outside, on street cars, in stores etc. watching me.

29. I have at times had to be rough with people who were rude or annoying.

30. I have at times stood in the way of people who were trying to do something, not because it amounted to much but because of the principle of the thing.

31. Some of my family have quick tempers.

32. I am often inclined to go out of my way to win a point with someone who has opposed me.

33. If given the chance I would make a good leader of people.

34. I am often so annoyed when someone tries to get ahead of me in a line of people that I speak to him about it.

35. I do not always tell the truth.

36. I sometimes find it hard to stick up for my rights because I am so reserved.

37. At times I feel like smashing things.

38. I do not dread seeing a doctor about a sickness or injury.

39. My worries seem to disappear when I get into a crowd of lively friends.

40. I have periods in which I feel unusually cheerful without any special reason.

41. At times I am all full of energy.

42. I am a good mixer.

43. I have strange and peculiar thoughts.

44. I have sometimes felt that difficulties were piling up so high that I could not overcome them.

45. I am often sorry because I am so cross and grouchy.

46. At times I have a strong urge to do something harmful or shocking.

47. At times I feel like swearing.

48. I enjoy the excitement of a crowd.

49. I seem to make friends about as quickly as others do.

50. I have had very strange and peculiar experiences.

51. When in trains, buses etc. I often talk to strangers.

52. Even when I am with people I feel lonely most of the time.

53. I was fond of excitement when I was young.

54. I find it hard to talk when I meet new people.

55. I am likely not to speak to people until they speak to me.

56. I should like to belong to several clubs or lodges.

57. I am about as able to work as ever I was.

58. I have very few quarrels with members of my family.

59. I have no dread of going into a room by myself where other people have already gathered and are talking.

60. I was a slow learner in school.

61. I frequently find it necessary to stand up for what I feel is right.

62. I like to attend lectures on serious subjects.

63. Sometimes I feel I must injure myself or someone else.

64. I like to go to parties and other affairs where there is lots of loud fun.

65. I think I would like the work of a building contractor.

66. I would like to be an auto-racer.

67. I like preparing a door-latch.

68. At times I have a strong urge to do something harmful or shocking.

69. At times I think I am no good at all.

70. I like parties and socials.

71. I am not easily angered.

72. I am a good mixer.

73. I would like to hunt lions in Africa.

74. I like to read about science.

75. I have never done anything dangerous for the thrill of it.

76. I wish I could be as happy as others seem to be.

77. My way of doing things is apt to be misunderstood by others.

78. It is not hard for me to ask help from my friends even though I cannot return the favour.

79. Once in a while I laugh at a dirty joke.

80. Once in a while I think of things too bad to talk about.

81. I enjoy social gatherings just to be with people.

82. In school I found it very hard to talk before a class.

83. I have never had a fit or convulsion.

84. I love to go to dances.

85. Sometimes when embarrassed I break out in a sweat which annoys me greatly.

86. Something exciting will always pull me out of it when I am feeling low.

87. When I get bored I like to stir up some excitement.

88. I like science.

89. My daily life is full of things that keep me interested.

90. I try to remember good stories to pass them on to other people.

91. I have had periods in which I carried on activities without knowing later what I had been doing.

92. I sometimes feel that I am about to go to pieces.

93. I like to cook.

94. I like to read newspaper articles on crime.

95. Parts of my body often have feelings like burning, tingling, crawling, or like 'going to sleep'.

96. I do not blame a person for taking advantage of someone who lays himself open to it.

97. I am often not in on the gossip and talk of the group I belong to.