

THE EFFECTS OF REWARD-PUNISHMENT, INTROVERSION-
EXTRAVERSION AND NEUROTICISM
ON VERBAL CONDITIONING

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CHAPTER I

INTRODUCTION

Since the publication of the early work of Pavlov (1927), which described marked individual differences in the conditioning performance of animals, the method of conditioning has held promise of elucidating basic parameters of human personality functioning. Early attempts to apply the method to human subjects encountered serious methodological difficulties. Apart from such technical problems as the measurement of the output of saliva in salivary conditioning of human subjects, it became apparent that the central factors of "attitude," "set," or "expectancy" are important sources of variability in human conditioning. The conditioning of other responses, such as the GSR, brought new problems of measurement. It is probably true, however, that the most significant barriers to progress were conceptual, rather than methodological. In the Soviet Union there was apparently a long period in which little advance was made on Pavlov's thinking in relation to the problems of individual differences in conditioning. In the Western world this aspect of Pavlov's theorizing had little impact, and there were no alternative theories which might have systematized the findings of existing research and pointed the way to significant areas of future study.

The resurgence of Western interest in problems of conditioning and human behavior over the past two decades or so seem to have resulted

chiefly from the development of two psychological theories of relevance to problems of behavior. These are the theories of Hull (1943, 1952) and Eysenck (1957). Between them these two theories have inspired the majority of Western studies of conditioning in relation to human behavior over the past two decades.

A further development leading to renewed interest in behavior-conditioning relations has been the application of direct conditioning methods in the therapy of behavior disturbances. This work received a good deal of its impetus from the application of conditioning methods in the study of experimental neuroses.

In addition to therapy, the area of conditioning and human behavior has numerous implications for diagnosis and etiology of maladaptive behavior. These implications will be discussed in a later section.

Eysenck's Theoretical Formulations

The only comprehensive theory of personality or human behavior which has given rise to explicit predictions concerning the differential conditioning performance of groups distinguished on the basis of personality is that of Eysenck. Conditioning is allotted a crucial role in Eysenck's theory. In the development of his theory, Eysenck began with a study of the problems of classification. At this stage the question asked was, "What are the major dimensions of personality with respect to which persons vary?" The answer, proposed on the basis of previous findings and original research, was that most of the variance in personality functioning can be accounted for in terms of the three orthogonal dimensions of psychoticism, neuroticism, and introversion-extraversion. Psychoticism is defined as a predisposition to develop

such symptoms of mental disorder as delusions, hallucinations, mood disturbances, motor retardation, and the like. Neuroticism is identified with emotionality or lability of the autonomic nervous system, which is considered to act as a predisposition to neurotic disorders. The introversion-extraversion dimension is defined in terms of a wide range of behaviors. The behavior of introverts is characterized by a relative lack of sociability, high persistence, high level of aspiration, an emphasis on accuracy rather than speed, reliance on inner standards of conduct, and a stress on moral scruples. Extraverts, on the other hand, are sociable, impulsive, dependent on the social evaluations of others, low in level of aspiration, and tough minded in their attitudes. Eysenck proposes that hysteria is the syndrome to be found in the extraverted neurotic, while dysthymia (syndrome characterized by anxiety, reactive depression, and/or obsessive-compulsive features) is typically found in the introverted neurotic (Eysenck, 1957, 1967; Lovibond, 1964).

In seeking likely neurophysiological mechanisms of the personality differences between extraverts and introverts, Eysenck followed Pavlov's excitation-inhibition theory and Hull's inhibition theory. He formulated his individual difference and typological postulates in terms of excitation-inhibition balance. Hull's (1943) statement of the law of inhibition is as follows: "Whenever any reaction is evoked in an organism there is left a condition or state which acts as a primary, negative motivation in that it has an innate capacity to produce a cessation of the activity which produced the state." He goes on to say that we shall call this state or condition reactive inhibition. The reaction decrements which have been attributed to reactive

inhibition obviously bear a striking resemblance to the decrements which are ordinarily attributed to "fatigue." It is important to note that "fatigue" is to be understood in the present context as denoting a decrement in action evocation potentiality, rather than an exhaustion of the energy available to the reacting organ.

For Hull, the net amount of functioning inhibitory potential resulting from a sequence of reaction evocations is a positively accelerated function of the amount of work involved in the performance of the response in question. Amount of work can be conceived not only as physical work but also as mental work, defined in terms of complexity of task, difficulty of task, amount and continuity of attention required, and so forth.

Another characteristic of reactive inhibition noted by Hull is that each amount of inhibitory potential diminishes progressively with the passage of time according to a simple decay or negative growth function. This formation extends the notion of inhibition as a fatigue product to the dissipation of inhibition over time, in very much the same way as fatigue is dissipated by rest.

The main contention put forward by Hull is that all responses leave behind in the physical structures involved in the evocation, a state or substance which acts directly to inhibit the evocation of the activity in question. The hypothetical inhibitory condition or substance is observable only through its effect upon positive reaction potentials.

Pavlov's (1927) concept of cortical functions distinguishes two fundamental processes: excitation and inhibition. On the basis of his observation of large individual differences in the rate of

conditioning among dogs, Pavlov postulated two temperamental types, the excitatory and inhibitory, which correspond to the cortical processes of excitation and inhibition respectively. The excitatory type developed stable positive conditioned responses with ease and retained these responses for a long time during extinction. The inhibitory type developed positive conditioned responses very poorly, which, once formed, were easily disrupted and soon extinguished. Following a large number of experiments on the conditionability of dogs and the induction of experimental "neurosis" in animals, Pavlov (1941) likened the kinds of neurosis developed in his various types of dogs to those found in man. He made many speculations about the causes of various human mental disorders in terms of pathological variations in his two cortical processes. He made the observation that neurasthenics possess an exaggeration of the central excitatory process whereas hysterics possess an exaggeration of the central inhibitory process.

Borrowing from Hull and Pavlov, the general relationship between personality and excitation-inhibition was put forward by Eysenck (1957) in two postulates. The first of these was called the postulate of individual differences: human beings differ with respect to the speed with which cortical 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-responses connections. The second postulate was called 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 behavior 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 behavior 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 behavior and to develop hysterical-psychopathic disorders in case of neurotic breakdown. Conversely, individuals in whom reactive inhibition is developed slowly, in whom weak reactive inhibitions are generated, and in whom reactive inhibition is dissipated quickly, are thereby predisposed to develop introverted patterns of behavior and to develop dysthymic disorders in case of neurotic breakdown (Eysenck, 1967).

A link between excitation-inhibition balance and (a) the personality patterns of introversion versus extraversion, and (b) hysterical-psychopathic disturbances versus dysthymia, is provided by conditioning.

In brief, a key difference between extraverts and introverts is the degree of socialization which is typical of each. Socialization, or the establishment of social controls over egoistic impulses, is mediated by conditioning. Because of their rapid strong development of excitation and their weak tendency toward the development of reactive inhibition, introverts condition well, and hence tend to become oversocialized. Conversely, the slow development of weak excitatory potentials, and the rapid and strong development of inhibitory potentials, makes extraverts condition poorly. As a consequence extraverts tend to be undersocialized.

Strong autonomic-emotional lability and reactivity produce excessive fear reactions to painful stimuli in all persons high on neuroticism, but in the introverted neurotic, the strong capacity for conditioning causes these fear reactions to become attached to a multitude of fortuitous stimuli, thus producing the excessive anxiety reactions of the dysthymic. The dysthymic, then, is characterized by oversocialization and excessive anxiety, while the hysteric is characterized by undersocialization and autonomic lability without excessive conditioned anxiety.

It is clear that Eysenck's theory postulates a general factor of conditionability. It also leads to the prediction that introverted normals will condition more rapidly than extraverted normals with any reliable conditioning procedure. Furthermore the theory predicts that neurotic introverts (dysthymics) will condition better than unselected normals, and that neurotic extraverts (hysterics and psychopaths) will condition less well than unselected normals. There is no suggestion, however that neuroticism, anxiety, or emotionality as such will be related to conditioning performance.

Recently Gray (1970) has advanced a new view concerning the nature of the psychological variables underlying the dimensions of personality of introversion-extraversion and neuroticism. It is the purpose of this study to investigate some of the hypotheses implied by Gray's new conception of factors involved in conditionability, extraversion-introversion, and neuroticism. Briefly Gray feels that the hypothesis in Eysenck's theory of introversion-extraversion attributing greater conditionability to the introvert should be replaced by the hypothesis that the introvert is relatively more sensitive to punishment and to

frustrative nonreward. He also conceives neuroticism as reflecting degree of sensitivity to both reward and punishment.

Gray's Theoretical Formulations

Gray feels that the experimental evidence that introverts condition better than extraverts under some conditions and not all has the most importance for Eysenck's general theory of introversion. The idea that introverts are more highly conditionable than extraverts has to bear a heavy burden within this theory. It is by way of this assumption that the vital behavioral and psychiatric differences between introverted and extraverted neurotic are accounted for. It is not all clear that this burden can be carried by the weaker assumption (demanded now by the experimental facts) that introverts condition better than extraverts only under some conditions.

For example, in a study by Eysenck and Levey (1967) investigating eyeblink conditioning in groups of extreme introverts and extraverts, three variables were investigated: reinforcement schedule (50 percent random vs. 100 percent), UCS intensity (an air-puff of 3 p.s.i. vs. one of 6 p.s.i.) and CS-UCS interval (400 msec vs. 800 msec). They found that the two reinforcement schedules did not have significantly different effects on introverts and extraverts and that introverts condition better than extroverts with low (3 p.s.i.) UCS intensity. It is true that in this experiment, introverts conditioned better than extraverts under those conditions which were less than optimal for the group as a whole. And one might well argue that, in real life, parental conditioning techniques are unlikely to be optimal very often. But the non-optimal conditions in Eysenck and Levey's (1967) experiment favored

introverts because they were especially chosen to do so. Had they been over-arousing ones, Eysenck's theory predicts that the introvert would not have fared that well. Thus, since there is no reason to suppose that parental conditioning techniques are more often under-arousing than over-arousing, there is equally no reason to predict the over-socialization of the introvert which is critical to the whole of Eysenck's theoretical super-structure.

Sensitivity to Punishment and Nonreward

Gray (1970) feels that if we accept Eysenck's description of introvert behavior as over-socialized and of extravert behavior, correspondingly, as under-socialized, and if we accept his view that the process of socialization consists in the formation of a cluster of conditioned fear reactions, then we must agree that Eysenck has asked the right question: why do introverts form conditioned fear reactions more strongly than extraverts? We have just rejected the answer: "because they are better at conditioning." Another answer is: "because they are more susceptible to fear or punishment" and this is one of the hypotheses to be tested in this study.

Support for this hypothesis can be found in experiments by Spence (1964) and Kimble (1969). They found that high anxious introverts form conditioned eyeblink responses better than low anxious introverts if the environment in which they are investigated contains some element of threat (e.g. shock). Notice also that all the data favoring the hypothesis that introverts are in general more conditionable than extraverts (Eysenck, 1965, 1967) also favor Gray's hypothesis, since they have all been obtained in aversive conditioning situations, mainly

that of eyeblink conditioning.

Gray's hypothesis that introversion involves a heightened susceptibility to fear (or to express the same point differently, a heightened sensitivity to punishment and warnings of punishment) has a great deal of face validity. Psychopathic behavior in the extraverted neurotic is easily regarded as a tendency to take a reward (by, say, stealing, lying, or sexual gratification) without thought for the consequences, i.e., with no fear of punishment. The recidivism which is such a feature of psychopathic behavior (Eysenck, 1964) is also most simply regarded precisely as a relative insensitivity to punishment. Conversely, the symptoms of the dysthymic neuroses are in many cases perfectly clear expressions of fear, as for example in the phobias and the anxiety state. In other cases it requires very little skill to discern the fear which lies less obviously behind the neurotic symptoms. A good example is the obsessional ritual or rumination. This may be performed in a state of apparent calm, but it is usually sufficient to prevent the patient from complying with the urge to perform the ritual for overt signs of fear, often intense, to become evident. Indeed, the obsessive-compulsive symptoms bear all the marks of an active avoidance response (Gray, in press, a).

Gray's hypothesis also predicts the same socialization differences as are postulated by Eysenck. The introverted neurotic child should socialize better than the extroverted neurotic because his greater sensitivity to punishment should lead to a firmer development of the conscience to the extent that punishment or withdrawal of reward are used as parental techniques of control of undesirable behavior.

In further considering Gray's hypothesis, we must bear in mind the extraversion factor is made up of two correlated (+.468) sub-factors (Eysenck and Eysenck, 1963), one of "impulsiveness" and one of "sociability" or "social extraversion." In the light of the present hypothesis we would propose that the extravert acts on the spur of the moment because his behavior, when compared to the introvert, is more determined by potential rewards in his environment. He is also less likely to avoid potential punishment. His greater interaction with people can be understood if we recall that people are the most important dispensers of both rewards and punishments for other people. Therefore, those who are less sensitive to punishment by other people are more likely to seek them out.

Arousability and Sensitivity to Punishment

Eysenck attributes the greater conditionability of the introvert to either the relatively lower susceptibility to processes of inhibition or to a relatively higher level of arousability (excitation) or to both (Eysenck, 1957, 1967). That is the introvert may be conceived of as having a higher level of arousability when compared with the extravert. There is good evidence in support of the view that introverts and extraverts do differ in their level of arousability (Eysenck, 1967; Gray, 1967). It would be in the interests of parsimony if the differences could be related to differences in arousability in the same way that Eysenck relates conditionability to arousability.

One way of doing this is to start from the fact that any stimulus, if it is made sufficiently intense, may act as a punishment. Then to note that differences in arousability may be regarded as differences

in the degree to which individuals amplify or dampen stimulation. Introverts amplify stimulation and extraverts tend to dampen stimulation. It must follow that, as any physical stimulus is increased in intensity, the point at which it becomes punishing will be reached sooner. The more introverted an individual is the greater his tendency to avoid intense stimulation when compared with an extravert. Direct evidence for the introvert's tendency to avoid intense stimulation is presented by Schalling and Kareby-Levander (1963). They worked with nine dysthymics (introverts) and ten psychopaths (extraverts). Electric pain stimulation was used, and sensation thresholds, pain thresholds, and tolerance thresholds established. Differences between groups were found to show greater pain tolerance and higher pain thresholds for the psychopaths (extraverts). The majority of these comparisons were statistically significant. Other evidence for the introvert's tendency to avoid intense stimulation is reviewed by Eysenck (1967).

Gray's (1970) view that the greater susceptibility to punishment of the introvert, relative to the extravert, may be derived from the same fundamental basis of introversion-extraversion which is postulated in Eysenck's theory. The introvert has a higher level of arousability than the extravert and is therefore more susceptible to punishment.

The Nature of Neuroticism

Gray (1970) also presents a new hypothesis concerning the nature of neuroticism. As shown above, Eysenck equates this with emotionality. That is, the more neurotic a person is, the more intense are his emotional reactions of all kinds. Concerning this dimension, Gray (1970) proposes a second modification of Eysenck's theory. This step

concerns the translation of emotionality into terms of the theory of learning. Eysenck (1957, 1967) suggests that we may conceive of emotional arousal as the equivalent of the Hullian construct of drive. However, in recent years there has emerged within learning theory a view of the emotions as essentially modes of reaction to various classes of reinforcers (e.g. Mowrer, 1960; Millenson, 1967; Gray, in press, a, b). In this way, they become different from drives (such as hunger, thirst, sexual arousal, etc.) while no doubt being dependent on drives for their initial formation. Thus, rather than equate emotionality with general drive, as do Eysenck (1957) and Spence (1956), Gray treats emotionality as a degree of sensitivity to both reward and punishment (Gray, in press, a, b), even though it may contribute to generalized drive.

Comparison Between Gray and Eysenck's Theories

Although the two theories appear to be somewhat similar, there are two major theoretical differences. These follow:

1. Eysenck proposes that introverts form conditioned reflexes with greater ease than do extraverts because they are more highly conditionable. The greater conditionability of the introvert is in turn attributed by Eysenck either to a relatively lower susceptibility to processes of inhibition than the extravert or to a relatively higher level of general arousability or to both (Eysenck, 1957, 1967).

Gray feels that introverts condition faster than extraverts in some situations because they are more susceptible to punishment and frustrative nonreward. But he continues to derive susceptibility to

punishment from the more basic factor of general level of arousability (Gray, 1970).

2. Concerning the dimension of neuroticism, Eysenck views the role of neuroticism as raising the general intensity of emotional reactions. Neuroticism is treated as equivalent to degree of emotionability. He suggests that we may conceive of emotionality as the equivalent of the Hullian construct of drive (Eysenck, 1957, 1967).

Gray suggests that neuroticism be conceived of as degree of sensitivity to reinforcing events in general (reward and punishment), rather than in terms of general drive.

Figure 1 is presented for a better conceptualization of Gray's hypotheses concerning the psychological variables underlying the dimensions of introversion-extraversion and neuroticism.

It can be seen that several differential conclusions can be drawn from Gray's and Eysenck's positions. Some of these follow.

1. Eysenck proposes that individuals high on neuroticism condition better than individuals low on neuroticism in some situations (e.g. in a simple conditioning situation). Hull and Spence state that subjects with high drive perform better in simple conditioning situations. High drive tends to interfere with performance in a complex conditioning situation. Since Eysenck's concept of neuroticism can be equated with the Hullian concept of drive, this prediction can be made.

Gray states that individuals high on neuroticism condition better than individuals low on neuroticism in all conditioning situations involving positive or negative reinforcement.

2. Eysenck states that introverts condition better than extroverts in all situations. Extraverts never condition better than introverts.

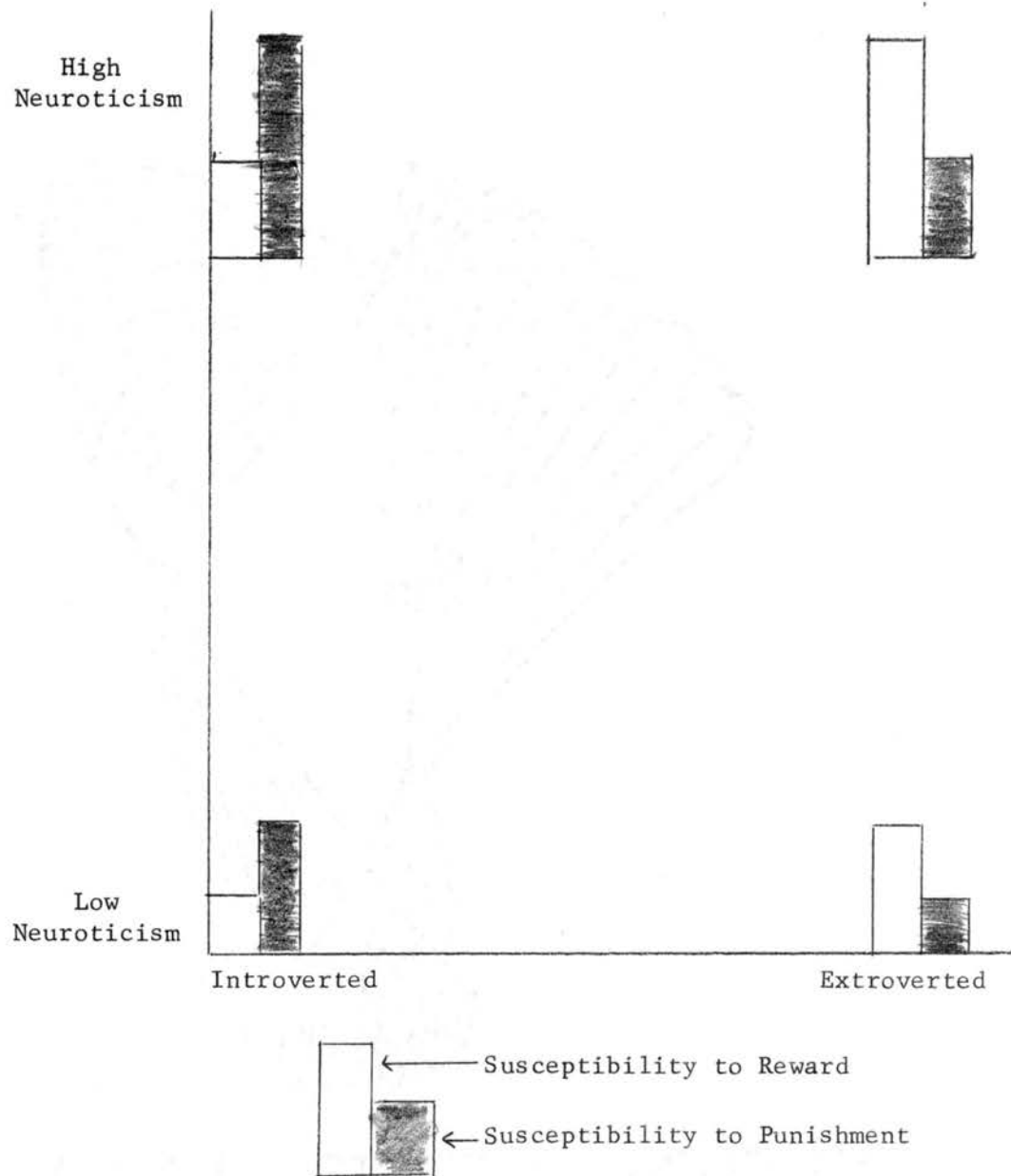


Figure 1. Proposed Relationships of Susceptibility to Reward and Susceptibility to Punishment to the Dimensions of Introversion-Extraversion and Neuroticism (Gray 1970)

Gray proposes that introverts condition better than extraverts only in situations involving punishment as a reinforcer. Extraverts condition better in situations involving reward as a reinforcer.

3. Eysenck feels that dysthmics (neurotic introvert) condition better than psychopaths (neurotic extravert) in all situations.

Gray hypothesizes that dysthmics condition better than psychopaths only in situations involving punishment. Psychopaths condition faster than dysthmics in situations involving reward.

These differences in theoretical orientations have not been adequately tested. A test between Eysenck and Gray's hypotheses would be an investigation of the conditioning of introverts and extraverts (as measured by the EPI) using both reward and punishment as reinforcement. Only one study (Binder and Salop, 1961) somewhat resembles this proposed investigation. Their investigation will be discussed in detail later in this paper, but will be briefly mentioned now. Using the MMPI, Binder and Salop studied the effects in verbal conditioning of certain personality variables, types of reinforcement, and their interaction. They found significant differences in the comparisons involving some of the MMPI scales. The conclusions of this study are presented in greater detail in a later section.

Eysenck Personality Inventory

Since the Eysenck Personality Inventory (EPI) and the Maudsley Personality Inventory (MPI) have been extensively used in the research that follows, a brief description appears below.

The Eysenck Personality Inventory is a self-report inventory which is designed to measure two dimensions of personality:

extraversion-introversion and neuroticism. It consists of 57 items, of which 24 are keyed to extraversion, 24 to neuroticism, and 9 to a lie (L) scale. Mean scores on the E and N scales are 13.7 (SD=4.1) and 10.9 (SD=4.7), respectively (Eysenck and Eysenck, 1963). Below is given a brief account of the "typical" extravert and of the "typical" introvert; these may be regarded as idealized end-points of a continuum to which real people may approach to a greater or lesser degree.

Extraversion-Introversion. High E scores are indicative of extraversion. High scoring individuals tend to be outgoing, impulsive and uninhibited, having many social contacts and frequently taking part in group activities.

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.

The typical 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," and distrusts the impulse of the moment. He does not like excitement, takes matters of everyday 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.

Neuroticism. High N scores are indicative of emotional lability and overreactivity. High scoring individuals tend to be emotionally overresponsive 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 actual neurotic breakdown; a person may have high scores

on N while yet functioning adequately in work, sex, family, and society spheres (Eysenck and Eysenck, 1963).

The Eysenck Personality Inventory, which is the revised version of the Maudsley Personality Inventory (Eysenck, 1962), was developed out of many years of intensive research on the quantitative and experimental analysis of personality. Operating on the assumption that measurement in the field of personality is impossible until the dimensions along which such measurement can take place are known, a large factorial study was carried out on a variety of personality traits whose presence or absence in 700 male neurotic soldiers was recorded by the psychiatrist in charge of the case (Eysenck, 1947). This study resulted in the isolation of the neuroticism and extraversion factors. Having isolated these factors, which appeared to indicate two dimensions of personality along which measurement might fruitfully be undertaken, an effort was made to discover objective tests which would make possible such measurement. A comparatively large number of tests were found to be discriminative in this connection. They are described in great detail elsewhere (Eysenck, 1947).

For the purpose of constructing the Eysenck Personality Inventory, a number of factor analytic studies were carried out, one of which resulted in a matrix of 108 entries which included all the items in Forms A and B, as well as a set of substitute items. Subjects of these investigations were more widely representative than is customary in such studies. Apart from university students, use was made of various middle-class and working-class groups, varying in age and sex, as well as of representative samples of the whole population, interviewed by experienced representatives of a leading firm of market research

consultants. Essentially, item selection, followed by factor analysis, was sure as to minimize the correlation between the scales. The scales are thus considered to be independent, or orthogonal (Eysenck and Eysenck, 1963).

The reliabilities of the E and N scales of the Eysenck Personality Inventory are about as promising as could be expected of a personality test. They run between .84 and .94 when the test-retest method is used, and between .74 and .91, when the split-half method is employed. The only validity data cited by the authors involved the use of the method of nominated groups. Using this method, S.B.G. Eysenck (1962) and Eysenck (1963) have several times shown that when independent judges are asked to nominate extraverted or introverted, stable or unstable subjects, and when these nominees are then asked to fill in the Eysenck Personality Inventory, there are clear and predictable differences between the scores of the respective groups. With regard to validity of the Eysenck Personality Inventory, Eysenck and Eysenck (1963) suggest that by virtue of the close similarity of the Eysenck Personality Inventory, it is reasonable to argue that the validity data collected on the Maudsley Personality Inventory (Eysenck, 1962) would also apply to the Eysenck Personality Inventory.

Research Evidence

Before discussing the methodology of this proposed study, it is necessary to review some of the conditioning studies that have been performed in order to test Gray and Eysenck's basic hypotheses concerning introversion-extraversion and neuroticism. Most of the studies presented will be in terms of Eysenck's theory. Gray uses the studies

that have or have not supported Eysenck's position and then reinterprets the data to support his position.

Although the procedures of classical conditioning of involuntary responses are often referred to as "simple conditioning," it is becoming increasingly clear that we are confronted with sufficient complexity to make interpretation far from straight forward. Since the study of the operant or instrumental conditioning of voluntary responses in the human being introduces further complexity, more emphasis has been given to classical conditioning procedures. In terms of Eysenck's theory, classical conditioning studies account for most of the investigations of personality and conditioning which have been carried out to date. In addition to the classical conditioning studies, several verbal conditioning studies will be presented. The studies that support Eysenck's position will be presented first. These will be followed by the nonsignificant studies and then the investigations which support Gray's theory.

In Support of Eysenck

Much work has been done in recent years in attempts to test Eysenck's hypotheses using both eyeblink conditioning and GSR conditioning. This work has been reviewed in some detail by Eysenck (1965). He concludes that it seems that extraverts are poorer in eyeblink conditioning when conditions favor the development of inhibition, as by the use of partial reinforcement. Extraverts are poorer in GSR conditioning when relatively mild stimuli are used, but do not differ from introverts when very strong stimuli are used, making impossible the development of cortical inhibition. They are also poorer than

introverts when discrimination learning is involved, facilitating the growth of inhibition. Correlations between conditioning and Introversion-Extraversion appear to be dependent on the suitability of experimental conditions to evoke inhibition. But there are exceptions and positive results have been reported even when reinforcement is 100 percent. It is interesting in this connection to mention that the most negative studies, showing zero correlation between extraversion and eyeblink conditioning under 100 percent reinforcement, have been done in Iowa, where, as Spence (1964) has pointed out, conditions are specially arranged to be as arousing as possible, thus presumably wiping out any possible differences in excitation favoring the introverted group. In general the studies reviewed by Eysenck (1965) appear to support his statement that Introverts form conditioned responses significantly better than Extraverts.

Other recent investigations (Mogel, 1969; Morgenson and Martin, 1969; Ramsay, 1969) in the area of classical conditioning and neuroticism have supported the conclusions in Eysenck's (1965) review. For example, Mogel (1969) investigated the relation between the dysthymic (neurotic introvert) and the hysteric (neurotic extravert) and the rate of establishing and extinguishing a conditioned finger withdrawal response. He found that dysthymics established a conditioned finger withdrawal response much more quickly than hysterics. The results also showed that hysterics extinguish at a much more rapid rate than dysthymics.

In addition to eyeblink, GSR, and verbal conditioning, other methods have also been used, but the results will not be reviewed here as it is doubtful if they are of any great significance. For example,

Willett (1960), who has carried out tests of several methods, including salivary conditioning, has shown the difficulties attending the use of these tests, including the crucial one of knowing whether the observed effects are in fact due to orthodox conditioning.

In a verbal conditioning situation, Eysenck (1959) presented 19 extraverts and 28 introverts (as measured by the MPI) 100 cards containing the pronoun "They" and three verbs. One of the verbs always referred to muscular activity (e.g. run, swim) and the other two did not (e.g. burn, made). The subject was required to comprise a sentence containing the pronoun and one of the verbs. Whenever the subject made up a sentence using a verb that referred to muscular activity, he was reinforced by the experimenter's saying "Hm-mm." Eysenck found that introverts performed significantly better than extraverts in producing sentences containing a verb that referred to muscular activity. These results support Eysenck's hypothesis that introverts condition better than extraverts.

Jawanda (1966) used subjects at three age levels (21-25, 36-40, and 56-60 years). Within each age level, four groups of subjects were selected such that they were respectively high and low on E and N (N+E+, N+E-, N-E+, and N-E-). Ten replications of this 3x4 design were programmed, giving a total of 120 subjects who were selected on the basis of a Panjaki version of the MPI. The technique used was that of "sentence completion"; i.e., a card was exhibited in the center of which was printed a neutrally toned past tense verb, with the five (I, you, we, she, he) personal pronouns printed underneath. The task of the subject was that of making up a sentence containing the verb and one of the personal pronouns. No reinforcements were given during

trials 1-25; during trials 26-85, the experimenter responded with the word "Good" at the end of any sentence beginning with "I" or "We". Trials 86-110 again omitted any reinforcement. Analysis of variance disclosed that personality differences affected the conditioning ratio in a highly significant manner. Jawanda found that subjects scoring low on extraversion develop verbal conditioning better than their counterparts, scoring high on extraversion and that subjects scoring low on neuroticism develop verbal conditioning better than their counterparts scoring high on neuroticism. There was no significant interaction or age effects. The results agree with Eysenck's prediction regarding the greater conditionability of introverts but contradict his hypothesis of neuroticism facilitating conditioning.

In a study aimed at providing information on the effects in verbal conditioning of certain personality variables, a few reinforcement conditions (control, reward and punishment) and their interaction, Binder and Salop (1961) gave the MMPI to a group of all male subjects. On each trial in the experiment, the subject was presented with a card containing four pronouns and two different verbs, one in the past and one in the present tense. His task was to make up a sentence using one of the pronouns and one of the verbs. There were 150 trials and these were divided into 15 blocks of 10 trials each. For all subjects no reinforcement followed the sentences given in response to the first block of cards. Beginning with block two and extending through block nine, Group G subjects were rewarded and Group S subjects were punished. Reinforcement was stripped after block nine for Groups G and S, and no further reinforcement was given through block 10 to 15. The third group of subjects, Group G, served as controls and received no

reinforcement throughout the experiment. The experimenter said "good" whenever a Group G subject made up a sentence using the past tense verb, and administered a mild electric shock whenever a subject in Group S used the past tense verb. No reinforcement was used with Group C. At the end of 150 trials, all subjects in the reinforced groups were asked questions to determine their awareness of the relationship between their responses and reward or punishment. Only those subjects who did not verbalize this relationship were included in the analyses.

The Group G subjects did show effects of verbal conditioning during acquisition, but the Group S subjects did not show significant effects. No extinction effects were found for Group G, and when punishment was stopped for Group S a marked further decrease, rather than increase, in the use of past tense verbs used during the extinction trials.

The median score on each of the 10 most widely used MMPI clinical scales and the median of Hy-Pt distribution were computed for each group separately, and the learning trends for high (above the median) and low (below the median) groups were compared. Significant differences were found in the comparisons involving the comparisons on Hs, D, Sc, and Si for Group G and on Hs for Group S during extinction. These data might be interpreted to support Eysenck's hypothesis that introverts condition better than extraverts, but Binder and Salop used the MMPI, thus making their finding difficult to compare with those of the other authors cited.

Beech and Adler (1963) report an investigation of verbal conditioning in a number of clinical psychiatric groups. Altogether 28 schizophrenics, 31 neurotics, 22 depressives, and 31 normal controls

were examined, using a verbal conditioning technique and the MPI. The subjects were asked to construct sentences. They were to start each one with one of a given number of pronouns (I, we, he, she, they), and include a given verb. The verbal reinforcement consisted of the experimenter say "good" whenever the subject began a sentence with "we". The aims of the investigation were (a) to examine the differences between the groups employed on a measure of verbal conditioning, (b) to assess the influence of awareness of the contingency of response and reinforcement, and (c) to investigate the contribution of anxiety and extraversion to verbal conditioning.

Using a standard set of questions at the end of the verbal conditioning test, Beech and Adler split the subjects into two groups, those who were aware and those unaware of the relation between the reinforcement and a particular response. Among the "unaware" groups only schizophrenics showed significant changes in the direction of more frequent usage of the reinforced response. Of groups categorized as "aware," both schizophrenics and normals showed the expected changes. No relationships between extraversion and verbal conditioning and between anxiety and verbal conditioning were apparent when the groups were simply separated into "aware" or "unaware." However, when those subjects showing positive change scores of verbal conditioning were categorized according to clinical group, there was some tentative evidence for a relationship between extraversion and verbal conditioning and neuroticism and verbal conditioning. Both extraversion and neuroticism were negatively correlated with verbal conditioning. "Awareness" such as, independent of the extent of verbal conditioning, was not related to either N-scale or E-scale scores. The results of

this study provide some support for Eysenck's theory of introversion-extraversion, but the results are contrary to both his and Gray's hypotheses concerning neuroticism.

In an experiment (Otis and Martin, 1968) designed to examine the interaction effects of extraversion and anxiety (neuroticism) on performance in an instrumental avoidance task, sixty subjects, comprising three levels of extraversion and two levels of neuroticism, could avoid a noxious stimulus by making up sentences containing a personal pronoun and an evaluative verb. Otis and Martin found that high-neuroticism extraverted subjects performed better than low-neuroticism extraverts, while low-neuroticism introverted subjects performed better than high-neuroticism introverts. They also found that low-extraversion subjects performed better than high-extraversion subjects and these results support Eysenck's prediction.

Studies with Nonsignificant Results

The investigations presented in this section do not support either Gray or Eysenck because no significant relationship was found between introversion-extraversion and conditioning.

McDonell and Inglis (1962) studied verbal conditioning in 65 undergraduate students chosen on the basis of the MPI so that their scores on the E-scale would approximate as closely as possible to a normal distribution (mean, 27.30; SD, 9.21). Subjects were required to construct sentences using verbs typed on stimulus cards. The experimenter reinforced the use of the pronouns "I" and "We" by saying "good" when these were selected for use from among the other pronouns also typed on the cards. None of the responses to the first 20 of a

series of 80 cards was reinforced, and an index of operant level was calculated using these data. Responses to the next 60 cards which used the two pronouns were reinforced. Another series of 80 cards was then presented without any reinforcement, so as to secure a measure of extinction.

McDonell and Inglis found a significant increase for the group as a whole in their emission of the reinforced pronouns between operant level and the last 20 conditioning trials. The correlation of change scores with the measure of introversion-extraversion was not statistically significant. The decrease from conditioning level on the last 20 items of the extinction series was also significant for the group as a whole, but there was again no significant relationship between rate of extinction and introversion-extraversion. These findings do not support either Gray or Eysenck because the results fail to support the hypothesis that conditioning is related to introversion-extraversion.

Clum (1969) gave 17 normal subjects and 35 psychiatric patients a battery of tests purportedly measuring drive level, introversion, and cortical excitation. Scores on the Taylor Manifest Anxiety Scale, E and N Scales on the Maudsley Personality Inventory, the Lykken Activity Performance Questionnaire, and auditory vigilance measure, and a spiral after effect test were correlated with a measure of discriminant GSR conditioning. No relationships were found between introversion, cortical excitation and GSR conditioning. This finding does not support either Gray or Eysenck.

In an investigation of autonomic reactivity, eyelid conditioning and their relationship to neuroticism and extraversion, Kelly and Martin (1969) found no evidence to support the hypothesis that neurotic

patients demonstrate over-reactivity of the autonomic nervous system in response to stressful stimuli. They also did not find any support for the hypothesis that introverts and extraverts differ in the formation of conditioned responses. In an investigation of anxiety (neuroticism), extraversion and GSR conditioning, Cowan (1968) was not able to find a significant correlation. Both Kelly and Martin (1969), and Cowan's (1968) studies fail to support either Gray or Eysenck's predictions.

In Support of Gray

Since Gray's hypotheses concerning the psychological variables underlying the dimensions of introversion-extraversion and neuroticism are relatively (1970) new, there is not much research which directly supports his position. As was mentioned above, Gray usually uses the studies that have or have not supported Eysenck's position and then reinterprets or explains the data to support his position. The following two studies offer direct support for Gray's hypotheses.

Mohan and Claire (1968), using the MPI, divided 80 subjects into 4 personality groups based on extraversion and neuroticism. All subjects were tested in a verbal conditioning situation similar to Beech and Adler's (1963). Reward was used as reinforcement in this study. The results reveal that extraverted subjects condition better than introverted subjects, high neuroticism subjects condition better than low neuroticism subjects, and girls condition better than boys. The results of this study are just the opposite of Eysenck's predictions, but agree with Gray's.

In an eyelid conditioning situation in which subjects were given the Taylor Manifest Anxiety Scale and the MPI, Piers and Kirchner (1969) found that the subjects who conditioned the best were more likely to be high on Anxiety, neuroticism and extraversion. The authors report that this study was not designed to be either emotional arousing or inhibition producing. Because of this, this study differs from the other eyelid conditioning studies. The results of this study support Gray's predictions.

This study leads to an interesting point. It can be seen that almost all the data favoring the hypothesis that introverts are in general more conditionable than extraverts (Eysenck, 1965, 1967) also favor Gray's hypothesis. Since they have all been obtained in aversive conditioning situations, mainly that of eyeblink conditioning, the results support Gray's hypothesis that introverts condition better than extraverts because introverts are more sensitive to punishment. In this light, the study by Otis and Martin (1968) and all the studies reported in Eysenck's (1965) review support Gray.

It can be seen that the data relating to introversion-extraversion and neuroticism does not entirely support one position. Additional research is needed.

It appears that a good test between Eysenck and Gray's hypotheses would be an investigation of the conditioning of introverts and extraverts (as measured by the EPI) using both reward and punishment as reinforcement. In the next chapter, hypotheses will be derived from the foregoing in an attempt to test some of the differences in Gray and Eysenck's predictions.

CHAPTER II

STATEMENT OF PROBLEM

Although Gray's and Eysenck's theories appear to be somewhat similar, there are two major theoretical differences:

I. Eysenck proposes that introverts form conditioned reflexes with greater ease than do extraverts because they are more highly conditionable. The greater conditionability of the introvert is in turn attributed by Eysenck either to a relatively lower susceptibility to processes of inhibition than the extravert or to a relatively higher level of general arousability or to both (Eysenck, 1957, 1967).

Gray feels that introverts condition faster than extraverts in some situations because they are more susceptible to punishment and frustrative nonreward. But he continues to derive susceptibility to punishment from the more basic factor of general level of arousability (Gray, 1970).

II. Concerning the dimension of neuroticism, Eysenck views the role of neuroticism as raising the general intensity of emotional reactions. Neuroticism is treated as equivalent to degree of emotionality. He suggests that we may conceive of emotionality as the equivalent of the Hullian construct of drive (Eysenck, 1957, 1967).

Gray suggests that neuroticism be conceived of as degree of sensitivity to reward and punishment, rather than in terms of general drive.

Several differential conclusions can be drawn from Gray's and Eysenck's positions:

(A) Eysenck proposes that individuals high on neuroticism condition better than individuals low on neuroticism in some situations (e.g., in a simple conditioning situation). Hull and Spence state that subjects with high drive perform better in simple conditioning situations. High drive subjects perform better in simple conditioning situations. High drive tends to interfere with performance in a complex conditioning situation. Since Eysenck's concept of neuroticism can be equated with the Hullian concept of drive, the above prediction can be made.

Gray states that individuals high on neuroticism condition better than individuals low on neuroticism in conditioning situations involving positive or negative reinforcement.

(B) Eysenck states that introverts condition better than extraverts in all situations. Extraverts never condition better than introverts.

Gray proposes that introverts condition better than extraverts only in situations involving punishment. Extraverts condition better in situations involving reward.

(C) Eysenck feels that dysthymics (neurotic introverts) condition better than psychopaths (neurotic extraverts) in all conditions.

Gray hypothesizes that neurotic introverts condition better than neurotic extraverts in situations involving punishment. Neurotic extraverts condition faster than neurotic introverts in situations involving reward.

It can be seen that some of the hypotheses implied by Gray's new conception concerning conditionability and the nature of the psychological variables underlying the dimensions extraversion-introversion and neuroticism are different from Eysenck's predictions. These differences in theoretical orientations have not been adequately tested. Therefore the specific purpose of this study was to investigate, in a verbal conditioning situation, the relationship of extraversion-introversion, reward-punishment, and neuroticism in order to test some of Gray's new hypotheses concerning personality and conditionability. The following hypotheses were formulated for testing:

1. When degree of Neuroticism is held constant and incorrect responses are punished and correct responses are ignored, Low Extraversion subjects (Introverts) have significantly more correct responses than High Extraversion subjects (Extraverts).
2. When degree of Neuroticism is held constant and correct responses are rewarded and incorrect responses are ignored, High Extraversion subjects (Extraverts) have significantly more correct responses than Low Extraversion subjects (Introverts).
3. When degree of Neuroticism is held constant,
 - a. Low extraversion subjects (Introverts) receiving Punishment have significantly more correct responses than Low Extraversion subjects (Introverts) administered Reward.
 - b. High Extraversion subjects (Extraverts) receiving Reward have significantly more correct responses than High Extraversion subjects (Extraverts) administered Punishment.
4. When Extraversion-Introversion and Reward-Punishment are held constant, High Neuroticism subjects have significantly more correct responses than Low Neuroticism subjects.

CHAPTER III

METHOD

Subjects

The Eysenck Personality Inventory was administered to 587 volunteers from the Introductory Psychology Class at Oklahoma State University. Then 80 subjects, 43 females and 37 males, were selected on the basis of their scores on the Eysenck Personality Inventory. Next, 20 subjects were assigned to each experimental group on the basis of the following scores: (1) neurotic introvert (N scale ≥ 15 ; E scale ≤ 10), (2) neurotic extravert (N scale ≥ 15 ; E scale ≥ 16), (3) stable introvert (N scale ≤ 8 ; E scale ≤ 10), (4) stable extravert (N scale ≤ 8 ; E scale ≥ 16). Originally the cutoff scores were to be one SD above or below the mean, but because of the large amount of testing that would have been required to obtain the needed sample the above cutoff scores were used. These scores are less than one SD above or below the mean. Next, 10 subjects from each of these populations were randomly selected to receive reward or punishment (i.e., rewarded neurotic introvert, punished neurotic introvert, etc.). The mean neuroticism and extraversion scores of each group are presented in Table I.

TABLE I
 MEANS OF SUBJECT'S SCORES ON THE EYSENCK
 PERSONALITY INVENTORY

	Reward		Punishment	
	Introverts	Extraverts	Introverts	Extraverts
High Neuroticism	N = 17.1 E = 7.7	N = 17.8 E = 18.9	N = 16.9 E = 8.4	N = 17.7 E = 18.5
Low Neuroticism	N = 6.7 E = 7.9	N = 6.9 E = 18.1	N = 6.6 E = 8.0	N = 7.0 E = 18.9

Apparatus and Materials

Extraversion (E) and neuroticism (N) were assessed by the Eysenck Personality Inventory, Form A (Eysenck and Eysenck, 1963).

The stimuli for the instrumental verbal conditioning situation consisted of a series of 120 3 x 5 inch cards on which four pronouns and two verbs were typed. The pronouns you, we, they, I appeared on every card, with the order randomized over cards. The two verbs on each card differed in content and one was in the past tense while the other was in the present tense. Moreover, a given verb appeared on only one of the cards.

The total of 240 verbs that were used in this experiment were selected from a much larger listing of verbs on the basis of ease of pronunciation, simplicity, lack of emotional connotations, and general appropriateness. These verbs were divided into 120 arbitrary pairs and each pair was typed on only one card. The particular verb in each pair put in the past tense and that put in the present tense was decided randomly. The verb pairs which were used were taken from Binder and Salop (1961) and may be seen in Table II.

Subjects sat at a table opposite the experimenter in a small room. Between subject and experimenter was a black cloth and wood partition with two slots at the base. A counter operated by the experimenter was on the table in front of the subject. The order of presentation was counterbalanced. Prior to the first ten trials all subjects were given the following instructions:

You will be given through this slot some cards on which there are printed four pronouns and two verbs. I want you to make up a sentence aloud using one of the pronouns and one of the verbs. I want you to respond as rapidly as possible

TABLE II

VERB PAIRS PRESENTED TO SUBJECTS

observe	planned	recorded	remember	bounced	reach
lifted	drop	succeed	wrote	blow	elected
improve	gained	recognize	admitted	answered	get
greet	demonstrated	originated	fill	continue	paid
fed	investigate	spill	baked	derived	include
explained	order	smiled	knock	occupy	needed
broke	combine	told	pour	join	influenced
determined	encircle	stand	marked	divide	bent
retired	foresee	marched	adjust	regulated	repeat
practice	danced	elevate	recalled	permit	registered
pull	discussed	deposited	check	surrounded	return
kept	compose	imagine	enjoyed	relieved	entertain
advise	transferred	invent	concluded	omit	hurried
act	cheered	listed	stop	noticed	find
declare	polished	grew	throw	wanted	discriminate
chose	interfere	encouraged	recommend	spoke	employ
promised	taste	examined	move	ignore	participated
grasp	breathed	hide	built	guided	happen
sailed	protect	introduce	infected	forget	defended
produce	went	mailed	install	appear	commended
lock	descended	noticed	grant	allowed	blot
live	saw	inspected	imitate	manage	acknowledged
insert	corrected	traveled	decorate	sell	tried
gaze	drove	listened	point	stepped	begin
devise	picked	liberated	separate	swam	hinder
send	loaded	follow	wondered	rode	slip
deliver	added	emptied	gather	came	ponder

TABLE II (Continued)

fall	indicated	communicated	paint
enclose	obeyed	turned	cancel
enter	boiled	inspired	hear
earn	nominated	furnish	desired
abandon	verified	fix	departed
clean	recovered	expected	magnify
hinted	insure	directed	mention
invited	create	meet	interpreted
overlooked	finish	prefer	hoped
maintain	depended	talked	look
measure	injected	passed	name
inscribe	played	accept	gave
emphasized	prolong	altered	have
discover	watched	learn	ran
decided	react	fished	glance
deviated	call	flip	carried
construct	mixed	counted	formulate
held	make	close	hired
	compared	distribute	
	realized	replace	
	respond	left	

after each new card is presented, without analyzing the sentence or trying to censor or change it in any way. Each sentence could be of any length or structure so long as it contains one of the pronouns and one of the verbs. When you are finished, put the card into the slot.

After the subject indicated that the instructions were understood, the experimenter presented the first card. The first block of ten trials, during which the experimenter did not make a response to the subject, provided an estimate of operant level. After these trials, all subjects wore a set of earphones which were connected to a microphone and a Lafayette 11 watt P.A. amplifier located on the experimenter's side of the partition. The subjects receiving punishment (punishment group) were instructed:

Now you will be given some cards with words on them, the same as before, but this time you will be able to earn money. Right now the counter in front of you reads zero and this represents \$2.50. You can keep this if you do not make up any incorrect sentences. Each time you make up an incorrect sentence the counter will advance one point. I will subtract 2 cents from your total each time the counter advances one point. Your task is to make up sentences that will prevent the counter from advancing. You can avoid losing money by making up the right sentence. The more incorrect sentences you make up the more money you will lose. At the end of the experiment I will subtract 2 cents from your total for each point you have on the counter. You will receive the money that remains. I would like to emphasize again that you are to respond as rapidly as possible after each new card is presented, without analyzing the sentence or trying to censor or change it in any way. Would you put this set of earphones on. I will be giving you additional instructions through the earphones during the experiment.

Those subjects that received reward (reward group) were administered the following instructions:

Now you will be given some cards with words on them, the same as before, but this time you will be able to earn money, as much as \$2.50 if you make up all correct sentences. Right now the counter in front of you reads zero, but everytime it advances one point you will have earned two cents or one point will be added to your total,

you can earn more money by making up the correct sentences. Your task is to make up sentences that will make the counter advance. The more correct sentences you make up the more money you will be able to earn. At the end of the experiment, you will get two cents for each point you have on this counter. I would like to emphasize again that you are to respond as rapidly as possible after each new card is presented, without analyzing the sentence or trying to censor or change it in any way. Would you put this set of earphones on. I will be giving you additional instructions through the earphones during the experiment.

On the remaining 110 trials, the correct response consisted of a sentence containing a past tense verb. Each time a subject in the Punishment Group made an incorrect response the experimenter would say "wrong" in a volume above the conversational level. The amplifier was also set on a loud volume (3.5, an arbitrary unit on the volume control of a Lafayette 11 watt P.A. amplifier). No comment was made to a correct response. In this group, the correct sentence did not affect the subject's money total, but all other sentences resulted in the counter advancing one point. And this represented a two cents loss.

Each time a subject in the Reward Group made a correct response the experimenter said "right" in a mild conversational level. The amplifier was also set on a mild volume (2.5, an arbitrary unit on the volume control of a Lafayette 11 watt P.A. amplifier). No comment was made to an incorrect response. In this group, the correct sentence added two cents to the subject's total and all other sentences did not affect it.

After 110 trials were completed, each subject was asked questions to determine the facility with which he could verbalize the response class and reinforcement contingency. All subjects were first asked if they knew what the experiment was about. Then if he was in the Punishment Group he was asked "Do you have an idea of when or why you were

losing money?", while those in the Reward Group were asked, "Do you have an idea of when or why you were earning money?". The data on subjects who knew what the experiment was about or could verbalize the response class or reinforcement contingency was not used in the overall analysis. In all, 19 subjects were eliminated because they could verbalize the response contingency. Their scores were not appreciably different ($M = 100.44$, $SD = 6.12$). Three subjects from each of the following groups were disregarded: Rewarded Stable Extraverts, Rewarded Stable Introverts and Punished Neurotic Extraverts. In the remaining 5 groups, the data on two subjects from each group was not used in the final analysis.

CHAPTER IV

RESULTS

The statistical treatment of the data was guided by the five hypotheses. In addition to an overall analysis of covariance, planned comparisons of the hypothesized treatment means were computed (Winer, 1962, p. 580). The comparisons that were made follow: (a) Punished Introverts vs. Punished Extraverts, b) Punished Introverts vs. Rewarded Introverts, c) Rewarded Extraverts vs. Rewarded Introverts, d) Rewarded Extraverts vs. Punished Extraverts. A three factor (2 x 2 x 2) analysis of covariance was employed, with the operant level serving as the covariate. The independent variables were: Extraversion-Introversion, Neuroticism, and Reward-Punishment. There were 10 subjects in each of the 8 experimental groups (N = 80). The dependent variable in this study was the number of correct responses in the verbal conditioning situation. The adjusted mean number of correct responses for each group appears in Table III. Figure 2 depicts the percent of correct responses for each group in graphic form.

The results for the analysis of covariance, Table IV, indicate the main effect of the treatment of Reward-Punishment ($F = 5.16$; $df = 1, 71$; $p < .05$) was significant. When degree of Neuroticism and Extraversion are held constant, subjects who received punishment had significantly more correct responses than subjects who received reward. It was also found that the Reward-Punishment Extraversion interaction

TABLE III
ADJUSTED MEAN NUMBER OF CORRECT RESPONSES
FOR EACH GROUP

	Reward		Punishment	
	Introverts	Extraverts	Introverts	Extraverts
High Neuroticism	70.84	74.64	82.59	79.66
Low Neuroticism	72.48	76.06	85.10	74.56

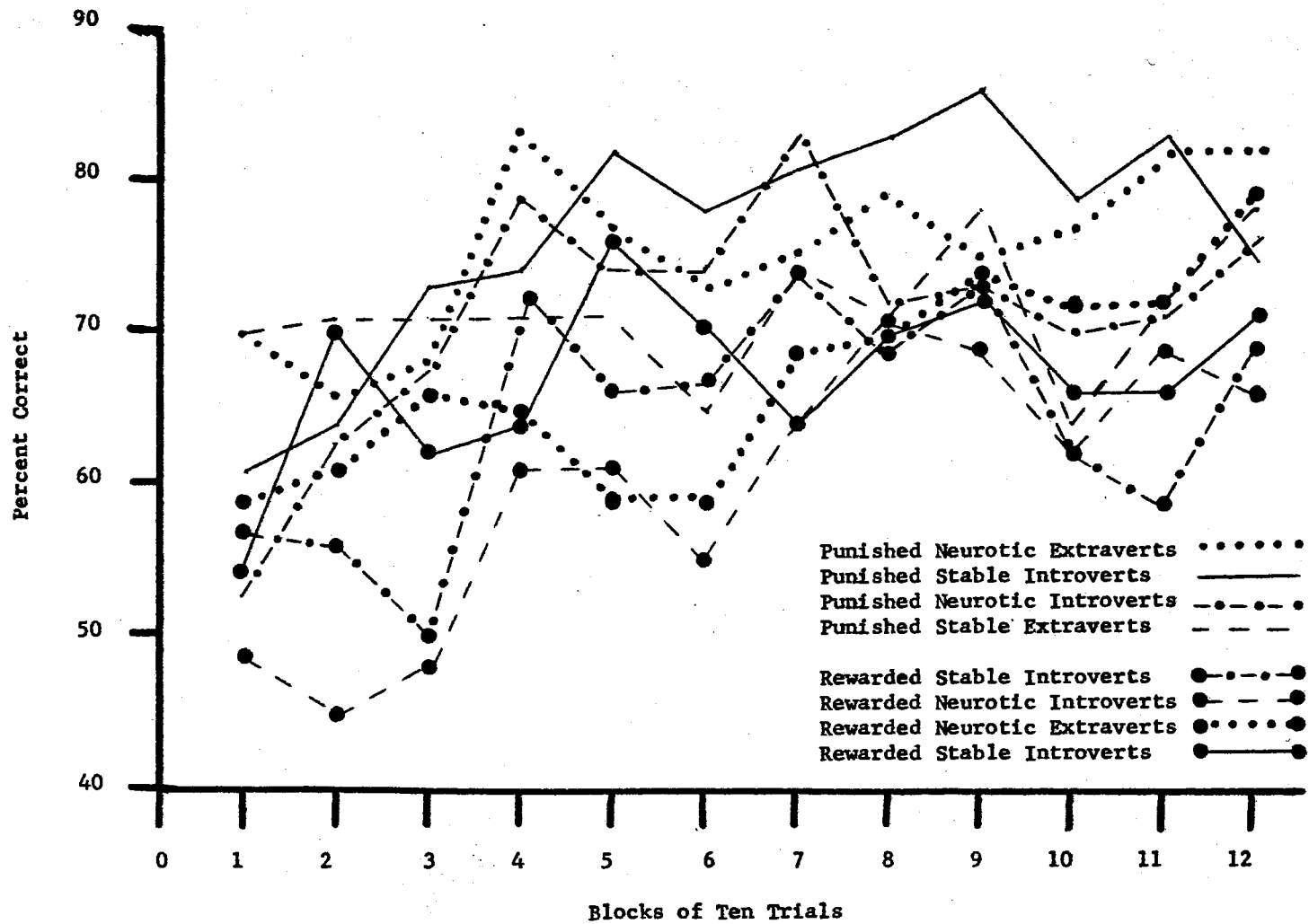


Figure 2. Percent of Correct Responses for Each Group for Each Block of Ten Trials

TABLE IV
SUMMARY OF ANALYSIS OF COVARIANCE

Source	df	SS	MS	F
Neuroticism	1	2.5023	2.5023	.02
Reward-Punishment	1	835.9026	835.9026	5.16*
Extraversion	1	30.5404	30.5404	.19
Neuroticism X Reward-Punishment	1	53.5939	53.5939	.33
Neuroticism X Extraversion	1	58.1050	58.1050	.36
Reward-Punishment X Extraversion	1	576.4183	576.4183	3.56**
Neuroticism X Reward-Punishment X Extraversion	1	87.0314	87.0314	.54
Error	71	1151.9127	162.1396	

* p < .05

** p < .07

($F = 3.56$, $df = 1$, 71 ; $p < .07$) approached statistical significance.

No significant differences were found for the Neuroticism variable ($F = .02$; $df = 1$, 71 ; $p > .05$) or Extraversion variable ($F = .19$; $df = 1$, 71 ; $p > .05$). Thus, the hypothesized difference in conditioning between High and Low Neuroticism subjects was not supported by the present experimental results. These results also fail to support Eysenck's general statement that Introverts have more correct responses than Extraverts.

The results also show that there were no significant interactions between Neuroticism and Reward-Punishment ($F = .33$; $df = 1$, 71 ; $p > .05$), Neuroticism and Extraversion ($F = .36$; $df = 1$, 71 ; $p > .05$), and Neuroticism, Reward-Punishment and Extraversion ($F = .54$; $df = 1$, 71 ; $p > .05$).

For the planned comparisons, a t test was used to test for significance between the hypothesized group combinations. The results are presented in Table V. From Table V, it can be seen that: Punished Introverts have significantly more correct responses than Punished Extraverts ($t = 2.83$, $df = 71$; $p < .005$) and Rewarded Introverts ($t = 3.03$; $df = 71$; $p < .0025$). Although the difference was in the predicted direction, the results did not support the hypothesis that Rewarded Extraverts have significantly more correct responses than Punished Extraverts ($t = .83$; $df = 71$; $p > .05$) or Rewarded Introverts ($t = 1.03$; $df = 71$; $p > .05$). The adjusted mean number of correct responses for each of these groups can be seen in Figure 3.

TABLE V
VALUES OF t FOR HYPOTHESIZED COMBINATIONS OF TREATMENT EFFECTS

Comparison*	df	t	p
Punished Introvert vs. Punished Extravert	71	2.83	< .005
Punished Introvert vs. Rewarded Introvert	71	3.03	< .0025
Rewarded Extravert vs. Rewarded Introvert	71	1.03	> .05
Rewarded Extravert vs. Punished Extravert	71	.83	> .05

*When a significant difference exists, the group that appears first in the comparison conditioned significantly better than the group that appears second.

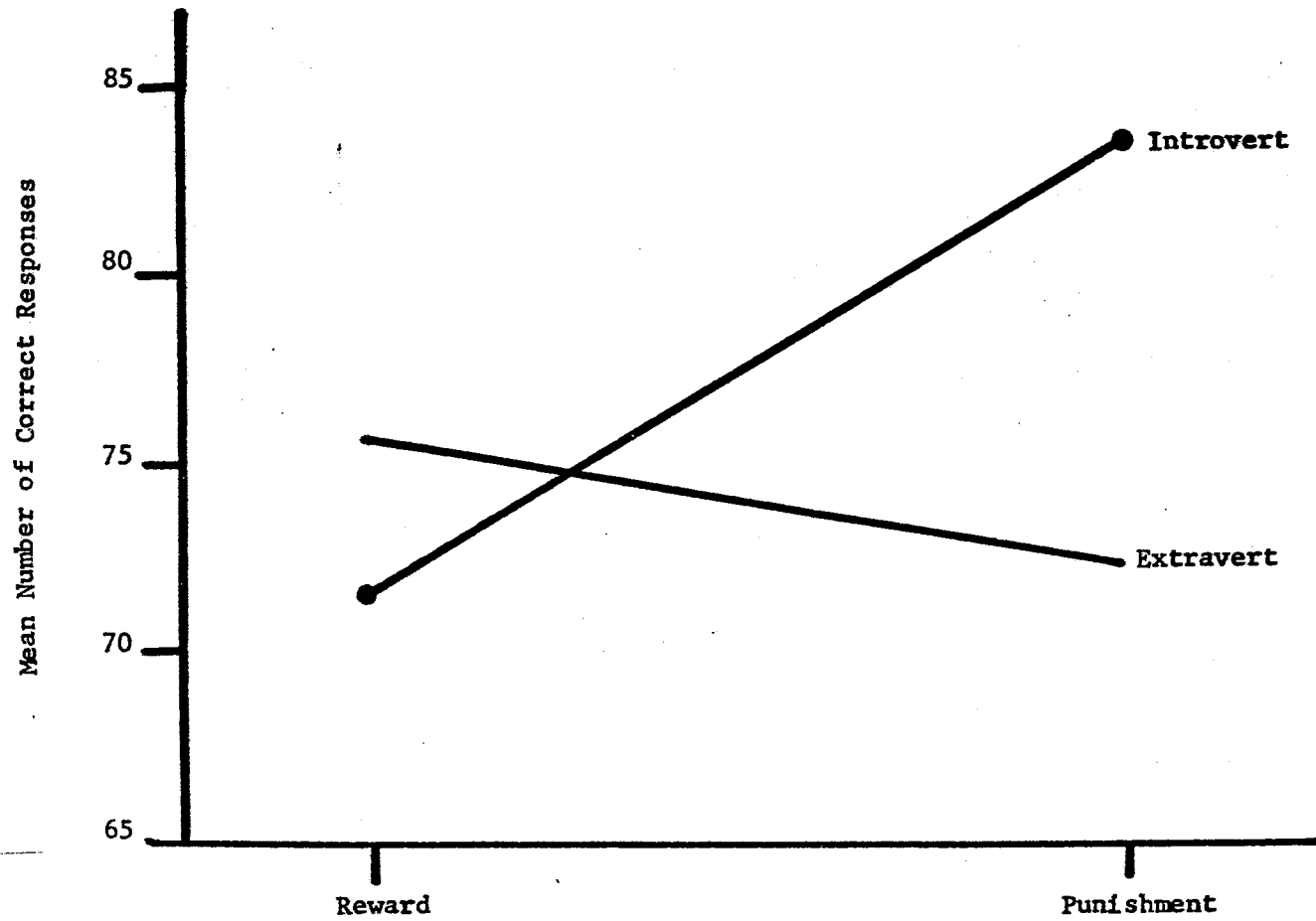


Figure 3. Mean Number of Correct Responses for the Hypothesized Combinations of Treatment Effects

CHAPTER V

DISCUSSION

Previous investigations have provided only limited data concerning the relationship of personality to conditioning. Several studies have investigated the relationship of introversion-extraversion and neuroticism to conditioning, but only one, using the MMPI, has been interested in the relationship between introversion-extraversion, neuroticism, reward-punishment and conditioning. With the introduction of Gray's theory (1970) concerning conditionability, introversion-extraversion, neuroticism and reward-punishment, it has been pointed out that the reward and punishment may be a prime consideration in relating personality types to conditioning. Gray proposes that the reinforcement operations must be specified before predictions can be made concerning which personality type will have more correct conditioned responses. In this study an attempt was made to carefully investigate, in a verbal conditioning situation, the relationship between introversion-extraversion, neuroticism and reward-punishment in order to test some of the differences in Gray's and Eysenck's hypotheses concerning personality and conditionability. In formulating the hypotheses for this study, the primary concern was the evaluation of Gray's specific statements concerning reward and punishment and the dimension of introversion-extraversion.

The results of this study revealed significant differences in verbal conditioning among some of the groups. The following hypotheses were supported.

1. When degree of Neuroticism is held constant and incorrect responses are punished and correct responses are ignored, Low Extraversion subjects (Introverts) have significantly more correct responses than High Extraversion subjects (Extraverts).
- 3a. When degree of Neuroticism is held constant, Low Extraversion subjects (Introverts) receiving Punishment have significantly more correct responses than Low Extraversion subjects (Introverts) administered Reward.

Although the following two hypotheses were not directly supported, the findings were in the predicted direction.

2. When degree of Neuroticism is held constant and correct responses are rewarded and incorrect responses are ignored, High Extraversion subjects (Extraverts) have significantly more correct responses than Low Extraversion subjects (Introverts).
- 3b. When degree of Neuroticism is held constant, High Extraversion subjects (Extraverts) receiving Reward have significantly more correct responses than High Extraversion subjects (Extraverts) administered Punishment.

The final hypothesis was rejected.

4. When Extraversion-Introversion and Reward-Punishment are held constant, High Neuroticism subjects have significantly more correct responses than Low Neuroticism subjects.

This study also produced some other interesting findings that were not hypothesized.

- A. There was no significant difference in the condition-ability of High Extraversion subjects (Extraverts) and Low Extraversion subjects (Introverts) when degree of Neuroticism and Reward-Punishment are held constant.
- B. When degree of Neuroticism and Extraversion are held constant, subjects who receive Punishment have significantly more correct responses than subjects administered Reward.

The hypotheses that were supported and the trends that were found, together with the finding that there was no significant difference between Introverts and Extraverts when degree of Neuroticism and Reward-Punishment were held constant, seem to give ample support to part of Gray's theoretical formulations. Some evidence seems to be provided for his statement that, in relating personality types to conditioning, the reinforcement operations should be considered. Gray feels that Eysenck's hypothesis attributing greater conditionability to the introvert should be replaced by the hypothesis that the introvert is relatively more sensitive to punishment and to frustrative nonreward.

Under the conditions of this experiment, Eysenck would have made considerably different predictions than were found. For example, he would have predicted that Introverts would have more correct conditioned responses than Extraverts under both Reward and Punishing conditions. He would have also predicted that Rewarded Introverts would not differ from Punished Introverts and Rewarded Extraverts would not differ from Punished Extraverts.

The finding that subjects who received Punishment as a reinforcer, excluding degree of Neuroticism and Extraversion, condition significantly better than subjects who received Reward as a reinforcer requires further consideration. The role of punishment in controlling behavior has been hotly debated by experimental psychologists, and opinions have changed markedly over the years. Thorndike (1913) popularized the early view that the effects of punishment were the obverse of the effects of reward; that is, punishment weakened associative strength whereas reward increased associative strength. Later Thorndike (1932) revised his position on the basis of numerous experiments and concluded

that the effects of punishment were extremely complex. Guthrie (1935) felt that punishment acts like a drive, producing maintaining stimuli that keep the organism active until it finds relief. Guthrie states that sitting on tacks does not discourage learning. It encourages one in learning to do something else than sit. It is not the feeling caused by punishment, but the specific action caused by punishment that determines what will be learned. To train a dog to jump through a hoop, the effectiveness of punishment depends on where it is applied, front or rear. It is what the punishment makes the dog do that counts or what it makes a man do, not what it makes him feel (1935, p. 158).

Subsequent experimental work, particularly by Estes (1944) led to the widely adopted position that punishment temporarily suppresses behavior which will subsequently reappear. Even more recently, the position has changed again, largely as a result of a brilliant series of studies by Azrin and his colleagues. In a recent comprehensive review of the problem, Azrin and Holz (1966) have shown just how complex are the effects of punishment (Yates, 1970).

The extensive empirical and theoretical analysis of punishment provided by Azrin and Holz will not be summarized here, but some of their important conclusions which are related to this study will be mentioned. The effects of a punishing stimulus depend upon many factors which interact in a very complex fashion and no doubt account for the inconsistent results of punishment experiments so vividly described by Solomon (1964). Azrin and Holz (1966) point out that one of the variables that influences the effect of punishment is the number of responses available. Punishment is more effective in eliminating a response when an alternative reinforced response is available (but the

complexity of the phenomena is apparent, since the effect is more pronounced with high than with low levels of punishment). They point out that in most studies of punishment a single response is made available to the subject for obtaining the reinforcement. When this response is also punished, the subject has no alternative means available for obtaining the reinforcement. If the punishment causes the subject to cease responding entirely, no reinforcement results. Azrin and Holz next present an experiment in which the subject does have some alternative response available that is unpunished and that can produce the reinforcement. This experiment follows.

In a study by Holz, Azrin, and Ayllon (1963), humans were conditioned to respond for cigarette reinforcements on a variable interval schedule. In one part of the experiment, one response manipulandum was available to the subjects. A time-out period was then programmed to occur for every tenth response on that manipulandum. There was no alternative response available and the time-out period produced at most only partial suppression of the punished responses. In a second part of the procedure, two responses were available, either of which would result in reinforcement. Time-out was then scheduled in the same way as before to occur after every tenth response on one of the manipulanda. Under this alternative response procedure, almost immediate and virtually complete suppression was produced on this manipulandum by the time-out period. Responding was displaced to the manipulandum for which no time-out period was being programmed as a punishing stimulus. It appears, then, that a period associated with extinction, that is a time-out period, can serve as a punishing stimulus, but that it is not very effective compared with other types of punishing stimuli such as

noise or electric shock or even conditioned aversive stimuli. Nevertheless, time-out can be a very effective punishing stimulus if the organism has available an alternative response that is unpunished.

After presenting several other experiments supporting this position, Azrin and Holz conclude that the alternative response situation leads to greater suppression by punishment than does a single response situation, whether the aversive stimulus is a period of time-out, an annoying noise, electrode shock, or whether the subjects are human or pigeon.

Punishment by means of "response cost" is another topic which Azrin and Holz (1966) discuss which seems to be related to this study. Weiner (1962) has used punishment by means of response cost on human subjects who were working for points on a counter. After behavior had become fairly stable, he arranged to have each response subtract one point from the counter. This subtraction of counter points as a consequence of a response was designated as response cost. The effect of this procedure was greater than usually seen when a time-out period (signaling the absence of reinforcement) has been used as the punishing stimulus. Weiner found a reduction of responses that was immediate and in some instances almost complete. For every subject, the response cost contingency reduced the number of responses to a small fraction of the unpunished level. It would appear, then, that response cost is similar to intense electric shock in terms of the extent of the response reduction achieved. Response cost appears to be a punishing stimulus that has a great effect on human responses. The response is particularly interesting because of its similarity to the use of monetary exchange. In addition, the response cost procedure provides

an elegant illustration of how positive and negative reinforcement may be considered to lie along a single continuum. In Weiner's procedure, the addition of a point to the response constituted a reinforcement. Conversely, the subtraction of a point from the response counter constituted a punishing stimulus. In general, Azrin and Holz's review shows clearly the extraordinary complexity of the factors that determine the precise effects of a punishing stimulus in any given situation.

Guthrie's statement concerning the nature of punishment in conjunction with the findings of Azrin and Holz may have particular significance for this study. Punishment may have been more effective because an alternative response was available. Punishment is usually thought to be general in its effect whereas reward is specific. That is, the important aspect of punishment is not what is punished, but what the punishment makes the subject do. In the case of reward, the important aspect is what is rewarded. In this experiment when punishment was administered, it may have activated the subject and enabled him to make more varied responses than the subject that was rewarded and this probably facilitated increased changes in the punished subject's response set. By changing his response set more frequently than the rewarded subject and because the subject was forced to choose between two verb responses (the verb determined the correct response), the subject receiving punishment had a higher probability of finding the correct response. The results showed that there was an increase of the unpunished response without any obvious reinforcement for that response.

In our society, punishment is a frequent method of behavioral control. Our educational systems and penal institutions seem to rely

heavily on punishment as a means of control. Other examples are fines, imprisonment, dismissal from a job, denial of favors, and withdrawal of privileges. It also must be pointed out that a monetary loss is probably the strongest type of response cost punishment. Because of the subjects greater familiarity with response cost type of punishment, it may be that losing two cents from a large total of money provides a greater incentive than adding two cents to nothing or a small total of money. Perhaps losing money is a stronger incentive than earning money.

In addition to the loss of money, the punishment procedure also involved a loud response of "wrong" from the experimenter when an incorrect response was made. This may have contributed to the better performance of the punished subjects. Intensity of punishment has been found to be a major determinant of the degree of response reduction by punishment. Studies of the intensity of punishment have found that the greater the intensity of the punishing stimulus, the greater is the reduction of the punished response (Appel, 1963; Azrin, 1959; 1960; Azrin, Holz and Hake, 1963).

In addition to the loss of money and the punishment intensity, the social aspects of these operations might also be considered. Even though the "right" and "wrong" responses of the experimenter were by a microphone, they still can be considered as social reward and punishment. It appears that in our society a large number of people are more concerned with avoiding disapproval than obtaining approval (Azrin and Holz, 1966). Perhaps social punishment (disapproval) was a stronger incentive than social reward (approval) for the sample of subjects used in this experiment. The above reasons for the superior performance

of the punished subjects were discussed independently, but the findings may be the additive result of all these factors or a combination of part of them.

The finding that there was no significant difference in verbal learning between subjects possessing High and Low Neuroticism permitted rejection of one of the hypotheses. Although this finding appears not to support either Gray or Eysenck's predictions, in some aspects it may be interpreted to support Eysenck. Neuroticism is treated by Eysenck (e.g., 1967) as equivalent to degree of emotionality. He supposes that under conditions likely to produce emotional activation, highly neurotic subjects will have higher levels of general drive (Hull, 1943) and in some situations (e.g., in a simple conditioning situation) condition better than low neurotic subjects. Hull and Spence state that subjects with high drive perform better in simple conditioning situations. High drive tends to interfere with performance in a complex conditioning situation. Therefore low drive subjects would be expected to perform better in a complex conditioning situation. Within Eysenck's theoretical framework, an explanation can be offered for the results concerning Neuroticism. The findings that there were no significant differences in conditioning between High and Low Neuroticism subjects is consistent with Eysenck's theory if the conditioning task is considered to be of intermediate complexity with intermediate arousability. That is, not a simple or complex conditioning situation, but one somewhere in between. In this type of conditioning situation, High Neuroticism subjects would not have a significant advantage over Low Neuroticism subjects and vice versa. Therefore Eysenck would predict no significant differences between the two groups. Perhaps this

accounts for the nonsignificant finding between Low and High Neuroticism.

In general, the findings obtained here are somewhat in agreement with part of Gray's (1970) predictions and the experimental findings of McDowell and Inglis (1962), Mohan and Claire (1968), and Piers and Kirchner (1969). Therefore some additional support has been given to Gray's statement that the hypothesis in Eysenck's theory of introversion-extraversion attributing greater conditionability to the introvert should be replaced by the hypothesis that the introvert is relatively more sensitive to punishment and to frustrative nonreward.

Since Gray's hypotheses concerning the psychological variables underlying the dimensions of introversion-extraversion and neuroticism are fairly new (1970), there is not much research which is directly related to his position. Additional research in this area is needed.

In future research in this area, it is suggested that more attention be focused on the relationship between reward-punishment and the dimension of introversion-extraversion. The dimension of neuroticism could be excluded and more emphasis placed on the reward-punishment and introversion-extraversion variables. By eliminating neuroticism it would be easier to obtain a more extreme sample of introverts and extraverts. It seems that the verbal conditioning paradigm used in this study is a useful technique for examination of such a relationship. But it would also be interesting to use other learning paradigms (e.g., maze, operant, classical) to see if the relationships found in this study are transsituational. It would also be of interest to use different reward and punishment conditions to see if the relationships remain the same.

In future attempts to determine the relationship between personality and conditioning, subjects assigned to the different criterion groups could be selected on the basis of careful behavioral ratings and performance on objective laboratory tests in addition to the questionnaire scores. For example, introverts and extraverts might be chosen on the basis of their performance on Spielmann's (1963) tapping test, Petrie's (1967) kinesthetic figural aftereffects task, or other laboratory tasks which yield rather large differences in the performance of the two groups.

Practical Implications of the Obtained Results for Diagnosis,
Psychopathology and Behavior Therapy

The implications of the above results for clinical diagnosis could possibly find practical applications. As we have seen, personality factors were related to reward-punishment and conditionability. Thus, the possibility of differentiating personality types by means of the conditioning method would seem to offer measurable variables for some diagnostic categories which are now defined in general clinical terms without reference to specific behavior. As a matter of fact, Gantt and his coworkers (Gantt, 1950; Gantt and Muncie, 1942; Gantt and Fleischmann, 1948; Fleck and Gantt, 1951; Reese, Doss and Gantt, 1953) have used conditioning techniques to help establish a differential diagnosis between psychogenic and organic psychoses.

These studies have revealed interesting characteristics of psychiatric patients and pronounced differences between the psychogenically and the organically determined psychoses. Patients with organic psychoses, such as Korsakoff's alcoholic dementia, severe

cerebral defects, and certain temporary cerebral disturbances, such as those after some shock treatments, when studied in this way, have been found to be deficient in the ability to form conditioned responses. While patients with psychogenic psychoses, even severe conditions, such as catatonic schizophrenia, have been found to retain this ability. Such observations make it possible to use a modified conditioned reflex examination as a means of differentiating the organic and the psychogenic psychoses. In the study of the psychiatric patient by the Pavlovian method interesting mechanisms were revealed that were not apparent with the ordinary methods of psychiatric study. Thus, the catatonic patient is capable of forming conditioned responses, although general inhibition in the motor system obscures their appearance; i.e., the catatonic patient is adaptive to his environment in a manner that the organic patient is not.

It is also felt that Gray's theory and the findings of this study have important implications concerning the etiology of symptoms. If behavior is considered to be learned, emphasis on certain types of reinforcement operations may result in different behavioral manifestations. As was mentioned in an earlier section, psychopathic behavior in the extraverted neurotic is easily regarded as a tendency to seek a reward (by, say, stealing, lying, or sexual gratification) without much thought for the consequences, i.e., with no fear of punishment. The recidivism which is such a feature of psychopathic behavior (Eysenck, 1964) is also simply regarded as a relative insensitivity to punishment. Conversely, the symptoms of neurotic introvert are in many cases perfectly clear expressions of fear, as for example in the phobias and the anxiety state. In other cases it requires very little

skill to discern the fear which lies less obviously behind the neurotic symptoms. A good example is the obsessional ritual of rumination. This may be performed in a state of apparent calm, but it is usually sufficient to prevent the patient from complying with the urge to perform the ritual for overt signs of fear, often intense, to become evident. Indeed, the obsessive-compulsive symptoms bear all the marks of an active avoidance response (Gray, in press, a).

Recently Wolpe (1958, 1969), Eysenck (1960, 1967), Bandura (1969), Yates (1970) and many others have emphasized the use of learning techniques to eliminate such behaviors as enuresis, encopresis, stuttering, phobias, obsessions, compulsions, tics, delinquency, criminality, sexual disorders, psychosis, alcoholism, drug addiction, etc. The results obtained in this experiment seem to have practical applications for therapies employing learning techniques.

Therapy would be more economical and the probability of behavioral change could be maximized if the parameters which would facilitate learning for specific individuals were known. Although this study does not define the entire situation, it does provide evidence for maximizing learning for different personality types under different reinforcement operations. For example, on the basis of the Eysenck Personality Inventory and other laboratory tasks (e.g., Spielmann's tapping test, Petire's Kinesthetic figural after effects task), it could be determined whether a patient was more introverted than extraverted or vice versa. Although punishment worked best for all subjects, this study has provided some evidence for the statements that reward maximizes learning for those individuals defined as extraverts and punishment enhances learning for those identified as introverts. Therefore when

a behavior therapist is dealing with an introverted patient, he has some indication that punishment will be more effective in changing that individual's behavior. In the case of an extravert, reward may maximize the probability of behavioral change.

CHAPTER VI

SUMMARY

In this study an attempt was made to determine the relationship of extraversion, reward-punishment, neuroticism and number of correct responses in a verbal conditioning situation. In formulating the hypotheses and interpreting the results, the primary concern was testing the differences between Gray's and Eysenck's theoretical formulations concerning introversion-extraversion, neuroticism and conditionability.

Eighty subjects (20 neurotic introverts, 20 neurotic extraverts, 20 stable introverts, 20 stable extraverts) were selected on the basis of their extraversion and neuroticism scores on the Eysenck Personality Inventory. Next, 10 subjects from each of these populations were randomly selected to receive reward or punishment. A verbal conditioning situation was used in which subjects were required to construct a sentence given 4 pronouns and 2 verbs. Each time a subject in the reward group made a correct response, the experimenter would say "right" in a mild conversational level and a counter mounted in front of the subject would move one point (this represented 2 cents earned). Each time a subject in the punishment group made an incorrect response, the experimenter said "wrong" in a volume above conversational level and the counter moved one point. But this time it represented a 2 cents loss from a total given to the subject at the start of the experiment.

A 3 factor (2 x 2 x 2) analysis of covariance was employed, with an operant level serving as the covariate. Planned comparisons of the hypothesized treatment means were also computed. The dependent variable was the number of correct responses in the verbal conditioning situation. The results are summarized below.

The following hypotheses were supported.

1. When degree of Neuroticism is held constant and incorrect responses are punished and correct responses are ignored, Low Extraversion subjects (Introverts) have significantly more correct responses than High Extraversion subjects (Extraverts).
2. When degree of Neuroticism is held constant, Low Extraversion subjects (Introverts) receiving Punishment have significantly more correct responses than Low Extraversion subjects (Introverts) administered Reward.

Although the following two hypotheses were not directly supported, the findings were in the predicted direction.

3. When degree of Neuroticism is held constant and correct responses are rewarded and incorrect responses are ignored, High Extraversion subjects (Extraverts) have significantly more correct responses than Low Extraversion subjects (Introverts).
4. When degree of Neuroticism is held constant, High Extraversion subjects (Extraverts) receiving Reward have significantly more correct responses than High Extraversion subjects (Extraverts) administered Punishment.

The final hypothesis was rejected.

5. When Extraversion-Introversion and Reward-Punishment are held constant, High Neuroticism subjects have significantly more correct responses than Low Neuroticism subjects.

This study also produced some other interesting findings that were not hypothesized.

6. There was no significant differences in the conditionability of High Extraversion subjects (Extraverts)

and Low Extraversion subjects (Introverts) when degree of Neuroticism and Reward-Punishment are held constant.

7. When degree of Neuroticism and Extraversion are held constant, subjects who receive Punishment have significantly more correct responses than subjects administered Reward.

The obtained results were interpreted as lending support to Gray's statement that, in relating personality types to conditioning, reward and punishment should be considered. Gray feels that Eysenck's hypothesis attributing greater conditionability to the introvert should be replaced by the hypothesis that the introvert is relatively more sensitive to punishment and frustrative nonreward. The finding that punishment was more effective than reward was discussed in the light of previous research. Practical implications of this study for diagnosis, psychopathology, and behavior therapy were discussed. Areas for further research were also suggested.

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Psychological Association; Associate Member, American
Psychological Association; Member, Southwestern Psychological
Association; Member, Southeastern Psychological Association;
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Trainee, Central Louisiana State Hospital, summer 1969;
Graduate Teaching Assistant, Oklahoma State University,
fall 1970; Clinical Practicum, Payne County Guidance Center
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fall 1970 and spring 1971; Psychologist, Bi-State Mental
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