

# DRUG ADDICTION AND HABIT FORMATION— AN ATTEMPTED INTEGRATION\*

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## INTRODUCTION

IN view of the promise attached to the recent attempts to integrate learning and personality theory (Eysenck, 1957), and the suggestion that drug addiction might be a learned response, it would appear profitable to consider the relevance of this integration to a better understanding of addiction, a suggestion reinforced by two recent papers by Partridge (1959a, b). On the basis of a clinical survey of addiction he came to the conclusion that the extent and severity of addiction was dependent on “. . . the extent to which the particular personality can tolerate them (i.e. the symptoms, such as anxiety, which would arise without the drug) . . . patients with a low tolerance of discomforts and frustrations are those more likely to be addicts, just as they are more likely to turn to drugs in the first place . . . the development of addiction, in fact, depends much on the personality . . . the form of addiction depends more on the circumstances and opportunities with which the particular personality has been confronted.” Such considerations and conclusions can be conceptualized within and predicted from the theoretical framework to be proposed later in the present review.

Eysenck and his colleagues (1947, 1952, 1953, 1957) have demonstrated in a series of factor analytic studies, for example, that personality can be resolved into independent dimensions, and that all individuals have positions on these dimensions. The dimensions which have so far been isolated being neuroticism, introversion-extraversion, intelligence and more recently psychoticism. An independent study by Trouton and Maxwell (1956) verified the existence of two orthogonal factors of neuroticism and psychoticism. More important for the present review is that their neuroticism factor was characterized by “. . . ‘life-long or episodic anxiety’, ‘low energy output’, ‘neurotic traits in childhood’, ‘unsatisfactory adolescent adjustment’ ”. These symptoms are very characteristic of the usual descriptions of neurotic illness and there is little doubt that Partridge had just this type of person in mind when he talked about the strength of the addiction being dependent on the extent to which the individual personality could tolerate the symptoms that arose without the drug.

The second of these supposed mutually independent dimensions, introversion-extraversion, has generally received more attention, particularly in the attempts to try to place it on a causal basis. Presumably again Partridge's use of the term “personality” might tentatively be taken to include this dimension.

In the search for personality variables said to be typical of the drug addict, it is important that one of the dimensions isolated by Eysenck and his

\* Based on evidence prepared for a Working Party convened by the British Psychological Society in order to present evidence to the Interdepartmental Committee on Drug Addiction.

colleagues (i.e. intelligence), does not appear to be strictly relevant to the subsequent discussion. Isbell and Fraser (1950), following a review of earlier studies on drug addiction, came to the conclusion that there was no significant relationship in intelligence between drug addicts and normals. It seems possible that, although intelligence may play a part in the genesis of addiction in the individual case, it is not a crucial factor in explaining addiction as a phenomenon.

The possibility of a relationship between addiction and psychoticism will not be pursued here since psychotic addicts are somewhat rare (Vogel, Isbell and Chapman, 1948).

Subsequent to the identification of the two main dimensions of personality attempts have been made by Eysenck to discover the causes underlying individual differences in introversion-extraversion and neuroticism. A great deal of work has been completed on attempts to place the former dimension on a causal basis.

The dynamic theory of anxiety and hysteria first presented by Eysenck in 1955 was foreshadowed by Pavlov's discussion of the methods by which experimental neurosis could be produced in men and in dogs (Pavlov, 1927, 1928, 1941). Pavlov concluded that hysterics possessed an exaggeration of the "inhibitory process" and a weakness of the "excitatory process", whilst the neurasthenic possessed an exaggeration of the excitatory and weakness of the inhibitory process. Pavlov's conclusion was next formalized in terms of Hull's psychological law of reactive inhibition by Eysenck (1955), ". . . it is easy to see what Pavlov and Hull had in mind in advocating this concept of inhibition. Whenever a stimulus-response connection is made in the central nervous system there are created both excitatory and inhibitory potentials. The algebraic sum of the potentials determines the amount of learning that takes place, and through it the particular reaction the organism makes whenever the stimulus in question is presented again."

Eysenck next proposed a postulate of individual differences with respect to the speed with which reactive inhibition was produced. This was implicit in Pavlov's own work but neglected by Hull. Following the development of a limited postulate system he argued, "The theory just outlined tells us that individuals in whom excitatory potentials are generated quickly and strongly and in whom inhibitory potentials are generated slowly and weakly, will tend to be introverted in personality. It also follows directly from our statement of the laws of excitation and inhibition that such people should form conditioned reflexes quickly and strongly. Conversely, individuals who generate weak excitatory potentials, and who generate strong inhibitory potentials tend to be extraverted in personality, such people, according to the statement of the law of inhibition and excitation should form conditioned reflexes slowly and with difficulty."

Eysenck (1957) agrees with Mowrer (1950) when he says there is considerable evidence for the proposal that, "the socialization process is mediated to a considerable extent by conditioning reactions of an autonomic kind (anxiety) and that we are immediately led to a chain of deductions which runs something like this:

- (a) Socialization is mediated by conditioning.
- (b) Extraverts condition poorly.
- (c) Introverts condition particularly well.

Therefore under conditions of equal environmental pressure we would expect extraverts to be under-socialized, introverts to be over-socialized, with people in less extreme positions on the extravert-introvert continuum showing intermediate degrees of socialization."

As a link between personality and speed of conditioning is suggested, it would appear profitable to examine the problem of addiction in the light of this (i.e. as a problem of learning) and to examine critically the theory which first gives rise to such a possible link. But first, a brief survey of some of the studies completed on the personalities and diagnoses of addicts with some reference to the possible effects of culture and environment in the development of addiction.

#### EXPERIMENTAL STUDIES OF ADDICTION IN RELATION TO PERSONALITY, DIAGNOSIS AND CULTURE-ENVIRONMENT

The research team at Lexington, Kentucky, one of the principal centres for research into addiction, believe that one of the most important factors predisposing to drug addiction is personality disorder (Vogel, Isbell and Chapman, 1948). It is also interesting to note at the outset of this review that the Lexington research team make a clear distinction between the more or less neurotic types of addiction and the psychopathic.

Vogel, Isbell and Chapman (1948) reviewed the personality types commonly needing treatment for drug addiction. Five general groups emerged. The first, a rather small group, consisted of patients who had received a drug for medical purposes for a long time and continued to use it long after it was required for treatment. The authors suggest an emotional basis to this perpetuation. The second group consisted of neurotics who take drugs to relieve symptoms such as anxiety. The third group (the largest) consisted of psychopaths who became addicts by associating with other addicts. A very small fourth group consisted of those who had developed addiction, the addiction obscuring an underlying psychosis. When the drug is withdrawn the psychosis becomes manifest. A final group consisted of a mixture of psychopathic and neurotic individuals who appear to make some initial attempt to adjust to society, though their adjustment is only marginal at the best of times. Addiction increases their marginal efficiency in adjustment to society.

In a later review of addiction to opiates Isbell and White (1953) said the main characteristics of this type of addict were tolerance, physical dependence ("the drug produces a metabolic state which results in a change in physical responses and the appearance of the 'abstinence syndrome' when the drug is discontinued") and emotional dependence. In a similar vein Isbell (1954) in discussing the barbiturate group, said, ". . . a strong physical dependence develops which necessitates an individual consuming these drugs to prevent the appearance of very characteristic illness. So they are addictive . . . addiction to these particular substances (sedative or hypnotic drugs), as well as to any other drug, is more of a human problem than it is a pharmacological problem. Every addict to any of these drugs, and to any other drugs as well, always has some personality maladjustment, which, as far as can be determined from the history, anteceded the beginning of the addiction."

Henderson and Gillespie (1947) had this to say about drug addicts, ". . . the large number of opium habitués are people originally of a psychopathic make-up." Quoting the Mayor of New York's Committee on Drug Addiction they say that the Committee reported on 318 male cases, the majority of whom

took heroin and the remainder morphine. Half were considered to be psychopathic, and the majority of the remainder to be criminals, vagrants, homosexuals and paranoid personalities.

These results have been tentatively confirmed by the writer in an analysis of the 968 short case histories in Hathaway and Meehl (1951). These cases were a representative sample of in-patients in the Psychiatric Unit of the University of Minnesota Hospitals. Of these patients 105 were alcoholics or drug addicts. There were 77 alcoholics and 28 drug addicts. Sixty-one of the alcoholics were psychologically abnormal, showing at least one M.M.P.I. peak over 70 (i.e. 79 per cent.), whilst 19 of the 28 drug addicts (67 per cent.) returned at least one abnormally high peak. In order to obtain a finer diagnostic picture the M.M.P.I. records of the alcoholics and drug addicts were examined separately. The highest score of each patient on the M.M.P.I. was recorded. The hysteria, psychopathy and hypomania scales were considered to be the best face-validity measures of both extraversion and neuroticism—the depression and psychasthenia scales to be the best face-validity measures of introversion and neuroticism. Forty-eight of the alcoholics showed their highest peak on one of the neurotic-extravert peaks, whilst only 16 had their highest peak on the neurotic-introvert scales. Of the drug addicts, 15 showed the highest peak on the neurotic-extravert scale, only 7 on the neurotic-introvert scales.

In a review of personality studies of alcoholic addicts, Sutherland, Schroeder and Tordella (1950) summarized the results of Rorschach tests given to 383 alcoholics. The results indicated that the alcoholic lay somewhere between a neurotic and a psychopath, though the reviewers favoured a neurotic emphasis. Wilkins (1952), in making reference to this summary, said, "There are apparently two kinds of alcoholics—one looks neurotic on the Rorschach and is presumably a compulsive drinker because of neurotic personality factors. The other looks psychopathic on tests and probably in behaviour as well. The 'neurotic' alcoholic is 'self-centred, lacks emotional warmth, makes poor adjustments in his social and interpersonal situations; he is a highly constricted person, stereotyped and pedantic' ". There then followed a summary of the work of Griffiths and Dimmick (1949), Halpern (1946), Kardiner and Ovesey (1951), Reitzell (1949) and Sutherland, Schroeder and Tordella (1950). According to these studies, he said, the neurotic alcoholic suffered from anxiety and guilt feelings, his principal characteristic being an inability to withstand strain and tension, meaning that he could not persevere in overcoming difficulties and disappointments in spite of high ambitions. This conclusion is similar to that of Kennedy and Fish (1959), "The addict to barbiturates is psychologically of a different make-up from the opiate addict and has more in common with the alcoholic who drinks directly to forget his troubles."

Some authors have suggested that alcoholics incline towards the introverted (Strecker *et al.*, 1939; Strecker, 1941), others have stressed the psychopathic nature of the alcoholic (Manson, 1948; Button, 1956; Landis, 1945), whilst others have sought to identify the individual at some point of the introversion-extraversion dimension (Davidoff *et al.*, 1940; Norbury, 1942; Wenger, 1944). As stressed by Franks (1958) these studies are subject to serious criticisms, especially the fact that they were based on subjective assessments. Others have failed to demonstrate differences at all between the personalities of alcoholic addicts and normals (Sutherland, Schroeder *et al.*, 1950; Diethelm, 1955; Landis, 1945; Sherfey, 1955; Jellinek, 1942; Bleuler, 1955).

Buhler and Lefever (1947) developed a series of distinguishing Rorschach signs for use with alcoholics. Such traits emerged as, “. . . lack of persistence in goal achievement, coupled with high ambition; lack of resourcefulness in setting up realizable goals and lack of drive to reach such goals, immaturity, anxiety and feelings of guilt; and good sense of reality.”

Hewitt (1943) undertook to investigate the personality of a group of alcohol addicts, who were active members of the Fellowship of Alcoholics Anonymous (AA). Further alcoholics were later included from a city workhouse and probation office. The latter groups were selected at random. Thirty-seven members of AA were tested using the M.M.P.I. Twelve other subjects were also tested. They enjoyed drinking but rarely drank to excess. Their composite M.M.P.I. profile did not resemble the curve of the addicts. It showed only a normal deviation. Hewitt concluded, “Alcohol addiction in the group studied in this survey seemed to be associated, with but few exceptions, with deep personality disorders. Even those exceptions are doubtless more apparent than real. There were very few whose drinking was exogenously determined and whose habituation was brought about chiefly by long exposure to alcohol . . . nearly all the alcohol addicts in this study showed marked psychopathic deviation which was often associated with neurotic, paranoid, or schizoid trends.” It is interesting to note Hewitt’s observations on the relationship between social introversion and alcoholic addiction—“. . . their responses show a strong feeling of social inadequacy. A tabulation of the frequency of certain answers (M.M.P.I.) bears this out. The results suggest that many alcoholics suffer from feelings of inadequate social adjustment and inferiority which are relieved by alcohol.” The nine women tested by Hewitt showed consistently greater deviation on most of the M.M.P.I. scales. He calculated that alcoholic addiction among women was indicative of a greater personality disorganization than among men. He continues, “. . . this may be reasonably explained on the grounds that excessive drinking meets with stronger social disapproval for women than for men, and that consequently a woman who drinks to excess might be expected to be less well adjusted to her environment . . . it is noteworthy that the psychopath deviate score of 70 is the highest of all the trait measures . . . .”

Banay (1941) in a study of 102 sex offenders in Sing Sing, indicated similarly that more than half the cases showed a history of alcoholism, hostility and resentment towards authority.

Wilkins (1952), following a review of the available evidence, reaches the following conclusion, “It appears that the majority of alcoholics are basically neurotic in personality structure. On the other hand, the majority of drug addicts, at least those seen at Lexington, seem basically psychopathic.” This view has also been expressed by Higgins (1953), McLaughlin and Hains (1952), Lolli (1952), Meerloo (1952), Kielholz (1952) and Knight and Prout (1951). Felix (1944), Pfeffer and Ruble (1947), Fort (1954), Gerard and Kornetsky (1954, 1955) and Isbell (1954) have all similarly stressed the psychoneurotic, psychopathic or pre-psychotic features of the drug addict. Kennedy and Fish (1959) on the other hand conclude in a review of alcoholism, that, “practically all authors agree that alcoholism is not related specifically to any one pre-alcoholic personality” (Bertagna, 1953; Williams, 1956; Wexberg, 1949; Sutherland, Schroeder and Tordella, 1950).

According to Eysenck’s theory the background and circumstances which infringe on the individual will, in certain cases, be those likely to be learned. It is of importance therefore to consider briefly whether socio-cultural factors have

been shown to be relevant to addiction. The sociological studies from Yale have demonstrated a very significant relationship between the incidence of alcoholism and racial and national background (Williams and Strauss, 1950) and social status (Strauss and Winterbottom, 1949). The study of Roe and Burks (1949) of children of alcoholic parents, who had been reared in foster-homes showed that when they were reared in a satisfactory background they failed to develop symptoms of alcoholism like their parents.

Wickler (1953) has also pointed out that culture may dictate the type of drug used. Eastern cultures, it is argued, value the non-aggressive personality, thus favouring opiate addiction. The West, in contrast, favours the outgoing personality and so alcohol is approved of more and opiate addiction frowned upon. McLaughlin and Haines (1952) have demonstrated a high incidence of broken homes and a tolerant attitude to addiction, whilst Gerard and Kornetsky (1955) indicate that many addicts are truants and delinquents who drift into the illegal narcotic trade. In a cross-cultural study Horton (1943) showed that there was more drinking in "anxious" societies.

It is apparent that, apart from the agreed psychological abnormality of the addict, there is little agreement as to what constitutes the remaining major personality variables of the addict. One tentative suggestion is that, within our culture pattern, the alcoholic addict is rather more neurotic or anxious than the drug addict, the latter inclining more towards the psychopathic. The relationship between introversion-extraversion and addiction is however, on the basis of the evidence, unlikely to be a linear one. It seems opportune, therefore, to examine critically the theory which might offer a tentative explanation of the genesis of drug addiction, particularly since already there is much evidence to support the idea that drugs may alleviate those symptoms of which the individual complains and so reinforce a dependence on the drug. It will be remembered that Dollard and Miller (1950) have already pointed out that psychosomatic symptoms may be the direct physiological effect of high states of drive and an indirect product of learning whilst Masserman and Yum (1946) with cats and Conger (1947, 1951) with rats have investigated the effects of alcohol on previously learned responses. Conger demonstrated for example that alcohol reduced fear in rats and consequently reinforced the rat's response of drinking whenever it was frightened. Reichard (1947) has similarly stressed the importance of situational anxiety or anxiety arising from various somatic disorders as important in addiction. Williams (1950) and Tiebout (1951) have both postulated that anxiety is one of the major drives reduced by alcohol and so taken in times of stress, whilst Bacon (1945) and Ullman (1952) have also both stressed its tension reducing properties. Masserman's work (1940, 1943, 1946a, b) with animals supports this; whilst Stewart (1898) and Richter (1926) have shown that over-active behaviour in the rat, ascribable to tension, is reduced by alcohol. Miller (1948), in a similar vein, has shown that decreases in fear or anxiety could serve as a reinforcing agent in the learning of a habit, just as Tong (1959) has postulated that delinquent behaviour may be a learned response to anxiety which also functions as a learnable drive. Conger (1956) has suggested that conflicts produce tension, whilst Dworkin *et al.* (1937) have indicated that alcohol, amyta, nembatal and hyoscine all reduce the tension resulting from an experimental neurosis based on a conflict situation. Bailey and Miller (1952) have similarly shown that barbiturates abolished conditioned fear responses in cats and Bartholomew *et al.* (1958) that oblivon reduced anxiety in humans.

CRITICAL ASSESSMENT OF CERTAIN ASPECTS OF PERSONALITY AND  
LEARNING THEORY

## 1. THE DIMENSIONS OF NEUROTICISM AND EXTRAVERSION

Although most studies are agreed that the alcoholic or the drug addict is poorly adjusted, there appears to be little consistency in the use of diagnostic terms. Differences are frequently drawn between the neurotic and the psychopath. In the majority of studies the neurotic appears to be characterized by anxiety, guilt, poor interpersonal relationships, etc., whilst by inference the psychopath is not neurotic though he is the asocial or antisocial individual who fails to conform to society, who is purposeless in his way of life and who does not learn from previous errors. This distinction appears to be contrary to the experimental evidence incorporated into Eysenck's explanatory theory of personality (Eysenck, 1955, 1957). According to this theory, it is the introverted neurotic who tends more to present the symptoms of anxiety, guilt, over-sensitivity to his environment and over-cautiousness. The neurotic extravert on the other hand tends to be insensitive to his environment, impulsive and unreliable. Both groups are neurotic, they differ essentially in terms of introversion-extraversion. The relationship between the dimensions of neuroticism and extraversion and diagnostic psychiatric categories has been tentatively demonstrated experimentally by Hildebrand (1953, 1958). It is the neurotic extravert who, according to Eysenck's theory, conditions or learns rather more slowly than the neurotic introvert. Differences in conditionability between these two groups are basic to his theory. As there is by no means general acceptance of Eysenck's dysthymia-hysteria dichotomy, the first essential is thus to examine critically the evidence central to this dichotomy.

Storms and Sigal (1958) have criticized the dichotomy of the extraverted-hysteric and the introverted-dysthymic. They report that Sigal *et al.* (1958) gave the Maudsley Personality Inventory to a hysteric-psychopath group and to a group of dysthymics, selected according to Eysenck's earlier descriptions of symptoms of these groups (Eysenck, 1947, 1953). The two groups were found to be significantly different on neuroticism, but not on introversion-extraversion. The hysteric-psychopath group had a mean extraversion score very similar to normals (Eysenck, 1956). The hysterics were found to be on the introverted side of normals. They quote Hildebrand (1953), Martin (1955), and Nicholls (1955) as showing results of hysterics who were also found to lie on the introverted side of normals, though not significantly so, and of hysterics who were significantly less neurotic than dysthymics. Storms and Sigal (1958) also report that, ". . . the MAS, the MMQ and the Guildford D+C intercorrelate most strongly, and that all three also have significant correlations with the R scale. The MMQ and the D+C scores have been used by Eysenck as measures of neuroticism and the R scale as a measure of 1-E. It therefore seems quite possible that the R is loaded on neuroticism as well as on 1-E (in the Hildebrand analysis, the loading was -0.25) or that neuroticism and 1-E are non-orthogonal. Furthermore, not only were the hysterics significantly lower than dysthymics on the MAS (which fact Eysenck attributes to the loading on 1-E), but they were also significantly lower on D+C, the best measure of neuroticism in the Hildebrand analysis."

Franks (1954) also reports large differences between dysthymics, hysterics and normals on the Taylor MAS. A significant difference occurred between the dysthymics and the hysterics. Eysenck attempts to explain this by saying, "The difference between dysthymics and hysterics is accountable for in terms of the

failure of the Taylor scale to be a pure measure of neuroticism; as mentioned before, it also has a projection on the introversion axis." It is very much to be doubted that such large differences could however be attributed to the loading on introversion, since the MMQ correlates about  $+ \cdot 9$  with the MAS (Eysenck, 1957).

In a study of "Anxiety, Internalization and Eysenckian classification" (Mather and Walton, 1959), the same trend was detected. Dysthymics were more neurotic on the M.P.I. than hysterics, though this disparity did not reach statistical significance ( $\cdot 2$ ).

Tong's demonstration (1959) that the within-hospital unstable psychopath is characterized by little anxiety in response to stressors, whilst the within-hospital "dysthymics" are characterized by too much anxiety is supportive of these trends.

Field's work (1959) also raises the question of contamination in the M.P.I. E scale. He investigated the personality dimension of extraversion-introversion with regard to a group of recidivists and apprentices. According to Eysenck's theory the criminals as a group should be more extraverted than normals when early experiences are held constant. This would be because the criminal would be less able to acquire and retain conditioned emotional needs making for socialized behaviour. Field found that the young recidivists were one-third S.D. more extraverted than the norms for the E scale, though the older recidivists were one-tenth S.D. less extraverted than the norms. He also found that the young recidivists were one-fifth S.D. less extraverted than the apprentices. He then further analysed the E scale items. He divided the 24 extraversion items into three sub-groups on the basis of their face-validity; 11 items he called social extraversion items, 7 behavioural extraversion items and 6 remaining items were termed ambiguous. In analysing the differences between the recidivists and apprentices on these three scales he found the recidivists to score significantly lower than the apprentices on nominal social extraversion—the recidivists to score significantly higher than the apprentices on nominal behavioural extraversion and no differences to be manifest on the nominally ambiguous scale between the two groups. He concludes by saying, "Whether or not the discrepancy is in self-description; that the recidivists see *themselves* as Lone Rangers, but quick on the draw; or that they want to *present* such a description of themselves; or that they really *act and live* like that, is a matter for further investigation." Field's work does lead one to consider that there may perhaps be within the M.P.I. E scale at least two types of extraversion item one of which is more subject to variation according to changes in N, that is reflecting some degree of social introversion consequent upon anxiety, the other more subject to variations according to the intensity of the other type of emotional response related to a hyper-reactive sympathetic nervous system, namely aggression. The aggressive individual would presumably score high on the total E scale, the excessively anxious person low on the total E scale.

If "hysterics" are less anxious or neurotic than dysthymics and such as Guildford's Rhathymia Scale and the M.P.I. E scale measure in part social introversion consequent upon anxiety, then these scales should reflect lower scores in dysthymics with hysterics and normals returning scores not very different from each other. This might be said to have been tentatively demonstrated by Hamilton (1959) in his summary of mean R scale scores for hysterics, dysthymics and controls (Eysenck, 1955; Franks, 1956; George, 1954; Hildebrand, 1953; Martin, 1955; Nicholls, 1955). If Tong's results (1959) are any guide, however, one would expect that psychopaths with minimal P.G.R.



responsiveness, would show on the basis of this hypothesis, the largest extraversion score, a hypothesis confirmed by Eysenck (1959). Hysterics and psychopaths combined then into one group might produce misleading results, with regard to absolute scores on the I-E continuum. Hysterics, it is hypothesized, being more neurotic (i.e. more anxious) than normals would be somewhat more introverted than them, though less introverted than dysthymics who were more anxious. Psychopaths, being the least anxious, would be the most extraverted.

In support of these ideas are Eysenck's own findings (1953) that lack of sociability and autonomic imbalance are common to both introversion and neuroticism. The fact that neuroticism and introversion may also have something in common on test evidence has been suggested by Jensen (1958). He reported high negative correlations between N and E. Eysenck (1959) recently has confirmed these trends—"In normal samples this correlation (between neuroticism and extraversion) tends to be around  $-0.1$ , whereas in neurotic groups it rises to  $-0.4$ . This cannot be accounted for in terms of selection. I thought at first that possibly the most neurotic and most extraverted groups might not be found in mental hospitals at all, but perhaps in prisons. However, studies with recidivist and other prison populations have shown that these have scores of both neuroticism and extraversion very similar to the scores obtained by hysterics. Furthermore, when we compared the correlations obtained from sub-groups of our normal sample, selected for high and low neuroticism respectively, we found the same phenomena, viz i.e., zero correlations for the group which is low on neuroticism and substantial negative correlations for the group high on neuroticism. These relations are definitely extra-chance; they have been found quite independently by American investigators using the M.P.I."

Certain other results are relevant. They are related to changes on testing which may occur in the acute or chronic phases of neurotic breakdown. Statistical analysis revealed (Mather and Walton, 1959) that with an increase in length of illness hysterics became significantly more neurotic ( $+0.478$ ) and dysthymics significantly less neurotic ( $-0.38$ ) on the M.P.I. Dysthymics showed a tendency to become more extraverted and the hysterics more introverted the longer they were ill, though these changes were not statistically significant. In other words, with an increase in N in the hysterics so was there a decrease in E, and vice versa for the dysthymics, a finding predictable from the above discussion. That one must consider not only length of illness but also the age of the patient in evaluating any such differences between dysthymics and hysterics has recently been demonstrated by Nelson and Gellhorn (1958). They showed that both sympathetic and parasympathetic reactivity declined with age. This opinion has been voiced from as early as 1881 (Charcot) and more recently by Cannon (1942), Safford and Gellhorn (1945) and Andrew (1956).

Foulds and Caine (1958) have similarly observed that an extraverted or clinically hysterical type of personality may develop anxiety or a symptom more characteristic of the introverted neurotic. This they maintain may be due to the fact that the hysteric has tried to manipulate the situation and failed. It is believed that the apparent inconsistency between Foulds's findings and those of Eysenck has arisen because it has not been adequately recognized that one type of neuroticism, namely over-activity of the sympathetic nervous system, can give rise to either excessive anxiety or aggression according to circumstances, and so changes in introversion and extraversion respectively. Thus a hyper-reactor through a particular set of life experiences may be a predominantly

extraverted subject. He is nevertheless capable of generating anxiety if subject to stress. This would naturally decrease his extraversion.

Other variables which might affect the absolute scores on the N and E scales are those relating to differential response to threat and the effect of defensiveness on test scores. Alper (1946) has reported that under objectively non-stressful conditions, only those tasks which had been completed were remembered by those with weak egos, whilst those with strong egos tended to recall their failures. Under stress, however, it was the weak egos who recalled their failures and the strong egos their successes. To explain this, Eriksen (1954) has said that weak egos, threatened by the objectively non-threatening, bolster their self-esteem by recalling their successfully completed tasks. They are, however, overwhelmed by their inadequacy under stress and recall their failures. Strong egos are less easily threatened and when stress does occur they cope with it by emphasizing their successes. Low self-esteem seems to be related to a higher susceptibility to stress. Thus, it is hypothesized by Inglis (1959), that those with weak egos, whom he considers to be neurotic introverts, experience a greater degree of anxiety under ego-involving conditions than the relatively stronger egos (the neurotic extraverts) and this will disrupt effective avoidance or defensive behaviour. Rosensweig and Sarason (1942) have found also that the tendency to recall completed tasks, when self-esteem is threatened, is correlated with hysteria. Eriksen (1954) similarly found that scores on the hysteria scale (M.M.P.I.) were inversely related to the tendency to recall more incompletely rather than completed tasks when the situation was objectively self-esteem threatening. This field of work thus suggests an important hypothesis with respect to reported differences in the speed of conditioning as related to I-E to be discussed more fully in the next section. Franks (1954, 1955, 1956) has demonstrated, using a group of normal subjects, a significant relationship between I and speed of classical conditioning though not between N and speed of conditioning. If one regards a questionnaire, such as the M.P.I. as objectively non-threatening then according to Alper (1946) and Eriksen (1954) those with weak egos (presumably the marginal neurotic introverts) would be more on the defensive than the extravert. The effect on test scores would presumably be that the N1 would be more likely to be defensive on neurotic items than on I-E items. Thus whilst showing a tendency towards I, they would return lower N scores than was actually the case. The marked extravert, on the other hand (with less anxiety), would be likely to manifest true lower N scores. Thus, actual scores might reflect a trend towards high E and low N and low E and low N. In other words, there might be a significant negative correlation between conditionability and extraversion and no significant correlation between conditionability and N. If, however, a low E were combined with a somewhat higher N there should then be a significant correlation between conditionability and N. Thus both N and I would be significantly related to conditionability, a fact deducible and predictable from the results contained in the present review.

On the physiological side Wenger's work (1942, 1948) supports the idea that autonomic imbalance is significantly related to neuroticism, as judged psychiatrically. Van der Meuve (1948) demonstrated that on basic emotional tension hysterics compared with normals show a shift or imbalance to parasympathetic predominance, whilst compared with normals, an anxiety group showed a shift in the direction of sympathetic predominance. Eysenck (1953) says this supports the idea of a predominance of the sympathetic and parasympathetic functions for the introvert or extravert respectively. He criticizes Wenger's work inasmuch as Wenger appears, he says, to have related sym-

pathetic predominance to neuroticism and not to have made it at all clear whether the relatively normal person is one showing a parasympathetic-cholinergic predominance. His own alternative hypothesis is that "neuroticism is correlated with deviation from autonomic balance, in either direction, while extraversion and introversion are related to the direction of the deviation from autonomic balance".

The mediating role of the autonomic in relation to the strength and persistence of conditioned drives is also clearly illustrated in the work of Solomon *et al.* (1953), Solomon and Wynne (1954), Wynne and Solomon (1955) on the effect of sympathectomies. Sympathectomies had the effect of significantly reducing "conditioned response-drive combinations".

It will be remembered that Eysenck considered that "socialization was mediated to a considerable extent by conditioning reactions of an autonomic kind (anxiety)". Tong's results (1959) indicate that different degrees of sympathetic reactivity correspond to different degrees of socialization. Those who might be deemed psychopathic showed a hyporeactive sympathetic, those who were more sociopathic (probably the "dysthymics", though including non-psychopathic aggressive subjects) exhibited considerable hyperreactivity. These differences suggest a further way in which the hysteric and the dysthymic might differ in N. The M.P.I. N scale may be overloaded with those items favouring dysthymic hyperreactivity of the sympathetic nervous system, whilst not taking sufficiently into account the postulated psychopathic hyporeactivity of the sympathetic. Hyporeactivity would appear to be just as neurotic as hyperreactivity, though at the moment a low N score might be interpreted as being more compatible with normality.

Other physiological findings of importance relate to the recording of peripheral vasomotor responses. Volume plethysmography is a method often used in estimating the peripheral blood flow in man (Barcroft and Swan, 1953). Many investigators have studied the effect of a variety of stimuli on the finger plethysmograph (Sturup, 1940; Hertzman and Dillon, 1940; Burch, Cohn and Neuman, 1942; Elithorn, Piercy and Crosskey, 1951), a method which Ackner (1956) considers the most suitable for emotionally disturbed patients, particularly in terms of simplicity and reliability of method. Only a decrease in volume was reported following a wide variety of acute stimuli. The features of these stimuli producing immediate cutaneous vasoconstriction have been the subject of much study. Ackner (1956) considers that, ". . . it appears that the vasoconstrictor response is part of an arousal or alerting reaction to a new stimulus situation. Stimuli which are emotionally significant to the individual are likely to prove more effective than those which are not so charged."

Following the pioneering plethysmographic studies of Hallion and Comte (1894, 1895) it has been recognized that excessive peripheral vasoconstriction is the product of an emotional disturbance and probably related to the sympathetic nervous system. Neumann, Cohn and Burch (1942), found an increase in pulse volume in subjects who were examined in a room more like a bedroom than when they were tested in a laboratory. Burch, Cohn and Neumann (1942) produced compatible results. Neumann, Lhamon and Cohn (1944) discovered a relationship between large pulse-waves and small finger-volume fluctuations in relaxed and contented subjects, whilst small pulse-waves and small finger-volume fluctuations were noted when anxiety was a dominant feature. Van der Meuve and Theron (1947) and Theron (1948) found that an "emotional stability-lability factor was significantly correlated with the rate of change in finger volume and that more "tense" subjects tended to show smaller pulse

volumes. Van der Meuve (1948) also demonstrated a tendency on the part of an anxiety group to have smaller pulse volumes than controls, the hysterics to have larger pulse volumes. Ackner's own experimental work (1956) confirmed that peripheral vasoconstriction was related to the anxious patient.

The tentative hypothesis emerges that those patients subject to considerable cutaneous vasoconstriction possess a hyperreactive sympathetic nervous system, that the dysthymic neurotic is so characterized though over-aggressive non-psychopathic extraverted patients are expected to respond in the same way, whereas those with a hyporeactive sympathetic nervous system should manifest peripheral vasoconstriction to a much lesser degree and be psychopathic. Hysterics might be expected to occupy an intermediate position between dysthymics and normals.

Whilst discussing the role of the autonomic nervous system and its relationship to conditioning, it must not be forgotten that in recent experimental investigations of electrical cortical activity the EEG has been used to study specifically the cortical-physiological mechanisms of the conditioned reflex (Anokhin, 1959). Anokhin made a comparative study of two types of conditioned reflex, the biologically positive (food, warmth, etc.) and the biologically negative (pain, fear, danger). As one criterion of each type of reaction he used the degree of influence exerted by the reticular formation on the cortex of the large hemispheres. A comparison of the three levels of activity of the C.N.S. (large hemispheres, thalamus, reticular formation) showed a tendency for the reticular formation to begin synchronization and desynchronization rhythms somewhat earlier than the cortex of the large hemispheres, especially in the early stages of conditioning. Anokhin argues that following Professor Dell's work it has become recognized that once adrenalin is introduced into the blood it activates the rostral part of the reticular formation of the brain stem, which in turn activates the cortex of the large hemispheres bringing about a similar desynchronization of cortical electrical activity. *It was found later that the desynchronizatory cortical conditions corresponded fully to the tension state of an experimental rabbit. Injection of chlorpromazine then eliminated the desynchronization and the conditioned avoidance response developed as a reaction against electro-cutaneous pain stimulation. Injection by adrenalin then results in clear desynchronization of electrical activity of the cortex of the large hemispheres and a heightened reaction to the previous conditioned defence stimulus.* The main conclusion from this work is that biologically negative reactions appear to develop on the basis of the integrated sympato-adrenaline system and the adrenergic mechanism of the reticular formation of the brain stem. Whilst it is thus recognized that many systems become involved in dealing with stressful situations, for the sake of clarity of exposition the role of the autonomic only will be emphasized, this step only being taken in that the evidence is very strong with regard to the similar and integrated functions of the reticular formation and autonomic nervous systems, a hyperreactive or hyporeactive sympathetic paralleled by similar degrees of arousability in the reticular formation. This viewpoint is similar to that expressed by Sigg (1959)—“Increasing importance is now being attributed to adrenergic mechanisms operating at the level of the brain stem reticular formation. Thus adrenergic neurohumors, which are highly concentrated in the brain stem stimulate the ascending as well as the descending reticular system, producing cortical activation and facilitation of motor and spiral reflex activity.”

In summary, there appears some evidence to suggest that real differences exist on the M.P.I. N scale between dysthymics and hysterics and particularly

between the dysthymics and psychopaths; that the M.P.I. E scale may be a contaminated measure (that is assessing in part changes in N according to degree of anxiety or aggression or different types of E), and that dysthymics may differ from hysterics in terms of degree of reactivity of the sympathetic nervous system. The results suggest that the dimension of neuroticism along which the normal and the neurotic occupy extreme positions (Eysenck, 1947) might be replaced by a dimension of sympathetic reactivity along which neurotics occupy the extreme positions of hypo- and hyperreactivity and normals the intermediate ones. There is less evidence available on the influence exerted by the parasympathetic in determining psychiatric differences between the dysthymics and hysterics-psychopaths. The role of the parasympathetic might be limited to its known homeostatic function. Autonomic lability and imbalance have often been said to characterize the neurotic. It is possible that such lability might occur when the parasympathetic attempts to regulate the extreme swings in sympathetic hyperreactivity and hyporeactivity. The final assessment might suggest that those with a hyperreactive sympathetic would manifest considerable anxiety in response to stress, return high M.P.I. N scores and somewhat lower E scores (scores on the part of the E scale which measures social extraversion would decrease in such cases, whilst the presence of anxiety would also undoubtedly lower the scores on the behavioural extraversion scale), whereas those with a hyporeactive sympathetic would manifest less anxiety, a lower M.P.I. N score and perhaps a corresponding increase in the E scale score.

In considering the influence of a hyperreactive sympathetic nervous system one cannot limit the discussion to anxiety. Excessive aggression can just as easily arise from an over-active sympathetic, providing the circumstances are suitable (one of the most important of these is that the subject has not previously been the centre of too many "anxiety" situations). Thus the additional suggestion is made that the separate behavioural E scale existing within the total M.P.I. E scale might reflect differences in the degree of aggression developed as a result of sympathetic over-activity. It is not considered, however, that this scale is entirely independent of "social extraversion" which might well reflect variations in anxiety. The aggressive individual might be less anxious (subject to the above qualifications) and so return moderately high social extraversion scores. In a similar way the anxious person might be said to be less impulsive than the aggressive person and so returns somewhat lower behavioural extraversion scores. Thus an over-active sympathetic might be responsible for either excessive anxiety or aggression, these related to introversion and extraversion respectively.

## 2. SPEED OF CONDITIONING

The first prediction made by Eysenck on the basis of his theory related to the establishment of conditioned responses. The evidence available on this point can be subsumed under the following three headings (a) experimental, (b) clinical-experimental, (c) symptomatology.

### (a) *Experimental*

The first crucial experiments were carried out by Franks (1954, 1955, 1956) —"It was found that dysthymic neurotics formed conditioned reflexes very easily and that these reflexes were difficult to extinguish, whereas hysterics and psychopaths formed conditioned reflexes very poorly, and that, once formed, these reflexes were readily extinguished. It was found also that intro-

verted normal subjects conditioned much better than extraverted normal subjects. For all groups there was a significant correlation between conditionability and a personality questionnaire which measured introversion-extraversion, and there were no significant correlations between conditionability and questionnaires which measured the dimension of neuroticism. These findings strongly suggest that the underlying causal explanation for the personality dimension of introversion-extraversion is indeed to be found in the cortical processes of excitation and inhibition as adumbrated by Pavlov."

Franks did, however, add cautiously, ". . . drive does not affect conditioning in situations where the drive is an irrelevant one . . . it is, for example, clear that drives may increase the learning of instrumental responses (Munn, 1950), but it would seem difficult to conceive of eyelid conditioning in the present series of experiments as primarily and consistently instrumental. It is also clear that under certain circumstances, drives increase conditioning when the drives are directly relevant to the conditioned stimuli, thus Zener and McCurdy (1939) found that hungry dogs yield a greater conditioned salivary response than non-hungry dogs, and Lashley (1916) and Winsor (1928) obtained similar results with humans.

Franks (1957) conducted a further experiment to test the Spence (1951, 1953), Taylor (1951, 1956) and Hull (1943, 1950) prediction that increased drive strength increased conditionability and that, "total effective drive . . . is determined by the summation of all extant need states, primary and secondary, irrespective of their source and their relevancy to the type of reinforcement employed". His results failed to demonstrate support for the Spence-Hull theory of conditioning, although he concluded that the results were in agreement with an alternative theory which related conditionability to introversion-extraversion and that drives do not summate in the way suggested by Hull. In this experiment a conditioned eyeblink response was developed at the same time as the subject was suffering from food, drink and tobacco deprivation.

In summary, Frank's work suggests that in an experimental situation involving classical conditioning, speed of conditioning may be related to the I-E dimension and not to neuroticism, though not denying the relevance of instrumental learning in other contexts which might operate with either neuroticism or anxiety as the drive.

There is by no means agreement on this subject. Storms and Sigal (1958) have criticized Eysenck's inference that "conditionability" was a unitary trait, quoting in support of their argument the work of Razran (1939) and Roff, Payne and Moore (1954). They make other criticisms of Frank's experiments. They ask whether the groups were equated on initial sensitivity to the tone? They argue that the supposed superiority of the dysthymics over the hysterics in the total number of blinks was due to higher spontaneous blink rates among the dysthymics. They also added that the high negative correlations reported between extraversion and conditionability may be inflated because the subjects chosen for the experiment were extreme scorers on extraversion or introversion. Eysenck (1959) answered some of these criticisms. He argued, for example, that the available evidence did not suggest a positive relationship between blink scores and data from personality inventories (Meyer, Bahrick and Fitts, 1953), whilst Franks (1956) did not find any significant differences between hysterics and dysthymics over a one-minute period following the conditioning and extinction trials. He added that this would load the dice in favour of Storms and Sigal because of the possible reminiscence effects.

Such authorities as Hilgard, Hull and Skinner are also not agreed about the

independence of classical Pavlovian conditioning and instrumental learning. Hilgard, for example, says there is no clear evidence for the Pavlov type of conditioning, depending, as it does, on the approximate simultaneity of stimuli. Skinner (1938) also does not believe it exists in such a pure form. Skinner favours instrumental conditioning, that is reinforcement cannot follow unless the conditioned response appears.

Hilgard similarly presents evidence to the effect that when the experimental circumstances are excellent for demonstrating type S conditioning (Pavlov classical), it is very difficult to demonstrate conditioning (Wedell, Taylor and Skolnick, 1940; Hilgard, Dutton and Helmick, 1949; Young, 1954). On the other hand Kotake and Mihama (1951) and Mihama and Kotake (1954) have reported success, though their results were highly unstable.

Examination of the available evidence does not suggest with any degree of confidence that classical conditioning exists in such a pure form as suggested by Franks. Part at least of the results might alternatively be explained on the grounds of instrumental learning. The puff of air might, for example, be regarded as a stressful stimulus. To this stimulus those with a hyperreactive sympathetic nervous system will generate considerable anxiety. The blink will reduce this stressful anxiety, thus the more anxious the patient the greater the need to reduce this unpleasant feeling. It will be remembered that many of the studies conducted previously with regard to pain threshold demonstrated an over-reactivity to pain stimulation in neurotics (Hall, 1953; Lanier, 1943; Chapman and Jones, 1944; Clausen and King, 1950; Rez, 1943; Wolff and Goodell, 1943; Chapman, Finesinger, Jones and Cobb, 1947; Hemphill, Hall and Crookes, 1952; Chapman, Cohn and Cobb, 1946; Malmö *et al.*, 1948; Malmö and Shagass, 1949; Malmö, Shagass and Heslam, 1951; Malmö and Shagass, 1952). Tong's work has also demonstrated, in this context, that people showing hyperreactive autonomic nervous systems and high autonomic conditionability also show a rapid report of pain. They tolerate it far less. Thus, following a rapid build up of anxiety in the hyperreactors (both as a reaction to an experimental stressor and to the laboratory (Neumann, Cohn and Burch, 1942)) there is an increased drive towards a reduction of this anxiety as soon as possible. The subject therefore blinks as soon as he hears the tone because the tone has always preceded the puff of air, and the blink is an effective unconditioned avoidance response. The model seems to be precisely the same as that operative with Tong's patients. Those patients who tend to report pain later show a lower conditionability score and extreme inhibition with regard to stress reactivity. They are less easily aroused in other words and so instrumental learning is required to a lesser degree.

It will be remembered that hyperreactivity can result in either excessive anxiety or aggression and that they might be related to introversion and extraversion respectively. Tong apparently demonstrated, however, that as both groups could not tolerate stress they both conditioned quickly. Thus a NE might not necessarily have a bad prognosis because anxiety can be generated. Eysenck would however consider the NE to have an unfavourable prognosis because of the poorer conditionability of the extravert. Tong's work thus provides an apparent contradiction to Eysenck's theory inasmuch as a small group of discharged hyperreactive patients showed a tendency towards subsequent social stability, irrespective of temperament. It was the hyporeactive subject who showed a lesser tendency towards improvement. Socialization might therefore be conceptualized within an instrumental learning model with emotionality acting as the drive.

Additional hesitancy with regard to accepting Franks's results might be suggested by the hypothesis developed in the previous section following an examination of the findings of Alper (1946) and Eriksen (1954). Both workers suggested that when the person with a weak ego (NI) was confronted by an objectively non-stressful stimulus he would tend to be on the defensive. It was argued that if this hypothesis was correct, then Frank's results were inevitable, though not necessarily correct. The result to be expected, if defensiveness were not present, would be significant correlations between speed of conditionability and both N and I. This result would be consistent with the results of the many researches reported in this paper and predictable from them.

That caution should be observed before accepting Frank's suggestion of a significant relationship between conditionability and introversion is thus reinforced by the results of the various quoted studies. It is felt, at this stage of the review, that studies still need to be conducted to establish much more adequately the degree of conditionability as related to I-E and indeed to establish whether there is such a thing as classical conditioning which is emphasized in the introvert and which is shown to be independent of the influence of one aspect of N (anxiety).

(b) *Clinical-Experimental*

Evidence that conditioning and introversion might be related was provided by the findings of Franks and Lavery (1955), Lavery and Franks (1956) and Lavery (1958) that sodium amytal, a cortical depressant, reduced conditionability and at the same time increased the degree of extraversion. The work of Shagass (1954, 1956, 1957) and Shagass and Naiman (1955, 1956) is relevant. Eysenck continues, ". . . Sodium amytal, being a depressant drug, would be postulated to increase inhibition. An extravert, whose cortex, according to our theory, is already in a relatively inhibited state, should require comparatively little sodium amytal before reaching the critical sedation point; such a person should have a low sedation threshold. The introvert, on the other hand, whose cortex is in a state of considerable excitation and low inhibition, would require a considerable amount of sodium amytal before reaching the critical sedation point; he would be predicted to have a high sedation threshold. If we express this general hypothesis in terms of neurotic groups and their standing on the extraversion-introversion continuum, then we would expect psychopaths to have the lowest threshold, followed by the hysterics. Mixed neurotics would be intermediate and anxiety states, obsessionals, and reactive depressives would have high sedation thresholds." Shagass's results tend to bear out these predictions, though one must bear in mind not only that recently serious criticisms have been levelled at his criteria of sedation (Ackner and Pampiglione, 1959) but that the reported differences might alternatively be due not directly to differences in I-E, but to differences in the degree of reactivity of the sympathetic nervous system. His results show some support for this. There is one crucial omission in his experimental population. No psychopaths were included in his different neurotic groups. From the previous discussion it will be apparent that two classes of patients might psychiatrically be classified as psychopathic and indeed perhaps manifest very similar aggressive behaviour. They would be the hyper- and the hypo-reactors. The hyperreactor would, in the laboratory-type situation necessary for the assessment of the sedation threshold generate considerable anxiety. *His sedation threshold would be expected to be high, though on testing he might well be extraverted because of considerations discussed*



*previously*. On the other hand the hyporeactor will generate little anxiety and so manifest a low sedation threshold. He might also be expected to be extraverted. Differences in sedation threshold might therefore be explainable on the grounds of differences in sympathetic reactivity rather than I-E, though because of the close incidental relationship between these two variables apparent agreement between Shagass and Eysenck would be expected.

Individual differences in alcohol tolerance in humans may be related to these results (Victor and Adams, 1953), as might Drew's work (1958) on the relationship between driving skills, alcohol and extraversion. Mayerhoffer (1933), Vernon (1936), De Silva (1937) and Newman (1955) have all similarly demonstrated the deleterious effects of alcohol on the learning of driving skills. In this context it will be remembered that Eysenck (1947) found that extraverts ascribed the characteristic of "accident proneness" to themselves more than did the introverts. Kerr (1950) and Kral (1953) produced similar results. Kerr administered the Bernreuter Personality Inventory Scale to accident and non-accident cases. He found that the accident cases were *less neurotic and less introverted* (a finding of interest especially in view of previous discussion), more self-confident and returned higher dominance scores. Kral selected from hospital records 32 accident repeating children and matched them with a control group for age, mental age, sex, school and grade. Two 20-minute standardized doll play interviews were carried out. The accident-prone children showed more aggression in their doll play, less inhibition, less delay in expressing aggression, more activity and more commands, threats and prohibitions in their doll play. In other words accident-prone individuals show a tendency towards extraversion and less anxiety than non-accident-prone subjects. One might say that anxiety produces caution and so less risk of accidents. The anxious introvert would therefore tend not to have accidents and would require correspondingly more alcohol than a less anxious person to reduce his anxiety level to the point where carelessness would arise.

At first glance one might say that these results appear in a general way to be supportive of Eysenck's personality-drug action postulates and predictable from them. In his chapter on drugs and personality Eysenck (1957) provides further evidence and many references to work and results which he considers deducible from his general theory. There are five major references dealing with attempts to relate drug-action and personality to the effects of continuous work, visual after-effects, etc. These experiments on the whole are again superficially supportive of his general hypothesis of a relationship between drug-action and personality (Eysenck, 1957).

Further clinical-experimental evidence can be and has been adduced in support of his general theory. Kennedy (1954, 1955) has pointed out the similarities between the hysteric, the psychopath and the brain-injured person. Experimental support for this opinion is provided by the work of Petrie (1952, 1953, 1956), Le Beau (1954), Le Beau and Petrie (1956) and Teuber and Weinstein (1956). A full discussion on the relationship between brain-damaged and extraverted behaviour is contained in Eysenck (1952). More important for the general argument is that Reese *et al.* (1953), Gantt (1950) and Gantt *et al.* (1942) have shown a lack of conditionability to follow brain damage. Similarly Klein and Krech (1952) have demonstrated that the brain-injured show greater figural after-effects than the non-brain-damaged. The hysterics showed very similar results to the brain-injured. Skinner and Heron (1937) also report the restoration by amphetamine of conditioned reflexes, in rats, which had been extinguished, whilst Lewis's (1947) work suggests that those who have received

head injuries are more susceptible to the effects of alcohol and the shorter the interval between the head injury and the alcoholic addiction the greater the likelihood of abnormal anti-social behaviour. Several earlier studies also apparently support Eysenck's proposals. Shorvon (1945), Hill (1947) and Shorvon (1947) all describe the successful application of benzedrine to the treatment of psychopathic states and behaviour disorders. Bradley (1937), Bradley and Bowen (1941) and Lindsley and Henry (1942) compared the beneficial effects of benzedrine with those of barbiturates which tended to exacerbate the symptoms of this group. Hill and Waterson (1942) and Hill (1944) observed the presence of an abnormal EEG in certain adult cases of psychopathy, associated with aggressiveness in the personality. Success was achieved with amphetamine sulphate with these patients.

Shapiro (1951, 1952, 1953, 1954), basing his work on Pavlov's negative induction model, also carried out experiments using brain-injured and non-brain-injured patients. Negative induction ("excitation of one part of a sensory surface leads to inhibition in other parts"), was found to be much stronger in the former group. It is difficult to decide at the present state of knowledge on the extent to which reactive inhibition, satiation phenomenon and negative induction are the same. Shapiro's results appear nevertheless to offer many interesting leads which do not appear unrelated to the general theoretical formulations above.

Further clinical-experimental evidence concerning the validity of Eysenck's proposals comes from the application of principles directly deducible from his integration of learning and personality theory to the treatment of clinical problems. According to this theory the introverted neurotic should respond to conditioning types of treatment, the extraverted neurotic to inhibitory types of treatment. Jones (1956) and Walton (1959a, b, c, d) successfully applied conditioning techniques to the treatment of introverted neurotics, whilst Yates (1957) and Walton and Black (1959), working with extraverted patients, successfully made use of reinforcement by inhibition. Meyer (1957) and Walton and Black (1959) similarly successfully treated patients by stimulant and depressant drugs, the drugs being used according to Eysenck's drug-action postulates.

Although Lavery (1958) has demonstrated an increase in extraversion following the administration of sodium amytal, *he has also demonstrated a reduction in neurotic symptoms such as anxiety, depression, obsessional thoughts, etc.* This reduction occurred more frequently in the neurotic introverts, though it was by no means exclusive to them. To measure extraversion he used Guildford's rathymia scale (Guildford, 1940). Franks (1957) has, however, criticized this scale because certain of its items correlate more highly with the total score on the C and D scales, i.e. those characterizing neuroticism, than with the total score on the R scale. It leads one to suggest nevertheless that an increase in E might sometimes be associated with a decrease in N. Results similar to those of Lavery have been reported by Petrie (1952). Following leucotomy she found both a decrease in neuroticism and an increase in extraversion. This type of response has also been observed in a clinical-experimental study by Walton and Black (1959). Following improvement in a case of chronic hysterical aphonia there was a significant drop in neuroticism and a most significant increase in extraversion. The fact that Franks and Lavery (1955) demonstrated a reduction in conditionability and an increase in extraversion following the administration of sodium amytal links up very well with the results of these other studies. If anxiety is reduced by amytal with the result that

extraversion scores increase, and if instrumental learning does play a part in Franks's experimental work, as has been suggested, then conditionability should also be lowered in the extravert. The central role of anxiety and tension in the development of conditioned reflexes was illustrated forcibly by Skinner and Heron (1937). Activation of the sympathetic nervous system by amphetamine restored previously extinguished conditioned responses. The administration of sympathomimetic amines, e.g. amphetamines, by Shorvon (1945), Hill (1947), Shorvon (1947), Bradley (1937), Bradley and Bowen (1941) and Lindsley and Henry (1942) to the treatment of psychopathic states is relevant. Improvement in behaviour might well have occurred because of the increased arousability of the sympathetic nervous system. Anokhin's results (1959) are fully consistent with this interpretation. In addition, if Laverty's article (1958) is any guide there is a significant increase in distractibility following the administration of sodium amytal, an effect also designed to lower the conditionability of the patient.

There is much in this section which people might regard as supportive of Eysenck. It appears that there might be a relationship between drug-action and personality. Both experimental and clinical studies tentatively suggest this. It is, however, in the interpretation of this relationship with respect to speed of conditioning and personality that difficulties arise. An alternative interpretation to that provided by Eysenck is suggested.

### (c) *Symptomatology*

A final piece of evidence should be provided, according to Eysenck, by the theory being able to account for the dominant features of the hysteric and the dysthymic repeatedly described in psychiatric textbooks. In Eysenck (1957) an attempt is made to effect a link between excitation-inhibition and the usual clinical personality descriptions of the hysteric and the dysthymic. The main distinction drawn between the two groups is the failure of the former group to become as socialized as the latter. Two sets of evidence are reported early in his chapter on socialization and personality—the experimentally observed facts relating to hysterics and to dysthymics and secondly the predominant clinical features of these groups (Henderson, 1939; Maudsley, 1896; Kahn, 1931; Bianchi, 1906; Sadler, 1936; Bumke, 1948; Delgado, 1953; Henderson and Gillespie, 1947). The differences which had been demonstrated experimentally between hysterics and dysthymics were in intellectual functioning (Himmelweit, 1945; Foulds, 1956), persistence (Eysenck, 1947), speed/accuracy ratio (Himmelweit, 1946), level of aspiration (Himmelweit, 1947; Miller, 1948), sense of humour (Eysenck, 1947, 1956), social attitudes (Eysenck, 1954) and qualitative performance on the Porteus Maze Test (Hildebrand, 1953; Foulds, 1951). These experiments all again tend to support the hypothesis of the dysthymic's over-socialization compared with the hysteric, though not necessarily for the same reasons as advanced by Eysenck.

It will be remembered that Eysenck's argument is as follows. As both the hysteric and the dysthymic are fundamentally the same in neuroticism an elucidation of the ways in which they differ is basic, i.e. in those characteristics related to extraversion-introversion. He considered that he had to explain in terms of his theory, the following points:

1. "The failure of socialization in the hysteric-psychopathic group as compared with the dysthymics.
2. The development of anxiety in relation to neutral stimuli on the part of the dysthymics, as compared with the hysteric-psychopathic group."

Having made the hypothesis that the socialization process was mediated to a considerable extent by conditioning reactions of an autonomic kind (anxiety), he went on to suggest, on the basis of his previous experimental work, that,

- (a) "Socialization was mediated by conditioning.
- (b) Extraverts condition poorly.
- (c) Introverts condition particularly well.

Therefore under conditions of equal environmental pressure we would expect extraverts to be under-socialized, introverts to be over-socialized, with people in less extreme positions on the extravert-introvert continuum showing intermediate degrees of socialization."

He continued,

"The individual's failure to condition easily, on this view, accounts for his failure to become fundamentally socialized, and thus is responsible for those many-sided behaviour patterns. This would appear to be a truly dynamic account of the genesis of hysterical, psychopathic and criminal behaviour patterns . . . precisely the opposite picture is predicted, and found, among introverts and dysthymics. Here we have, in the ethical realm, an excess of socialization leading to pre-occupation with social duties, ethics, guilt and similar moral notions . . . the theory accounts also for the main features of dysthymics' personalities, namely their excessive anxiety reactions. Strong autonomic-emotional lability and reactivity produce excessive fear reactions to painful and harmful stimuli; through unusually strong and responsive conditioning mechanisms these fear reactions become attached to accidental, irrelevant, neutral stimuli which happen to precede or accompany the fear producing occasion. Through their connection with these conditioned fears or anxieties, the previously neutral stimuli now acquire drive properties, such that avoidance of these stimuli became rewarding through reduction of the conditioned fear or anxiety attaching to them . . . the fears and anxieties of the dysthymics are the products of excessively high drive and excessively high conditionability (D × S R)."

In a similar vein Franks (1956) has this to say about recidivists, "One could predict that those recidivists who were introverted in personality, and who also conditioned well would be the ones whose environment had been a continually undesirable one, and with whom no serious attempts at re-education or psychotherapy had been made. This kind of recidivist would probably respond favourably to such attempts and in particular to thorough attempts to condition him to a more desirable form of environment. On the other hand, one could predict that those recidivists who were extraverted in personality, and who formed conditioned reflexes very poorly and whose conditioned reflexes were soon extinguished would be the ones who should be classed as psychopathic. Such recidivists, possessing a constitutional excess of cortical inhibition, would be constitutionally unable to learn (i.e. condition to) the rules of the society in which they lived, no matter how socially perfect their environment. This kind of psychopathic recidivist would probably fail utterly to respond to re-education or psychotherapy."

Several studies are relevant to these formulations and again at first appear to support Eysenck and Franks. Marcus (1955) studied a large group of prisoners who had passed through H.M. Prison, Wakefield. Recidivism was found to be largely associated with introversion. Those prisoners who tended to get into trouble after release tended to be extraverted in personality. Franks deduces, "It would seem reasonable to postulate that the majority of so-called 'recidivists' tend to be slightly introverted in personality; these people have simply fallen into a criminal environment, they are amenable to training and are not intrinsically psychopathic. On the other hand, there is a small proportion of recidivists who tend to be more extraverted in personality; these people are in general not amenable to training and would probably be best classified as psychopathic."

Tong and Mackay's (1959) work tends to support this viewpoint. They found, in a statistical follow-up of mental defectives of dangerous or violent propensities, that the type of behaviour in hospital associated with relapse, following transfer from Rampton, was characterized by aggression, escaping, attempting to escape, and possibly damage (i.e. under-socialized relapses). They also found that length of stay was related to a good prognosis. They found that the mean length of stay was much less for the relapse groups than for the other groups. This is consistent with Eysenck (1959), ". . . I have shown how psychopathic reactions originate because of the inability of the psychopath, due to his low level of conditionability, to acquire the proper socialized responses. But this failure is not absolute; he conditions much less quickly and strongly than others, but he does condition."

Field (1959) has similarly found that when two groups of prison inmates are compared, those that were in prison longer were significantly more neurotic and more introverted. Both groups were more neurotic than normals, but only those that had had a lot of past prison experience were less extraverted than normals. The young recidivists were one-third S.D. more extraverted than the norms. Although he has not yet been able to quantify the data, it appears from the case histories that more of the older recidivists endured "abnormal or abnormally weak pressures to conform in early life".

Durand (1955), in a prognostic study, provided evidence compatible with the formulations of Franks, Tong and Eysenck. He divided his patients into two main groups, the compulsive and the impulsive. The impulsive felt no regret or guilt over their addiction whilst the compulsive addicts felt that their condition was wrong. After three years 1 of the 33 impulsive addicts had recovered (approximately 3 per cent.), whilst 4 of the 22 compulsive addicts (approximately 20 per cent.) had recovered.

Hansen and Teilman (1954) investigated a group of convicted criminal alcoholics. They were divided into two groups. The first group were abnormal psychologically and long-term prisoners, the second group were under short-term detention orders and soon released on parole. The former group had a substantial number with head injuries (possibly more extraverted). Only 13 per cent. of this group improved, in spite of therapy, whereas 35 per cent. of the other group improved without treatment.

Thus, although this section contains studies which provide apparent support for Eysenck's theory the results also suggest an alternative explanation, as have the previous sections. First, Eysenck considers that there are two types of activities which each person has to learn. The first of these can be subsumed under instrumental conditioning, the second under classical Pavlovian conditioning. In illustrating the latter, he suggests that the expression of aggressive and sexual urges, for example, may be rewarding in themselves and so instrumental conditioning and the law of effect are not relevant and that the satisfaction of these urges therefore without regard to the consequences should be effected very easily. It might well be argued alternatively that this is an example of instrumental learning. A person may experience sexual feelings but because of anxiety and fear of rebuff, etc. he does not translate these feelings into overt behaviour. His failure to make sexual advances therefore avoids the possibility of rebuff and anxiety, and so is instrumental in creating and reinforcing what is a respectable social response, that is a lack of response. In the same way and for similar reasons people may learn to refrain from other types of anti-social behaviour. A neurotic introverted boy by associating with "bad lads" can develop a delinquent style of behaviour. Eysenck might argue

that this is due to the marked conditionability of this type of person. An alternative explanation might be as follows. His delinquent friends represent sources of stress in that failure to follow their style of behaviour might result in criticism which the boy cannot tolerate. Conformity therefore reduces this anxiety and is responsible for the development of his delinquency.

Tong (1959), in a series of laboratory studies with psychopathic defectives, demonstrated that reactivity to stress varied from a high degree of excitation (much anxiety) to one of a high degree of inhibition (little anxiety). Subjects who were rated as unstable within the hospital were found to be of either a very high stress reactivity or very low reactivity. Stable subjects within hospital demonstrated a moderate degree of reactivity. Patients who demonstrated a subsequent social instability following discharge from hospital showed a tendency to manifest low stress reactivity. High stress reactivity was associated with subsequent social stability following discharge. Although there are similarities between these results and Eysenck's ideas, an alternative explanation can be offered to his own theory. Eysenck suggests that since the dysthymics and the hysterics are similar in terms of neuroticism, differences in socialization are due to differences in I-E. Any anxiety which is aroused in the dysthymic becomes attached to irrelevant stimuli because of the greater conditionability of this type of patient. In the hysteric poorer conditionability therefore fails to relate this anxiety to these stimuli. Tong's work appears to contradict this for many of his under-socialized psychopaths were hyporeactive on tests of sympathetic reactivity. They failed to register much anxiety. Their under-socialization may in part be therefore attributable to an absence of fear of consequence or a poor arousal to the possible stresses associated with anti-social behaviour rather than due to poor conditionability dependent on extraversion. Those psychopaths who showed subsequent social stability were hyperreactors, that is they were capable of generating excessive anxiety responses, even though their behaviour might show signs of impulsiveness and extraversion.

One inference from Field's work, especially in view of the previous discussion, is that although the longer term inmate may score lower than the norms on I, the older recidivists are nevertheless showing response to treatment. This might be formulated in another way. The older recidivists when first committed to prison exhibited aggressive anti-social behaviour. The fact that on test evidence they now return high neuroticism scores might indicate that their aggression was originally the result of a combination of adverse environmental pressure and a hyperreactive sympathetic nervous system. They might therefore have exhibited on admission, if testing had been carried out, a picture very similar to the young recidivists in Field's study, that is somewhat more extraverted in behaviour. As has been stressed in this paper hyperreactive aggressive subjects are capable of generating excessive anxiety responses, though their speed of response to treatment, dependent on this anxiety, might vary according to the rigidity of the aggressive behaviour pattern developed as a result of years of unsuitable environmental stimulation. Thus the hyperreactive aggressive criminal would respond to treatment though only slowly, this depending on the degree of rigidity. As he improved he would thus become less extraverted. This is of course not saying that he is responding to treatment because he is introverted, *it is rather suggesting that NE can respond to treatment providing they are hyperreactors.*

With regard to Marcus's results (1955), he found that those prisoners who tended to get into trouble after release tended to be extraverted in personality.

Several times in this review results have been quoted showing significant negative correlations between extraversion and neuroticism and which suggest that the M.P.I. neuroticism scale may be more a measure of sympathetic N.S. over-reactivity. If this is the case then those extraverted inmates who relapsed may either be less anxious (the hyporeactors) and so motivated less towards social conformity, i.e. the true psychopath, or hyperreactors who had been subject for too long, before prison committal, to adverse environmental pressure so that they find it extremely difficult to change the rigidity of their aggressive behaviour pattern.

In Eysenck (1957) further examples are given of human classical conditioning—"In the experiment the subject may be shown a series of words on a screen. Every time a particular word is shown to him an electric shock is administered. Very soon the psycho-galvanic reflex which always accompanies the shock becomes associated with the word itself, which thus becomes a conditioned stimulus." By experiments similar to this Eysenck has tried to demonstrate a relationship between I-E and speed of classical conditioning. This experimental design might also be considered instrumental rather than classical in its emphasis on the type of learning demanded and so raise further doubts about a significant relationship between I-E and conditionability of the Pavlovian type. It might be argued that the establishment of a relationship between the presentation of a word and an exaggerated P.G.R. response is evidence of an arousal response on the part of the patient, preparation for the reception of a noxious stimulus, i.e. bodily preparation to meet something unpleasant and so indirectly rewarding. It helps to meet the threat. If the sympathetic is less easily aroused, less *additional* sympathetic activity may be in evidence, and much less relationship between a word and a P.G.R. response would thus be demonstrable.

#### CONCLUSIONS AND SUGGESTIONS ARISING OUT OF THE CRITICAL ASSESSMENT OF CERTAIN ASPECTS OF PERSONALITY AND LEARNING THEORY

##### 1. *Evidence Related to the Validity of Eysenck's Dysthymia-hysteria Dichotomy*

The evidence suggests:

(a) That real differences exist on the M.P.I. N scale between dysthymics and hysterics.

(b) That the dysthymics and hysterics differ in the degree of sympathetic reactivity.

(c) That reported differences between these two groups on the M.P.I. scale may be partly due to this scale being more a measure of sympathetic hyper-reactivity.

(d) That it is possible for those patients showing a hyperreactive sympathetic nervous system to manifest either considerable anxiety, high M.P.I. N scores and somewhat lower M.P.I. E scores (scores on the social extraversion scale would decrease in such cases), or considerable aggression with a corresponding increase in E. Because the N scale appears to favour anxiety-type items the neurotic aggressive hyperreactor might return spuriously low N scores. Those patients with a hyporeactive sympathetic nervous system might manifest correspondingly lower N scores. Since the hyporeactor generates little anxiety and conditions badly (Tong, 1959) it is suggested that the term psychopath might justifiably be restricted to this diagnostic group.

(e) That the M.P.I. E scale may be a contaminated measure, that is measuring in part N and different types of E, a decrease in E associated with anxiety, an increase in E associated with the presence of aggression.

(f) That if one wishes to retain the term neuroticism for both the dysthymics and the hysterics, then abnormality might be understood in terms of the former's tendency towards hyperreactivity, somewhat less reactivity in the hysteric, with the psychopath showing a tendency towards hyporeactivity in his sympathetic nervous system. All three groups might be considered to be neurotic, the former because of an excessive emotional response to stress, the latter because of a hyporeactive emotional response.

(g) That circumstances and experiences are important determinants in the behaviour of the hyperreactors, of much less importance in the hyporeactors.

## 2. Evidence Related to Speed of Conditioning and Personality

Because of the probable contamination of the M.P.I. E scale and because of its relationship to the N scale, it is possible that Franks's results reflect the influence of instrumental learning in which anxiety acts as the drive. A suggestion arising from the work of Tong and Field might be that the over-socialization of the dysthymic is due to excess anxiety, this in some instances acting as the drive, in others disrupting effective social behaviour so that unreasonable degrees of conformity result, whilst the relative under-socialization of the hysteric-psychopath is attributable to the presence of a lesser degree of anxiety. The evidence which attempts to relate degree of socialization to differences in I-E is much less convincing. Tong's work (1959) in this sphere is basic. A fundamental difference between Eysenck and Tong relates to the committal of anti-social acts by neurotic introverts. Eysenck would suggest that those N1 with anti-social histories turned to crime because of their greater conditionability dependent on introversion and because they were also subject to anti-social backgrounds. Nevertheless these people would respond to therapy. Tong has shown, however, that people with a hyper-reactive sympathetic nervous system (i.e. *people with excessive anxiety (introverted) or aggression (extraverted) show, following treatment, a tendency towards social stability*). It is only when there is an absence of anxiety or responsiveness that the patient fails to respond to treatment.

Much of the evidence relating speed of classical conditioning and introversion thus remains equivocal, though a strong positive alternative explanation links socialization with instrumental learning dependent on anxiety.

## 3. Suggested Amendment to Eysenck's Theory

If Eysenck wishes to regard dysthymics and hysterics as similar in terms of neuroticism, though different in terms of introversion-extraversion, certain modifications in terms of what is meant by these two factors are unavoidable. Eysenck (1959) has argued that, "all statistical and methodological analyses are 'artifacts', i.e. 'a product of human art and workmanship'; it is difficult to see how they could be anything else." Thus any failure by questionnaires to support a dysthymia-hysteria dichotomy might, with justification, be questioned on similar grounds. If, however, many investigators using both verbal and physiological methods reach conclusions which can be integrated into an alternative system to that proposed by Eysenck, then the possibility of human error being held responsible for a failure to demonstrate the validity of the dysthymic-hysteria dichotomy must be less.



On the basis of the available evidence the following suggested amendment to his theory appears worthy of consideration. He believes that both the dysthymic and the hysteric are characterized by high scores on tests purporting to measure neuroticism. Neuroticism he regards as "strong autonomic drive reactions" or "as a form of drive related to the *over*-excitability of the autonomic nervous system, particularly the sympathetic branch". Studies have been cited, however, which indicate that whilst dysthymics may be so characterized, the psychopath in particular proves the exception. Hysterics show the trend towards hyperreactivity to a lesser degree than dysthymics. The results lead one to suggest that neuroticism is not just related to over-excitation of the sympathetic but also to under-excitation. This of course changes the complexion of his theory, particularly since such differences can provide a plausible explanation for many of the differences in N and E between dysthymics and hysterics noted in current research reports and which are at variance with Eysenck's theory.

The first suggestion is that dysthymics differ from hysterics and psychopaths in terms of the degree of anxiety generated as a reaction to stress. Dysthymics are characterized by excessive anxiety responses, the hysterics by less anxiety, the psychopath least of all. *If "neuroticism" is to be retained it must cater not only for over- but also for under-excitation of the sympathetic nervous system.* The second suggestion is that conditionability might not be related to introversion as defined, for example, by the total M.P.I. E scale, *though introverts as assessed by the Guildford Rhathymia scale or the M.P.I. E scale are likely to show more rapid conditioning and extinguish these conditioned responses more slowly than extraverts so assessed by the above two scales,* providing these extraverts do not score at the upper end of the M.P.I. N scale. This statement needs some elaboration. If dysthymic neurotics are subject to *excessive* anxiety responses then some degree of social introversion is almost inevitable. Both the Rhathymia scale and the M.P.I. E scale appear in part to measure this factor. Thus anxiety (or one type of neuroticism) and social introversion appear to go together. As has been suggested earlier, Franks's work might be interpreted as evidence for instrumental conditioning in which anxiety acts as the drive. Thus the more anxious the individual the greater the speed of conditioning. If anxiety is minimal (the other type of neuroticism) then social introversion scores are likely to be less and total extraversion scores higher. These people would condition rather badly. Thus it is possible to achieve the same results as Eysenck but for other reasons. The essential differences between the two approaches are that the present suggestion recognizes differences in neuroticism (as defined above) between the two groups, that part of the differences in I-E between these same groups is related to this, and that according to the model presented earlier degree of arousability of the sympathetic nervous system will dictate speed of conditioning, though this might wrongly be ascribed, due to contamination of the available E scales, to introversion as defined by such as the total M.P.I. E scale.

Let one simple example suffice to illustrate the difference. Eysenck (1959) quotes Watson's famous experiment (1920) with little Albert, the young child who was fond of white rats. Watson created a fear of white rats in the boy by making a loud noise with a hammer whenever the child reached for the animal. This Eysenck quotes as an example of classical Pavlovian conditioning in which the animal was the conditioned stimulus, the loud noise the unconditioned stimulus and the unconditioned response was the fear. In other words the fear became associated with the rat and the child developed a phobia. Now few people would argue about the immensely important mediating role of anxiety

in learning theory, least of all Eysenck (1959). Indeed he has stressed this repeatedly. He would, however, argue that if young Albert was introverted he would condition much more quickly than young Tom who was extraverted. As Eysenck says (1959), "Watson was lucky in his choice of subject; others have banged away with hammers on metal bars in an attempt to condition infants, but not always with the same success". In other words Eysenck would consider the "young Alberts" of this world to condition much more quickly if they were introverted than extraverted. The alternative suggestion is that those with hyperreactive sympathetic nervous systems, show an exaggerated emotional response to the stress of a loud, unpleasant noise, that this stressor always followed attempts to reach for the animal and so there developed an understandable avoidance response, the speed and persistence of this conditioning bearing some relationship to the degree of anxiety. It would still be an instrumental rather than classical conditioning model and basically related to neuroticism though also probably related to introversion for reasons discussed earlier. Support for this viewpoint might be obtained from the work of Spence and Farber, 1953; Spence, Farber and Taylor, 1954; Spence and Taylor, 1951, 1953; Taylor, 1951.

If this modification is worthy of consideration then it should be capable of generating independent explanations or suggestions with regard to some of the major components of Eysenck's theory, for example, the central role played by reactive inhibition and its relationship to extraversion. According to the present argument those scoring high on extraversion scales are either behaviourally aggressive and so less anxious, though nevertheless capable of excessive anxiety responses, or show little evidence of emotional arousal to stressors. Stimulation of the sympathetic results, as is well known, in the post-ganglionic fibres liberating a substance almost identical with adrenaline, whilst glycogen stores in the liver are converted into glucose, etc. In other words the individual in such a state of arousal is physiologically more capable of dealing with an emergency; he has more immediate energy resources. Thus hyperreactive neurotic introverts and extraverts might be said to have these benefits more frequently than a person with a much less active sympathetic nervous system. If life can be regarded as being punctuated by a series of long-standing "stressful" situations demanding personal attention then the hyperreactive neurotic would appear physiologically particularly well endowed for this task. The energy resources at the command of such a person might be more than those possessed by the hyporeactive extravert. It is not difficult to appreciate how the latter in comparison may lag in terms of his application. Fatigue and indeed impatience would be more rapid in onset. In addition, of course, any pressure towards social conformity would also have less effect in such a person. Anxiety would be less and also the motivation towards conformity would be less. The hyperreactive introvert and the hyporeactive extravert might be said each to have the best and worst of two worlds. The former too much anxiety though greater energy supplies, the latter much less anxiety though less energy resources at his command. The hyporeactive extravert might well therefore be subject to excess reactive inhibition, because he has less sympathetically stimulated energy resources. Complicating the influence of reactive inhibition will always be the mediating role of anxiety. The less anxious hyporeactive extravert might show a rapid decrease in performance, perhaps wrongly attributable to reactive inhibition *in toto*, perhaps partly attributable correctly to the relative absence of anxiety not forcing conformity and persistence.

It might also be interesting to dwell for a moment on the relationship

between the action of adrenaline and the bodily metabolism. Wright (1947) has indicated that the ingestion of 1 mg. adrenaline in man increases heat production by as much as 20 per cent. for a short time. It is not difficult to see that the energy produced by the body might thus bear a relationship to the degree of sympathetic reactivity and that, in view of the previous suggestions, this might be linked directly to the degree of neuroticism as previously defined and only indirectly to 1-E. That is, varying degrees of reactive inhibition may correspond to varying degrees of sympathetic reactivity. At a more gross hypothetical level the well-known increase in application and persistence following the administration of sympathomimetic amines, e.g. amphetamines, might result from the stimulation of the sympathetic (they have a similarity in structure to adrenaline) just as the barbiturates might be expected to depress the sympathetic nervous system and so result in a lack of persistence and in sedation.

#### 4. *Relevance of the Conclusions from Previous Section to the Problem of Drug Addiction*

One of the main conclusions emerging from the review is that there is a strong body of evidence which suggests an alternative explanation to that offered by Eysenck's theory with regard to the possible relationship between personality, psychiatric diagnosis and conditionability.

Eysenck would suggest that introverted individuals subjected to adverse environments would, according to a classical Pavlovian conditioning model, "take-over" the moral standards and behaviour patterns of this type of environment. In other words introverts associating with drug addicts would tend to become drug addicts. Psychopaths might, on the other hand, turn to addiction because of their under-socialization dependent on their extraversion. The alternative explanation is that introverts are more likely to be anxious and it is this emotional response which plays a central role in one type of addiction. In other words instrumental rather than classical conditioning appears to be important in drug addiction, that is, part of the phenomenon of addiction can be understood in terms of drive reduction theory. Other aspects of addiction might be accounted for in terms of a combination of a hyporeactive sympathetic nervous system (the individual would show little concern about what society thought of his actions), plus some element of drive reduction other than that related to anxiety. These views will be elaborated in the next section.

#### THE RELEVANCE OF PHYSIOLOGICAL PROPERTIES OF DRUGS TO ADDICTION

Although serious doubts have been expressed concerning the validity of interpretations drawn from results of Pavlovian-style experiments, these doubts are by no means limited to the present review. It is one of the issues on which learning theorists tend to divide. Ever since the old law of association (ideas experienced together tend to become associated) and the later principle of association by contiguity were formed, doubts have been expressed by theorists about the exclusion of the role of reinforcement, reward or punishment, etc. from these systems. One of the main advocates of a stimulus-response association psychology was Guthrie (1930, 1942). The motivational state of the individual had no formal place in his theory. Of six experiments quoted by Hilgard (1956) relevant to this theory, four however presented evidence contrary to it (Seward, 1942; Seward, Dill and Holland, 1944; Zeaman and Radner, 1953; Wickens and Platt, 1954). Mueller and Schoenfeld (1954) similarly

concluded, "While the principles of conditioning which he expands (Guthrie) seem to have a parsimony that would be desirable in a theoretical formulation of behaviour, a closer analysis reveals that a formidable set of additional assumptions and constructs are required if his theory is to possess any real applicability to experimental data." Finally in support Hilgard (1956) has this to say, "Actual experiments in which autonomic conditioning takes place (salivation, galvanic response) are full of indirect accompaniments of Type R. When the circumstances seem almost ideal for demonstrating Type S conditioning, as in attempts to condition pupillary constriction by presenting a tone along with a light, it is extremely difficult to obtain any conditioning at all (Wedell, Taylor, Skolnick, 1940; Hilgard, Dutton and Helmick, 1949; Young, 1954) . . . pure cases of Type S conditioning are hard to find. The heart-rate conditioning of Notterman, Schoenfeld and Bersh (1952) includes the possibility of operant intermediaries." Indeed Hull published a formal derivation of Pavlovian conditioning on the basis of the reinforcement principle as early as 1937.

Because of these doubts the first essential is to examine the physiological properties of certain known addictive drugs to see whether these properties possess drive-reducing qualities which an alternative reinforcement theory of drug addiction would require. Table I presents the "benefits" and withdrawal symptoms associated with some of the well-known addictive drugs.

TABLE I

*The Benefits and Withdrawal Symptoms Associated with Certain Addictive-Drugs*

Drug	"Benefits"	Withdrawal Symptoms
Morphine and its derivatives	Feeling of exhilaration and euphoria, diminution of individual's self-critical faculties; feeling of supreme contentment and self-satisfaction under the most deplorable conditions.	Depression; anxiety with restlessness; profound malaise; shivering and twitching; variable pain and muscular cramps; nausea; vomiting and diarrhoea.
Cocaine	Exhilaration; elation or euphoria, increased flow of ideas.	Insomnia, palpitations; general malaise, gastric disturbance; slight confusion.
Pethidine	Analgesic.	Sweating; malaise; anxiety; depression; cramp-like pains. Associated with larger dosages are more serious symptoms—convulsions, choreoathetotic movements.
Barbiturates	Alleviation of anxiety and tension. Disinhibition.	Anxiety; tremors; palpitations; postural dizziness, vomiting.
Amphetamines	Increased energy, mental alertness and agility.	—
Marijuana	Sense of euphoria, volubility and hyperreactivity followed by a sense of calm and relaxation.	—

In view of the frequency of withdrawal symptoms noted in this table, can physiological dependence account for drug addiction? It certainly appears that the body adapts to the effects of some of these drugs, though not in a uniform way, so that many more times the original dosage is required to produce the same effect. If the drug is suddenly withdrawn, once tolerance has been developed, unpleasant withdrawal symptoms result. To avoid these

unpleasant withdrawal symptoms the addict need only take the particular drug again. In other words he must take the drug habitually to prevent the onset of this physiological distress. Nevertheless there appears to be a more basic reason to explain drug addiction for withdrawal symptoms tend not to be unbearable whilst the self-limiting nature of the condition results in their disappearance in a matter of ten days. Similarly if drug addiction were caused by physiological dependence it could not explain the fact that some 75 per cent. of drug addicts discharged from hospital free from physical dependence started using the drug almost immediately after discharge (Ausubel, 1952). It would also appear illogical as Ausubel argues, that most people would be "willing to pay the fantastic price of the drug and risk imprisonment, social disgrace, and ostracism merely to avoid a moderately severe ten-day illness. Secondly, every year thousands of persons with serious fractures, burns, and surgical conditions receive opiates long enough to develop physiological dependence, but are nevertheless able to break this dependence quite easily. Thirdly, the dosage of morphine required to prevent withdrawal symptoms is never more than one or two grains daily. Hence, why will drug addicts take up to twenty grains a day if they take the drug, as they claim, 'just to feel normal'? Fourthly, withdrawal symptoms can be adequately relieved if morphine is taken by mouth. Therefore, why will addicts give themselves pain and run the risk of infection by injecting the drug 'main-line', or directly into their veins, with crude, homemade syringes? The answer to both these questions is that the large dose and the 'main-line' route increase the 'kick' or euphoric effect of the drug. Fifthly, a new opiate has been developed which has all the analgesic and euphoric properties of morphine, but for which withdrawal symptoms are minimal. Nevertheless, the evidence is conclusive that addiction develops just as rapidly for this drug as for other opiates."

If physiological dependence is not *basic* to the development of addiction, what other qualities do addictive-drugs possess which make them a necessity to the addict? A principal pharmacological property of morphine and its derivatives is euphoria—the addict can feel "supremely contented and self-satisfied under the most deplorable conditions". This effect can also be produced by cocaine, and marijuana addiction. The amphetamines produce a similar reaction, though of less intensity—it takes the form of increased energy, mental alertness and agility. The barbiturates and alcohol might also be said to produce similar effects to each other—an alleviation of anxiety and tension and disinhibition. In other words the beneficial adjustive qualities of these drugs might initially be of more importance than the subsequent physiological dependence. Within this context it is therefore important that, in the section of the review dealing with the experimental studies of addiction, it became apparent that the addict was, in the majority of studies, considered to be psychologically abnormal and this abnormality to precede his addiction. Studies were cited subsequently which suggested that neurotic abnormality varied between extreme and minimal degrees of anxiety, neurotic categories bearing a relationship to this dimension. Thus those neurotics prone to anxiety, tension and social difficulties might prove particularly susceptible to the beneficial effects of the barbiturates and alcohol. Their over-socialization might also prevent them from resorting to the socially unacceptable drugs such as marijuana, heroin and opium if the opportunity arose, or indeed to prevent them from being part of a set of circumstances likely to provide the temptation in the first place. Psychopaths, on the other hand, might alternatively resort to these latter drugs with less of a conscience and because of their under-socialized

behaviour may have more opportunity to resort to these drugs. If the thesis of the present paper is correct then the true psychopath, with less anxiety, should have less need to become addicted to the barbiturates and alcohol, though one can see more clearly the benefits of the euphoric drugs to him.

Such a clear demarcation between the types of drugs taken by these two main classes of patients is probably far too simple. Anxious patients do presumably become opium and marijuana addicts. The euphoric effect of these drugs can readily be seen to possess drive-reducing qualities. The conclusion appears to be that all of the quoted drugs possess qualities which are likely to be more beneficial to the psychologically abnormal subject than to the normal person and so drug addiction may be a learned phenomenon developing as a simple function of the consequence of the drug in question. If these rewards are influential in determining learning, is the extent of the learning (the addiction) a function of the amount of reward? In other words is there a relationship between the strength of the addiction and degree of neuroticism? Thorndike (1933), it will be remembered, held the view that reward operated in an all-or-none fashion. Variations in the amount of reward, according to this view, had little effect on the learning process providing the reward was sufficient to produce the reinforced response. Hull (1950) tends to agree with this formulation for habit is said to be a function of the frequency of reinforcements rather than the amount of reinforcement. The work of Grindley (1929), Gantt (1938), Crespi (1942) and Zeaman (1949) on the other hand suggests that performance does increase as the amount of reward increases. In order to reconcile these findings McGeoch and Irion (1952) suggest that habit has to be separated from performance and that the amount of reinforcement determines the latter rather than the former. Hull has done precisely this. Performance he regarded as a multiplicative function of habit and reward. The facts, unfortunately, do not suggest any clear picture. Human learning experiments tend to favour the idea that reinforcement acts in an all-or-none fashion. Learning does not always increase with an increase in reward and what is equally important, when this increase does occur it is not always proportional to the amount of reward (Thorndike and Forlano, 1933; Rock, 1935; Eisenson, 1935). Thus one cannot say with any confidence that the severity of the addiction is a simple function of the severity of the neurosis, though some degree of neuroticism appears necessary to guarantee that the rewards are sufficient to produce the reinforced addictive response.

Reinforcement theorists are less divided about learning being an increasing function of the number of reinforced trials. This assumption is basic to the work of Thorndike and Hull. The facts of conditioning and instrumental learning experiments tend to bear out this view. Similarly there is much evidence supporting the idea that responses which occur in close temporal contiguity to a reinforcing agent tend to become more strongly learned than those separated from the reinforcement in time. In other words the more frequently an unstable addict resorts to the drug the greater the learning, whilst drug effects also tend to occur in "close temporal contiguity" to the drug stimulus and so lead to further reinforcement.

In conclusion, if physiological dependence is not basic to the initial development of addiction, what might be its role in the development of the phenomenon? Its probable role might best be illustrated within an instrumental learning model proposed to explain drug addiction. The subject takes a drug which is found to possess drive-reducing qualities.

The strength of the habit then develops as a multiplicative function of

drive reduction, the frequency with which the patient resorts to the drug and the temporal contiguity of the stimulus and reward. Hand in hand with the development of this habit the body builds up a tolerance for certain of these drugs which necessitate larger dosages to produce the same effect, an effect which has become an "additional" necessity as it has itself become reinforced in the development of the addiction. Correlated with the increased tolerance and dosages are the withdrawal symptoms. It is suggested that these may have a differential effect on the hyperreactor and on the hyporeactor. In view of the apparent lower tolerance of stress in the former group, avoidance of the withdrawal symptoms may become more of a necessity, such avoidance acting as the reward and so directly assisting in the further development of the habit. Thus the avoidance of the unpleasant withdrawal symptoms would not be essential to the development of addiction, as well illustrated by Ausubel, but the presence of these symptoms might well reinforce a further dependence on a drug both through an inability to tolerate the stresses associated with them and the immediacy of the reward associated with their termination. The patient need only take the drug again to avoid these unpleasant symptoms.

## ACKNOWLEDGMENTS

I would first like to thank Dr. J. E. Tong, Rampton Hospital, for allowing me to read and to quote from his article on "Stress-Reactivity" in advance of publication; secondly I would like to acknowledge the help I received from Dr. J. G. Field, Maudsley Hospital, on the subject of the personalities of criminals. Dr. P. O'Flanagan, Winwick Hospital, helped in no small way by elucidating points of neuro-physiology, whilst Dr. E. Thorpe and Miss D. Mather greatly assisted by reading critically the original drafts of the paper.

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