THE RELATIONSHIP BETWEEN PSYCHOPHYSIOLOGICAL AND COGNITIVE RESPONSE STYLE IN SCHIZOPHRENIA

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Abstract

A review of the literature on electrodermal activity and cognitive processes in schizophrenia is presented which highlights the heterogeneous nature of schizophrenia and the inability of previous findings to explain the variability underlying both symptomatology and behaviour. Some studies suggest, however, that there are consistencies in relation to the orienting and habituation characteristics of schizophrenic patients on the one hand and in relation to cognitive response style on the other. Insofar as they reflect modes of deploying attention it was hypothesised that a relationship would exist between the patterns of responding on both cognitive and psychophysiological measures.

This hypothesis was explored in three studies measuring electrodermal and cognitive variables.

The first study included patients with and without schizophrenia and normal control subjects. Across subject groups a general tendency was found in the direction of hyper-responding and a right hemisphere bias being associated with field independence, overinclusion, flexibility, sharpening, scanning and augmenting. These results were interpreted as consistent with the view that hyper-responding reflects a more adaptive response style than hypo-responding.

A test-retest study in normal control subjects only partially replicated the findings of this study but

nevertheless suggested that any relationship obtained held over time.

At variance with the first study, the third study indicated differences between patient and nonpatient groups such that field independence and reduced interference on the Stroop task were related to hypo- rather than to hyper-responding in the two patient groups. These were found to be related to anxiety measures and interpreted within the context of a compensatory gating mechanism. Other differences were noted in the relationship between hemispheric asymmetries and the two cognitive measures. They suggested that a switch in attentional mode may have occurred and were interpreted in the context of fixed and dynamic processes and the relationship between anxiety and hemisphere processing.

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INTRODUCTION

The Relationship Between Psychophysiological and Cognitive Response Style in Schizophrenia: An Introduction

In a study in 1974 Otteson attempted to account for the discrepant findings in psychological research on schizophrenia by looking at the relationship between cognitive response style and schizophrenia. He argued that the difficulties in interpreting the performance of schizophrenic patients on perceptual tasks "stem from the fact that such studies have tended to ignore the roles of attention and cognitive structures within the perceptual act." He further argued that the high variability of performance "may reflect individual differences in cognitive style which could well be impervious to the effects of schizophrenicity."

At about the same time Gruzelier (1973a) was attempting to reconcile differences in the psychophysiological literature about the nature of psychophysiological responding in schizophrenic patients. Ever since the introduction of electrodermal measurement as a tool to examine the nature of psychopathology (Feré, 1886), the findings in the research on schizophrenia have generated more confusion than clarity. The confusion lay initially in the attempt to define a pattern of electrodermal arousal that would characterise schizophrenia. In 1973, Depue and Fowles published a review suggesting that schizophrenics showed a hyperactive response pattern, a stance that was challenged by an equal array of evidence

for electrodermal hypoactivity (Jordan, 1974). Rather than stating a compromise position that the data were inconclusive, as Stern and Janes (1973) did, Gruzelier and Venables (1972) and Gruzelier (1973a,b) concluded that there were, in fact, two quite different patterns of electrodermal responding in schizophrenia, lending further support to the idea that this was not a homogeneous but a heterogeneous illness. Both cognitive and psychophysiological response styles reflect an individual's mode of responding to internal and external stimulation. The current study is an attempt to examine whether a relationship exists between these two styles and, if so, whether and how it might be related to different forms of psychopathology, in particular, schizophrenia.

Cognitive style refers to cognitive control principles that remain relatively stable within a particular person over time. The concept of cognitive controls emerged from a programme of research begun by Klein (1958) and his associates (Gardner et al 1959; Gardner and Moriarty, 1968; Holzman and Rousey, 1971). These studies attempted to account for individual differences in performance on traditional perceptual tests by proposing the concept of regulating cognitive structures which intervene between stimulus or task on the one hand, and perceptual-cognitive behaviour on the other. Klein and his associates described a number of such cognitive controls (e.g., levelling-sharpening, constricted-flexible, focussing-scanning, field articulation, tolerance of ambiguity) which were inferred from stable patterns of correlations between apparently different tasks. They maintained that these

controls reflected a person's enduring adaptive strategies for organising sensory stimuli.

Constellations of such controls or regulative tendencies comprise a person's enduring 'cognitive style' of perceiving, remembering and thinking. In support of this, they have been found to be relatively consistent over time. Gardner and Long (1960), for example, found them to be stable over a three-year period inspite of major disruptions in the lives of many subjects. Similarly, Witkin (1964) cited numerous studies showing that one cognitive control, field articulation, has a predictable line of development from early childhood (5 years).

Psychophysiological response style is the term I am using to refer to the various dichotomies that have been alluded to in research using the electrodermal response. Electrodermal activity is linked biologically (Venables and Christie, 1973) and psychologically (Sokolov, 1963) to the cognitive mechanisms controlling learning and attention (Ohman, 1979). To the extent that cognitive style comprises different cognitive controls so that psychophysiological response styles comprise different autonomic components that might also be said to reflect an individual's mode of processing incoming stimuli. These components include the orienting response, habituation of the orienting response, tonic measures of arousal, temporal measures relating to the phasic response and bilateral differences in tonic and phasic responding.

All these components can be viewed as bipolar dimensions

similar to those of cognitive controls in the sense that individuals have been divided into dichotomous groups according to whether a) a given stimulus elicits an orienting response of large or small magnitude, that is, high or low orienters (Maltzman and Raskin, 1965; Maltzman, 1967; Maltzman and Mandell, 1968; b) habituation is slow or fast, that is, whether individuals are characterised by a predominance of inhibitory or excitatory processes (Neblylitsyn, 1966); c) individuals exhibit large or small numbers of spontaneous fluctuations, that is, are electrodermally labile or stable (Lacey and Lacey, 1958); d) individuals show characteristically high or low levels of arousal, that is, are hypo- or hyper-aroused (Gruzelier and Venables, 1975) and e) individuals show larger left- or right-hand responses (Gruzelier, 1973b). Whilst these particular patterns relate to skin conductance measures similar patterns may be found in electroencephalogram and heart rate measures.

As with perceptual-cognitive responding, so the individual's mode of psychophysiological responding has also been shown to have early developmental origins. For example, Lustman (1956, 1957) and Richmond and Lustman (1955) conducted a series of studies with neonates in which individual differences in electrodermal reactivity were found to exist as early as one day after birth.

Both these concepts are therefore referring to different ways of measuring perceptual information-processing and it is by accepting this common ground that a basis for a relationship between the two styles is being examined.

The introduction so far has implied that it is a trait rather than a state phenomenon which we are dealing with. There is, however, evidence to show that this may not necessarily be the case (e.g., Rubens and Lapidus, 1978). This raises the issue of whether the disruption caused by psychosis could modify or destroy cognitive strategies or whether there exist particular styles that characterise particular forms of psychopathology (e.g, a 'schizophrenic style') or stages within an illness.

The aim of this thesis is therefore to explore these various issues in the context of a possible relationship between cognitive and psychophysiological styles and its importance for psychopathology, in particular schizophrenia. In the first experiment (Chapters 5 - 13) schizophrenic patients were compared with nonschizophrenic psychiatric patients and normal control subjects on an electrodermal habituation paradigm and six cognitive tasks that have been traditionally used to elicit a pattern of electrodermal responding on the one hand and cognitive control styles on the other.

CHAPTER 1

Electrodermal Activity in Schizophrenia

Electrodermal activity has been used to investigate psychopathology since the end of the last century (Fere, 1886). The earliest psychophysiological studies of schizophrenia were largely devoted to identifying reliable differences between nonpsychotic and schizophrenic subjects. This literature has been reviewed by Lang and Buss (1965). Since then, much research has been directed towards determining whether there is a characteristic mode of psychophysiological responding in schizophrenic patients. This has been explored in relation to a variety of electrodermal parameters. The following summarises the evidence in relation to the two aspects or response styles that are under study in this thesis.

(a) Responding-Nonresponding

Up to 1970, the majority of reports on the orienting response in schizophrenia pointed in the direction of hypo-responding. Orienting responses were small or absent (Feigenberg, 1969; Saarma, 1969; Traugott et al, 1958), and there was evidence of faster than normal habituation across all stimulus intensities (Bernstein, 1964, 1969a, 1969b, 1970). However, Lynn (1963), in a review of Russian research, concluded that in addition to the majority of schizophrenics in whom OR activity was low, there was a small group in whom reactivity was higher than normal. In support of this there were reports of slower habituation in schizophrenic patients (Zahn et al, 1968; Zahn, 1964).

Furthermore, Gruzelier and Venables (1972) reported evidence of both hypo- or nonresponding and hyper-responding with reduced habituation. Schizophrenic nonresponders had lower skin conductance levels and fewer spontaneous fluctuations than schizophrenic responders or normal control subjects whereas responders were above the controls on both measures. Each type occurred with almost equal frequency, but with nonresponding more frequent among institutionalised patients. Bimodality has been consistently reported by Gruzelier and his colleagues (Gruzelier and Venables, 1974a; Gruzelier, 1978a, b; Gruzelier et al, 1981) and has been subsequently confirmed by other studies (Lobstein, 1974; Patterson and Venables, 1978; Rubens and Lapidus, 1978; Rippon, 1979).

After considerable controversy regarding the replicability of findings, recent reviews (e.g., Ohman, 1981) as well as cross-laboratory comparisons using standardised methodology (Bernstein et al, 1982) have agreed that across countries, laboratories and widely different samples of schizophrenics close to 50% fail to show electrodermal responses to simple stimuli. This represents at least a five-fold increase compared to the proportion of nonresponding typically observed in normals (7-10%).

In addition, the Bernstein et al (1982) comparative study showed that many of the schizophrenics who have orienting responses often habituated faster than did nonschizophrenic responding subjects. Both these findings support a predominantly hyporesponsive pattern in schizophrenic patients. This was seen in a majority of the studies and

laboratories included in the study, although conflicting evidence was presented by a minority. On the one hand, Zahn (1976) found no difference in hyporesponsiveness between patients and normal controls. This was attributable to a high level of nonresponsivity among the normal group (40%), not seen in the other studies, as well as to an additional 20% who habituated on the first trial. On the other hand, Frith et al, (1979) found that a majority of their acute schizophrenics displayed nonhabituating responses with very few seen as either nonresponders or fast habituators. A similar trend was found by Bernstein (1970), Zahn (1976), Gruzelier et al (1979) and in a study by Bartfai et al (1983) no nonresponders were found. In addition a special form of hyper-responding, an 'irregular stop and go pattern' has also been observed in schizophrenic patients by some authors (Zahn et al, 1968; Gruzelier et al, 1981).

Thus rate of habituation, whether fast or slow, and nonresponding, may represent important individual differences within the schizophrenic population. The elucidation of the cognitive significance of these subgroups was the main purpose of this study. It is therefore important to review the various factors relating to stimulus and response criteria and to individual differences that might account for the variation.

(i) Stimulus intensity

Venables (1977) maintained that the proportion of nonresponding is relatively independent of stimulus intensity and that hyporesponsivity has been shown across different

intensities. There is, however, evidence to show that loud stimuli are more likely to elicit responses than stimuli at lower intensities. Bernstein (1970) examined responses to 60, 75 and 90 dB tones in three different groups of schizophrenics. He found a large decrease in nonresponding from 60 to 90 dB. A similar finding was made by Lobstein (1974).

Gruzelier et al (1981) also found that the majority of schizophrenic patients who did not respond to 70 dB tones responded to 90 dB tones. Nevertheless, both a high and low incidence of nonresponding has been reported in studies using moderately high intensity tones of 85 dB (Gruzelier and Venables, 1972; Frith et al, 1979; Straube, 1979). Attempts to explain differences in terms of another stimulus factor, tone frequency, have also been inconclusive. Lower frequencies (300/500 Hz) have been used in studies where both low (Zahn, 1976) and high (Stern et al, 1965) incidences of nonresponding have been found.

Another aspect of the stimulus which is closely related to intensity is the effect of different rise times. Fast onset may heighten the subjective experience of stimulus intensity and it has been shown that, if relatively intense tones are presented with a very rapid rise time this may trigger a startle reflex (Flesher, 1965; Graham, 1979). Bernstein et al (1981) showed that the incidence of nonhabituation dropped from 32% to 0% in schizophrenics and from 72% to 10% in normal subjects when a more gradual rise time was used. However, Graham (1979) presents evidence which suggests that startle responses can

habituate quite readily counteracting the above arguments. Furthermore, Gruzelier and Venables (1972, 1974) did not find that bimodality was influenced by whether tones up to 85 dB had controlled or uncontrolled onset.

(ii) Stimulus significance

Another important stimulus-related factor is signal value or the significance of a stimulus. This may be attributed by task demands or by a subject's evaluation of the task.

Both Gruzelier (1978) and Venables (1975) consider non-responding to be specific for nonsignal stimuli. In a joint study (1973) they reported that the majority of schizophrenics who were nonresponsive to 'neutral' or nonsignal tones became responders when significance was attached to the tones by requiring a differential button press to them. [Seven nonresponders with levels of skin conductance below 1 microsiemen were deliberately excluded from this study]. Bernstein and Taylor (1976) found adolescent schizophrenics to be hyporesponsive to neutral tones but not to intensity-matched stimuli of high intrinsic significance such as the human voice. In addition, when the tones where preceded by instructions prompting subjects to 'listen harder to the tones', responses in these patients rose to control levels and the effect was retained over the five trials given after prompting was discontinued. Finally when required to press a pedal to one of three previously neutral tones, responses among adolescent schizophrenics again reached control levels when the targeted tone was presented, but remained lower in amplitude to 'nonsignificant' tones.

However, Lobstein (1974) using a paradigm in which the autonomic response to a significant stimulus event was separated from the motor movement required to signal its occurrence found that only 3 out of 10 nonresponders changed to responding status to the signal tone. Similarly Rippon (1979) reported that only 3 out of 18 nonresponding schizophrenics changed status with a shift from nonsignal to signal conditions. These two studies challenge the idea that nonresponding is specific to nonsignal stimuli.

The extent to which an experimenter can convey the neutral nature of the stimuli to the subject may vary in subtle ways and the 'innocuous' instruction to 'just listen to the stimuli' may be interpreted in a variety of ways, particularly among schizophrenics (Iacono and Lykken, 1979). Bernstein et al (1982) suggested that in the Frith et al (1979) study, the instructions advising subjects of an impending change might have made the tone series significant and heightened the schizophrenic orienting response. This would not, however, have accounted for the increased hyper-responsivity found in the Bernstein study where 90 dB tones were given without such instructions.

Further support is presented by Bernstein et al (1980) who examined responses to trials consisting of both a visual and an auditory stimulus with onsets 20 seconds apart. Under 'innocuous' conditions, chronic schizophrenics again were hyporesponsive relative to controls to stimuli of either modality. When made significant, however, the schizophrenics' reponses became similar to those of controls to both signals. On the other hand, Zahn (1964,

1975) and Zahn et al (1981a) found schizophrenics become less responsive as stimulus meaningfulness increases.

(iii) Response measures

There are a number of response measures that might appear to influence the degree of nonresponding. Electrodermal activity can, for example, be measured either by a constant current or a constant voltage method. These two methods are said to give identical results for amplitude although not for recovery (Boucsein and Hoffman, 1979), but they may give different results for response frequency because of differences in the criterion for a minimal response (O'Gorman, 1978). This criterion is not the same in resistance units and conductance units. In the Zahn (1976) study a minimal response criterion of 400 ohms was used. This corresponds to a lower response criterion than the .05 microsiemens used in the studies by Gruzelier and could account for the lower incidence of nonresponding (O'Gorman, 1978). However, Zahn (1978) showed that the application of a .05 microsiemens criterion to his data did not substantially change the distribution of responsivity patterns.

(iv) Medication

Another possible explanation for the discrepant findings may be the effects of medication. Whilst the findings of Gruzelier and Venables (1972, 1974a) showed that both responders and nonresponders were on the same type and dose of medication, there are studies to show that differences do exist between patients on and off medication and between subsamples of schizophrenics (Stern

et al, 1965; Magaro, 1973; Goldstein et al, 1972).

The incidence of nonresponding has been found to be slightly smaller in patients off medication (Straube, 1979; Frith et al, 1979; Gruzelier and Yorkston, 1978; Zahn, 1976). Yet in a drug withdrawal study by Gruzelier and Hammond (1978) in which skin conductance responses were recorded in patients four weeks on chlorpromazine, four weeks off drug and then four weeks on drug again, the majority of the nonresponders in the first phase retained their nonreponder status when taken off drug.

Overall, phenothiazines have been found to affect tonic functions by lowering, for example, levels of skin conductance (Straube, 1979; Venables, 1975; Gruzelier and Hammond, 1978; Spohn et al, 1971; Pugh, 1968; Bernstein, 1967) but do not directly affect spontaneous fluctuations or phasic responses to innocuous stimuli (Bernstein, 1967; Venables, 1975; Spohn et al 1977; Straube, 1979). Whilst some studies have reported decreased phasic responding in medicated schizophrenics, this has consistently involved stimuli that were 'unpleasant' (Pugh, 1968) or 'tension arousing' (Goldstein et al, 1966).

Gruzelier and Hammond (1978) found no drug effects on responses to neutral stimuli tones, but reduced responding to 'subjectively loud and unpleasant' noises used as unconditional stimuli in the same patients. Reduced responsiveness to such stimuli has been considered to reflect a drug-associated diminution in the internal distress or anxiety otherwise accompanying the stimulus

rather than a lowering of phasic orienting response (OR) to stimulation per se (Pugh, 1968; Goldstein et al, 1966). However, although phenothiazines can reduce responses to aversive stimuli and those with signal value, it is not always possible to separate experimentally signal and nonsignal or unpleasant and nonsignal influences.

Furthermore, Frith et al (1979) indicated that response habituation (or the absence thereof) in acute schizophrenic patients is as effective in predicting response to phenothiazines as the traditional indicators of prognosis such as insidious or sudden onset of illness. They found that habituators show a positive response to drug treatment while nonhabituators do not.

Finally, whilst phenothiazines do not appear to account for differences in the incidence of nonresponding, other drugs like propranolol do (Gruzelier and Yorkston, 1978).

(v) Subject Sampling

Another factor that may account for differences in responsiveness between studies relates to patient sampling. Traditionally, schizophrenic patients have been classified according to whether they are acute or chronic, paranoid or nonparanoid, process or reactive, etc. More recently, individual symptoms or their clustering have proved to be a more meaningful dimension in differentiating groups of patients and there is evidence to show these are related to electrodermal reactivity patterns.

Zahn (1976) has suggested that sampling differences may be

important in that the early nonbimodal studies were carried out in the 1960s whereas the bimodal studies were carried out in the 1970s when more liberal discharge policies might have produced a sample of patients resistant to neuroleptic medication. Bernstein et al (1982) suggested that in their group of patients, the lack of drug response may have been associated with higher responding. As support for this he used the finding by Gruzelier (1976) that noninstitutionalised nonhabituators were more active and more hostile than noninstitutionalised nonresponders. But they found no evidence of hyper-responsiveness in more recent studies drawing on chronic, still-hospitalised patients (Bernstein et al, 1981).

The initial study that identified the responder-nonresponder dichotomy (Gruzelier and Venables, 1972) indicated that the two groups did not differ on variables such as chronicity, institutionalisation or diagnostic category. However, Mirkin (1985) suggests that an acute-chronic distinction does exist. According to his comparative study, the research failing to obtain bimodality (Iacono, 1982; Straube, 1979; Frith et al, 1979 Tarrier et al, 1978; Zahn, 1976; Patterson, 1976) used either acute or chronic patients whereas studies confirming bimodality (Rubens and Lapidus, 1978; Gruzelier and Venables, 1972) included both kinds of patients. In his study Mirkin showed that acute schizophrenics (N=22) were electrodermal hyper-responders whereas the chronic patients (N=38) were hypo-responders suggesting that bimodality is most likely to arise when both are present

in an experimental group.

However, in Mirkin's study the differences in electrodermal activity reflected not just a difference between acute illness and chronicity. Within groups it was the acute patients with positive symptoms who tended to over-respond and the chronic patients with negative symptoms who under-responded. As positive schizophrenic symptoms are usually associated with acute illness and negative symptoms with chronicity (Crow, 1983), this suggests that the apparent parallel between level of responding and the acute/chronic dimension was probably dependent on the degree to which either group showed negative or positive symptoms rather than the level of chronicity.

Although no differences in overall ratings of psychopathology have been found (Gruzelier and Venables, 1972; Gruzelier, 1976), differences between responders and nonresponders in terms of symptoms have been found in previous studies (Bernstein et al, 1981; Straube, 1979; Gruzelier, 1976). In the Gruzelier (1976) study differences between schizophrenic responders and nonresponders were examined using the Wittenborn Psychiatric Rating Scale (1968). Among noninstitutionalised patients (less than 5 years total hospitalisation) responders were significantly higher in the more active symptoms (manic state, anxiety, psychotic belligerence, attention-demanding and assertiveness). Whilst differences were not significant between institutionalised (more than 10 years hospitalisation) responders and nonresponders, a significant correlation was noted between skin conductance

response amplitude and withdrawal, with more withdrawn responders exhibiting smaller amplitude responses.

A similar pattern of results was obtained using the Brief Psychiatric Rating Scale (Overall and Gorham, 1962) by Straube (1979) in a sample of acute schizophrenics. Patients who were autonomically nonresponsive were characterised by cognitive disorganisation, emotional withdrawal, motor retardation, depression and somatic concern whereas more responsive patients had high ratings of mannerisms and posturing and excitement. These two symptom patterns are very similar to the differences between positive and negative schizophrenic symptoms. It was, in fact, a predominance of positive symptoms in the patient sample in the Bartfai et al (1983) study that was thought to account for the lack of nonresponding.

Bernstein et al (1981) confirmed Straube's findings with a sample of chronic patients although differences in depressed mood, motor retardation, somatic concern or mannerisms and posturing were not significant which may reflect the differences between the acute and chronic populations. Two other relevant studies by Deakin et al (1979) and Krawiecka et al (1977) found that the more severely ill chronic schizophrenics showed slower response habituation, that is, more responsiveness, than less severely ill patients. Severity was, however related to positive rather than negative symptoms so whilst the findings appear discrepant they in fact support the other findings in this area.

(vi) Genetics

Few people doubt the important genetic contribution to the etiology of many schizophrenic illnesses (Gottesman and Shields, 1982). There does, however, appear to be some discrepancy in relation to the electrodermal findings with some studies suggesting hyperarousal in high-risk offspring (Mednick and Schulsinger, 1968, 1974; Mednick, 1978) and others an increased rate of nonresponding (Robinson et al, 1977).

In a recent study by Alm et al (1984) nonresponders in his sample were found to have a significantly higher incidence of schizophrenic relatives than responders. They also tended to show more psychotic symptoms although they did not differ in cognitive distractibility or in biochemical and computed tomographical measures. Subjects with a family history had fewer responses and a lower SCR/SF ratio than those without although there were no differences in skin conductance levels or spontaneous fluctuations. These findings appear opposite to previous high-risk studies showing electrodermal hyper-reactivity and Alm suggests this is because of differences in the samples used. Firstly, in their study subjects already had a schizophrenic diagnosis, suggesting that the transition from a high-risk status to a definite diagnosis is accompanied by a change in electrodermal reactivity, from a responding to nonresponding status. Secondly, it may be that the subsample of high-risk children who are electrodermally hypo-reactive are under-represented because as adults they develop into Kraepelin's dementia praecox type and because their parents would be of the

process-type who are typified by low sexual activity, low rates of marriage and low fertility (Venables et al, 1978).

(vii) Prognosis

Various studies have looked at prognosis/outcome in relation to level of responding. Both Frith et al (1979) and Zahn et al (1981a) found that a hyperactive electrodermal pattern during simple repeated tone stimulation was associated with poor outcome in nonmedicated acute schizophrenics. The sample of Zahn et al (1981a) consisted of acute patients with good premorbid history assessed at admission and discharged three months later. The group which later improved differed from the nonimproved group in that it had fewer spontaneous fluctuations and faster habituation. The sample of Frith et al (1979) had both first and repeated admission patients including both acute and insidious onsets to their illness. On admission the patients were divided according to whether they habituated or not. After 4 weeks the nonhabituating group showed less improvement than the habituating group.

Ohman (1981) suggested that these two studies are indicative of the way in which the pattern of electrodermal reactivity relates to the individual per se rather than to his schizophrenic illness, and as such may index vulnerability to schizophrenic episodes. Other studies, however, indicate that electrodermal measures may follow changes in the psychotic state of schizophrenics (Stern et al, 1965; Depue et al, 1975) or that a change in response status may be indicative of good prognosis (Rubens, 1977; Rubens and Lapidus, 1978).

In summary, whilst the evidence does not support bimodality in the sense of equal proportions of hypo- and hyperresponsivity, schizophrenics do appear to differ psychophysiologically from normals in two opposing directions. On the one hand, there are nonresponders, characterised by low levels of tonic electrodermal activity and negative schizophrenic symptoms and, on the other, responders characterised by higher tonic physiological arousal and often slow habituation coupled with positive schizophrenic symptoms but sometimes with fast habituation.

(b) Hemipheric Asymmetry

Bilateral asymmetry in tonic and phasic measures has proved to be another important area of research in relation to schizophrenia. Insofar as individuals with a predominantly left greater than right hand pattern have been shown to differ on various measures from those with the reverse pattern of asymmetry it can be considered as a another psychophysiological dimension. The following is a review of studies of hemisphere asymmetry in schizophrenia.

(i) Tonic Measures

Several studies have examined bilateral asymmetries in skin conductance level among schizophrenic patients but so far the data remain inconclusive. One of the first reports by Syz (1926) indicated a marked and consistent asymmetry in stuporous catatonic patients; the direction was, however, not specified. Fisher and Cleveland (1959) found higher spontaneous or nonspecific activity on the right compared with the left in 41 male, dextral, noninstitutionalised schizophrenic patients (hospitalisation less

than two years). And Dykman et al (1963) found lateral asymmetries in both directions in the level of activity of both acute and chronic schizophrenic patients.

Furthermore, Gruzelier (1973) reported an interaction between skin conductance level asymmetry and the responder/nonresponder status of schizophrenics in the direction of higher right than left hand levels in responders and higher left than right hand levels in non-responders. This interaction was also observed by Rippon (1979) and Lobstein (1974, Exp. 1), particularly in noninstitutionalised patients. Some studies have, however, failed to support this finding (Lobstein, 1974, Exps 2, 4; Gruzelier and Yorkston, 1978) or found that the asymmetry depends on task demands (Gruzelier and Venables, 1974a). These findings are important in relation to whether laterality is independent of background electrodermal activity.

(ii) Phasic Measures

The data for bilateral asymmetry of responses are more consistent than those for levels. Whereas normal subjects show only small asymmetries in orienting response amplitudes, several studies have reliably observed larger right than left hand responses among schizophrenics (Gruzelier and Hammond, 1976; Gruzelier, 1973; Gruzelier and Venables, 1973, 1974a) although the effect has been restricted sometimes to institutionalised (Gruzelier, 1973) and sometimes to noninstitutionalised patients (Gruzelier and Venables, 1974a). An extreme example of response asymmetry has been noted in patients who are nonresponders on the left hand but responders and

nonhabituators on the right hand (Gruzelier and Hammond, 1977; Gruzelier, 1973).

However, both Ohman (1981) and Bernstein et al (1981) failed to replicate the Gruzelier findings of bilaterality in schizophrenics using both auditory and visual orienting stimuli. Bernstein et al (1981), for example, found overall larger left-hand magnitude in schizophrenics, psychiatric controls and normal controls with no significant differences between them.

(iii) Symptomatology

In the same way that symptom profiles were found to characterise the responder/nonresponder distinction (Straube, 1979; Gruzelier, 1976), lateral asymmetries, whether right- or left-hand predominant, have been found to have characteristic symptom profiles. Gruzelier and Manchanda (1982) looking at a group of 48 unmedicated schizophrenic patients diagnosed with the help of the Present State Examination (Wing et al, 1974) found that those with larger left-hand responses (19) had more grandiosity and pressure of speech on the BPRS, while on the PSE CATEGO syndromes they had more simple ideas of reference, hypomania, situational anxiety, delusions of grandeur, hypochondriasis and depressive delusions and hallucinations. Patients with larger right-hand responses (29) had more withdrawal, motor retardation, blunted affect and uncooperativeness on the BPRS, while on the PSE they were more irritable during interview, had more slowness and simple depression. These symptom patterns reflected high behavioural, cognitive and emotional arousal in

in patients with larger left hand responses and lower arousal in those with larger right hand responses. The two patient groups were not distinguishable on the basis of Schneiderian symptoms. In a subsequent factor analysis, the authors identified six main factors, three of which characterised the florid group: heightened arousal and exaggerated self-awareness and bodily concern; and three characterised the non-florid group: slowness and emotional withdrawal, simple depression and social withdrawal.

This study has to some extent been supported by evidence from two other recent studies. Rabavilas et al (1986) examined the relationship between symptoms and lateral asymmetries in positive symptom, paranoid schizophrenic patients and found that the larger the asymmetry of left-hand responses, the higher the ratings of tension, grandiosity, suspiciousness, conceptual disorganisation and hallucinatory activity. A right-hand asymmetry in tonic levels of activity was also associated with higher ratings on some negative symptoms. This finding was also indicated in a study by White et al (1987) in relation to chronic negative symptom schizophrenic patients.

As yet the body of evidence for electrodermal bilateral asymmetry is quite small. It does, however, suggest the presence of two styles of responding that can be differentiated according to electrodermal arousal and schizophrenic symptomatology. In view of the much larger body of neurological and cognitive evidence of hemispheric asymmetries it therefore seems appropriate to pursue the idea of a relationship between the different domains.

CHAPTER 2

Cognitive Processes in Schizophrenia

Schizophrenia is a mental illness defined on the basis of a cluster of symptoms and evolving signs of dysfunction. Increasingly this clustering is thought to contain several syndromes and hence schizophrenia is viewed as a category subsuming the schizophrenias. The etiology of this condition is still largely unknown. Cognitive abnormalities have long been considered a prominent feature of schizophrenia (Kraeplin, 1919; Bleuler, 1911). They have been traditionally seen as secondary to a primary disturbance that may be organic in origin, the varying pattern of symptomatology representing differing adaptations to similar cognitive abnormalities. Bleuler (1911), for example, believed there were two stages in the disease, each with a different psychological mechanism. The first stage had both organic and psychological components. The organic part was the cerebral substrate of the disease process, the psychological part was the 'loosening of associations' or primary thought disorder caused by it. The disturbance of association was seen to underlie a second psychological mechanism which was then responsible for secondary symptoms like delusions and hallucinations.

Venables (1975) has also emphasised that the observed behaviour of the schizophrenic patients is partly the result of attempts to gain some control over the development in primary disturbance. He has distinguished four stages in this process. Firstly, there is the prepatient

who, although showing only minimal overt signs of disease, may already demonstrate psychological or physiological disturbance. Secondly, there is the patient with the first overtly recognisable disorder; in the case of the process patient who has already experienced the gradual onset of disturbance, some adaptive strategies may have already developed. Thirdly, in the reactive patient, where the disorder may follow an identifiable stress, the pattern of disorder will be influenced by pre-existing, relatively mature behaviours. Finally, there is the chronic patient in whom the primary disorder may or may not be apparent anymore, and in whom both the overt and covert symptoms may be largely aspects of secondary and learned processes.

These two viewpoints address indirectly the issue of the heterogeneity of schizophrenic performance that has made it difficult to define either a single etiology of schizophrenia or a unified theory of psychological deficit. They highlight the interactions between primary deficit and individual differences which form the focus of the current thesis. The intention of this chapter is thus to review the various psychological deficits that have been noted in schizophrenic performance and theories that have been used to explain them and then to look at the work on cognitive response style as an alternative explanatory concept.

Theories of psychological deficit in schizophrenia have fallen broadly into two categories. On the one hand, it is viewed as an information processing defect; on the other it is related to constitutional or emotional aspects.

a) Information Processing

Early theories of defective information processing in schizophrenia were based on Broadbent's (1958) model. According to this model, stimuli impinging on the nervous system are first registered by a sensory receptor and then entered into short-term storage. Further processing of stimuli only occurred if they were selected by a filter for entry into a limited capacity channel. After input had been selected from short-term storage conditional probabilities from long-term storage of past contingencies then acted to predict and reduce signal redundancy and to select stimuli that previously maximised the probability of appropriate reinforcement. The processing deficit in schizophrenia could thus occur at various stages.

(i) Defective Filter Mechanism

One group of studies has suggested that schizophrenics, or at least certain subgroups of schizophrenics, may have a defective filter mechanism (Payne and Hewlett, 1960; Chapman and McGhie, 1962; Payne et al, 1964; Payne and Caird, 1967; Hawks and Marshall, 1971). Payne and his colleagues were interested in the concept of overinclusion that is, the tendency to include irrelevant and extraneous aspects when responding to stimuli. Overinclusion was first described by Cameron (1938, 1939) and considered initially to be a form of thought disorder. Payne, however, saw overinclusion not as a form of thought disorder but as secondary to a more fundamental disturbance of attention, namely, a defective filtering mechanism that was no longer able to exclude irrelevant stimuli so that thinking became distracted by external

events and irrelevant personal thoughts and emotions.

Using an object classification test, Payne and Hewlitt (1960) were able to show that of all the various factors influencing the thinking of psychotic patients over-inclusion was specific to schizophrenia. However, Payne noted that only about half of the schizophrenic patients were overinclusive in their thinking. They suggested on the basis of subsequent studies that overinclusion was mainly associated with paranoid schizophrenia (Payne, 1961; Payne et al, 1964; Payne and Caird, 1967). They also showed that overinclusion was found predominantly in acute patients with the overinclusive scores of chronic schizophrenics tending to fall within the normal range (Payne, 1962, 1971; Payne and Friedlander, 1962; Prior, 1973).

There have been several attempts to explain the acute-chronic differences. Gathercole (1965) suggested that they were due to the lowered responsiveness of the more chronic patients as this group tended to make fewer usual as well as fewer unusual sortings than acute schizophrenics on Payne's object classification test. In the same vein Hawks and Marshall (1971) considered overinclusive thinking and retardation to be manifestations of the same primary attention defect. They suggested that some schizophrenics may learn to adapt to information overload by slowing the rate at which they respond, resulting in decreased overinclusion but greater retardation, this being more prominent in chronic patients. By manipulating response speed they found it was possible to change the number of associative errors made by schizophrenics.

Chapman (1961) also reported strong evidence for the over-inclusion hypothesis but argued that schizophrenics could be both over- and underinclusive (i.e., overexclusive). He saw the inappropriate enlarging or restricting of the application of common concepts as a preference for those of a particular breadth. Using two kinds of task, one to elicit errors of overinclusion, the other overexclusion, he found that schizophrenics made both kinds of errors although there was a predominance of overinclusion errors. The same tendency was observed in normals, albeit greatly diminished, suggesting that findings in schizophrenics were merely an exaggeration of similar findings in normals. This was supported by Seth and Beloff (1959) who considered the underlying reason to be a lowering or alternation of the attention process. Weckowicz and Blewitt (1959), on the other hand, suggested that both disorders of perception and thinking in schizophrenia are secondary to a disorder of attention span which can be too broad or too narrow, or may alternate between the two. Thus excessively broad attention leads to overinclusive concepts, excessively narrow attention to overexclusive concepts. Alternating between too broad or too narrow attention would lead to both overinclusive and overexclusive errors as were found by Chapman (1961).

According to Broadbent's model, the purpose of the selective filter was to ensure that the capacity of the limited processing channel was not overloaded. The limit of the channel was an information one, so that the number of stimuli which could be responded to at any one time was determined by the amount of information they contained. If

schizophrenics had a defect in filtering this would vary with task and be more evident in complex tasks. This was shown in a series of studies by McGhie and his colleagues on the effects of distraction on aspects of schizophrenic performance (Chapman and McGhie, 1962; McGhie et al, 1965) They found that on simple speed tests involving motor responses to predictable stimuli, schizophrenics like other psychotic patients, performed lower than normals and showed only a slight decline with distraction. However, on signal tracking tasks involving unpredictable signals schizophrenics showed a greater performance decrement in the presence of distraction. Similar findings were shown on dichotic listening tasks involving the process, storage and recall of information (Lawson et al, 1966).

The evidence supporting a defective filter mechanism in schizophrenics thus introduces the idea that there is an adaptive mechanism at work affecting attention and perception that reflects different ways of dealing with the input of information. Schizophrenics have shown over- and underinclusion, over- and underestimation, narrow and broad attention. Furthermore, although the differences may be related to different subsamples of the schizophrenic population, these modes of processing information appear to be characteristic of the normal population as well, with schizophrenics' performance constituting merely an exaggeration of a normal pattern. This is apparent in other areas of investigation as well.

(ii) Collapsed Response Hierarchies

A second theory based on Broadbent's 1958 model was

suggested by Broen (1968). Here, the focus of the deficit was not on the selective filter itself but on the usage of the conditional probabilities that influence the filter, that is, a proposed defect in the long-term store. This theory shifted the emphasis away from an input dysfunction to a deficit in the response or output mechanism. The Broen and Storms collapsed response hierarchies theory (Broen and Storms, 1966, 1967; Broen, 1968, Storms and Broen, 1969) centred around the concept of hypothetical orderings of response probabilities which were thought to have been partially collapsed in schizophrenics, resulting in stronger competition between the dominant and subordinate responses from any given situation. The ordering of response hierarchies was the same for both schizophrenics and normals; it was only their relative probability of being manifest in overt behaviour which was altered. Broen and Storms also suggested that there was a ceiling of response strength which was lower for schizophrenics than for normals. After the dominant response reached the response strength ceiling, only the competing subordinated responses could be increased in strength. Thus when the dominant or competing responses had high habit strength, the difference between their probabilities was likely to be decreased by the low ceiling of the schizophrenic.

Broen (1968) suggested that in order to deal with the subsequent information overload or disorganisation, schizophrenics learn to restrict the range of stimuli they observe at any one time. In support of this view, Feeney (1971) showed that chronic as compared to acute schizophrenic patients manifest a narrower range of cue

utilisation resulting from a narrowing of the range of sensitivity to stimulation as well as reduced distractibility. Other examples of reduced responsiveness to complex environmental stimulation have been reviewed by Silverman (1972). These include evidence that responsiveness to novel stimuli is inhibited; low-complexity stimuli are preferred to high-complexity stimuli; information sampling is slower than in normals and behavioural and perceptual disturbances are reduced with exposure to sensory deprivation. Silverman (1972) related these responses to clinical symptoms such as withdrawal, blocking of thoughts and loss of spontaneity in movement and speech. He saw them as attempts to reduce the perceived intensity of stimulation, external and internal.

Another factor Broen and Storms felt might affect the response hierachies is that of high arousal. They hypothesised that the effect of increased arousal in normals is to increase dominant response strength at a faster rate than competing responses until a ceiling is reached. Further increases in arousal would then only increase the strength of competing responses, leading to interference. Broen considered, however, that this deficit was likely to be reversible rather than permanent since, for example, many of Payne's overinclusive schizophrenics had good prognosis. Broen suggested that increased arousal may be a factor that would reduce probabilistic coding in such a way as to lead to reversible loss of filtering for relevancy. This causal role of increased arousal is consistent with the McGhie and Chapman's (1961) suggestion that an inhibitory dysfunction of the reticular activating system

might underlie the filtering deficiency.

(iii) Slowness in Processing

Another theory based on Broadbent's model was put forward by Yates (1966). Rather than an inability to exclude irrelevant stimuli, Yates saw the schizophrenic deficit as slowness in processing relevant information in the primary decision channel. This implies that more information would be passed to the short-term memory system, leading to overloading and loss of information. Yates saw part of the schizophrenic confusion being a result of registering only a small part of the relevant environment input.

Studies of speed of functioning have indicated that the schizophrenics are generally slower than other psychiatric groups (Karras, 1973); chronic patients are also slower than acute patients (Huston and Senf, 1952; King, 1954, 1961; McGhie et al, 1965), process than reactive (Claridge, 1967), and nonparanoid than paranoid patients (Shakow, 1962). Attempts to test Yates' theory have tended to focus on tasks that could be varied in speed and complexity, such as choice reaction time (CRT) tasks. Schizophrenics have been shown to be slowed by an increase in task complexity on CRT tasks (Yates and Korboot, 1970; Slade, 1971) and also to improve performance under slowed conditions (Hemsley, 1971; Hemsley and Hawks, 1974).

(iv) Pigeonholing Defect

Broadbent updated his information processing model in 1971 in order to give more weight to the response selection aspects occurring beyond the filtering level. This model

distinguishes between filtering and pigeonholing aspects of information processing. Filtering here refers to the process that determines what evidence, or input, to the limited capacity channel will result from each stimulus whereas pigeonholing refers to rules linking this evidence to possible response outputs. In this model the filter acts only to weight the various inputs rather than to completely block some stimulus sources. The response selection or pigeonholing mechanisms can then be influenced by the full range of incoming stimuli and output is dependent on the combination weightings from both the filtering and pigeonholing process. Hemsley (1975), reviewing the evidence on attention and information processing, suggested that much of the work on attention defects in schizophrenia has confused these two hypothetical mechanisms. He also concluded that if one adopts the 1971 definition of filtering many tasks have been inappropriately interpreted as indicating a schizophrenic filter defect.

The idea that schizophrenic distractibility might be seen as demonstrating slowness in response selection has been supported by several studies. Hemsley (1976) using a card-sorting task with schizophrenics, depressives and normal controls showed, first of all, that both patient groups were slowed in their sorting by the presence of a distracting stimulus on the card suggesting that defective filtering was not specific to schizophrenia. Schizophrenic patients were, however, significantly more affected by increasing response uncertainty than depressed patients supporting similar findings by Marshall (1973).

(v) Inability to Maintain Set

Another body of evidence has centered around Shakow's 1963 hypothesis that the schizophrenic is impaired in his ability to maintain major sets so that his behaviour is controlled by a number of independent and isolated segmental sets. He attributed this to the failure of the cortical mechanism to control, integrate and organise current input and past experience so as to produce goal-directed, integrated behavour. This model suggests disturbances in both attentional and intentional behaviour. Shakow's ideas were based on a series of reaction time studies. He noted (1962) that schizophrenics showed less deficit on tasks such as tapping, in which time of onset and termination is not important to adequate performance, than on tasks like reaction time which require preparation for the response at the discretion of the experimenter.

In Shakow's experiments there were three major findings: Firstly, schizophrenics have slower reaction times (RT) than other patients and normal subjects (Huston et al, 1937; Rodnick and Shakow, 1940). Secondly, whereas normal performance on RT tasks improves when the preparatory interval (PI) is known to be regular and is therefore predictable, schizophrenics were unable to take advantage of the predictability except where the preceding preparatory interval (PPI) was very brief (not more than 6 seconds). Where PIs were longer there was a crossover effect such that schizophrenics were faster with irregular PIs. Thirdly, schizophrenics were greatly affected by the immediately preceding interval so that when a series of longer PIs giving longer RTs, preceded a series of shorter

intervals, RTs for the shorter series were lengthened (Zahn et al, 1961). Rodnick and Shakow (1940) developed a "set index" based on length of RT and its relationship with regular and irregular preparatory periods. This index successfully differentiated schizophrenic and normal groups without overlap and was positively correlated with ratings of schizophrenic disorganisation (Rosenthal et al, 1960).

In CRT tasks schizophrenic performance is affected by the presence of irrelevant stimuli which do not evoke a response. Shakow (1962) hypothesised that irrelevant stimuli, that is, stimuli that were incidentally present in the experimental setting or occurring internally, are the source of the schizophrenic inability to maintain the major set. It is the active formation of minor sets to these irrelevancies that disturb the major, task-appropriate set, not an empty lapse of attention. In regular PIs it was the internal distractors, and in the irregular PIs the non-identical PPI that became the additional source of irrelevant stimulation.

Both Venables (1964) and Broen (1968) have interpreted the marked PPI effect of chronic schizophrenics as indicating a narrowing of attention. As applied to the PPI effect during irregular PI series narrowed attention here refers to the disproportionate focussing on the last PI. Normal subjects were presumed to consider the entire range of PIs in determining how to regulate their preparedness. Venables (1964) viewed sympathetic hyperarousal as the cause of this narrowing of the attentional field, whereas

Broen (1968), in line with Shakow, suggested that both acute and chronic schizophrenics have the same basic disorganisation of attention, but that chronic schizophrenics are more likely to have learned to restrict their scanning in order to cope with the flood of irrelevant attentional responses. Silverman (1964) also suggested that scanning differences between acute and chronic patients reflected the adoption of certain coping strategies by the chronic group. Differences between other schizophrenic subgroups have also been found but are equivocal (Shakow, 1963; McGhie et al, 1965; Sutton and Zubin, 1965; Payne and Caird, 1967; Goldberg et al, 1968; McGhie, 1969; Bellissimo and Steffy, 1972).

(vi) Processing Capacity Dysfunction

There are a number of theories since Broadbent (1971) that have come to view information processing not in terms of discrete stages but in terms of processing capacity. Kahneman (1973) suggested that mental operations differ in the amount of attentional capacity they require, with demands on attentional capacity increasing as mental operations move from the early stage of processing toward the response end. Some researchers, however, believe that only the later operations are subject to the limitations of the capacity system. These later operations have been referred to as 'controlled' (Shiffrin and Schneider, 1977), in that they are processes that regulate the flow of information in and out of short-term storage and between different processing levels; or as 'effortful' (Hasher and Zacks, 1979), in that they will interfere with other cognitive operations with high processing demands, but not

necessarily with more automatic operations.

The idea that the deficit in schizophrenia is related to the effortfulness of cognitive operations is supported by the finding that schizophrenics appear adequate in filtering but defective in pigeonholing (Hemsley, 1975; Schwartz, 1978; Hemsley and Richardson, 1980) as pigeonholing would appear to require more processing of information than filtering. (In filtering, the relevant and the irrelevant stimuli differ by one sensory feature, whereas in pigeonholing there is a set of responses (pigeonholes) which are distinguished from each other by various combinations of sensory features.) Further support comes from the work of Oltmanns and his colleagues on the effect of distractors on schizophrenic performance. They provide evidence that distraction affects the performance of schizophrenics on digit span tasks only where lists are relatively long (Oltmanns and Neale, 1975) and only in respect of early rather than late items in the list.

Kahneman (1973) also suggested that attentional capacity is not permanently fixed but varies both among and within individuals as a function of both organismic and environmental states. Gjerde (1983) has subsequently proposed that these states are more likely to influence performance when the task at hand, or the mental operation required, has high attentional requirements than when the demand is for more automatic processing. Thus capacity dysfunction will affect attention-demanding processes such as the use of imagery, mnemonics or other elaborative devices, clustering and rehearsal but not less attention-demanding

processes such as recognition, sensitivity to frequency occurrence, coding of spatial information or activation of word meaning. These are all processes that appear to need little or no attention capacity (Hasher and Zacks, 1979). Thus, according to Gjerde (1983), capacity theory implies that a nonspecific dysfunction would be manifest in a wide range of tasks involving different cognitive operations rather than in a specific structural deficit restricted to a discrete stage of processing. This inadequate performance may result from a) a general absence or diminution of cognitive capacity; b) a failure to mobilise existing attentional resources; or c) the allocation of attentional processes to task-irrelevant activities. Whichever of these is correct poor performance will mainly occur whenever the attentional requirements exceed the available capacity, that is, under conditions of capacity overload.

Studies supporting the idea that schizophrenics appear inadequate in their use of active organisational processes have focussed on verbal memory tasks. Schizophrenics have been shown to cluster less in recall (Koh et al, 1973; Traupmann, 1975; Russel and Beekhuis, 1976), show a marked reduction in primacy effect and an inability to benefit from a slower rate of presentation (Oltmanns, 1978) or from changes in the nature of information presentation known to facilitate performance in nonschizophrenic subjects (Depue and Fowles, 1974; Koh et al, 1973; Russell et al, 1975; Traupmann, 1975). In addition, semantic content is less effective in improving recall in schizophrenics than in normal subjects (Russel and Beekhuis, 1976) and has also affected recognititon studies (Russel

et al, 1975; Traupmann, 1975). On the other hand, short-term memory for nonverbal material remains good (Koh et al, 1976), lexical storage is observed to be intact (Koh et al, 1974; Larsen and Fromholt, 1976; Russel and Beekhuis, 1976) and iconic memory is unimpaired (Knight et al, 1977). However, reaction time crossover studies do not support this idea as schizophrenics become progressively slower when the preparatory interval becomes more regular (Rodnick and Shakow, 1940; Shakow, 1962; Steffy and Galbraith, 1974; Bellissimo and Steffy, 1975). A regular PI should decrease the demands on attentional capacity.

The idea that schizophrenic deficit is related to capacity or information overload has been put forward by several authors and several studies have noted in normal subjects responses similar to these schizophrenics when asked to perform under conditions of stress (Usdansky and Chapman, 1960; Grimes and McGhie, 1973). Miller (1960) suggested a number of adjustment processes employed by subjects against the stresses of information input overload: omission, error, queuing, filtering, approximation and escape. Possible relationships between these modes of adaptation and common schizophrenic symptomatology have been outlined by Hemsley (1977). For example, omission may express itself clinically as under-responsiveness and poverty of speech, approximation as undifferentiated responding, filtering as narrowed attention, and escape as social withdrawal and catatonic symptoms. Preferences for any one of these modes of adaptation may be influenced by the severity of the information overload, the quality of the environment and the premorbid personality.

(vii) Genetics

A further aspect of information-processing is whether it constitutes a possible cognitive marker of vulnerability to schizophrenia. There is evidence that the RT crossover effect, noted in adult schizophrenics, is present, albeit to a lesser degree, in their first degree relatives (Cromwell et al, 1979). A reaction time deficit has also been found in the children of schizophrenics (Garmezy, 1978), although their RTs were not, however, influenced by the length of PPI or deviation on the Rodnick and Shakow Set Index. Marcus (1972) found offspring of schizophrenic mothers had significantly slower RTs across all PIs, for both regular and irregular series, than normal controls. In addition, these high-risk children remained significantly impaired in RT under conditions designed to facilitate performance, that is, supplying information about the length of the next PI (information condition) and offering a material reward for fast reactions (high incentive condition).

Van Dyke, Rosenthal and Rasmussen (1975) showed that groups reared by a schizophrenic parent were significantly slowed in overall mean RT compared to those reared by nonschizophrenic parents. Groups with differing genetic background for schizophrenia were, however, not discriminated by their RT performance. Two other studies also failed to support any marked genetic contribution to the slowing of RTs in schizophrenia (Rosenthal, 1963; Zahn, 1976). Studies of children at risk for schizophrenia have also found poorer performance on some other measures of attention and cognition (Grunebaum et al, 1974; Rutschmann

et al, 1977; Erlenmeyer-Kimling and Cornblatt, 1978; Oltmanns et al, 1978; Asarnow et al, 1978). It has also been suggested that a deficit in remitted schizophrenics might reflect a core schizophrenic process (Asarnow and MacCrimmon, 1978) and both remitted and acute schizophrenics were found to perform much worse than normal control subjects on both the Continuous Performance Test and Span of Apprehension Test.

In summary, psychological dysfunction conceptualised as a disorder of attention has been seen as the result of an incompetent filter (Broadbent, 1958; 1971); an inability to change set (Shakow, 1963); a deficit in the selective and inhibitory functions of attention (McGhie and Chapman, 1961); a vulnerability to distraction (Oltmanns and Neale, 1978); inefficient strategies for organising information to be memorised (Koh, 1978); inappropriate pigeonholing (Hemsley, 1977) or an attentional capacity dysfunction (Gjerde, 1983). It is, however, important to note that a number of studies have failed to find significant correlations between tasks measuring attention (Kopfstein and Neale, 1972; Asarnow and MacCrimmon, 1978) which questions the adequacy of a general construct of attention to explain schizophrenic deficit.

b) Motivation

Moving away from theories of an information processing deficit as the underlying cause of dysfunctional cognitive processes in schizophrenia, I shall now discuss other individual differences that have been hypothesised to account for the disruption between stimulus and response.

In their review, Buss and Lang (1965) differentiate between two main variants of what they term, the social-motivational view. On the one hand, it is suggested that schizophrenics are oversensitive to punishing and/or affective stimuli which causes them to withdraw and thus produce performance deficit. On the other hand, it is assumed that schizophrenics are already so withdrawn from interpersonal situations that the usual incentives, rewards and punishments employed in experimental situations do not motivate them so their performance suffers.

(i) Social Censure Hypothesis

The social censure hypothesis (Rodnick and Garmezy, 1957) stated that schizophrenics are sensitive to threat of criticism or rebuff which accentuates their difficulty in differentiating cues in their environment. However, whilst negative feedback has been shown to affect learning or performance on conceptual tasks in schizophrenics this deficit also occurs in response to many kinds of affective stimuli, not just those denoting censure. Buss and Lang (1965) suggested that this was because they trigger more associations than do neutral stimuli. This hypothesis also saw psychological deficit as insufficent motivation to perform well. Schizophrenics have been shown to be less cooperative or motivated than normals but whereas studies using positive rewards have shown improvement in performance, physical punishment was the most consistent and effective reinforcer of behaviour producing a reduction and sometimes the temporary elimination of psychological deficit. Buss and Lang (1965) considered that intense stimuli served a focussing or arousal function by creating

a sharper differentiation between relevant and irrelevant inputs rather than acting as an incentive or reinforcer, suggesting that the significant factor is information about inadequate responses rather than the interpersonal context. This view was also consistent with studies indicating the inability of schizophrenics to maintain or usefully alter a response set (Shakow, 1962) or to benefit from incidental learning (Greenberg, 1954; Winer, 1954).

(ii) Drive

Two drive theories have been identified. On the one hand, schizophrenics have been seen as extremely anxious, with anxiety considered as a high drive state that worsens performance especially on complex tasks. Broen and Storms (1961) suggested that this leads to the collapse of response hierarchies so that the normal probabilities of a stimulus evoking a certain response are disrupted, whereas Mednick (1958) proposed that high drive/anxiety leads to excessive stimulus and associative generalisation. On the other hand, it has been proposed that there is a protective, cortical inhibition in schizophrenia that slows down learning and increases reminiscence. This idea was first suggested by Pavlov (1941) who saw a predominance in schizophrenia of inhibition over excitation. This theory known as 'protective inhibition' was developed further as negative drive or reactive inhibition (Venables and Tizard, 1956; Claridge, 1960; Eysenck, 1961; Rachman, 1963) and predicted that schizophrenics would develop reactive inhibition faster and dissipate it slower than normals, that is, they will learn more slowly than normals and show greater reminiscence. This has been confirmed in

only a few studies (e.g., Venables and Tizard, 1956).

c) Arousal

Closely linked to anxiety as an internal or organismic factor that can influence cognitive processes is the concept of physiological arousal. The relationship between arousal and schizophrenia has been reviewed in Chapter 1. Here I will concentrate on ways in which research has focussed on drawing parallels within schizophrenia between arousal and cognitive deficit. The effect of arousal on cognitive functions has been explored in two main areas: attention and memory.

(i) Attention

Several hypotheses have been put forward as to how arousal and attention might be related. Callaway and Thompson (1953) suggested that narrowing of attention occurs under conditions that increase sympathetic nervous system activity or produce an alert EEG (i.e., arousing conditions). His hypothesis was supported in a series of studies with normal subjects looking at the effects of drugs and other procedures on perceptual tasks (Callaway and Dembo, 1958; Callaway and Band, 1958; Callaway, 1959; Agnew and Agnew, 1963). A similar idea was put forward by Easterbrook (1959) who claimed that high arousal restricts the range of cue utilisation. In support of this, Korchin (1964) noted a large reduction in incidental learning in aroused subjects and suggested that they paid less attention to information in the visual periphery than non-aroused subjects. Reductions in incidental learning has also been noted in schizophrenics (Koh and Petersen, 1978).

(ii) Memory

Levels of arousal have been shown to affect several aspects of memory. With respect to verbal recall, Eysenck (1974) has shown that high levels of arousal increased the number of words recalled by extraverts but reduced the number recalled by introverts. As introverts are thought to be more aroused than extraverts he concluded that the results were consistent with the curvilinear relation between arousal and performance. He also showed that arousal affects recall and recognition differentially and suggested (Eysenck, 1976) that greater susceptibility of recall to interference by arousal may be for two reasons. On the one hand, the storage locations to be accessed are given to subjects in recognition but not in recall. This he suggests may be related to Broadbent's (1971) idea that arousal increases the intake of information from dominant sources of information. On the other hand, in the two-process theory of recall (Kintsch, 1970) recall requires retrieval whereas recognition does not and there is evidence to show that speed of retrieval is negatively related to arousal and that hyperarousal tends to disrupt semantic clustering in free recall (Horman and Osterkamp, 1966).

With respect to semantic encoding there is evidence to show that arousal affects both the degree of encoding of the memory material and the ability to use semantic structure at output (Eysenck, 1977). High arousal increases the selection of information about physical characteristics of stimuli and decreases the processing of semantic word properties (Schwartz, 1975). And Folkard (1976) has suggested that arousal interferes with the

processes that maintain information in short-term memory, such as rehearsal. Schwartz (1975) also found that arousal has a greater effect on pigeonholing than filtering. Eysenck (1977) has interpreted the decrease in semantic processing in the context of Walley and Weiden's (1973) neuropsychological theory of attention. They argue that arousal interferes with the simultaneous encoding of different stimuli by causing a switch from parallel, or simultaneous to serial processing. Consequently, highly aroused subjects will process information more slowly because their encoding must occur serially rather than concurrently. Eysenck suggests that as physical and phonemic processing require less time than semantic processing, highly aroused subjects opt for physical processing because of a greater probability of successful completion.

(iii) Attention and Arousal in Schizophrenia

The idea that attention and arousal might be causally related in the etiology of schizophrenia has been taken up by several authors (see reviews by Venables, 1964, 1966, 1977; Claridge, 1967; McGhie, 1970; Gjerde, 1983). Firstly parallels have been drawn between physiological and attentional measures of arousal. For example, the two-flash fusion threshold (the ability to differentiate light flashes presented in close temporal proximity) increases with heightening level of arousal (Steriade and Demetresu, 1962). Nonparanoid patients have been found to have an abnormally high fusion threshold, indicating a state of overarousal (Venables and Wing, 1962). There is also a positive association between social withdrawal in schizophrenia and a high fusion threshold (Venables, 1967).

Another example is the Spiral After-Effect, an after-effect of apparent movement in the opposite direction produced when a rotating spiral is fixated for some time. It is used to measure changes in brain damage and is correlated with alpha-blocking, suggesting that longer after-effects indicate high arousal levels (Claridge and Herrington, 1960). Some studies found no differences between normal and schizophrenic subjects (Krishnamoorti and Shagass, 1964) whilst others reported longer after-effects in schizophrenics (Claridge, 1960, 1967; Herrington and Claridge, 1963) with nonparanoid patients having longer after-effects than paranoid patients (Claridge, 1967).

Secondly, studies looking at the effects of drugs on task performance have shown that drugs that lower arousal level (e.g., sedative or phenothiazine medication) produce both clinical improvement and also improved cognitive performance in schizophrenics (Williams, 1953; Brooks and Weaver, 1961; Venables and Wing, 1962; Kornetsky and Mirsky, 1966; Orzack et al, 1967).

Theories specific to the relationship between attention and arousal in schizophrenia have been put forward by several authors. Venables (1964, 1966) suggested that the disorder of attention in schizophrenia was an input dysfunction linked to a disturbance in arousal. He claimed that acute schizophrenics were underaroused and had a broader attention span whereas chronic schizophrenics were overaroused with narrowed attention. He later suggested (Venables, 1967) that in chronic schizophrenics autonomic

and cortical systems of arousal operate in parallel. Cortical activity was not controlled by the normal regulatory action of the reticular system so schizophrenics were unable to control selectively their responsiveness to significant stimuli. This resulted in an indiscriminate arousal reaction to all stimuli. These ideas were later modified (Venables, 1977) when the bimodal distribution of responsivity of skin conductance was found not to relate to acute-chronic diagnostic subcategories. Claridge's (1967) dual arousal model differentiated both cortical and autonomic measures of arousal and between a tonic arousal system and arousal modifying system. The function of the tonic system was to maintain an individual's overall level of arousal whereas the modifying system regulated the activity level of the tonic arousal system and guarded the central system from overstimulation. Apart from its homeostatic role, the modulating system also filtered incoming information so as to facilitate the reception of relevant and inhibit the reception of irrelevant data. Claridge suggested that in schizophrenia the two systems become functionally disassociated due to a breakdown in the feedback mechanism which preserves the normal balance. The effects of an imbalance would depend on which of the two systems was predominant in its function. If the modulating system was weakened, the subsequent disinhibition of the tonic system would cause abnormally high levels of arousal As incoming information would no longer be monitored, attention would become less selective and directed in its operation. However, if the imbalance produced a weakening of the tonic system and a strengthening of the modulating system's functions, arousal level would fall and attention

would become severely narrowed. In this model all schizophrenics suffer from both high and low levels of arousal depending on the arousal components being considered.

Gjerde (1983) sees a causal relationship between arousal and his attentional capacity theory suggesting that the inability to mobilise or allocate sufficient attentional resources in schizophrenia is related to hyperarousal. To support his theory he draws first on the way that arousal and attention may vary together according to the Yerkes-Dodson law. In the low range of arousal, capacity and arousal are related monotonically, but when a certain arousal threshold is exceeded there is a curvilinear, inverted U relationship between the variables. Thus under-aroused subjects will perform poorly because of insufficient investment of capacity; and overaroused subjects will perform poorly because of deleterious changes in their allocation of attentional capacity. According to Gjerde, hyperarousal introduces specific biases into the processing of information so that attention becomes increasingly concentrated on the most salient aspects of environmental information; the ability to discriminate relevant from irrelevant information is impaired and the lability of attention allocation increases. His hypothesis supposes, however, that a) arousal is a unitary process; b) schizophrenics are characterised by a state of hyper-arousal; c) the effects of arousal on information processing are process-specific. Whilst the evidence suggests that unlike normals schizophrenics tend towards a state of unitary arousal (Gruzelier, 1978; Spohn et al, 1978), the evidence for hyperarousal is not conclusive (Chapter 1).

CHAPTER 3

Cognitive Response Style

From the review on cognitive dysfunction in schizophrenia it is evident that there is great within-group variability on the different perceptual and cognitive tests. It would seem that the schizophrenic is not lacking any identifiable skill but rather that his perceptual activity is limited by some attentional factor or a dysfunction in cortical, homeostatic or proprioceptive control. Many major theories of schizophrenia have focussed on attentional disturbance as central to an understanding of disturbed perception. Shakow (1962) regarded schizophrenic pathology as a disturbance of attentional set reflecting a lack of cortical regulation and integration of stimuli. Mednick (1958) related high arousal to attentional factors and Venables (1964) saw high levels of arousal leading to narrowed attention. Silverman (1964b) used the cognitive controls of scanning and field articulation as indicators of a basic attentional dysfunction in schizophrenia and Payne (1960, 1966) interpreted overinclusion as primarily an attentional dysfunction. In each of the theories the attentional deficit has been seen as central although each theory attempted to relate this deficit to high arousal, neurological disorders, or traumatic experience.

An alternative way of explaining the variance on these tests has been the suggestion that it reflects some kind of cognitive consistency or style within the individual rather than a perceptual deficit per se (Holzman, 1969).

This idea has followed on from the 'new look' approach to perceptual research (Bruner and Goodman, 1947; Krech and Calvin, 1953) which focussed primarily on motivational and temperamental traits rather than on cognition as the intervening variables in perceptual activity. Rapaport (1957) referred to such cognitive styles as "cognitive tools' and adaptive strategies which although showing great interindividual differences, nevertheless are permanent organisations which are readily available and stable over many situations. McGhie (1970) seemed to be suggesting a similar approach when he postulated that chronic schizophrenics may differ from acute patients as a result of differing 'behavioural strategies' that the two groups utilise in dealing with high levels of arousal. In this sense, Mednick's stimulus generalisation, Shakow's segmental set and Venables' theory of narrowed attention can all be explained in terms of differences of style.

Cognitive style then refers to constellations of several cognitive controls or stable adaptive strategies according to which sensory stimuli are cognitively organised, and which serve a regulatory or mediatory function between the urges of drive and the requirements of reality. As such cognitive controls are similar to Allport's instrumental attitudes and psychoanalytic character defenses. One of the first major studies on cognitive controls was carried out by Klein and his associates at the Menninger Foundation (1958). They isolated a number of cognitive controls based on perceptual tests (levelling-sharpening, scanning, constricted-flexible, field articulation, equivalence range, tolerance for unrealistic experiences).

This group used only normal subjects so that the style variables it was measuring would not be confounded by the effects of psychopathology. Subsequent studies have to a large extent also confined themselves to normal groups (e.g. Gardner et al, 1960; Gardner and Moriarty, 1968), although there is a small literature covering attempts to explore the relationship between cognitive controls and psychopathology. In reviewing this literature here I will focus only on those cognitive controls included in the present study (focussing-scanning, constricted-flexible, equivalence range, field dependence-independence, augmenting-reducing, levelling-sharpening). Details of the theoretical underpinning of these cognitive controls are also included in this section.

A) Cognitive Controls and Schizophrenia

(i) Field Dependence-Independence

(a) Theoretical Considerations

Field dependence-independence or field articulation has been extensively studied by Witkin and his colleagues (Witkin, 1949, 1964; Witkin et al, 1954; 1962) and Gardner et al (1959) and is considered to represent the capacity to articulate stimulus fields or respond to relevant cues while surmounting the misleading effects of irrelevant or competing cues. In essence, field articulation requires the extraction or "disembedding" of certain aspects of the perceptual field while actively inhibiting others. Witkin originally hypothesised that individual differences in performance on tests of field articulation reflected the

degree to which subjects were psychologically differentiated. Other approaches have been concerned with neurophysiology and psychodynamics. Gardner and Moriarty (1968), for example, suggested that abnormalities in differentiation might reflect abnormalities in the ascending reticular formation, whereas Gardner et al (1960) viewed attention deployment in terms of secondary process functioning and habitual coping solutions.

Studies validating the concept of field articulation provide evidence that performance on field articulation measures is related to performance on a variety of other perceptual tests which involve the ability to overcome an embedding context (Loeff, 1961; Witkin et al, 1962; Pascual-Leone, 1969) and to performance on a variety of intellectual tasks which involve the same ability, such as memory tasks (Gardner and Long, 1962; Shapson, 1973; Alovisetti, 1976), tests of spatial ability (Goodenough and Karp, 1961; Karp, 1963; Elkind et al, 1963) and focussed attention (Shapson, 1973).

A number of studies also demonstrate that differentiated functioning in perception is also associated with more differentiated functioning in other psychological areas. With regard to social behaviour field dependence has been associated with a less developed sense of separate identity as reflected in a tendency for attitudes, beliefs and self-concept to be strongly influenced by the prevailing social context (Linton and Graham, 1959; Jackson and Messick, 1963; Kipperman, 1964; Zuckerman, 1968) and with a less differentiated body concept

(Dershowitz, 1966; Karp et al, 1969; Winestine, 1969). Furthermore, the development of field articulation may be related to parental or cultural child-rearing practices encouraging dependent or independent behaviour (Witkin et al, 1962; Dyke and Witkin, 1965; Berry, 1967; Dawson, 1967) with parents showing similar styles to their children (Dershowitz, 1966; Schaffer, 1969).

Studies relating field articulation to the nature of defenses indicate that field independent subjects tend to use specialised defenses such as intellectualisation and isolation, signifying a more differentiated defensive structure whereas field dependent subjects tend to use relatively nonspecific defenses such as massive repression and primitive denial (Schimek, 1968; Ihilevich, 1968; Lapidus, 1968; Minard and Mooney, 1969; Bogo et al, 1970).

Field dependence-independence has also been found to show developmental stability. In a longitudinal study Witkin (1964), for example, reports significantly high test-retest correlations in subjects measured at several points between the ages 10 to 24. Developmental studies have also found marked individual differences in field articulation as early as age five (Witkin et al, 1962). These studies suggest that field articulation represented a dimension of perceptual-cognitive functioning with reliable and long-standing individual differences. A perplexing finding, however, is the consistent difference between men and women, with women tending to be field dependent and men tending to be field independent (Witkin et al, 1967; Bogo et al, 1970; Morf et al, 1971; Saarni, 1973; Parlee and

Rjogopal, 1974; Macoby and Jacklin, 1974). This may be due to females' socialisation or to perceived sex roles (Witkin et al, 1962) but support for these views is equivocal. Performance on the Embedded Figures Test has been found to improve with practice with learning typical of all subjects (Witkin, 1950). Moreover, although men and women may begin the test at significantly different levels of performance, after several practice trials sex-related differences are no longer reliable Goldstein and Chance (1965). This finding has implications for the concept validity of field articulation if a field dependent individual can become independent with practice.

Silverman (1965) introduced the idea of 'moderator variables' to account for sex differences in personality research in general. He suggested that variables such as anxiety, masculinity-femininity and ego strength, moderate geneotypic differences in ways that might not be evident in many studies. Vaught (1965) found support for this view when he subclassified a heterogeneous group of subjects showing the same gender differences on the Rod and Frame Test of field articulation, on the basis of scores on the Gough Femininity and Barron Ego Strength Scales (1956). Irrespective of sex, high scorers on the former were more field dependent and on the latter more field independent.

Waber (1977), however, suggested that sex differences may be related to biological factors (genetic, endocrinological and neurological) in the same way that sex differences in spatial ability do as both processes have been shown to be highly correlated. She also suggested that maturational

rate may be important as it has implications for hormonal levels and ratios as well as hemispheric organisation. Data from several studies has indicated that men are more completely lateralised for various functions than women (Kimura, 1969; McGlone and Davidson, 1973) and in general, it has been found that more differentiated, field independent subjects show greater lateralisation effects than less differentiated, field-dependent subjects. This relationship held true with such tasks as digit recall in dichotic listening (Pizzamiglio, 1974), unilateral letter and face recognition (Pizzamiglio and Zoccolotti, 1981; Rapaczynski and Ehrlichman, 1979; Zoccolotti and Oltman, 1978) and unilateral tactile orientation (Zoccolotti et al, 1979) and also using EEG measures (O'Connor and Shaw, 1978; Oltman et al, 1979).

Taking the parallel between spatial ability and field articulation further, it might also be assumed that field articulation is associated with right hemisphere processing. This is implied in a study by Cohen et al (1973) in which patients given electroconvulsive therapy (ECT) to the left hemisphere showed a decline in field articulation performance whilst those given ECT to the right hemisphere showed improvement. Another suggestion has been that both hemispheres are important with the disembedding function located in the right hemisphere but with the degree of "perceptual pull" dependent on left hemisphere activation (Case and Globerson, 1974). Thus individuals in whom the balance of activity is biased towards the left hemisphere will show better performance than less well-lateralised individuals in whom the bias is towards the right.

(b) Field Dependence-Independence and Psychopathology

Witkin and his colleagues were one of the first major groups of researchers to include schizophrenics within their sample. Whilst clear differences were found in normals between subjects who were field dependent and those who were field independent, their investigations with pathological groups led them to conclude that groups such as schizophrenics were not necessarily either field dependent or field independent but that they rather tended to fall at either extreme of the continuum (Witkin, 1965). This is consistent with the perceptual literature cited earlier, where schizophrenics as a group were not found to have any universally identifiable perceptual dysfunction, although their performance was generally poorer on all measures and the scores had great variance.

Some studies have shown differences between subgroups of the schizophrenic population. Process schizophrenics have been found to be more field dependent than reactive schizophrenics (Bryant, 1961; Gibeau, 1965; Stelle, 1968); catatonic schizophrenics have tended to be field dependent whereas paranoid schizophrenics were more field independent than nonparanoid patients (Witkin et al, 1954; Jannucci, 1964; Witkin, 1965; Franco and Magaro, 1977). In general, however, Witkin et al (1962) concluded that a particular mode of field approach did not characterise patients in the major diagnostic categories, although it was associated with particular symptoms. Consistent with this rationale Taylor (1956) found that delusional male psychotics were more field independent than hallucinating male psychotics as was a normal control group. The control

group, however, was not significantly different from the delusional group. Powell (1964) compared recent and past hallucinators with non-hallucinating schizophrenics and found that normal controls performed better than recent and non-hallucinators but were not significantly different from past hallucinators. She suggested that differences were related to greater susceptibility to attentional lags in hallucinators. Witkin et al (1962) suggested also that hospitalised psychiatric patients might be handicapped in maintaining the focussed, sustained attention essential to adequate performance on field articulation measures.

In a review of the relationship between psychopathology generally and psychological differentiation, Witkin (1965) suggested the type of disorder developed may be related to level of differentiation. Korchin (in Witkin et al, 1974) found that field independent patients showed a more differentiated clinical picture than those who were field dependent. A strong positive correlation has also been found between field dependence and overinclusive thinking, which is characterised by the absence of conceptual boundaries and diffusion of cognitive processes (LaTorre, 1978)

The general level of symptom intensity does not, however, appear to be related to field dependence. Adevai et al (1968), for example, reported a similarity in the MMPI profiles of field dependent and field independent groups. Parkes (1981) looked at the extent to which anxiety, irritability and depression were differentiated as separate entities with characteristic patterns of somatic and cognitive symptoms by normal field dependent and field

independent female subjects. Although she found that field dependence did not affect the overall levels of symptom intensity it did appear to influence the extent to which individuals differentiated neurotic symptoms as being associated with particular emotions. Whereas in the field independent group the correlations between the three emotions were low and nonsignificant, reflecting a clear-cut differentiation in symptom configuration, in the field dependent group, intercorrelations were significant and positive, corresponding to relatively poor symptom differentiation comparable to a psychiatric patient group.

Gardner et al (1959) have also suggested that cognitive control dimensions may be capable of temporary variations under the impact of such factors as intense need or anxiety. However, studies looking at the stability of field articulation in psychiatric patients have found no significant changes during treatment interventions such as tranquiliser therapy, electrical or inhalant convulsive therapy (Pollack et al, 1960). Powell (1964) hypothesised that the presentation of an aversive stimulus prior to the discriminative stimulus would produce greater arousal and hence improve performance but failed to find differences in her various subject groups.

Two further studies have viewed field articulation as a moderator variable in the development of psychiatric symptoms and prognosis. Ullmann and Krasner (1969) suggested there was a relationship between learned selective attention to threatening stimuli and the development of persecutory delusions. In an attempt to test this theory,

Locascio and Snyder (1975) manipulated attention to threatening and nonthreatening statements in a group of normal subjects and looked at its relationship to field dependence. Although a significant increase in scores on the paranoia measure was not found overall, it was greater in more field independent subjects suggesting that susceptibility to develop paranoid behaviour through selective attention to threat cues may increase as a function of field dependence. This is consistent with studies showing that paranoid psychotics are more field independent.

With respect to prognosis, Cancro and Sugerman (1969) found a curvilinear correlation between field articulation and prognosis with midrange scores showing good progress and process or poor prognosis cases obtaining extreme scores. This study appears to be consistent with the trend in field articulation studies that a linear relationship to many variables is not to be expected.

Summarising, whilst there is some evidence of subgroups of schizophrenic patients being differentiated along the dimension of field articulation, overall schizophrenics have not necessarily been found to be either field dependent or field independent. Differences may, however, relate to presenting symptoms and to prognosis.

(ii) Focussing-Scanning

(a) Theoretical Considerations

The perceptual-cognitive control referred to as 'scanning' or 'focussing' (Schlesinger, 1954; Klein, 1958; Gardner et

al, 1959; Silverman, 1964) refers to individual consistencies in the extensiveness with which stimuli are sampled from a field. It is a continuum along which subjects have been found to vary according to the degree to which they are open to extraneous information, both externally and internally, or tend to focus variously on given tasks.

It has been conceptualised as the perceptual dimension of the defense known as isolation (Gardner and Long, 1962; Luborsky et al, 1965), a dimension derived from Freud's (1926) observation that the defense of isolation separates an idea from other ideas in consciousness and from its emotional attributes. Freud proposed that concentration is utilised to keep at a distance not solely matters of indifference or things that are irrelevant, but in particular things that seem inconveniently counter to the matter at hand. As a consequence Schlesinger's (1954) original concept of scanning as a distinct cognitive control had two aspects: a) a tendency to narrow awareness and to keep experiences discrete and b) a tendency to separate affect from idea. Using a size estimation task involving disks containing distracting cues, Schlesinger hypothesised that some subjects (focusers) could more accurately judge the sizes of these disks than others (nonfocusers or scanners) since they would be more able to narrow their attention to relevant stimuli while ignoring the distractors. Subsequent studies (Gardner et al, 1959, 1960; Gardner and Moriarty, 1968) used disks involving distractors such as texture, weight and colour. However, it appeared that distractors did not seem to affect performance in size estimation but that scanning was

related more to time on task than accuracy of judgement (Gardner et al, 1959). This was evaluated using visual observations and electronic recordings of eye movements which provided detailed measures of actual scanning behaviour (Gardner and Long, 1962).

The accuracy of performance was then explained in terms of Piagetian rather than Freudian terminology as Gardner and Long (1960, 1962) found a positive relationship between scanning behaviour (the repeated looking back and forth from one segment to other segments of a visual field) and Piaget's centration hypothesis. According to Piaget, the magnitude of a stimulus in the centre of the attentional field is automatically overestimated as a function of its actual size and the duration of centrations upon it. In the course of development, strategies of attention deployment (decentration) are evolved that counteract centration effects so that in adults, extensiveness of scanning would lead to minimal over- or underestimation. Focussing-scanning is thus conceptualised in terms of the extensiveness of attention deployment.

(b) Focussing-Scanning and Psychopathology

Silverman (1964) tried to extend the cognitive control principles of the Menninger group and of Witkin to the problem of attention in schizophrenia. According to Silverman, attention has two components: extensiveness (i.e., the comprehensiveness with which environmental cues are sampled) and intensiveness (i.e., the articulation of the sampled cues into relevant and irrelevant aspects). Silverman used "scanning" as measured by size estimation

tasks to evaluate extensiveness and field articulation (as measured by the rod-and-frame) to analyze intensiveness. Both these controls are recognised to be independent measures of attention deployment (Gardner et al, 1959). Using this approach, Silverman (1964a) concluded that nonparanoid schizophrenics show a tendency toward underestimation of stimuli and heightened autokinetic effect, both of which have been shown by Gardner and Long (1962) to be associated with minimal scanning; and to show poor and undifferentiated field articulation. Paranoid schizophrenics, on the other hand, tend to be extensive scanners and field independent (1964). Silverman explained these results using Bruner's (1957) concept of 'cognitive filtering' and the idea of 'ideational gating' to suggest that the sensory input of the paranoid patient is excessively scanned to facilitate the rejection of input likely to be disturbing to the patient. Unlike other hypotheses this suggests active monitoring by the schizophrenic.

Some of Silverman's work (1964) suggests that extensive field scanning by paranoids lessens as they become more chronic, that is, as they develop strategies to deal effectively with the hostile environment. Other studies (Harris, 1957; Bryant, 1961), however, suggest that minimal scanning is more typical of process and extensive scanning of reactive schizophrenics. In a later study, Silverman (1967) concluded more comprehensively that it was acute, paranoid, good premorbid schizophrenics who showed extensive scanning and nonparanoid, poor premorbid schizophrenics who showed relatively minimal scanning. The findings with acute and chronic patients have been suppor-

ted by Broen (1968), who showed that acute schizophrenics scan a broad range and were unable to organise their responses in a structured hierarchical order as normals can, and by Feeney (1971) and Broen (1973) that chronic schizophrenics have a narrowed range of scanning.

Thus psychiatric groups appear to show both hypo- and hyper-scanning. In view of Silverman's finding that hyperscanners direct their attention more onto internal events such as hallucinations and less onto environmental events whereas hyperscanners are more attuned to external stimuli, it may also be that scanning is related to symptomatology rather than to schizophrenia per se.

(iii) Equivalence Range

(a) Theoretical Considerations

The equivalence range control principle relates to the degree to which individuals are impelled to act upon or ignore an awareness of difference. It refers to an individual's tendency toward broad or narrow categorising, i.e., degree of differentiation imposed when confronted with an array of familiar, heterogeneous stimuli. Adults high in conceptual differentiation (narrow equivalence range) tend to define groups in terms of their minimal conceptual distance from the physical properties or functions of objects Broad categorisers, on the other hand, are distant from stimuli, tending to categorise in terms of extraneous factors, such as location, association with persons; they are more personalised and less stimulus-bound (Gardner et al, 1959). For example, Gardner found that narrow

categorisers made more accurate retinal and object matches on a shape-constancy test and were more able to equate the brightness of two light patches. Narrow categorisers were more rooted in literality and stereotypy whereas broad categorisers were more distant from concrete properties of stimuli with more human movement and colour response on the Rorschach (Gardner et al, 1959). On the Thematic Apperception Test those higher in conceptual differentiation produced relatively constricted stories involving large amounts of stimulus description and minimal creative thematic material whereas broad categorisers produced more original, creative stories (Gardner and Schoen, 1962).

In addition to the control of spontaneous conceptual differentiation operation of this control involves several other factors that might determine individual responses. For example, there are sets of learned substructures such as learned associations between objects as well as object and person characteristics that might determine the types of concepts employed in categorising; there is an individual's capacity to abstract or his preferred level of abstraction as well as factors that relate directly to the test itself like the nature of the instructions and items used. There is, however, evidence to show that differences in equivalence range are independent of these factors.

In a developmental study, Gardner and Moriarty (1968) found that although the general line of developmental change from preadolescence to adulthood was toward lower degrees of spontaneous conceptual differentiation, greater distance from physical properties, greater reliance on

verbal concepts and more effective coordination of verbal concept grouping, the individual consistencies referred to as conceptual differentiation were independent of these changes. This seems to indicate that individual consistencies in group behaviour relate to a relatively autonomous controlling structure that persists in spite of changes in relevant substructures. Furthermore Gardner et al (1960) showed differences in equivalence range are independent of inductive and deductive abilities and level of abstraction

The work on over- and underinclusion in schizophrenia is also linked to breadth of categorisation but rather than being seen as a structure determining individual consistencies in perception and cognition it was originally seen as underlying the psychotic symptom of thought disorder. Cameron (1939) originally defined overinclusive thinking as the inability to select, restrict and eliminate the less closely related elements from the conceptual structure which he interpreted to mean that the psychological boundaries were functionally insufficient, resulting in overinclusion. It thus denoted a widening of category limits so as to include items which normal people would reject. Underinclusive thinking, on the other hand, would be characterised by abnormally narrow categorisation.

Since then, other researchers have tended to focus on over- and underinclusion as one aspect of a more general attention deficit either in terms of an input dysfunction related to the filtering of incoming stimuli, a processing deficit, or as a response disorder linked to distractibility or interference due to drive, motivation or arousal

(see Chapter 2). These hypotheses suggest a closer parallel to the idea of a cognitive control structure with schizophrenic behaviour representing an extreme example.

(b) Equivalence Range and Psychopathology

An early review of the literature by Payne (1960) suggested that overinclusion was confined to schizophrenia and was present in 50% of all patients. There was no reported incidence at that time in neurotic or depressed patients. Later studies went on to point out that it was acute not chronic patients who were abnormally overinclusive (Payne and Friedlander, 1962) and that there was a tendency for overinclusive thinking to be associated with delusions and paranoid schizophrenia (Payne, 1961; Payne et al, 1964; Payne and Caird, 1967). Furthermore overinclusive thinking was not a permanent characteristic of individuals who periodically develop a schizophrenic illness. Instead, it appeared to be symptomatic of the illness since after remission schizophrenic patients, both those who have been deluded and those who have not, are not abnormally overinclusive. Thus according to Payne and Friedlander, overinclusion was characteristic of acute schizophrenia in relapse and not a feature of either chronic schizophrenia or other psychiatric disorders. This statement has since been modified as overinclusion has been found to occur in mania (Andreason and Powers, 1974) and correlates with how florid the psychosis is (Davis and Blaney, 1976). It has also been found to be more common in unmedicated patients than those on phenothiazines (Chapman and Knowles, 1964).

Furthermore, overinclusion has been considered to be

relatively independent of the generalised retardation which characterises most psychotic patients. Cameron (1967) addressed this issue directly by attempting to apply the concept of efficiency (Wishner, 1955) to the categorising behaviour of schizophrenics. Wishner proposed that psychopathology was characterised by an inefficiency in meeting task requirements and not necessarily by any specific set of acts. Thus Cameron suggested that in relation to a categorising task inefficiency might lead to over- and underinclusion depending on the task requirements. Using monetary rewards to direct attention to the task he found that whilst schizophrenic subjects earned less money than normals, they were no more inclusive in a category if their attention was directed to that category. In addition to being overinclusive schizophrenics have also been observed to be overexclusive (i.e., underinclusive) in their sorting. That is, they exclude from a category instances that properly belong to it and sort by a more narrow category than is appropriate (Epstein, 1953; Chapman, 1961). This has been less investigated, but according to Epstein (1953) is at least half as common as overinclusion. For example, underinclusion has been found to be characteristic of a heterogeneous group of brain-damaged patients and of both process schizophrenics (Tutko and Spence, 1962) and chronic schizophrenics (Daut and Chapman, 1974). More recently, Cutting (1985) concluded that both acute and chronic schizophrenics have a disorder of categorisation, acute subjects tending to overinclude and chronic subjects tending to underinclude.

Overall the research suggests, however, that equivalence

range or over- and underinclusion as a cognitive style is not specific to schizophrenia although the two aspects of this dimension may again relate differentially to subcategories, symptomatology or the course of schizophrenia.

(iv) Constricted-Flexible

(a) Theoretical Considerations

The constricted-flexible cognitive control dimension was first used by Klein (1954) and relates to the capacity for response set flexibility and for differential response to specific aspects of a field in the face of explicitly interfering cues. Although there seems to be some theoretical overlap between this cognitive control and that of field independence these two dimensions have been inferred from performance on different perceptual measures and have been found to be factorially independent (Gardner et al, 1959; Gardner and Moriarty, 1968). Construct validity was established in the early studies for both the capacity for response set flexibility and for differential response to specific aspects of a stimulus field containing contradictory or intrusive cues. Constricted subjects have been found resistant to change preferring to maintain sets long after they were appropriate (Gardner et al, 1959) whereas flexible subjects were shown to be more capable of reorganising stimuli in an object sorting task when progressively new stimuli were introduced (Scott, 1962). Gardner et al (1959) also showed that constricted subjects were guided by the most obvious, central aspect of a field. When external cues seemed to contradict internal cues, the conflict was resolved in favour of obvious

external cues. Constricted subjects also tended to avoid using feelings or emotional reactions as a source of information. Lazarus et al (1957) found high interference-prone individuals were less able to modulate their behaviour and impulse expression when strong motive states were aroused. Loomis and Maskowitz (1958) have further found that flexible as compared to contricted subjects show greater capacity for integrating competing or contradictory elements of a stimulus situation.

The most frequently used measure of this dimension is the Colour-Word Test (Stroop, 1935) which pits two familiar but contradictory cues against each other (word reading/ colour recognition) and asks for selective responses to one cue while overcoming the misleading effects of the other. Thus adaptive or effective performance on this test requires suspending previously learned but inefficient behaviour in a new stimulus situation. Although the Stroop interference effect, even outside of cognitive style studies, has been the subject of research for fifty years, the exact mechanism producing the interference remains unclear and a number of theories have been put forward as to why and where the interference occurs. According to Naish (1985), the interference resulting from the interaction between colour and graphemic information might occur early in the analysis of the printed stimulus, at a late stage when a response is generated or in some middle stage of processing. Various theories have been put forward to support its location at each of these stages. As these have a bearing on attentional processes generally these theories are briefly outlined below:

(i) Perceptual Conflict Theory

Hock and Egeth (1970) argue that interference occurs early in analysis at the encoding stage. They suggested that it is due to the fact that semantic information in the stimulus (i.e., the word) interferes with the identification of perceptual encoding of the ink colour by diverting attention from it. The extent to which words acts as distractor is related to the degree to which it is semantically related to the required response. Dalrymple-Alford and Azkoul (1972), however, suggest that what is crucial in the memory search task is the need for subjects to produce an implicit verbal response to the colour. That is, as the memory set is probably colour names, the stimulus coding for making the memory match involves the covert generation of the names of these colour stimuli. It is therefore the response competition effects from irrelevant words that delay this encoding. Hock and Egeth's theory has also been criticised because it does not explain the facilitating effect of congruency (Hintzman et al, 1972).

(ii) Response Conflict Theory

Response competition theories suggest that interference occurs at the output stage where responses are generated. Using Morton's Logogen System (Morton, 1969) to explain this effect, it is assumed that the two sets of information (colour and word) activate two output logogens. Activation of a logogen puts a program for verbal production of a particular word into a response buffer which has capacity for only one such program. Thus if one program becomes available before another the output of the second will be delayed until the buffer is cleared. The required

response is the colour name, and to the extent that the program for the distractor becomes available before that of the colour name, production of the colour name response will be delayed. Interference is thus more probable when the distractor is processed faster than the relevant stimulus. This will occur when they are semantically related, as their logogen will have been primed via association in semantic memory (Morton, 1969); or in the case of the reading versus naming reponse, as reading is generally faster than naming (Cattell, 1886; Fraisse, 1969). However, this theory is criticised by Stirling (1979) because the logogen model contains no decision mechanisms for selecting the appropriate response. The absence of such a mechanism should lead to the word being named, rather than the ink colour, on occasions when the printed information reaches the output stages first.

(iii) Perceptual Encoding Theory

Seymour (1977) locates interference between the input and output stages suggested by the two other theories. He regards the logogen system as a mechanism for converting internal representation from one code to another, that is perceptual to conceptual. Stroop stimuli give rise to two perceptual codes: graphemic (word)and pictorial (colour). The Stroop task requires the retrieval of a single conceptual code that can be converted into an articulatory code used to generate the naming response. Seymour sees the interference arising from the increased processing time used in 'disambiguating' the two perceptual codes in order to select a single code for conversion into a response. Seymour tested this hypothesis by using new names for the

stimuli that were semantically unrelated to their usual names (e.g., Spring for green). This allowed the semantic areas of stimuli and response to be separated which is not possible in the traditional Stroop task where distractor words are all members of the set of response names. He found that responses to stimuli related to the distractor were faster than unrelated stimuli. This was true of responses both directly (Spring for green) and indirectly (Autumn for green) related to the stimuli. The former was evidence against the perceptual conflict theory and the latter against the response conflict theory. Subsequent work by Naish (1985) has supported Seymour's concept of overlapping conceptual codes although other work suggests that Stroop interference is located at both the conceptual encoding and the output stage (Stirling, 1979).

Selective Attention

Irrespective of where interference occurs, the question still remains as to how the choice between two percepts, codes or responses is made and how this relates to selective and information processing generally. In performing the Stroop test a subject is asked to base his response on one aspect of the stimulus (colour) whilst avoiding the use of the other stimulus attribute (colour-word). This raises the question of why irrelevant words can be gated out in many other tasks (counting, scanning and matching colours) but not during colour-naming. Treisman and Fearnley (1969) used a same-different card sorting task to probe the role of selective attention in the Stroop effect. Subjects had to decide whether a pair of items on a card were matched colour to colour, word to word, colour

to word or word to colour. They found that matching within attributes was fastest and across attributes was slowest and concluded that these results could not have been due to a bias in selective attention towards either words or colours suggesting that the problem of selection' is at a later stage than input. The other conclusion reached by Treisman and Fearnley was that the irrelevant information on the cards was not interfering. The effect of distraction on Stroop performance has been examined using auditory noise stimuli but the results are equivocal with some authors finding performance improved in or following exposure to noise (Houston and Jones, 1967; Houston, 1969; Broadbent, 1978) and others finding deterioration (Glass and Singer, 1972; Hartley and Adams, 1974).

Other evidence related to selective attention comes from studies comparing different drugs. According to Calloway and Dembo (1958) narrowed attention, i.e., the ability to focus attention and ignore irrelevant cues in the environment is enhanced by stimulant drugs. Calloway (1959) found that subjects taking stimulants showed a decrease in interference whereas those on depressant drugs showed an increase in interference by comparison to a placebo group, supporting the view that the ability to focus attention is directly related to interference on the Stroop task.

Serial vs Parallel Processing

Nielsen (1974) saw the Stroop effect in terms of a serial vs parallel processing dichotomy and assumed that a word cannot become interfering until it has been encoded. Once encoded, the word either adds a constant increment to

colour encoding time or it has no effect. The constant increment is a lengthening of the time taken to verbally encode the colour. He provides two explanations at a psychological level: Firstly, the colour and word encoding processes may be serial in time, so that the word is only interfering if it is encoded before the colour. Or, the word and colour processes go on simultaneously and the word cannot interfere unless its encoding finishes first. Nielsen rejected the serial model on the grounds that there was no evidence to show that either lengthening colour encoding would increase the probability of the colour encoding beginning first or that word meaning would affect the attribute of the word being encoded first. He thus assumed that word and colour encoding proceed in parallel and the word must finish this process first in order to be interfering. In support of this hypothesis, Nielsen (1974) found that vocal responses evoked higher levels of interference than manual responses. Intertrial interval had little effect on interference. He also found a semantic gradient effect and an increase in interference with increasing set size (increasing number of colours).

Further support for a parallel processing model comes from a study by Morikawa (1981) who compared Stroop effects using the two forms of Japanese orthography: Kanji and Kana. He argues that Kanji which uses ideographic characters is processed in the right hemisphere whereas Kana which uses syllabic orthography similar to English phonetic orthography uses the left hemisphere. As he only found Stroop interference when using Kanji he suggested this was because both Kanji and colours were processed in parallel

in the nondominant right hemisphere and the interference effect must arise during the input process.

Laterality

Morikawa's study suggests that Stroop interference is related to right hemisphere processes, a view put forward in earlier studies. Left gazers, for example, experience more difficulty on the Stroop test (Bakan and Schotland, 1969; DeWitt and Averill, 1976), with left-gazing thought to be mediated by processes associated with right hemisphere activity. Evidence from brain lesion studies is less clearcut. Some studies have shown that subjects with left brain damage are worse than those with right brain damage on both simple word-reading (Shai et al, 1972) and colour-naming (Callan et al, 1972) although Perret (1974) found that right brain-damaged subjects read colours more slowly than those with left brain damage. Golden (1975), on the other hand, found that whereas word naming correlated primarily with measures of left brain damage (verbal IQ and aphasia scores) colour-naming and colour-word interference were correlated with both right and left brain measures. Golden et al (1975) suggested, therefore, that interference was not due to different hemispheric locations of colour and word processing but that differences in different brain-damaged populations resulted from distortion between the relationship between colour and word. Thus, those with left brain damage would read more slowly because they cannot associate colour with word as easily as nonbrain-damaged subjects and those with right brain damage read more slowly because words are not meaningful, the left can recognise the colours but not

find names for them. This explains the discrepancy between the Callan et al (1972) and Perret (1974) studies.

The idea that both hemispheres are involved is supported by Alivisatos and Wilding (1982). Using divided field presentation of stimuli they showed that both hemispheres generated a Stroop interference effect. Although this was larger for materials presented to the right hemisphere the results suggested that the task is handled independently in each hemisphere rather involving transfer of information from one hemisphere to the other.

(b) Constricted-Flexible and Psychopathology

Schizophrenic patients have generally been found to show more interference and be more constricted than normal subjects (Golden and Golden, 1975; Schwartz and Shagass, 1960; Smith and Nyman, 1962; Wapner and Krus, 1960). Otteson and Holzman (1976) found no difference, however, between schizophrenics and normals although there was between normals and a dimension of general pathology suggesting that constriction was characteristic of other psychiatric groups as well.

Examining the dimension further in a small group of chronic schizophrenics, Grand et al (1975) found a negative relationship between colour naming with and without a word distractor, the opposite of what has been generally found in normals (Jensen and Rohwer, 1966). They suggested that a possible explanation for these apparently paradoxical results might be in the relationship between verbal encoding ability and deployment of attention to figure-

ground (colour-word) aspects of a stimulus configuration.

Developmentally as verbal encoding skills increase, errors in colour encoding on the interference task have been found to be a function of interference from the distracting words and not simply due to misnaming the colours (Rand et al, 1963) so that words become increasingly more capable of turning attention away from the adaptively relevant information (i.e, the colours) of the task. In addition, Klein (1964) suggested that in order to produce the appropriate colour-naming response and overcome the distracting influence of the colour-word configuration, subjects must "seek additional information from the region of relevant perceptual information (colour)" and thus focus on the colour aspect and not attend to the background word component. Thus the difference between normals and schizophrenics may relate to the ability to focus attention on the colour and inhibit the word distractor.

Grand et al (1975) further found that within their schizophrenic group, differences in the cognitive level of patients in terms of their linguistic communicative pattern (simple vs complex language) were directly related to the ability to name colours (perceptual-verbal encoding). Thus patients with simple language showed less interference and would appear to have been able to focus their attention more on the colour aspect of the stimulus configuration. This style of responding to the figure-ground relation of the colour-word configuration is consistent with Silverman's (1964) view of the chronic, nonparanoid schizophrenic perceptual style as being highly

anchored by "centration effects" (Piaget, 1950) which minimize the scanning of the perceptual field. On the other hand patients with more complex language showed more interference and susceptibility to distraction by the word appearing to be less anchored by centration influences.

Overall the findings in relation to schizophrenia are consistent with the view that it is characterised by an attentional defect.

(v) Levelling-Sharpening

(a) Theoretical Considerations

The terms levelling and sharpening were originally used by Wundt (1922) and Carmichael et al (1932) to describe systematic changes in memory traces. This idea was continued in the development of levelling-sharpening as a cognitive control principle. Its original formulation resulted from work done by Holzman and Klein (Holzman, 1954, 1962; Holzman and Klein, 1951, 1954, 1956) in which levelling-sharpening was measured using a number of perceptual tasks which required comparative size estimation when stimuli were presented progressively. The processes that were considered to underlie levelling and sharpening responses have been conceptualised in terms of the degree to which memory schemata were differentiated particularly when they corresponded to progressive stimuli. In this formulation levellers were thought to exhibit undifferentiated memory organisation as a result of a tendency for new stimuli to be easily assimilated to memory traces of older but similar stimuli and tend

therefore to show extreme underestimation. Sharpeners, in contrast are thought to have greater differentiation of memory organisation and therefore a greater capacity to distinguish between and to recall successive stimuli.

Although early studies maintained that the levelling-sharpening dimension measured the relative differentiation of stimulus field and was therefore similar to field dependence, this view has since been rejected. Measures of levelling-sharpening correlated only minimally with criterion tests for field dependence (Krathwohl and Cronbach, 1956) and consistently loaded on a separate factor in factor analytic studies. It was therefore concluded that levelling-sharpening represented a mode of organising sequences of stimuli and consequently related to the individual's style of preserving discrete or aggregate memory traces, whereas field articulation dealt with the differentiation of the stimulus field.

In regard to the relationship between levelling-sharpening and memory the differences that have been found between levellers and sharpeners relate to aspects of both long-term and short-term memory, that is, to differences in the number and nature of errors made in learning highly similar lists of words (Gardner and Long, 1960), in the serial reproduction of a story (Gardner and Lohrenz, 1960) and in the degree to which subjects were able to recall the different elements and core themes of a story (Holzman and Gardner, 1960). Significant differences were not found in performance on a paired associate memory test (Gardner et al, 1960). These studies suggest that levelling is

related to the simplification of schemata, that is, the collapse of traces into generalised undifferentiated schemata, but does not involve less effective handling of discrete unrelated traces in terms of storage and recall.

Whether or not similar traces can maintain their distinctness from each other seems also to be related to the allocation of attention. For example, Gardner and Lohrenz (1961) found that the degree of assimilation was greater in subjects who had less attention available to devote to their task. Thus levelling appears to be related to situations of reduced attention to incoming stimuli in which the capacity for maintaining distinctions among similar traces is reduced. However, Levine (1975) examined the schematising test scores of 60 subjects on their relationships with theoretically correlated functions of learning, attention, recall and assimilation. Recall was tested for both contextual material and for a proactive inhibition design of paired-associate (P-A) lists (A-B/A-C), this latter providing a verbal analogue of the schematising test to check for verbal assimilation of pre-existing schemata. No support was found for an attentional interpretation of levelling-sharpening nor a relation with learning rates. Rather levellers clearly assimilated on the P-A test, supporting the original concept of levelling-sharpening as a control governing assimilation of memory.

The process of assimilation between new stimuli and memory traces of older stimuli which results in levelling on perceptual tasks is also similar in principle to Freud's original formulation of repression (Freud, 1915). His idea

was that an unpleasant stimulus may be repressed and thereby removed from consciousness by virtue of its attraction (assimilation) to an already repressed idea on the basis of similarity between the two. Gardner et al (1959) suggested therefore that levelling and repression would be found to occur in conjunction with each other. Thus although the literature claims that cognitive controls should be distinguished from psychodynamic defense mechanisms, some studies have shown that subjects high in repression, as measured by projective tests, tended to be extreme levellers (Holzman and Gardner, 1959; Gardner et al, 1959). The reverse of this (i.e., that extreme levellers are high in repression) has, however, not always been found to be true.

The implication of the work on levelling-sharpening would appear to be that sharpening is more adaptive than levelling because this perceptual-cognitive behaviour does not result in an extreme degree of obscured stimulus differences. An extreme reliance on levelling may be less adaptive because the underlying degree of assimilation between stimuli is so pervasive that relevant or critical stimuli are overlooked and not taken into account in responding to certain situations or tasks. However, there may be conditions under which sharpening is not adaptive such as an object sorting task where the tendency to discriminate sharply between stimulus differences may prevent appropriate abstraction and broad categorisation.

(b) Levelling-Sharpening and Psychopathology

The data relating levelling-sharpening to either specific

forms of psychopathology or to specific symptoms is confined to a small number of studies. Israel (1966) found that in a sample of chronic, hospitalised schizophrenics, paranoid patients had higher and nonparanoid patients lower ranking accuracy scores than normal subjects. This was partially confirmed in a study by Hirschfield (1975) who found that paranoid patients were more likely to be sharpeners than levellers but differences were not significant. She accounted for the discrepancy in the two sets of results in terms of patient sampling as she used young, acute patients suggesting that their acute psychotic state may have had a disorganising effect on their style of sharpening. In addition, looking at the relationship between levelling-sharpening and psychotic symptoms, Hirschfield noted that suicidal ideation, emotional withdrawal and hallucinations were all related to lower accuracy or levelling and suggested further that this might have masked sharpening tendencies. Differences in affect were also found to relate to levelling-sharpening with depression leading to under-estimation (levelling) and manic feeling, reflected in denial of illness and excitement, leading to larger deviation in the direction of overestimation. Neurotic patients with obsessive-compulsive symptoms and drug-dependent neurotics were also found to be sharpeners rather than levellers.

Hirschfield's results suggest that symptoms which interrupt or interfere with immediate concentration such as hallucinations tend to cause less accuracy whereas those that involve hypervigilance, such as suspiciousness or obsessiveness relate to greater accuracy. These findings

support earlier attempts to relate levelling-sharpening with personality characteristics (Silverman, 1967; Lovinger, 1969). Lovinger (1969) found that levellers reported less anxiety than sharpeners and that suspiciousness and hyper-alertness to details for defensive manner was associated with ranking accuracy sharpening and incremental error overshooting. Silverman (1967) hypothesised that levellers may be able to accept fantasies and feelings more readily because they tend to reduce the experienced magnitude of external stimuli and focus on fantasy and relatively undirected models of thought.

In summary, differences between schizophrenic and normal samples suggest that overall schizophrenics have a tendency towards levelling although this is more characteristic of nonparanoid rather than paranoid patients. In neurotic patients levelling tends to be associated with symptoms of negative affect. This is likely to be related to the tendency for levellers to reduce attention to incoming stimuli which in turn reduces their capacity for maintaining distinctions among similar traces.

(vi) Augmenting-Reducing

(a) Theoretical Considerations

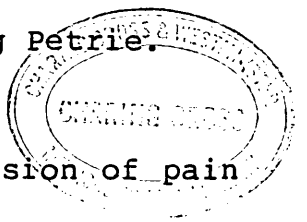
The augmenting-reducing or stimulus intensity control dimension relates to the perceived intensity of sensation, an underlying mechanism which modulates the intensity of incoming sensory signals. The first factor analytic derivation of this dimension was presented by Gardner (1961) in his paper on cognitive controls of attention. He

identified three factors: field articulation, scanning and a third factor which was interpreted as representing individual differences in "proneness to satiation effects." The test which correlated significantly with this last factor and not with the other factors was the Petrie Kinesthetic Figural Aftereffect (KFA) procedure. On the basis of performance on this test, Petrie (1967) suggested that the normal adult population could be characterised as either sensory augmenters, reducers or moderates and that these reflected basic differences in stimulus intensity modulation such that augmenter tend to increase and reducers to decrease the perceived intensity of stimuli.

Petrie attempted to validate the existence of such a mechanism by looking at individual differences in the experience of pain and sensory deprivation, reactions to drugs and perceptual characteristics of schizophrenics. She hypothesised that augmenters who typically amplify sensory stimulation tend to tolerate pain poorly but tolerate confinement and isolation well whereas reducers who in contrast attenuate sensory stimulation tend to tolerate pain well but tolerate sensory deprivation situations poorly. She found that the different kinesthetic judgements of these two types of individuals were consistent with their different responses to extreme sensory stimuli. Petrie's findings have been supported by several authors (Sweeney, 1966; Ryan and Foster, 1967) but not by others (Dinnerstein et al, 1962).

In the pain literature very few studies have looked at pain response measures in relation to different types of

induced pain. An exception is a study by Wolff (1971) in which he studied cutaneous and deep somatic pain induced by chemical, electrical and thermal noxious stimuli. From measures of pain threshold, pain tolerance and pain sensitivity a number of factors emerged. One was interpreted as cutaneous, two were thought to reflect gluteal sensitivity whereas a fourth appeared to be a specific pain factor that he called pain endurance. This was not related to the type of noxious stimulation or the body areas to which it was applied and was thus seen to relate to a central not a peripheral processing mechanism thus supporting Petrie.



Another area of research has been the suppression of pain by sound. Audio-analgesia is thought to be effective because of cross-modality masking. Gardner et al (1960) and Petrie (1967) suggested this supported a central stimulus intensity control mechanism. Audio-analgesia does not alter the pain threshold but there is evidence that it increases pain tolerance (Marone, 1968). Petrie found that white noise was only effective in decreasing perceptual augmentation in augmenters and argued that in reducers greater pain tolerance need not be accompanied by differences in threshold since tolerance level may be determined by differing rates of satiability rather than sensitivity.

Whilst the Petrie KFA is not itself a measure of sensation seeking, Sales (1971) suggested that reduction on this measure reflected a high need for stimulation and that reducers thus seek to increase their level of environmental stimulation. He confirmed this hypothesis in 3 out of 4 studies looking at different responses to stimulus

complexity. This has been subsequently replicated in work by Barnes and Hoffman (1975) and Haier et al (1984). Some authors have, however, taken the opposite view. For example, Silverman (1972) suggested that it is augmenters who should be sensation-seekers as reducers have become reducers in order to cope with their oversensitivity. This view is based on a study of the relationship between AER augmentation-reduction and responses on the sensation-seeking scale (Zuckerman et al, 1964) in manic depressives (Buchsbaum et al, 1971) but does not seem to be supported in studies with normal subjects (Barnes, 1976) suggesting differential processes in normal and patient populations.

With respect to alcohol and drugs, a number of findings have supported Petrie's hypotheses. Alcohol has generally been found to produce sensory reduction, both in relation to KFA task performance (Petrie, 1967) and to auditory, visual and somatosensory evoked potentials (Gross et al, 1966; Lewis et al, 1969; Spilker and Callaway, 1969; Porjesz and Begleiter, 1973; Salamy and Williams, 1973). In line with these findings, stimulant drugs have been found to produce augmenting and depressant drugs reducing relative to placebo control measurements (Gupta, 1974) and Petrie noted that chlorpromazine produced a change in scores towards the direction of augmenting. Deaux (1976) found that KFA scores related to choice of amphetamines or barbiturates in habitual drug users in a similar direction. These studies support the view that reducers have a greater need for stimulation and will seek to heighten stimulation through activities that involve stimulation situations (Ryan and Foster, 1967; Sales, 1972).

Overall the findings in relation to augmenting-reducing confirm Petrie's hypothesis that this is a cognitive control mechanism reflecting individual differences in stimulus intensity modulation.

(b) Augmenting-Reducing and Psychopathology

Studies with schizophrenics have been fairly consistent in demonstrating differences in both kinesthetic and visual aftereffects between schizophrenics and normals. Both kinesthetic and visual aftereffects have tended to be smaller in schizophrenics than in normals (Wertheimer, 1955; Wertheimer and Jackson, 1957; Petrie et al, 1963; Kelm, 1962; Houpt et al, 1972). A notable exception to these findings was a study by Day et al (1967) where no significant differences were found between schizophrenic, hospitalised nonschizophrenic and normal subjects for either visual or kinesthetic aftereffects.

The findings on schizophrenia generally seem to suggest that schizophrenics are perceptual reducers. Petrie (1967) quotes a study in which twice as many reducers were found among schizophrenics as in normal groups. In this study there were fewer augmenters among the schizophrenics but when they did augment they were extreme augmenters. Evidence of perceptual reduction in schizophrenics has also been found using AER and VER measures (Buchsbaum and Silverman, 1968; Rappaport et al, 1975; Schooler et al, 1976; Landau et al, 1975) and somatosensory stimuli (Shagass, 1973). This work has however been the subject of extensive methodological criticisms (Raine et al, 1981; Connolly and Gruzelier, 1982 a,b; Iacono et al, 1982).

Reduction may be an adaptive mode of adjusting to the environment. The relationship between stimulus intensity reduction and schizophrenia thus supports the view that in some schizophrenics their perceptual state is flooded with sensory stimuli (Chapman, 1966; Venables, 1974), so that distracting stimuli will be more disruptive to task performance and exposure to sensory isolation increases perceptual efficiency (Silverman, 1972). In addition, schizophrenics tend to score low on tests of stimulus-seeking behaviour (Siddle et al, 1963; Kish, 1970) and show severe response to conditions of sensory overload (Ludwig and Stark, 1973).

Schooler, Buchsbaum and Carpenter (1976) suggest, however, that "although the tendency to reduce sensation might be useful as a means of coping with painful stimulation, its excessive or inappropriate application might be either a symptom or a modulating mechanism of psychopathology". In line with this hypothesis are the findings of Landau et al (1975) that acute schizophrenics are AER reducers and that patients who recover within 4 months tend to be greater reducers initially and augmenters after recovery. Shagass (1973) also found that both normal subjects and chronic schizophrenics have higher EEG response amplitudes than do acute schizophrenics especially at high intensities.

Differences in style of stimulus intensity modulation may also be present within the schizophrenic population. In addition to the acute-chronic differences noted above, Silverman (1964) has found that paranoid schizophrenics had greater figural aftereffects than nonparanoid schizophrenics in the direction of greater augmenting in

paranoid and more reducing in nonparanoid schizophrenics. This finding was confirmed by Buchsbaum and Silverman (1968) and Schooler et al (1976).

Silverman (1967) went on to hypothesise that augmenting in paranoid schizophrenics was due to their need for vigilance which causes them to scan their environment constantly and implies that they have a broad rather than a narrow focus of attention. This is supported by the finding that paranoid schizophrenics show poorer signal detection performance than nonparanoid schizophrenics (Rappaport et al, 1972). Normals subjects have also been found to augment when they are distracted from focusing on a presented stimulus (Schechter and Buchsbaum, 1973).

A further aspect of stimulus intensity control in schizophrenia using VEP data has been researched by Connolly and his colleagues (Connolly and Gruzelier, 1982; Connolly et al, 1983). In their 1982 study hemisphere differences were found between augmenters and reducers defined using peak latency measures (P100, N120) which indicated that in augmenters response latencies were shorter in the left occipital placement and shorter than both left and right occipital placements in reducers. Also right temporal latencies were shorter in reducers than augmenters. This study was conducted in normals subjects. In the 1983 study, however, schizophrenic patients were used as well and they were found to have smaller left but larger right hemiphere amplitudes than normal subjects. In addition, all schizophrenics and a small number of normal subjects showed a decreasing pattern at the right temporal site

(indicative of reducing) whereas only 1 normal subject and a minority of schizophrenics showed an increasing amplitude pattern at the left temporal site (indicative of augmenting). These subjects had higher scores for nuclear schizophrenia on the PSE CATEGO syndromes.

Overall, the results were taken as evidence of left hemisphere abnormality in the schizophrenic patients. They were not interpreted in terms of augmenting-reducing in view of the discrepancy in defining standard EEG measures of this control dimension (Connolly and Gruzelier, 1982a, b; 1986). Their findings do, however, confirm previous findings that there is a greater incidence of reducing than augmenting in schizophrenic patients and suggest that this may be related to hemispheric asymmetries.

Differences in augmenting-reducing are, however, not only characteristic of schizophrenics but other psychiatric patients as well. Patients with affective disorders appear to show greater AER augmenting than do matched normal controls (Borge, 1973; Buchsbaum et al, 1971, 1973; Gershon and Buchsbaum, 1977). Unipolar patients tend to show less augmenting or even reducing by comparison with bipolar patients (Buchsbaum et al, 1973) although in some studies the difference has not been significant (Gershon and Buchsbaum, 1977). The AER slope measure appears to be relatively independent of the level of depression or mania (Buchsbaum et al, 1971) but one interesting study showed that whereas bipolar patients show mainly augmenting during depression, there was a tendency towards reducing just preceding behaviour switches into mania (Buchsbaum et

al, 1977). Thus the acute nonparanoid schizophrenic and the manic-depressive represent two extremes of the augmenting-reducing dimension.

The question as to why schizophrenics should be reducers was posed by Silverman (1972). He suggested that reduction was a compensatory adjustment to an overstimulation condition and related this to concepts of information overload in schizophrenics and to behavioural evidence of their attempts to reduce input. In addition, Silverman drew a parallel between the effects of phenothiazines on schizophrenic performance and perceptual reducing. Phenothiazine drugged schizophrenics show less responsiveness on cognitive and autonomic measures suggesting that the effect of medication is to attenuate the experienced intensity of stimulation. Phenothiazine-induced changes toward increased augmentation have been found on augmenting-reducing measures in schizophrenic and nonschizophrenic subjects (Petrie, 1967). Consistently on the AER procedure reducing was uncommon among medicated schizophrenics and whereas unmedicated nonparanoid schizophrenics show AER reduction, on medication they show AER agumentation (Buchsbaum and Silverman, 1968; Singer et al, 1969).

In summary, the research on cognitive controls and schizophrenia indicates that no one cognitive control dimension characterises schizophrenia and all apply both to normals and other psychiatric groups. However, different aspects of the control dimensions may relate more directly to symptomatology and serve as a predictor of prognosis.

B) Cognitive Controls and Psychophysiology

Another group of studies investigating cognitive style has focussed on possible psychophysiological correlates.

(i) Field Dependence-Independence

Research investigating the relationship between field dependence and psychophysiology has used a variety of measures (skin conductance, heart rate and EEG measures) which tend to suggest that more differentiated patterns of autonomic activation exist among individuals showing more differentiated field articulation. These studies can be summarised from two points of view: on the one hand, they have looked at the effects of differing levels of arousal during performance on tests of field dependence, while on the other hand, comparisons have been made between the different psychophysiological responses of individuals representing different aspects of the field dependence dimension. Performance on field dependence tests would appear to be facilitated by higher levels of arousal whether induced by drugs (Oltman, 1964), hormone levels (Dor-Shar, 1976; Brown and Heinenberg, 1976), noise (Shipman et al, 1970), the after-effects of sensory deprivation (Kurie and Mordkoff, 1970) or other stress factors (Britain, 1971). Alcohol and marihuana, however, had been found to have no effect on field dependence (Karp, 1963; Hayes, 1974; Schaefer et al, 1977).

In summarising the psychophysiological evidence for the differentially articulated groups it is important to distinguish between resting and stimulus-demand situations. In resting periods, for example, field dependent subjects

show more spontaneous fluctuations in skin conductance than field independent subjects (Block, 1957; Silverman et al, 1961; Hurstmeyer and Karnes, 1964; Goldstein et al, 1972), a relationship that is reversed when waiting for a stimulus to occur (Goldstein et al, 1972). Basal heart rates tend, however, to be higher in field independent subjects (Shipman and Heath, 1967) and whilst there are no differences in EEG alpha measurements with eyes closed between field dependent and field independent subjects, field dependent subjects showed less alpha with eyes open (Silverman et al, 1961; Pillsbury et al, 1967). Where no differences have been found between differently articulated groups, this has been sometimes due to sex differences. Hayes (1974), for example, found lower levels of activation on several different psychophysiological measures (SCL, HR, EEG) but only in male subjects.

On the other hand, field independent persons appear to show better GSR conditioning, more appropriate lability in heart rate conditioning, faster and better differentiated avoidance and conditioning and less distress in isolation as measured by spontaneous GSR activity (Silverman et al, 1961). In general, field independent persons react to novel or unknown situations with the typical orienting reaction of heart rate deceleration and increased skin conductance indicative of stimulus intake (Hein et al, 1966), whereas the field dependent person reacts to the same situation with the typical defensive response of heart rate acceleration (Dronsejko, 1972). It is in the responses of individuals to different kinds of stimuli or experimental conditions that the parallel

between psychophysiological and field articulation measures of psychological differentiation has been most clearly drawn.

Differences in the pattern of heart rate responding were, for example, illustrated in a study by Dronsejko (1972) that whereas during anticipation of the first UCS, field independent subjects reacted with cardiac deceleration, indicative of orienting (Sokolov, 1963) or attentive observation and searching of the environment (Lacey, 1967), it disappeared in these subjects within the first 10 trials suggesting appropriate lability and flexibility. Similarly, looking at the effects of instructions, field independent subjects showed a definite deceleration when given preparatory information, but an acceleratory-deceleratory response when uninformed, suggestive of adaptive preparatory anxiety and searching of the environment. In contrast heart rate changes in field dependent subjects were less differentiated showing cardiac acceleration under all conditions. These findings support previous evidence of differential responses in field dependent and field independent subjects in structured and unstructured situations (Culver et al, 1963) and under informed and uninformed conditions (Culver et al, 1964).

McCanne and Hathaway (1979) took a different approach using a field dependence measure (Embedded Figures Test) as an example of an attention-demanding task and looking at various psychophysiological measures (heart rate, skin potential, respiratory and electromyographic activity) during performance. They found a unidirectional increase

in respiratory rate and in tonic and phasic responding during presentation of the EFT stimuli and a bidirectional response pattern in heart rate that consisted of an initial decrease during the complex figure followed by an increase during the simple figure. Both response patterns indicated an increase in attentional demands. There were, however, differential changes relative to solved and unsolved problems and to different subject groups. During solved problems, in which attention to the embedded simple stimulus is presumably maximal, subjects exhibited lower heart rates than during unsolved problems. This is consistent with the association between deceleration and increased attention or information intake (Lacey and Lacey, 1970, 1974). There were subject differences however indicating that for field dependent subjects, higher rates of phasic responding occurred during unsolved problems than during solved problems, whereas the reverse was true of field independent subjects. In view of the evidence that increases in skin potential phasic responding occur during stressful experiences, McCanne and Hathaway suggested their results might indicate that field dependent subjects experience the situation as more stressful than field independent subjects. This view is supported by Primakoff and Goldberger (1976) and Sandman (1975).

Similar evidence of greater psychological differentiation in field independent subjects has also been found using EEG measures of cortical organisation. O'Connor and Shaw (1978) found a significant relationship between field independence and lower EEG coherence values which are hypothesised to indicate greater differentiation between

pairs of units in the cortex. This finding is consistent with the pattern of greater hemispheric lateralisation shown by more field independent subjects in other EEG studies (Tucker, 1975; Oltman et al, 1979).

One other area of importance in the context of psychophysiology is the relation between field dependence and the dimension of extraversion. A number of studies show that extraverts are more field dependent than introverts (Fine and Danforth, 1975; Loo, 1976). However, Cegalis and Leen (1977) found no differences between extraverts and introverts except under conditions of induced perceptual conflict when extraverts showed greater field dependence. They suggested that this could be because the complexity of the visual cues became so great at this point that the introverts, who are more highly aroused anyway, found it necessary to disattend vision in order to control escalating arousal. A different interpretation is suggested by Loo and Townsend (1977) who found that impulsiveness and quick decision times were related to field dependence. Extraverts may have shown greater field dependence because they were less likely to inhibit their first response impulse whereas introverts had greater field independence not by blocking out the environment, but by evaluating it cognitively in a more careful way.

A number of theories have been put forward to account for findings relating field dependence and psychophysiology. It has been suggested by Easterbrook (1959) that physiological arousal leads to a reduction in responsiveness to peripheral cues or narrowed attention (Callaway, (1959).

Differences in field articulation may therefore be due to differences in the level of physiological arousal which in turn affects breadth of attention. This has led to the view that increased physiological arousal will enhance (Oltman, 1964) or impair (Morf et al, 1971) performance on field articulation measures. Some support has been found for both these views.

Cohen (1967) invoked the reticular activating system, its homeostatic function of adjusting the relationship between input and output and its role in sensory integration or as a gating mechanism. He based his conclusions on evidence that field independent subjects show differential responsivity to different kinds of input which field dependent subjects do not. Furthermore, field dependent subjects show a more sustained level of nonspecific activity during low sensory input and less sustained levels with periodic input whereas field independent subjects begin with a high level of nonspecific activity which falls off much more rapidly than those who are field dependent. Cohen suggested that in field independent subjects generalised activity of a more adaptive nature occurs whereas field dependent subjects are activated in an environment with reduction cues, perhaps as a function of the increased scanning and searching for orienting signals. Hein et al (1964) suggested that in these subjects it was as if the homeostatic input-output adjusting mechanism was 'frozen'. Hayes (1974) suggested that performance on measures of field articulation was related to the level of development in the individual of some neural mechanism concerned with the control of physiological arousal. He identified this

mechanism as the frontal-septal-hippocampal axis and proposed that lower levels of activation reflected the level of inhibitory control over sympathetic activity. According to this individual subjects would show a characteristic level of physiological activation but would not be greatly affected in their performance by procedures aimed at changing the level of such activation. Again only partial support has been found to support his hypothesis.

All three theories are, however, consonant with the idea that there is a reciprocal relationship between the mechanisms underlying cognitive control functions and physiological patterns of responding.

(ii) Focussing-Scanning

Unlike the previous cognitive controls very little work has been done relating measures of focussing-scanning to psychophysiological measures. So far the only study of any relevance that I have been able to locate compared acute paranoid and nonparanoid schizophrenics on measures of size estimation and cardiac rate (McCormick and Broekma, 1978). They found that both schizophrenic groups showed frequent large-magnitude cardiac deceleration during the performance of the size estimation task. However, whereas cardiac deceleration tended to be associated with size underestimation (focussing) in the paranoid patients, it was associated with size overestimation (scanning) in the nonparanoid patients. The size estimation results confirmed previous findings that paranoid subjects underestimate and nonparanoid subjects overestimate and McCormick and Broekma suggested that perhaps the heart rate response was

acting as a moderator variable such that paranoid-nonparanoid differences in scanning were only occurring in the presence of a distinctively large decelerating response. Whilst this study does not explore the relation between focussing-scanning and psychophysiology in any depth, it does indicate the importance of measuring two or more interacting variables or response systems together. It would, for example, be interesting to know whether the tendency to focus or scan is reversed or changes in some way under conditions of cardiac acceleration?

(iii) Equivalence Range

Some studies have suggested a possible relation between psychological under-responsiveness and physiological underarousability in relation to the equivalence range cognitive control. For example, Hart and Payne (1973) found that overinclusion scores tended to have inverse correlations with ratings of psychomotor retardation in psychiatric patients. Similarly, Hawks and Marshall (1971) have shown that overinclusive subjects obtain lower overinclusion scores when their rate of responding goes down and that psychomotor retarded subjects obtain higher overinclusion scores when their response rate is increased. According to these studies, overinclusion would thus be related to hyper-arousability and underinclusion to hypo-arousability. Partial support for this view comes from a study by Loveless (1972) which compared cognitive styles, orienting responses and self-report measures of personality. He found that there was a significant negative correlation between the number of groupings made on an Object Sorting Test and the shape of the response to the

first unconditional stimulus, the rate of habituation to tones alone and the number of conditioned responses.

There do not appear to be any other studies looking directly at the relation between arousal and equivalence range. A study by Depue and Fowles (1974) looked at the relationship between arousal (muscle tension) and response interference (verbal learning task with proactive inhibition design) in schizophrenics' conceptual organisation based on the predictions of Broen's theory. They found that increased arousal produced decreased recall, more clustering and increased intrusions in schizophrenic, neurotic and normal subjects. Apart from supporting Storms and Broen (1972), these results are consistent with the findings above suggesting a positive relationship between level of arousal and breadth of categorisation.

(iv) Constricted-Flexible

The Stroop Test as a measure of the constricted-flexible cognitive control dimension has been used by some authors to examine the effects of stress on physiological measures. Frankenhauser et al (1967) found a decrease in skin conductance levels over sessions using a modified colour-word test, suggesting that initially it may have been a stressful task. Thackray and Jones (1971), however, found no evidence of the colour-word condition affecting measures of heart rate or respiration. They suggested that the Stroop test may reflect only attentional processes which are vaguely related, if at all, to general arousal. Few studies, however, have looked specifically at the relationship between the two.

Studies looking at arousal-related personality variables indicate greater interference in extraverts (Jensen, 1965; Callaway, 1959), whereas Jorgenson (1976) found that a medium anxiety group showed the least discrepancy between response conditions of the Stroop and also the least interference by comparison with a high or low anxiety group suggesting that the relationship may be curvilinear. This is also implied in Lehman and Knight's study (1961) where performance on the Colour-Word Test was better with d-amphetamine if the subject was an addict but not if the subject was not, indicating that there may be an optimum level of arousal that is determined intraindividually.

Another approach to the relationship between Stroop interference and arousal relates to studies looking at time of day. Human performance efficiency varies as a function of the time of day with performance better in early evening than early morning (Colguoun, 1971). Broadbent (1971) suggested that the variable underlying the change is the arousal level in the organism. On the one hand, diurnal changes suggest that arousal is greater in the early morning. Changes in performance, when accompanied by loud noise, are mediated by an increase in arousal (Broadbent 1971). Stroop interference has been found to increase after exposure to noise (Hartley and Adams, 1974) and from morning to evening (Hartley and Shirley (1976).

Overall, the studies summarised here suggest an increase in interference is associated with high levels of physiological arousal. The relationship may, however, be

curvilinear in that high interference has also been shown to relate to states of low arousal.

(v) Levelling-Sharpening

Studies by Israel (1966, 1969) and Orlebeke and Passchier (1976) have investigated the relation between levelling-sharpening and the orienting reflex and anticipatory cardiac response. In both studies of the electrodermal orienting response, no differences were found in either SF or SCL. There were, however, differences in phasic responses. Orlebeke and Passchier found that levellers had greater GSRs than sharpeners in response to tone sequences of three different stimulus intensities (50, 75, 100 dB). Israel (1966), on the other hand, found that sharpeners, whether schizophrenic or normal subjects habituated more slowly than levelers to repetitive neutral stimuli when habituation was measured as a decrement in GSR amplitude. These findings are contradictory. This may be due to methodological differences between the two studies, particularly as in Orlebeke and Passchier's study stimuli were presented under two different conditions with either intake (listen very carefully) or rejection (count backwards silently) instructions and they do not comment as to whether there were differences between the two. These instructional differences are likely to affect the level of stimulus significance and are therefore different from Israel's study where the stimuli were neutral.

More consistency was found in respect of cardiac measures. Israel (1969) looked at whether levellers and sharpeners differed in their anticipation of stimuli which they

judged to be either anxiety-arousing or uninteresting. Using visual stimuli (geometric figures) she found that during periods of anticipation cardiac sharpeners were characterised by deceleration, whereas levellers showed an anticipatory response that was closely tied to their attitude toward the coming stimulus. Thus levellers showed cardiac deceleration prior to highly preferred stimuli, no significant cardiac change prior to low preference stimuli and acceleration in anticipation of an anxiety-arousing stimulus. There were no differences in heart rate habituation. A similar finding of greater deceleration in sharpeners than levellers was found by Orlebeke and Passchier (1976) in response to three different tone intensities.

These results and their importance for levelling and sharpening can be seen in a wider theoretical context. According to Lacey's (1967) intake-rejection hypothesis, both cardiac deceleration and skin conductance increases are associated with an attentive, receptive orientation toward the environment (intake) whereas cardiac acceleration and skin conductance decrease are associated with the rejection of external stimuli. Lacey maintained that these changes have instrumental value for the central state of the organism such that the former (deceleration/intake) lead to an enhancement in perceptual efficiency whereas the latter (rejection/acceleration) lead to a decrease in perceptual acuity. Obrist et al (1970), on the other hand, maintained that deceleration is due to the central inhibition of irrelevant somatic activity. Thus by minimising 'internal noise' the organism has a greater readiness for the reception of external stimulation and

deceleration is an effect of such noise reduction.

Both these explanations account for deceleration in sharpeners leading to greater perceptual differentiation and acceleration in levellers leading to less differentiation.

(vi) Augmenting-Reducing

Direct comparisons between augmenting-reducing and measures of psychophysiology do not appear to have been made other than the studies using AER or VER as an alternative measure of stimulus intensity control. There is, however, some indirect evidence which looks at sensation-seeking and effects of medication which might suggest a possible relation.

Zuckerman (1969) argued that sensation-seekers have an 'excitable' central nervous system and that they should therefore give large orienting responses to novel stimuli. Neary and Zuckerman (1976) found that subjects with high sensation-seeking scores generally gave larger electrodermal responses to visual stimuli but this was only true of male subjects. Feij et al (1982) also found a positive correlation between sensation-seeking and the amplitude of skin conductance responses to the first presentation of an 80 dB tone. Other studies using cardiac or electrodermal measures have, however, failed to find a difference (Montgomery, 1971; Cox, 1978; Schooler et al, 1978; Ridgeway and Hare, 1981); although in the Ridgeway and Hare study the authors noted that the heart rate response to the first of a series of 60 dB tones was deceleration for subjects with high sensation-seeking scores while the

response of the low sensation-seeking group included what appeared to be startle components, a short latency accelerative response that habituated rapidly on subsequent trials. These studies suggest that sensation-seekers tend towards hyper- rather than hypo-arousal. Insofar as reducing is thought to reflect a high need for stimulation at least in normal subjects (Sales, 1971), this would then suggest that reduction is more likely to be associated with higher than lower levels of physiological arousal.

The evidence relating augmenting-reducing to drugs, however, suggests the opposite. Drugs which have a depressant action on the central nervous system are related to reducing whereas those with a stimulant action are related to augmenting. The effect of medication on electrodermal arousal shows a similar relation with hypo-arousal typical of patients on phenothiazine medication, suggesting that reducing is likely to be associated with lower levels and augmenting with higher levels of arousal.

In order to reconcile these two apparently contradictory sources of evidence about the relation between augmenting-reducing and psychophysiology we need to take account of several other facts. On the one hand, there is evidence to show that after treatment with chlorpromazine there is a change towards increased augmenting (Petrie, 1967; Buchsbaum and Silverman, 1968; Singer et al, 1969; Inderbitzen et al, 1970). According to Silverman's 1972 hypothesis this kind of medication is effective because it attenuates the experienced intensity of ordinary stimulation and controls sensory overload. It would thus appear

that medication allows a normal level of stimulus intensity control to be reestablished and permits an orientation towards intake rather than rejection of stimuli. On the other hand, habitual drug users who are reducers choose stimulants as a drug of choice and augmenters choose depressants suggesting that in normal subjects there is a more active compensation for any imbalance in stimulus intensity control.

More recently augmenting-reducing has also been linked to the personality dimension of introversion-extraversion (Haier et al, 1984). Using the original EP measures (Buchsbaum and Silverman, 1968) they found that reducers were more extraverted than augmenters. Thus reducing in both normal and patient populations can be seen as an attempt to alter the level of stimulus intensity control so as to reduce input which might be determined by either a compensatory disease process as in schizophrenia, or an individual characteristic or trait determining the way perceptual input is dealt with. The relationship between psychophysiology and augmenting-reducing would therefore appear to be dependent on whether the compensation is a passive or active process.

The studies relating cognitive control dimensions to psychophysiology are not sufficiently extensive to provide a consistent picture. The inconsistency, however, may be related to the need to look for a curvilinear rather than a linear relationship and to take account of individual or idiosyncratic differences in normal levels that may fluctuate over time and across situations.

CHAPTER 4

Attentional Processes in Schizophrenia : An Hypothesised Relationship Between Psychophysiological and Cognitive Response Style

Preceding chapters have reviewed psychophysiological and cognitive aspects of work on schizophrenia. This chapter attempts to draw together these two bodies of research by outlining the basis for a possible relationship between them and defining the hypotheses underlying this thesis. It is clear and noted by many authors that schizophrenia is not a unitary illness but heterogeneous in nature and presents considerable inter- and intraindividual variability in both symptomatology and behaviour. In this respect parallels may be drawn with research on the normal population even though their degree of experimental variability might be lower. It further suggests the importance of looking for an underlying mechanism or variable that might influence normal as well as patient behaviour. An obvious focus for this would be attention, a process that varies both inter- and intraindividually.

Attentional deficits have been found in many schizophrenic patients and it has been suggested that rather than being a primary dysfunction from which other dysfunctions and phenomena derive, attentional deficit may be significant in determining whether the inherited psychological deficit remains latent in the form of a personality disorder or becomes manifest as a florid psychosis (Mednick and Schulsinger, 1968; Parnas et al, 1982). This could imply

that what determines the type of illness is the degree to which an attentional deficit is present. I would like to suggest instead that it is not the extent of the attentional deficit as such but the characteristic way in which attention is deployed, that is, attentional style that determines whether or which type of illness becomes manifest.

Cognitive style research suggests that the deployment of attention is related to the way in which an individual characteristically processes ongoing stimulation, internal and external. Regulating cognitive structures intervene between stimulus or task on the one hand and perceptual-cognitive behaviour on the other, in the same way that, in ego psychology, defenses are seen as structural thresholds that set limits to the discharge of drive tension and the influx of external stimuli, thereby preserving an individual's given state of equilibrium. So far most research on cognitive controls has focussed primarily on performance differences between individuals on identical tasks. Ego psychology, however, also tells us that adaptive behaviour is unlikely to be brought about by any one cognitive response style, but as stimulus demands change the psychologically effective person's response style will reflect the capacity to instate different perceptual-cognitive behaviours determined by the 'fit' between the contingencies of different stimulus situations and appropriate or succcessful response styles. Evidence to support this view has come from studies in which the capacity for adaptive behaviour has been considered analogous to measures of personality integration or ego strength (Barron, 1954;

Thomas, 1969; Thomas and Seeman, 1968; Foxman, 1974). However, in the same way that an individual's cognitive response style may reflect the capacities for adaptive behaviour, it may equally reflect maladaptive or pathological behaviour. This possibility is given support by the evidence for personality styles such as the neurotic obsessive-compulsive style (Shapiro, 1965) and by the suggested relationship between particular cognitive controls (focussing-scanning, augmenting-reducing, field articulation) and the paranoid-nonparanoid dimension in schizophrenia (Silverman, 1964, 1967, 1969).

It has been suggested (Otteson and Holzman, 1976) that, inasmuch as cognitive controls remain stable within an individual over time, the ambiguous results generally yielded by these measures in schizophrenia research may reflect individual consistencies rather than schizophrenic disorganisation. In this sense they may represent characteristics of the person who becomes schizophrenic rather than being characteristic of schizophrenia per se. If the organisation of cognitive controls is the same in normal and psychopathological groups then the differences probably reflect differences in the extent of disorganisation between groups rather than 'schizophrenicity' per se. That is, rather than a person's cognitive style being altered by psychotic disruption, it is the development of a strategy for organising sensory stimuli which led to a maladaptive cognitive response style leading to psychotic breakdown. This is reflected in the idiosyncratic pattern of psychophysiological responses of schizophrenic patients Whereas most normal subjects can respond to novel stimuli

and habituate to them in a reasonable amount of time, in schizophrenic patients stimuli tend either to elicit unusually intense reactions which often slow habituation, or minimal or no reaction as though the stimuli have been virtually excluded from awareness. Similarly, baseline levels of arousal tend to be either very high or very low suggesting either hyper- or hypo-arousal.

Furthermore, Rubens (1977) has shown that patients classified as electrodermal responders or nonresponders may change and become nonresponders or responders respectively when retested at a later time, with changers having better prognosis than nonchangers. This alternation between response patterns was seen as an attempt on the part of the schizophrenic patient to modulate his responsivity to stimulation. In the same study Rubens looked at the relationship between electrodermal responding status and the Stimulus Barrier subscale of Bellak's Ego Function Scale (Bellak, 1973), a cognitive measure that has theoretical parallels to stimulus filters and gating mechanisms. This measure was highly correlated with the nonresponder/responder distinction in schizophrenia, with responders characterised by the most pathological stimulus barrier functioning, normal controls the least and nonresponders group lying in between. This study highlights the fact that cognitive response style may have a psychophysiological counterpart. This is further illustrated in a a study by Dykes and McGhie (1976) comparing the attentional strategies of creative and schizophrenic subjects. Whereas both high creative subjects and schizophrenics had a greater level of stimulus input only the high creative

subjects were actually able to deal with input so as to produce a high performance level. Low creative normals, on the other hand, restricted their level of input but produced a moderate level of performance which was nevertheless above that produced by the schizophrenics.

In addition to a psychophysiological response style related to arousal and habituation of the orienting response, another related to hemispheric asymmetry also reflecting differences in attentional processes has been suggested. There is evidence to show that the two hemispheres differ with respect to attention, the left or dominant hemisphere being superior in selective or focussed attention and the right (nondominant) hemisphere in sustained attention (Dimond and Beaumont, 1973; Dimond, 1976, 1979; Blakeslee, 1979). Furthermore, the control of attention is related to a balance between the activation patterns of the two hemispheres (Kinsbourne, 1973) which exert either an inhibitory or excitatory influence on attentional behaviour. In regard to electrodermal measures selective attention is reflected in low levels of responding and fast habituation which are also related to higher left- than right-hand responses, whereas sustained attention has been associated with more frequent responding and slow habituation and with higher response amplitudes on the right hand (Gruzelier et al, 1981). The predominant pattern of asymmetry in schizophrenia shows higher response amplitudes on the right hand although asymmetries in skin conductance levels appear to be related to levels of arousal (Gruzelier and Venables, 1974). This has been taken as evidence of a left hemisphere deficit and with

respect to attentional style suggests poor selective attention. Changes in bilateral asymmetry have, however, been noted in relation to drug administration (Gruzelier and Hammond, 1977; Gruzelier et al, 1981) and symptomatology (Gruzelier, 1981; Gruzelier and Manchanda, 1982).

A crucial etiological question in schizophrenia is whether or not the observed perceptual-cognitive deficits result from a tissue-based defect or selective ego adaptation to external conditions. It is beyond the scope of this study to answer that question. However, whether tissue-based or ego-adaptive the way in which incoming stimuli or information is processed should be reflected in the different perceptual-cognitive styles employed by the individual irrespective of whether it is measured cognitively or psychophysiologically. In view of the fact that there is some evidence of a relationship between cognitive and psychophysiological response styles, it is the intention of this study to explore the nature of this relationship further by testing subjects on an habituation paradigm using 70 dB and 90 dB tones and six cognitive control measures; and by relating patterns of autonomic reactivity and lateral asymmetries to the six cognitive measures.

Hypotheses

I. On the basis of the previous observations, the global hypothesis for the present study is that cognitive and psychophysiological response styles exist within schizophrenic patients but that no one specific style is characteristic of schizophrenia.

II. It is further hypothesised that insofar as both styles reflect particular modes of deploying attention that these will covary together.

In the testing of these hypotheses the following criteria need to be taken into account:

1. Psychophysiological Response Styles

For the purpose of this thesis autonomic reactivity will be considered as a continuous rather than a dichotomous dimension. The evidence for a bimodal distribution of responding is not conclusive and rate of habituation shows considerable variation that would appear to relate to patient sampling rather than to experimental factors (Ohman, 1981). Similarly, laterality indices will also be considered to lie on a continuum although account will need to be taken of the reciprocal relationship between rate of habituation and lateral asymmetry and the effect of anxiety on this relationship in slow habituators (Gruzelier et al, 1981).

Distributions along these two continua will therefore be considered for both the 70 dB and 90 dB tone sequences. The effect of the louder tone sequence may be twofold: on the one hand whereas moderate intensity tones may be considered to have no signal value, they may acquire signal value as a result of louder intensity; on the other hand, the louder intensity may raise anxiety and thereby alter relationships between autonomic variables.

2. Cognitive Response Style

Each of six cognitive control measures will also be considered as continuous rather than dichotomous variables. Although in the literature there is a tendency to subdivide cognitive control measures so that distinct groups are distinguished at both extremes, these are often based on arbitrary cut-off points and, for the most part, do not take into account the characteristics of subjects with non-extreme scores.

3. Psychophysiological and Cognitive Response Styles and Psychopathology

In comparing schizophrenic patients with nonschizophrenic patients and normal controls, different psychophysiological and cognitive response styles are not expected between groups, although a particular response style may be more predominant in one group than another. Thus, in relation to measures of psychophysiological response style, schizophrenic patients will be expected to show a predominance of hypo- rather than hyper-responding and of right- rather than a left-hand bias in lateral asymmetry measures.

Furthermore, when comparing subgroups of schizophrenic patients categorised according to the acute-chronic, institutionalised-noninstitutionalised and paranoid-nonparanoid dimensions, it is expected that chronic, nonparanoid or institutionalised patients will show lower reactivity and a right- rather than a left-hand bias in lateral asymmetry than acute, paranoid or noninstitutionalised patients. In relation to cognitive response style measures, it is expected that acute, paranoid or

noninstitutionalised schizophrenic patients will be more field independent, more overinclusive, more flexible and show a tendency towards greater sharpening and more extensive scanning and augmenting than those who are chronic, nonparanoid or institutionalised.

4. Psychophysiological and Cognitive Response Style and Demographic Variables

Sex and age differences are expected on some measures. With respect to tonic and phasic measures of the electrodermal response it is expected that autonomic reactivity will be lower in older than in younger subjects, and in women than in men. Similarly, on the basis of previous research, it is hypothesised that sex differences will be found in two of the cognitive control measures, that is, that men will be more field independent and more flexible than women. In view of the developmental stability of the different cognitive controls age differences are not expected within the adult sample used except in subjects who fall within the very old group.

5. Relationship Between Psychophysiological and Cognitive Response Styles

It therefore follows that psychophysiological and cognitive response styles will be related such that higher levels of autonomic reactivity and a right- rather than a left-hand bias in lateral asymmetry measures will be related to field independence, overinclusion, flexibility and a tendency towards greater sharpening and more extensive scanning and augmenting.

CHAPTER 5

Subjects and General Methodology

Subjects

One hundred and twenty subjects were examined on a tone habituation task and six cognitive tasks. The subjects were divided into three groups : 1. Schizophrenic patient group (N = 40); 2. Nonschizophrenic psychiatric patient group (N = 40); 3. Normal control group (N = 40).

All three groups were matched for age and sex, and all subjects were right-handed. The groups were not matched for IQ though an attempt was made to control for the effects of level of intellectual functioning using the vocabulary subtest for the Verbal Scale of the Wechsler Adult Intelligence Scale. This subtest is highly correlated with the Full Scale IQ and a good indicator of premorbid level of intellectual functioning. All subjects scored within the normal range of intelligence.

The means and ranges of ages and, in the case of patients, number of previous hospital admissions, age of onset of illness and length of current hospitalisation are given in Table 5 (i).

The schizophrenic patients were all diagnosed as unambiguously schizophrenic by the hospital psychiatrists. Most of the noninstitutionalised, new admissions, had also been diagnosed with the help of the Present State Examination (PSE) (Wing, Cooper & Sartorius, 1974). None of the

Table 5(i) Means and Ranges of Age and Illness Variables

Subject Group:		Schizophrenic Patients	Nonschizophrenic Patients	Normal Controls
Variable				
Age				
(Years)	$\bar{x}$	41.63	43.45	40.25
	Range	19-68	19-66	22-73
Age of Onset				
(Years)	$\bar{x}$	28.85	34.92	
	Range	16-57	16-59	
No. of Admissions				
	$\bar{x}$	2	2	
	Range	0-10	0-10	
Length of Current Admission	$\bar{x}$	6 years	5 weeks	
	Range	1 wk-17 yrs	1-31 wks	

patients were known to have brain damage. The patients were heterogeneous as regards the stage of their disorder and their current clinical picture. Subdivision of the patients into acute/chronic or paranoid/nonparanoid categories (Table 5 (ii)) was made on the basis of the psychiatrists' diagnosis or information from the case notes in accordance with the International Classification of Diseases (Ninth Revision, 1978). The noninstitutionalised patients were drawn from short-stay or admission wards and had been hospitalised (either currently or as a total length of hospitalisation) for less than five years. The institutionalised patients had been hospitalised for more than five years. Patients were taken from Charing Cross Hospital, Friern Hospital and St. Bernards Hospital.

The normal control group comprised a heterogeneous group of volunteers employed both within and outside of the hospitals. All subjects were asked to complete the General Health Questionnaire (Goldberg, 1972) and subjects scoring within an abnormal range were not included in the study.

The nonschizophrenic patient group comprised patients who had all been admitted to the above hospitals as psychiatric patients. The group included patients with depression (N = 31), personality disorders (N = 5) or neurotic disorders (N = 4). Patients with depression could be subdivided into those with reactive depression (N = 17) and those with endogenous depression (N = 14) in accordance with ICD-9. The latter were diagnosed on the basis of the presence of the following symptoms: early waking, diurnal mood variation and loss of appetite and weight.

Table 5 (ii) Diagnostic Subcategories in Patient Groups

Subject Group	Subdiagnosis	N
Schizophrenic Patients	Acute Schizophrenia	17
	Chronic Schizophrenia	23
	Paranoid Schizophrenia	6
	Nonparanoid Schizophrenia	34
	Institutionalised Patients	14
	Noninstitutionalised Patients	26
Nonschizophrenic Patients	Reactive Depression	17
	Endogenous Depression	14
	Personality Disorder	5
	Obsessional Neurosis	2
	Anxiety Neurosis	2

Table 5 (iii) Types of Medication Taken by Patients

Patient Group:	Schizophrenic Patients	Nonschizophrenic Patients
Medication		
Antidepressants:		
- Tricyclics	7	16
- MAOI	0	5
- Lithium	0	5
Phenothiazines	21	7
Haloperidol	6	4
Antiparkinsonian	19	5
Benzodiazepines	7	19

Eleven schizophrenic patients and seven nonschizophrenic patients were unmedicated. Details of medication taken by other patients is given in Table 5 (iii).

Methodology

Each subject was tested individually on two tone sequences and six cognitive tasks: Closure Flexibility Test, Stroop Colour-Word Test, Petrie Kinaesthetic Figural After-Effect Test, Size Estimation Test, Schematising Test and Object Sorting Test.

The two tone habituation sequences were always given first. The order in which the remaining tests was given was partially randomised across subjects to eliminate possible fatigue effects. The majority of subjects were able to complete all six tests in one session. Total testing time was approximately two hours per subject. The same examiner was present throughout testing and subjects were given short breaks between each test. Subjects who were unmotivated or uncooperative were not included. On the whole subjects, both patients and normal controls seemed to enjoy doing the tests. The procedure and instructions were explained individually for each test.

All Tables relating to this experiment and referred to in Chapters 6 to 12 are contained in the Appendix.

CHAPTER 6

The Orienting and Habituation Characteristics of Electrodermal Responses in Schizophrenic Patients

Subjects

All 120 subjects took part (see Subjects and General Methodology Section).

Method

Apparatus

Electrodermal orienting responses were examined to two tone sequences. The first sequence consisted of 15, 70 dB SPL, 1000 Hz tones, of 1 second duration with controlled rise and decay times of 25 msec. This sequence was followed by a second sequence of 10, 90 dB SPL, 1000 Hz tones of 5 seconds duration with similar rise and decay times. In both sequences tones were presented at quasi-randomised intervals between 20 and 40 seconds. The tones were either generated by a tone generator or recorded on cassette and presented via a Sony tape recorder, type TE 50. In both instances the tones were presented through Koss headphones.

Skin conductance was measured during the sequences from bipolar electrode placements on the medial phalanges of the first and second fingers. Recording was bilateral with identical electrode placements on each hand. Beckman silver/silver chloride electrodes, 1 cm in diameter, were fastened with tape and used with Beckman KCl electrolyte.

The electrodes were attached to a constant voltage skin conductance system, which in turn was connected to either a Grass model 7D polygraph in the Charing Cross Hospital laboratory or to a portable Grass model 5 at Friern and St Bernard hospitals. The minimum sensitivity on both machines was set at 0.02 microsiemens/cm with a minimum amplitude criterion of 1 mm per deflection.

Procedure

Sixteen schizophrenic patients, 30 nonschizophrenic patients and the 40 normal controls were tested at Charing Cross Hospital. A further 15 schizophrenic patients were tested at Friern Hospital and the remaining patients were tested at St. Bernards Hospital. At Charing Cross Hospital recording took place in a sound-attentuated room adjacent to the experimenter and the polygraph. At Friern Hospital and St. Bernard Hospital patients were tested in the same room as the experimenter, facing away from the recording apparatus. In both situations subjects were seated in a comfortable chair and instructed to sit and relax, to keep their eyes open and asked, if possible, not to move until the experimenter informed them that recording had ended. They were told that they would hear sounds through the headphones but told not to bother about them. At the end of the first sequence, subjects were informed that the subsequent sounds would be louder. This was to minimise the possibility of a startle response occurring. Movements coughs and talking were noted on each chart. Testing was always conducted by the same experimenter.

Skin conductance response characteristics were defined using the following criteria (Gruzelier, 1973):

1) An orienting response was operationally defined as an increase in conductance greater than 1 mm at a sensitivity of 0.05 microsiemens that occurred between 0.8 and 5.0 seconds after stimulus onset.

2) Nonspecific responses or spontaneous fluctuations were defined as responses with an amplitude greater than 0.05 microsiemens and occurring during the tone sequence but not within the latency window defined above.

3) Latency was the time elapsing between stimulus onset and onset of an orienting response.

4) Rise time was the time taken for a response to reach peak amplitude after onset.

5) Amplitude was defined as the highest point of a response and was measured from the level of skin conductance at response onset.

6) Recovery time was defined as the time elapsing from peak amplitude and the amplitude halfway to return to the level of skin conductance at response onset.

7) Skin conductance level was defined as the average level of conductance sampled at the onset and finish of the tone sequence and at every fifth trial during the tone

sequence. The criterion of habituation was the number of tones, termed trials, until responding ceased for a minimum of three successive trials.

Data Analysis

The data was scored manually and analysed using parametric or nonparametric tests as appropriate. Conservative degrees of freedom and two-tailed probabilities are reported throughout.

SECTION I: 70 dB Sequence

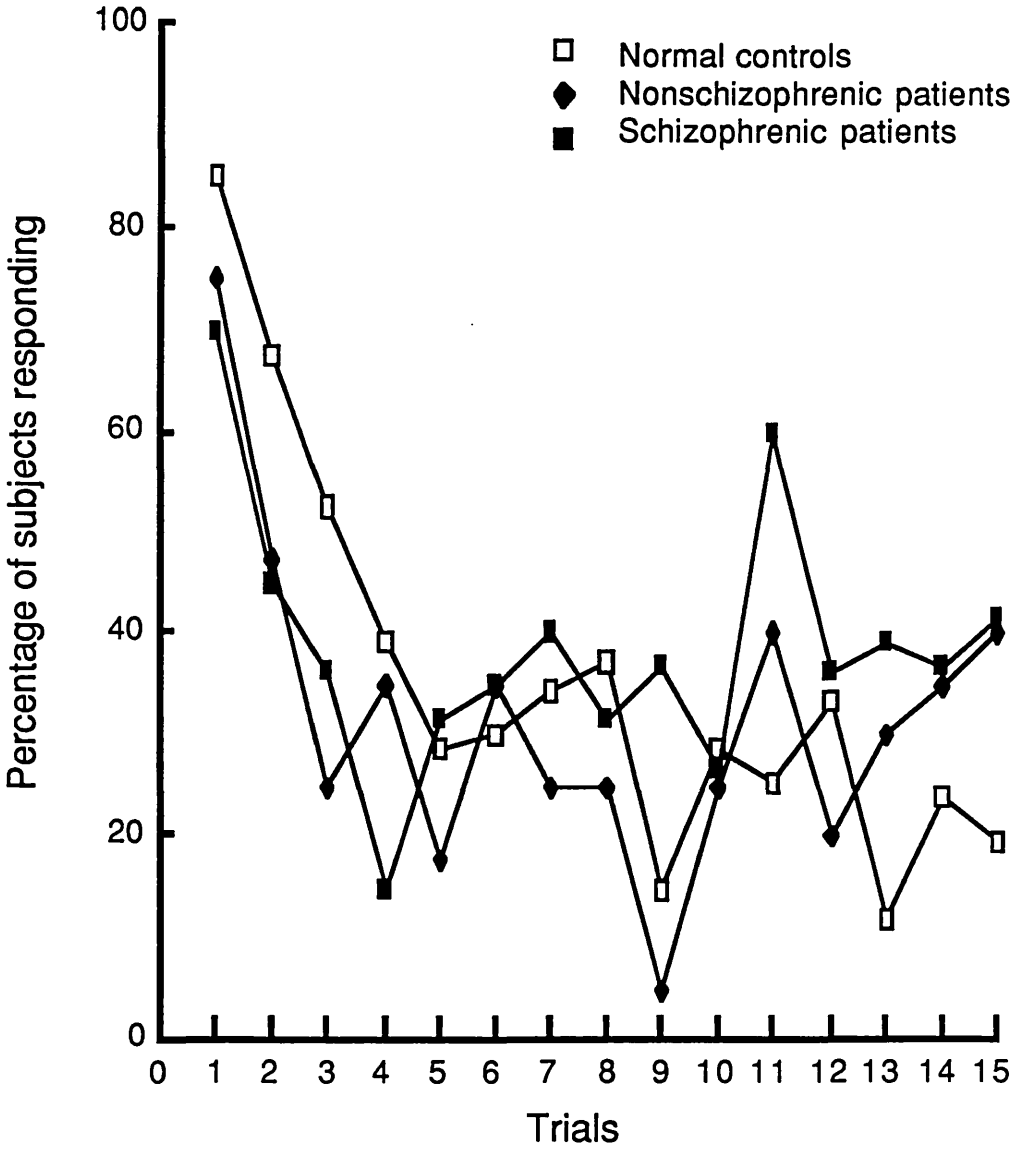
Results

a) Orienting Response Frequency

A significant difference was found between the three groups in the number of orienting responses (Kruskal-Wallis, $X^2 = 8.93$, $p < 0.01$) with nonschizophrenic patients having fewer responses than both normal controls (Dunn, $p < 0.001$) and schizophrenic patients ($p < 0.001$). Differences between normal controls and schizophrenic patients were not significant (Table 6(i)). The percentage of subjects responding in the three groups on each trial is illustrated in Figure 6 (i).

Nonresponding occurred in all three groups but was highest in nonschizophrenic patients. Whereas the proportion of nonresponders to responders did not differ significantly between schizophrenic (10:30) and normal subjects (7:33), there was a significant difference between the proportion found in nonschizophrenic patients (20:20) and both that

Figure 6 (i)


PERCENTAGE OF SUBJECTS WITH SKIN CONDUCTANCE RESPONSES ON EACH TRIAL (70dB sequence)
Normal controls
Nonschizophrenic patients
Schizophrenic patients
Percentage of subjects responding
100
80
60
40
20
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Trials

found in schizophrenic patients (Chi-Square, $X^2 = 4.32$, $p < 0.05$) and normal controls ($X^2 = 8.05$, $p < 0.01$). The lack of difference between schizophrenic and normal groups is most likely to be due to the high level of nonresponding among normal controls (18%) by comparison to the 5-10% nonresponding usually found among the normal population (Venables, 1977). Nevertheless, the incidence is lower in the schizophrenic group than that (50%) reported in the international comparison between studies (Bernstein et al, 1982). Comparing responding subjects only, no significant difference in response frequency was found (Table 6 (ii)).

Laterality Effects

Response asymmetries were noted in both the normal and schizophrenic groups. Four normal subjects had more responses on the left than right hand and in one subject the reverse was true. In the schizophrenic group six subjects had more responses on the right than the left and three more on the left than the right. The differences in both groups were small (Table 6 (iii). Whilst unilateral non-responding only occurred in one normal subject, intermittent unilateral nonresponding, that is non-criterion responding, over trials was evident in all three groups.

b) Nonspecific Electrodermal Activity

Nonspecific electrodermal activity occurred in about 70% of both normal and schizophrenic subjects and in about 50% of nonschizophrenic patients. The three groups differed significantly (Kruskal-Wallis, $X^2 = 7.96$, $p < 0.02$) with nonspecific activity highest among schizophrenic patients

whereas nonschizophrenic patients had a lower level of activity than both normal (Dunn, $p < 0.02$) and schizophrenic subjects ($p < 0.001$). The difference between these two last groups was not significant. Comparing responding subjects only, the difference between groups was no longer significant. In all three groups nonresponders exhibited less spontaneous electrodermal activity than responders (Mann-Whitney: schizophrenic patient: $Z = 4.42$, $p < 0.001$; nonschizophrenic patients: $Z = 4.92$, $p < 0.001$; normal controls: $Z = 3.22$, $p < 0.001$).

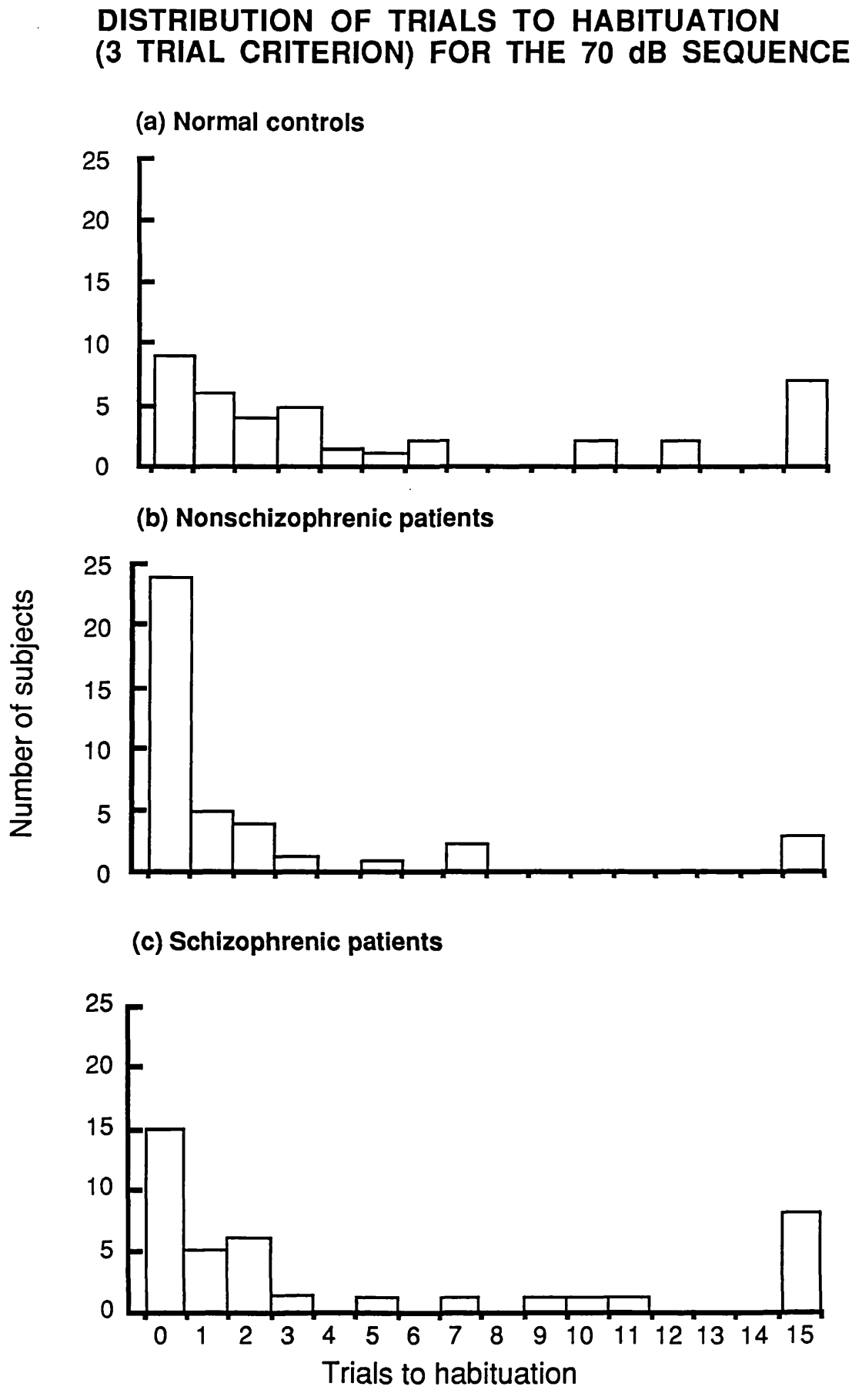
Laterality Effects

Lateral asymmetries were evident in all three groups (Table 6 (iii)). In normal controls asymmetries were minimal whereas nonspecific electrodermal activity tended to be higher on the right hand in schizophrenic patients and on the left in nonschizophrenic patients. These differences were not, however, significant although in the schizophrenic group they approached significance (Wilcoxon: $Z = 1.91$, $p < 0.06$). Consistent asymmetries in nonspecific responses in both responding and nonresponding subjects were negligible in all three subject groups.

c) Trials to Habituation

There was a highly significant difference between groups in the number of trials to habituation (Kruskal-Wallis, $X^2 = 10.65$, $p < 0.01$) indicating that nonschizophrenic patients were faster to habituate than both schizophrenic patients (Dunn, $p < 0.01$) or normal controls ($p < 0.001$), The difference between the schizophrenic and normal control groups was not significant (Table 6 (i)). The

Figure 6 (ii)


DISTRIBUTION OF TRIALS TO HABITUATION
(3 TRIAL CRITERION) FOR THE 70 dB SEQUENCE
(a) Normal controls
25
20
15
10
5
0
(b) Nonschizophrenic patients
Number of subjects
25
20
15
10
5
0
(c) Schizophrenic patients
25
20
15
10
5
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Trials to habituation

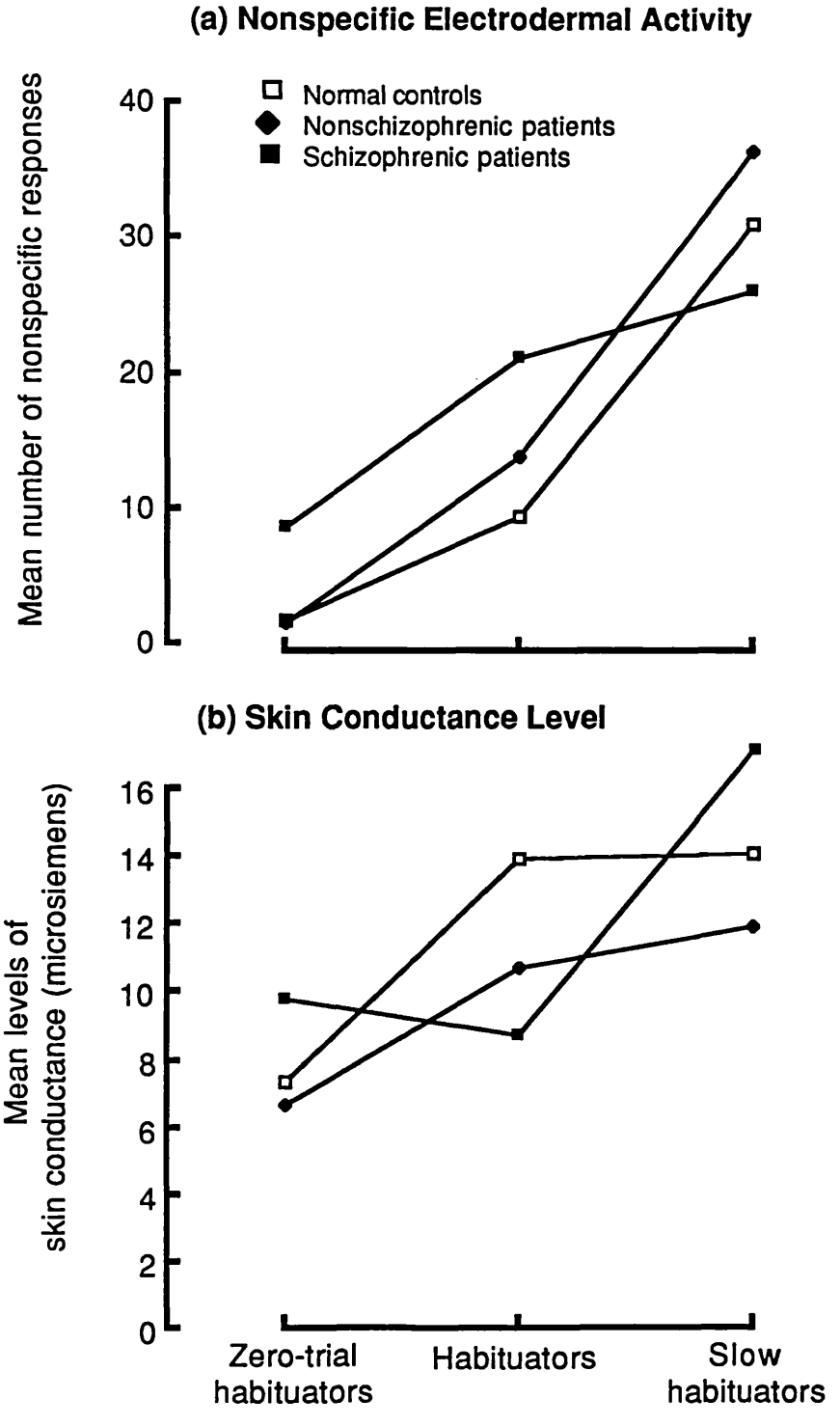
distribution of habituation over trials is illustrated in Figure 6 (ii). Comparing responding subjects only, the difference between groups was not significant although the pattern of difference remained the same.

With respect to habituation subjects were divided into three groups: 1) Zero-trial habituators, who give no response within the first three trials; 2) Moderate habituators, who have habituated by Trial 9; and 3) Slow habituators, who habituate after Trial 9 or not at all. Comparing the distribution of habituators within the three subject groups, nonschizophrenic patients differed from both normal controls (Chi-Square, $X^2 = 12.88$, $p < 0.01$) and schizophrenic patients ($X^2 = 5.99$, $p < 0.05$). The schizophrenic and normal control groups did not differ. Whereas there was a predominance of moderate habituators among normal controls, most nonschizophrenic patients, due to their high level of nonresponding, were zero-trial habituators. There was a fairly even distribution among schizophrenic patients.

Group means and standard deviations of the electrodermal response characteristics for the three habituator groups are given in Table 6 (iv). Significant differences were found (Figure 6 (iii)) for skin conductance level (ANOVA, $F(1,60)$ 4.52, $p < 0.05$) and nonspecific electrodermal activity (Kruskal-Wallis, $X^2 = 51.27$, $p < 0.001$). Overall, the differences between habituator groups indicated an increase in both tonic and phasic activity across groups with zero-trial habituators having the lowest levels of skin conductance and nonspecific response

Figure 6 (iii)

HABITUATOR GROUP DIFFERENCES IN NONSPECIFIC RESPONSES AND SKIN CONDUCTANCE LEVEL (70dB SEQUENCE)



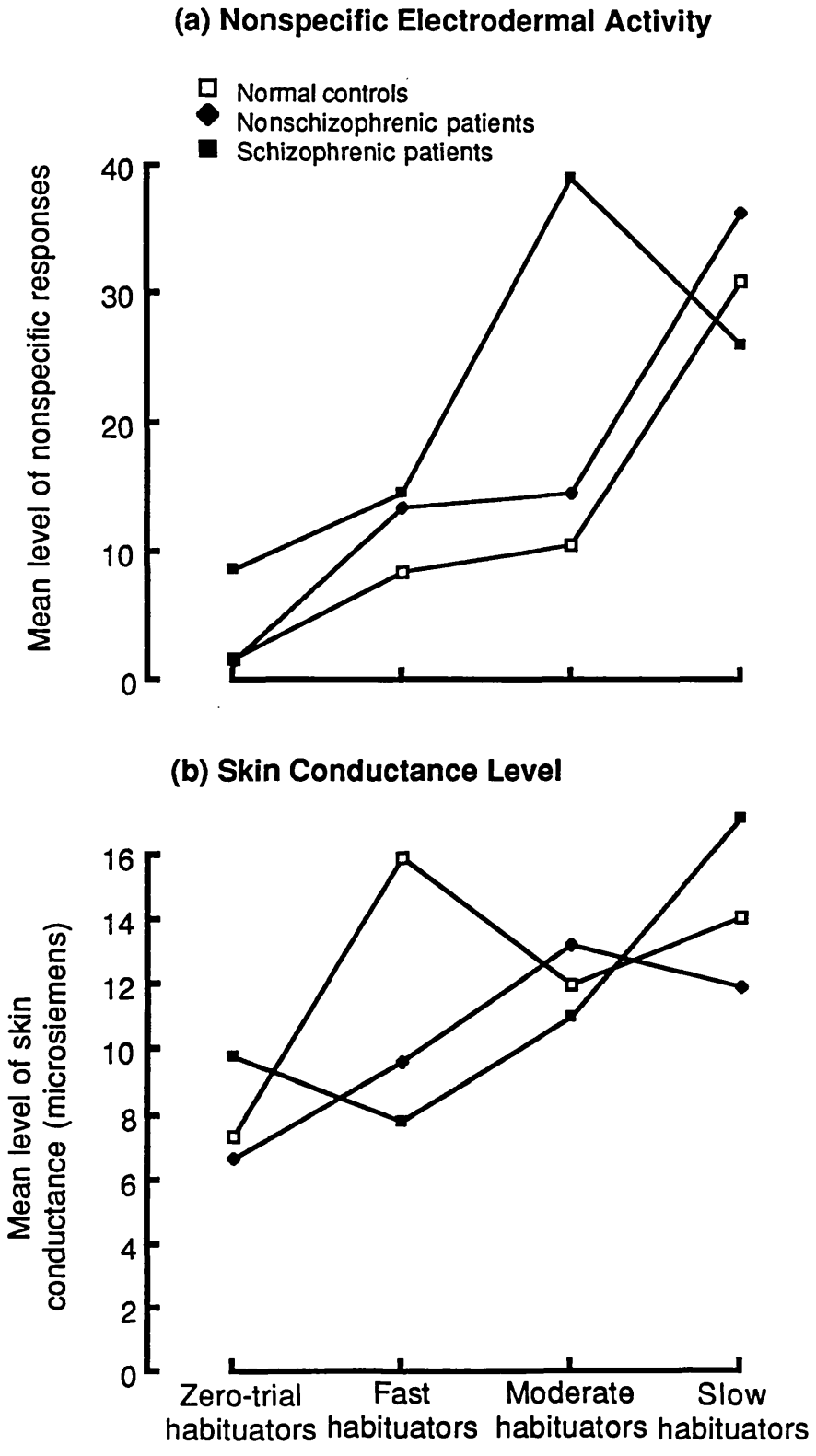
frequency, the lowest response amplitudes and longest recovery times and the slow habituators the highest with habituators in between. This finding supports previous research in which slow habituation has been associated with higher levels of electrodermal activity (Gruzelier, 1973). There were no interaction effects between subject group and habituator group with all three subject groups showing a similar pattern.

Patterson and Venables (1978) also identified a 'Fast Habituator' group among schizophrenic patients characterised by subjects who produce one or at most two responses before habituation. In view of this finding, the moderate habituator group in each of the three subject groups was further subdivided into a Fast habituator group comprising subjects who habituated on Trials 1 or 2, and a Moderate habituator group, redefined to include subjects who habituated between Trials 3 and 9. The redistribution into four groups indicated that in both the nonschizophrenic patient and schizophrenic patient groups most habituators were fast habituators, whereas in the normal group there was an even distribution between fast and moderate habituators (Table 6 (v)).

If we now compare the four habituator groups significant group differences were found for nonspecific electrodermal activity (Kruskal-Wallis, $X^2 = 52.15$, $p < 0.001$) with zero-trial habituators having significantly fewer nonspecific responses (Figure 6 (iv)) than the other three habituator groups (Dunn, $p < 0.001$). Other differences were not significant and there were no interaction

Figure 6 (iv)

HABITUATOR GROUP DIFFERENCES IN NONSPECIFIC RESPONSES AND SKIN CONDUCTANCE LEVELS (70 dB SEQUENCE)



effects between subject group and habituator group with all three subject groups showing a similar pattern. There was an increasing trend from zero-trial habituators through fast and moderate to slow habituators for nonspecific electrodermal activity, skin conductance level and response amplitude. As schizophrenic subjects have been found not to habituate in the same way as normal subjects it is possible that the four moderate habituators are hyper-responsive but that their overresponding is more nonspecific than specific. There would not appear to be any demographic variable which would distinguish these four with respect to the group as a whole.

Patterson (1976a,b) suggested that the group of 'Fast Habituators' seen in schizophrenics does not have a parallel in normals. Although Patterson and Venables (1978) found two fast habituators among their normal group they differed from schizophrenic fast habituators in respect of response amplitude, the normal subjects showing reduced response amplitude by comparison with other normal and schizophrenic habituator groups and the schizophrenic subjects showing very high response amplitudes. The results obtained in this study do not support their findings. Fast habituation accounted for a large proportion of habituators in all three groups (25%). Here the response amplitude of the schizophrenic fast habituators was the same as for the moderate habituators and skin conductance levels were lower, whereas the normal fast habituators showed increased amplitude and skin conductance levels by comparison with other habituator groups.

Examining all the various skin conductance parameters, Venables and Patterson (1978) found that the fast habituator groups differed from other habituator groups among the schizophrenic sample. In their study, subjects in this group were found to exhibit long response latencies, slow rise times and long recovery times. These findings were not supported in the current study. Fast habituators in the schizophrenic group did not differ significantly from other habituator groups on any of the temporal variables. Although, in the normal group fast habituators had longer response latencies, slower rise times and longer recovery times than the other habituator groups, these differences were not significant. A similar, but again nonsignificant, trend was shown in the nonschizophrenic patient group. Patterson (1976b) also suggested that slow or nonhabituators should be considered the same as responders, that is, moderate habituators, in that they do not differ on any parameter of skin conductance. This was confirmed by Patterson and Venables (1978) and is supported by the current study.

If, for the sake of comparison, a two-trial habituation criterion is used, there would appear to be no significant differences between groups in the distribution of the habituator groups, irrespective of whether three or four subcategories were used. The effect of using a two-trial criterion is to lower the mean number of trials to habituation, that is, to accelerate habituation. The significant difference noted in the normal (Wilcoxon: $Z = 2.17$, $p < 0.03$) and schizophrenic groups ($Z = 2.37$, $p < 0.02$) and when comparing the two-trial and three-trial

habituation criteria would tend to suggest that responding tended to be more intermittent from trial to trial (Figure 6 (v)) in these two groups.

Laterality Effects

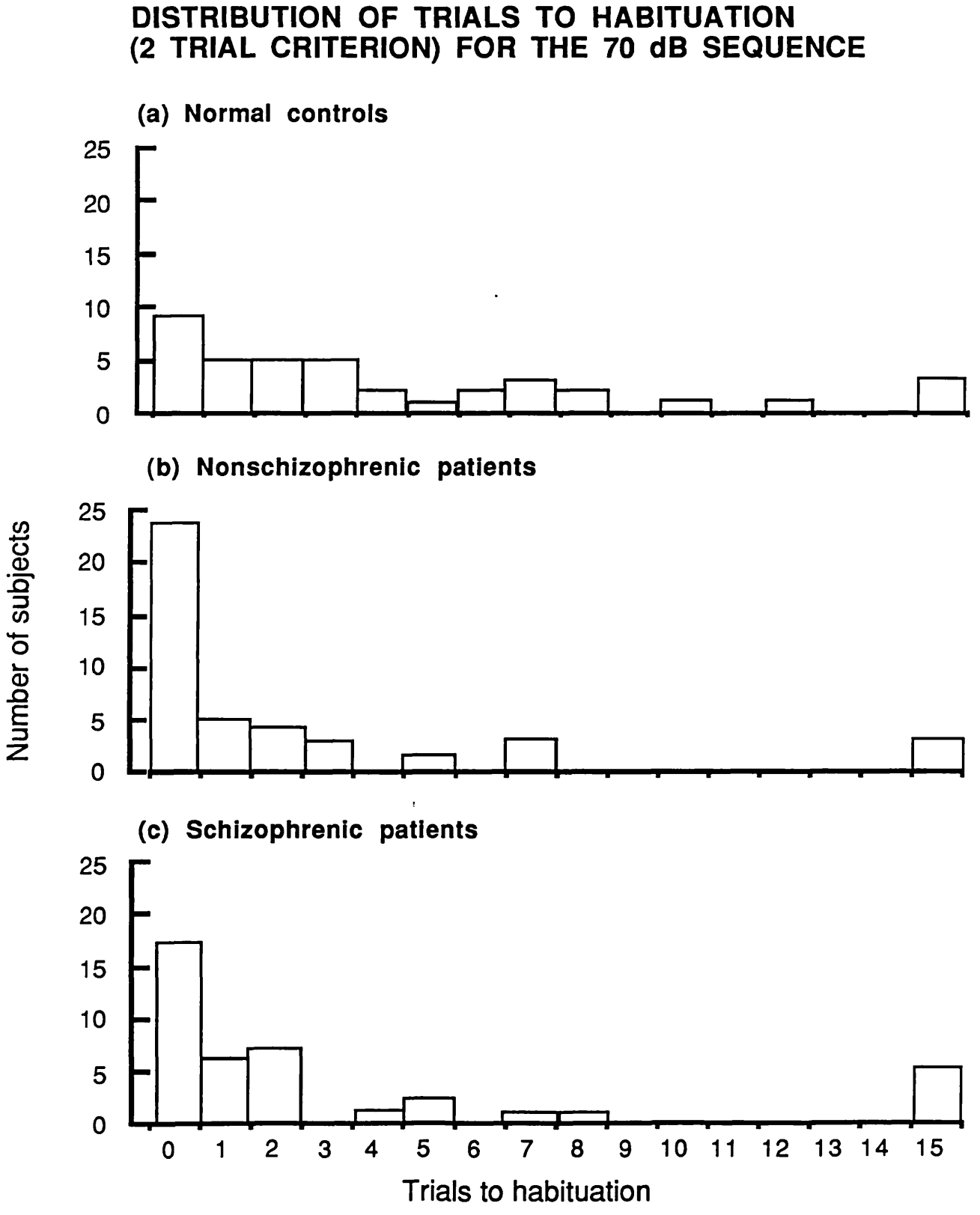
With respect to lateral asymmetry there was evidence of a significant asymmetry in trials to habituation only in the schizophrenic group (Table 6 (iii)) showing slower habituation on the right hand (Wilcoxon: $Z = 2.02$, $p < 0.04$).

d) Skin Conductance Level

Mean skin conductance levels were analysed using a 3 x 2 x 2 x 4 (Subject Group x Responder Group x Hand x Trial) analysis of variance. It was not possible to include sex as a factor as there was only one subject in the male nonresponder group. In the main analysis there was no subject group main effect. The means indicated, however, that skin conductance levels were highest in normal controls and lowest in nonschizophrenic patient group. A significant responder group main effect was obtained (ANOVA, $F(1,119)$ 8.87, $p < 0.004$) indicating that responding subjects had higher levels of skin conductance than nonresponding subjects (Table 6 (ii)).

In all three groups skin conductance levels increased from Trial 1 to 15 (ANOVA, $F(1,114)$ 9.33, $p < 0.01$). There were no significant interactions between Trial and either Subject or Responder/Nonresponder group suggesting the increase over trials was present throughout. From Figure 6 (vi) this appears to have been more marked in nonschizophrenic and normal controls than in schizophrenic patients

Figure 6 (v)


DISTRIBUTION OF TRIALS TO HABITUATION
(2 TRIAL CRITERION) FOR THE 70 dB SEQUENCE
(a) Normal controls
25
20
15
10
5
0
(b) Nonschizophrenic patients
Number of subjects
25
20
15
10
5
0
(c) Schizophrenic patients
25
20
15
10
5
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Trials to habituation

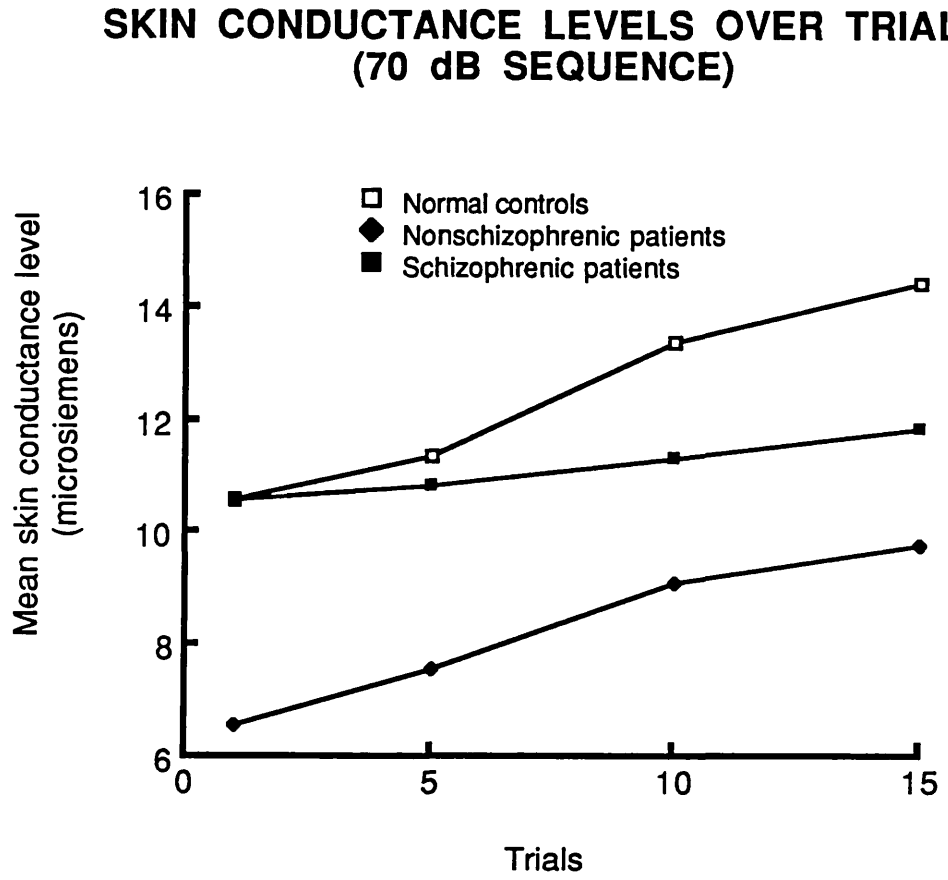
The increase in skin conductance levels over trials was present in both responders and nonresponders, although to a lesser extent in the latter group (Table 6 (vi)). Normal nonresponders showed an initial increase in skin conductance level followed by a decline over trials.

Laterality effects

With respect to laterality a significant interaction was obtained between Subject Group and Hand (ANOVA, $F(1,57)$ 5.25, $p < 0.03$). Normal controls had higher skin conductance levels on the right hand than nonschizophrenic patients (Scheffe, $p < 0.05$). Overall the normal and schizophrenic groups showed a similar right greater than left asymmetry whereas the nonschizophrenic patient group a left greater than right asymmetry as well as lower levels of skin conductance (Table 6 (iii)).

Looking at the distribution of asymmetry within groups, schizophrenic patients showed an equal distribution between the two asymmetries (L>R: 20/R>L: 19). Nonschizophrenic patients showed a predominance of subjects with higher skin conductance levels on the left than the right hand (L>R: 28/R>L: 12) whereas normal controls showed the reverse (L>R: 14/R>L: 26). The distribution of subjects between asymmetry groups was significantly different (Chi-square: $X^2 = 9.84$, $p < 0.01$). Differences in electrodermal variables between the two asymmetry groups were, however only significant in the normal control group and only for mean response amplitude (Mann-Whitney: $Z = 1.97$, $p < 0.05$). Subjects with higher skin conductance levels on the left than right hand had larger response amplitudes

Figure 6 (vi)


SKIN CONDUCTANCE LEVELS OVER TRIALS
(70 dB SEQUENCE)
Normal controls
Nonschizophrenic patients
Schizophrenic patients
Mean skin conductance level (microsiemens)
16
14
12
10
8
6
0
5
10
15
Trials

than those with the reverse asymmetry (Table 6 (viii)).

e) Response Amplitude

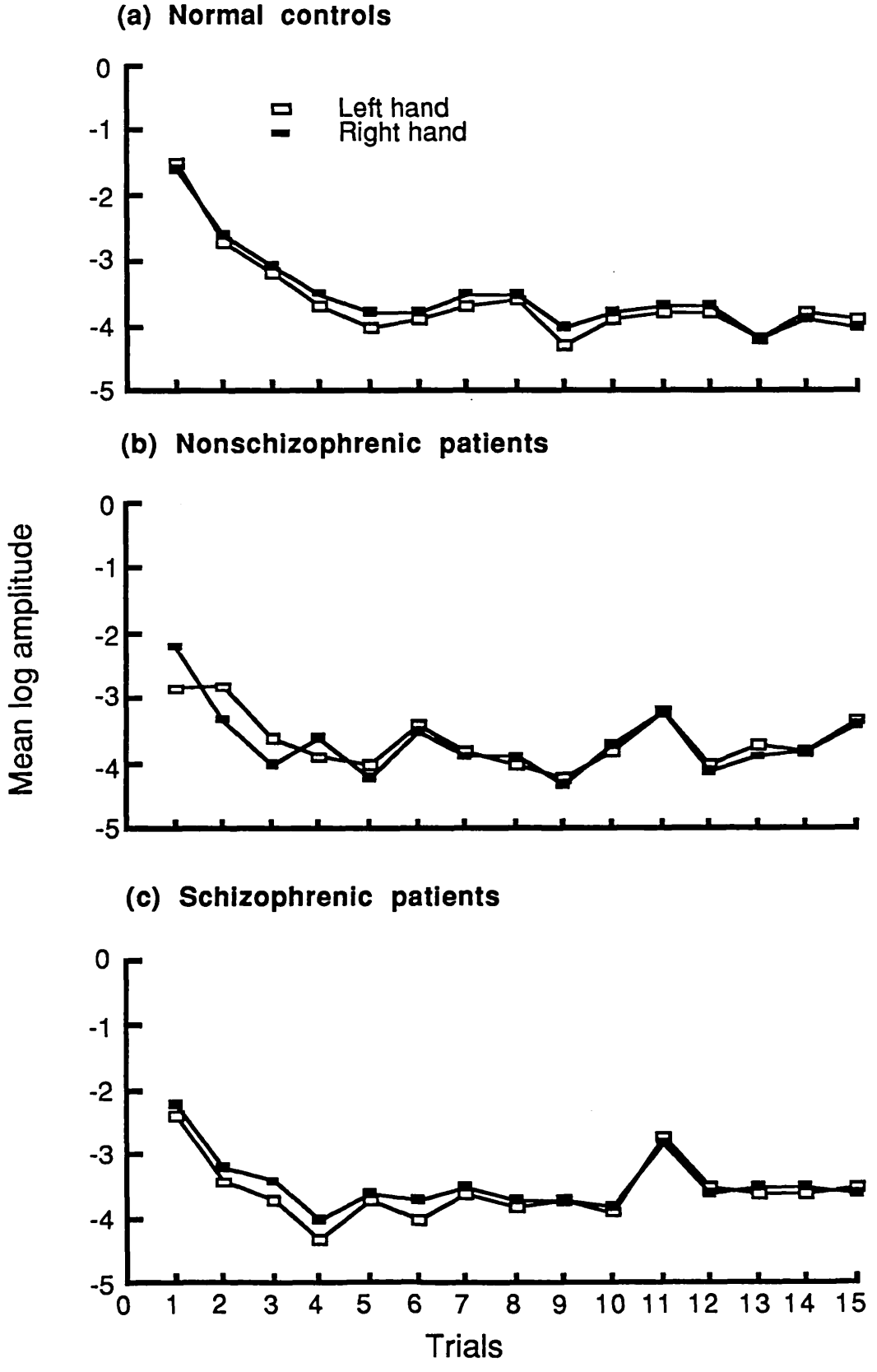
Response amplitudes were analysed using a 3 x 2 x 2 x 15 (Subject Group x Sex x Hand x Trial) analysis of variance. Subjects with bilateral nonresponding were excluded from the analysis. In addition the amplitude data was log transformed to exclude the possibility of data bias as a result of skewing due to occasional large amplitude responses. There was no significant main effect for subject group. Normal controls tended to have the highest mean response amplitude by comparison to the two patient groups (Table 6 (viii)). In all subject groups response amplitude declined over trials ($F(1,77)$ 8.35, $p < 0.01$) but differed between hands ($F(1,77)$ 16.04, $p < 0.001$). From Figure 6 (vii) it is clear that response amplitudes on the left hand were lower on Trial one but showed a higher initial increase than that on the right hand.

Laterality Effects

Response amplitudes were higher overall on the right than the left hand ($F(1,77)$ 16.72, $p < 0.001$) but differed across groups ($F(1,39)$ 7.34, $p < 0.01$). Both normal and schizophrenic subjects had higher response amplitudes on the right than the left hand whereas the reverse was true of the nonschizophrenic patients. The difference between hands, however, only reached significance in the normal group (a priori, $p < 0.001$). Comparing individual asymmetries there was a relatively even distribution between lateral asymmetries in both normal controls (L>R: 15/R>L: 18) and nonschizophrenic patients (L>R: 7/R>L: 8)

Figure 6 (vii)

RESPONSE AMPLITUDE OVER TRIALS FOR THE 70 dB SEQUENCE (RESPONDERS ONLY)



whereas in the schizophrenic group 17 subjects had higher response amplitudes on the right hand and only 9 on the left hand. The differences between the group distributions were not significant. Differences in other electrodermal measures between the two asymmetry groups were not generally significant (Table 6 (ix)). Subjects with larger response amplitudes on the right hand had longer response latencies in the nonschizophrenic patient group ($t = 2.61$, $p < 0.03$) and longer response rise times in the schizophrenic patients (Mann-Whitney: $Z = 2.03$, $p < 0.04$) than those with the reverse asymmetry.

In a paper on hemispheric influences on electrodermal habituation (Gruzelier, Eves and Connolly, 1981) a significant relationship between rate of habituation and the lateral difference in response amplitude was noted in the direction of fast habituation associated with higher left- than right-hand response amplitudes. This was confirmed in the present study but in normal controls only ($r = - 0.37$, $p < 0.03$). Thus the putative reciprocity of hemisphere influences on response habituation is probably affected by the disease process within the two patient groups under study here.

In the same study Gruzelier et al found that correlations between lateral asymmetries in electrodermal levels and response amplitudes were insignificant. This was not confirmed in the present study as the relationship was significant in both the normal ($r = 0.49$, $p < 0.01$) and schizophrenic patient groups ($r = 0.67$, $p < 0.001$) and approached significance in the nonschizophrenic patient

group ($r = 0.35$, $p < 0.07$). If the influence of levels on response amplitude is partialled out, as was done in the previous study, the relationship between habituation and response asymmetry in the normal control group was even stronger ($r = - 0.49$, $p < 0.01$), confirming that, here as in the former study, hemispheric influences on phasic orienting are independent of influences on levels.

There is ambiguity as to whether zero amplitude represents a failure to respond or whether a response has occurred but went undetected because it was less than the minimum amplitude. If mean response magnitude is calculated, that is, including both zero and non-zero responses and analysed using an ANOVA, there remained no difference between groups irrespective of whether all or responding subjects only were compared (Table 6 (ix).

f) Temporal Variables: Response Latency, Rise Time and Recovery Time

Group means and standard deviations for responding subjects are shown in Table 6 (x). Comparing responding subjects only, there were no significant differences between the three subject groups on any of the temporal variables, although the schizophrenic group had on average shorter recovery times than either the normal or non-schizophrenic groups. There were no laterality effects.

g) Intercorrelations Between Electrodermal Variables

Within each group there were significant positive correlations between all nontemporal variables (Table 6 (xi)). Among the temporal variables response rise time and

latency were positively and significantly correlated within all three groups. In the normal group, response latency was also positively and significantly related to response recovery time whereas in the two patient groups response recovery time was significantly and positively related to rise time only. The relation between temporal and nontemporal variables was not always consistent across groups. Despite the between-group differences the relation between temporal and nontemporal variables was generally negative indicating that higher electrodermal responsivity was characterised by quicker and shorter responses.

The results of the present study are generally consistent with the findings in the literature which have, for the most part, been obtained across individuals within a normal population. The difference between groups in the relationship between temporal and nontemporal electrodermal variables found in this study is consistent with the general finding of higher responsivity and shorter responses and is thus unlikely to reflect group-specific characteristics. Evidence by Martin and Rust (1976) which compared across subject and pooled within subject correlations suggested that subjects may display different but individually typical skin conductance response shapes. This issue was further explored using factor analysis.

The electrodermal variables shown in Table 6 (xiii) were analysed using an oblique solution which produced two factors accounting for all the variance. Response magnitude and initial response amplitude were excluded from the analysis as both were highly significantly

correlated with mean response amplitude and may have led to their overemphasis in the factor structure. Factor 1 comprised response frequency, nonspecific response frequency, mean trials to habituation, skin conductance level, response amplitude and response recovery time although the latter had a similar loading on Factor 2 as well. Factor 2 comprised response rise and latency times only. Factor 1 would thus appear to represent a response reactivity factor whereas Factor 2 related to temporal response characteristics and suggests an interdependence of rise and latency times. It was however surprising that half-recovery time fell within the reactivity factor. This was explored further by examining each group alone. The within-group factor analysis revealed group differences in the factor structure of the variables in question and in all three groups three rather than two factors emerged (Table 6 (xii)). In the nonschizophrenic group Factor 3 comprised response recovery time only which may account for the dissociation of recovery time from temporal variables noted in the total group analysis.

h) Summary of Results for 70 dB Sequence

The aim of presenting subjects with the tone habituation paradigm was to establish whether different electrodermal response patterns as identified in the literature reviews were obtained in line with previous findings. In the first instance this relates to the distinction between hypo- and hyper-arousal. The results of the 70 dB sequence confirmed this distinction although certain discrepancies with other findings were noted in subject group differences.

Nonresponders (i.e., subjects in whom no phasic autonomic responses were present) were found in all three groups and were characterised by a smaller frequency of nonspecific response and lower mean skin conductance levels than responders which confirmed previous research (Gruzelier, 1978; Straube, 1979; Bernstein et al, 1982). Comparatively however, normal controls had a higher incidence (18%) and schizophrenic patients a lower incidence (25%) than expected. The incidence of nonresponding (50%) in nonschizophrenic patients, who comprised 76% depressed patients was particularly high. Although not reported specifically in terms of nonresponding this finding is in line with recent research suggesting that hypo-arousal is not only characteristic of depressed patients but may also provide a possible biological marker (Ward et al, 1983). Thus, whereas schizophrenic patients had lower levels of both tonic and phasic electrodermal activity than normal subjects confirming the tendency towards hypo- rather than hyper-arousal noted by Bernstein et al (1982), it was the nonschizophrenic patients who differed significantly from both other groups having fewer orienting and nonspecific responses and faster habituation.

With regard to habituation, schizophrenic patients did not show a bimodal distribution between nonresponding and slow habituation. Subjects who failed to give a skin conductance orienting response on the first three trials comprised 38% of the total subjects which is closer to the general findings of 50% (Bernstein et al, 1982). Normal habituation rates were present in several schizophrenic subjects but most of these were fast habituators as

defined by Patterson (1976a,b). Fast habituation was not, however, specific to the schizophrenic group nor could fast habituators be distinguished as a group by temporal variable characteristics. Slow habituation was present in 25% of schizophrenic patients providing some support for the early findings of Gruzelier and Venables (1972, 1974a). Normal subjects showed a predominance of normal habituation whereas nonschizophrenic patients were dominated by a high proportion of nonresponding subjects.

A second aspect of autonomic responding was identified in respect of bilateral asymmetries in skin conductance levels and response amplitudes. Again the pattern of asymmetry in these two variables varied across subject groups. Schizophrenic patients did not show a predominant pattern for skin conductance levels but like normal controls had the expected predominance of larger response amplitudes on the right than the left hand. Nonschizophrenic patients showed the opposite asymmetry for skin conductance levels with almost equal representation in respect of response amplitude. This is consistent with previous findings (Gruzelier, 1973, 1979b; Gruzelier and Venables, 1974a) in which schizophrenics and depressives showed opposite asymmetries. Differences in mean skin conductance levels or response amplitude were not significant between the three groups. All showed an increase in skin conductance levels over trials and a decline in response amplitude. In normal controls, asymmetries in response amplitude were correlated with rate of habituation supporting the influence of cerebral laterality in habituation (Gruzelier et al, 1981). This relationship was not found in patients.

Finally the groups did not differ in temporal characteristics of the electrodermal response. It was noted that schizophrenics had faster recovery times but the difference was not significant enough to support previous findings (Venables, 1977, 1983).

There are a number of moderator variables that may explain or account for the differences between the above and previous findings: environmental factors, age, sex, medication, clinical status and severity of illness. Each of these will now be discussed in turn.

(i) Sex

Overall sex differences were not found for any of the electrodermal variables (Table 6 (xiii)). Men tended to be more electrodermally responsive and in the normal and schizophrenic groups the incidence of nonresponding was much higher in women. Furthermore, in the normal control group men were predominantly slow habituators (Chi-Square, $X^2 = 8.12$, $p < 0.05$). These results are supportive of previous research (Simons et al, 1983).

In view of the abnormally high incidence of nonresponding in normal subjects, it is perhaps worthwhile to pursue the effect of sex differences a little further. It is interesting to note that the incidence of nonresponding among normal male subjects (5%) is the same as that found in the normal population in most previous studies (see Venables, 1977). This suggests that within the normal group the higher incidence found in this study may be accounted for by the female subjects. It is interesting to note that

many studies (see Bernstein et al, 1982) have either excluded women or included only a small sample. Previous research (Little and Zahn, 1974; Bell, 1973; Bell et al, 1975; Asso and Braier, 1982) suggests that one possible explanation may relate to differences in electrodermal activity at different points within the menstrual cycle. Overall, the research seems to suggest that there is a decrease in electrodermal activity during the menstrual phase or when hormonal levels tend to be falling or low.

Of interest to the findings of this study is the similarity in hormonal levels of the normal nonresponding females. Four were menopausal. Following menopause there is usually a decline in oestrogen and progesterone levels. Similarly in both premenstrual and menstrual phases, oestrogen and progesterone levels are low. One of the nonresponding females was menstruating and one was premenstrual. Thus a higher proportion of nonresponding among the female subjects may be a function of low hormonal levels at the time of testing. As endocrine assays were not done the interpretation can, however, at best remain speculative.

Among schizophrenic patients seven of the nonresponders were female. Of these, two were menopausal. The remaining five, although they were still having periods, were uncertain as to where they were in their menstrual cycle. All that can be said is that they were not menstruating or immediately postmenstrual at the time of testing. The table over shows means for nontemporal variables according to whether subjects were in a low or high hormonal phase, menopausal or amenorrheic.

Electrodermal Response Characteristics During Phases of the Menstrual Cycle in Women with Schizophrenia

Hormonal Phase:	Low	High	Menopausal	Amenorh.
Electrodermal Variable	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$
Orienting Response	1.81	5.75	5.43	7.33
Trials to Habituation	1.31	8.25	3.14	7.33
Nonspecific Responses	3.63	24.00	22.43	31.33
Skin Conductance Level	12.28	12.79	12.38	5.95
Response Amplitude	0.07	0.41	0.13	0.13

These data present a rather unexpected picture. Bearing in mind the imprecision of where 9 subjects were in the menstrual cycle there are nevertheless some comparisons which can be made with the normal data (see Table below).

Comparison of Electrodermal Response Characteristics Between Men and Menopausal Women in the Normal (N) and Schizophrenic (Sz) Subject Groups

Subjects:	Male		Menopausal		Female	
	N	Sz	N	Sz	N	Sz
Electrodermal Variable	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$
Orienting Responses	5.95	5.08	1.29	5.43	3.40	4.28
Trials to Habituation	7.05	4.82	0.57	3.21	3.13	3.55
Nonspecific Responses	18.11	18.87	8.36	22.43	9.83	16.40
Skin Conductance Level	12.78	10.00	8.23	12.76	12.23	11.55
Response Amplitude	0.26	0.22	0.09	0.13	0.31	0.13

In the normal group the means for the menopausal subjects were low by comparison with the intermenstrual subjects. Within the schizophrenic group, however, female subjects who were menopausal showed relatively high means for all

nontemporal variables as did those in a low hormonal phase. Furthermore with the exception of trials to habituation they are not dissimilar to the means for the male group. The picture presented by this data does not reflect a menstrual or hormonal influence in the same way as with the data from the normal group but rather suggests that some other factor such as medication or the disease process may be influencing the hormonal balance.

Among nonschizophrenic patients the proportion of nonresponders to responders was much higher (50%) than in either of the other groups. There was, however, an almost equal proportion of male and female nonresponders suggesting that the high incidence was not related to gender.

(ii) Age

The results of this study support previous findings that skin conductance levels are lower and electrodermal responding is reduced in older subjects (Survillo and Quilter, 1965; Schmavonian et al, 1965, 1968). In all three groups there was a decline in both tonic and phasic activity with increasing age. In the normal control group the relationship was significant with respect to orienting response frequency ($r = -0.36$, $p < 0.02$), rate of habituation ($r = -0.33$, $p < 0.02$) and response amplitude ($r = -0.39$, $p < 0.01$). Normal nonresponders were overall significantly older than responders ($t = 2.37$, $p < 0.03$). In the nonschizophrenic patient group increasing age was significantly related to a decline in nonspecific orienting response frequency ($r = -0.35$, $p < 0.02$), skin

conductance level ($r = -0.30$, $p < 0.03$), response amplitude ($r = -0.38$, $p < 0.01$) and an increase in response latency ($r = 0.54$, $p < 0.02$) and response rise time ($r = 0.47$, $p < 0.02$). The relationship with age did not reach significance for any of the variables in the schizophrenic patient group even though the tendency for responsivity to decline with age was present. This suggests that whereas age may be affecting electrodermal activity in the normal and nonschizophrenic patient group this is not the case in the schizophrenic patients.

As subjects were individually age-matched the effect of age by itself should not have biased the results. With respect to nonresponding, however, there was an interaction between sex and age (Table 6 (xiv)) so that, whereas the general trend was for nonresponders to be older than responders ($t = 2.57$, $p < 0.01$), this was reversed in female schizophrenic patients. This is an unexpected pattern and again suggests that some other factor than age or sex such as medication or the disease process itself may be influencing the hormonal balance.

(iii) Clinical Status

Traditionally findings have been examined in relation to patient subtypes. In this study schizophrenic patients can be categorised along acute/chronic, paranoid/nonparanoid and institutionalised/noninstitutionalised dimensions. Nonschizophrenic patients can similarly be categorised along the depressed/nondepressed and reactive/ endogenous dimensions. Each of these will be dealt with in turn.

(a) Schizophrenic Patient Group

Significant differences in electrodermal variables between schizophrenic patient subgroups were not generally found (Table 6 (xv)). Nonresponding occurred in all subgroups except paranoid patients but tended to be more prevalent in chronic, nonparanoid, institutionalised patients. This supports previous findings (Gruzelier, 1976).

The pattern of habituation equally did not differ between patient subgroups. An important point to note here, however, is the confirmation of Patterson and Venables' (1978) finding of higher response amplitudes in fast habituators than moderate habituators. This was true in both chronic and institutionalised patients, a group that more closely resembles their patient group. This may account for why their findings were not confirmed by the earlier comparison in this study when institutionalised and noninstitutionalised patients were combined together.

Laterality Effects

Response amplitude asymmetries followed the predominantly right greater than left pattern in all subgroups except the paranoid patients. The evidence of left hemisphere activation in this latter group is consistent with the conclusions of a review by Gruzelier (1983) and the data of Gruzelier and Manchanda (1982) and Rabavillas et al (1986). Skin conductance level asymmetries were not shown to be directly related to amplitude asymmetries when considering the schizophrenic patient group as a whole. Comparing patient subgroups, again the distribution of subjects tended to be relatively equal.

Thus the findings of this study appear for the most part to cut across patient subtypes but with a tendency for chronic, institutionalised patients to be more hypo-aroused. The effects of age, duration of illness and also long-term medication must not, however, be discounted.

(b) Nonschizophrenic Patient Subgroups

Significant differences in electrodermal variables were again not found in relation to subgroups within the non-schizophrenic patient group (Table 6 (xvi)). Nonresponding occurred in about 50% of patients in each group and there was a predominance of patients who failed to give an orienting response within the first three trials. This was proportionally higher in depressed (65%) than in nondepressed patients (44%) and did not appear to be related to medication.

Laterality Effects

Skin conductance levels were higher on the left than the right hand in all groups whereas response amplitude asymmetries were more evenly distributed with a trend towards higher amplitudes on the left than the right in all but the patients with reactive depression.

Illness Factors

As the basis for the classification of schizophrenic patients into institutionalised and noninstitutionalised was related to length of stay in hospital, correlations between electrodermal variables and three other factors (age of onset, number of hospital admissions and duration of illness) were explored. The effect of duration of ill-

ness on electrodermal activity may, however, be confounded by the effect of medication. All the institutionalised patients were on medication, whereas only 14/26 noninstitutionalised patients were. Only duration was found to be a significant factor. This was correlated positively with response latency ($r = 0.37$, $p < 0.05$) and negatively with both mean response amplitude ($r = -0.30$ $p < 0.03$) and initial response amplitude ($r = -0.29$, $p < 0.04$), but only approaching significance in relation to skin conductance level ($r = -0.25$, $p < 0.06$). The longer the duration of the illness, the lower the levels of skin conductance and response amplitude and the longer the response latencies.

Unlike the schizophrenic patients it was age of onset of illness rather than duration of illness that was relevant to electrodermal activity in the nonschizophrenic patient group. The earlier the age of onset, the higher was the mean response amplitude ($r = -0.29$, $p < 0.04$), initial response amplitude ($r = -0.26$, $p < 0.05$), response magnitude ($r = -0.29$, $p < 0.04$); and the shorter was the response rise time ($r = -0.40$, $p < 0.05$) and response latency ($r = 0.61$, $p < 0.005$). Age of onset would thus appear to have a direct relationship to chronological age and suggests that in this group any decline in electrodermal reactivity is less likely to be linked with the consequences of illness such as long-term hospitalisation or institutionalisation. The extent to which medication plays a role is discussed in the next section.

(iv) Medication

The differential effects of medication have been examined in relation to the orienting reflex and it is generally concluded that, at least in respect of neuroleptic drugs, medication affects tonic functions but not phasic responses to innocuous stimuli (e.g., Venables, 1975). Nonresponding and slow habituation have been shown in both medicated and unmedicated samples. The only medication which has been shown to affect habituation is propranolol (Gruzelier and Connolly, 1980); this brought the habituation of electrodermal responses in overresponsive patients to within normal limits and reinstated responses in approximately 50% of nonresponsive patients.

The majority of medicated schizophrenic patients in this study were on phenothiazine medication (Table 5 (ii)). None were on propranolol. Comparisons between electrodermal measures in patients on and off medication did not show any significant differences suggesting that medication had no differential effect on tonic or phasic activity though these did tend to be higher in unmedicated patients (Table 6 (xvii)). However, if we compare the incidence of nonresponding in patients on and off medication we see a much higher incidence of nonresponding in patients on medication (32%) compared to those who were drug-free (8%), even though this was statistically not significant, such that 90% of all nonresponders were medicated. Since 68% of those on medication still did respond, this result neither proves that nonresponding is caused by medication nor explains why the overall incidence of nonresponding was lower than reported

elsewhere in the literature.

Looking at the distribution between habituator groups a similar trend towards greater hyporesponsivity in medicated patients was evident and the proportion of subjects not giving an orienting response to the first three trials (43%) was closer to previous findings.

Zahn (1976) in reviewing the literature on the bimodality of responding suggested that the differential response of patients to drugs might underlie any differences found. Bernstein et al (1982), however, pointed to studies both in America and England where both remitted and chronic, still-hospitalised patients were alike in showing only hyporesponsiveness. The only possibility that the data of this study permit to test out Zahn's hypothesis is to compare electrodermal responding in institutionalised and noninstitutionalised patients over the age of 40. The rationale for this is that patients who do not respond well to drugs are more likely to remain hospitalised.

Twelve subjects in this study fall into the category of institutionalised over 40 (7 male, 5 female) and 6 into the category of noninstitutionalised over 40 (3 male, 3 female). Four of the 12 institutionalised subjects were nonresponders and 2 of the 6 noninstitutionalised subjects were nonresponders. This is 33% in both groups and would not appear to support Zahn's hypothesis. However, chronic and institutionalised patients, all but two of whom were on medication, did show increased hypo-responding by comparison to acute and noninstitutionalised patients

irrespective of whether they were on or off drug.

In the nonschizophrenic patient group differences in electrodermal variables were not significant between medicated and unmedicated patients. Only seven patients were not medicated, of whom four were nonresponders and one failed respond to the first three trials. This patient group showed a very strong pattern of hypo-responsivity but this appeared to be completely unrelated to medication with the ratio of nonresponding to responding being quite equal in both medicated and unmedicated patients. Similarly, both groups of patients showed a predominance of fast habituation.

(v) Environmental Factors

Other factors which have been shown to influence electrodermal responding (Venables and Christie, 1975) include experimenter variables, familiarity with apparatus, time of day, ambient temperature, equipment and electrode placement. All subjects were tested by the same experimenter. Four normal control subjects were familiar with the testing situation but none of these were nonresponders. Seven of the forty schizophrenic patients were familiar with the testing situation. All of these were chronic patients but only 3 were nonresponders.

Differences were noted in respect of the testing venue. All the normal controls, eighteen of the schizophrenic patients and thirty-one of the nonschizophrenic patients were tested on the nonportable polygraph equipment in a

sound attentuated room. The remaining twenty-two schizophrenic patients and nine nonschizophrenic patients were tested on portable polygraph equipment located within a quiet, but not sound-attentuated room. Although both polygraphs were the same type, there was a difference in the two testing rooms regarding the possible intrusion of nonexperimental stimuli. Whilst this increased the likelihood of responses occurring through extraneous noise nine of the ten schizophrenic nonresponders and four of the nonresponding nonschizophrenic patients were included in this group. Overall those tested using portable equipment were faster to habituate with fewer responses ($\bar{x}$ = 3.45) than those tested in the sound-attenuated room ($\bar{x}$ = 8.30). The ambient temperature in both testing venues remained within the 18 - 24 degrees Centigrade range, well below the temperature known to influence sweat gland activity.

Furthermore there is evidence to show that diurnal rhythms in skin conductance do exist with a peak between 1 and 3 pm (Christie and Venables, 1973). This evidence is not supported by the results of this study. For example, in normal subjects mean skin conductance levels showed a drop rather than a peak at this time. Subject's times of testing were distributed fairly evenly throughout the day. This is unlikely therefore to have biased the level of responsivity in any of the three subject groups.

Overall the only factor that could be construed as having a significant effect was the place of testing and type of equipment used. However, were conditions of testing such

as to promote responsivity rather than nonresponsivity, the opposite appeared true. Similarly although 13/37 non-responders were tested on portable equipment this did not appear to change the ratio in the direction of increased hyporesponsivity by comparison with other findings.

SECTION II: 90 dB Sequence

Results

The pattern of results pertaining to the 90 dB sequence was very similar to that obtained for the 70 dB sequence (Table 6 (xviii)). Significant between-group differences were obtained in the frequency of both orienting (Kruskal-Wallis, $X^2 = 8.88$, $p < 0.02$) and nonspecific responses ($X^2 = 6.63$, $p < 0.04$), with lower levels in nonschizophrenic patients than in both normal controls or schizophrenic patients (Dunn, $p < 0.01$). Significant differences were not found between schizophrenic patients and normal subjects for any of the electrodermal variables.

Evidence has shown that subjects who do not respond to a moderate intensity tone often respond to a louder sequence (Gruzelier et al, 1981). The increase in tone intensity here produced responding in a few subjects in each group (2 normal controls, 1 schizophrenic and 4 nonschizophrenic patients) who had not responded to the 70 dB tones but not sufficiently to radically alter the incidence of nonresponding in the three groups. Several authors have compared the incidence of nonresponding to tones of different intensity (Bernstein, 1970; Zahn, 1978; Bernstein et al, 1982; Gruzelier et al, 1981). The findings here are not consistent either with Bernstein's data which show that nonresponsiveness in schizophrenics is higher to tones of lower intensity or to the Gruzelier et al (1981) findings that stimuli of greater intensity sharply diminish nonresponsiveness in schizophrenia. In this study two out of the seven schizophrenic nonresponders to the 70 dB tones

responded to the louder tones and in both cases responses to only two tones were elicited. Furthermore in all three groups there were a similar number of subjects who had responded to 70 dB tones but who failed to respond to the louder tones. Nonresponders were generally found to show less spontaneous electrodermal activity than responders (Mann-Whitney: Normal controls: $Z = -3.44$, $p < 0.001$; nonschizophrenic patients: $Z = -4.04$, $p < 0.001$; schizophrenic patients: $Z = -4.40$, $p < 0.001$).

Rate of habituation did not change significantly between tone sequences in any of the groups leaving the distribution of subjects among habituator groups relatively unchanged. Nonschizophrenic patients were again found to habituate more quickly than normal controls and schizophrenic patients (Kruskal-Wallis, $X^2 = 9.39$, $p < 0.01$) with the two latter groups not differing significantly. No one habituator group was found to be specific to a particular subject group and between-group differences in electrodermal variables in respect of a habituation mode were in general not significant (Tables 6 (xix) and (xx)). In support of Venables and Patterson (1978) Fast Habituators tended to have longer response latencies, slower rise and longer recovery times. For response recovery time, a significant difference was only found in schizophrenic patients (Kruskal-Wallis: $X^2 = 9.31$, $p < 0.01$) with Fast Habituators having longer recovery times than both the moderate and slow habituators ($p < 0.05$).

Skin conductance levels during the louder sequence no longer showed a sharp decline but tended to level off,

whereas response amplitudes continued to show a significant decline over trials ($F(1,77)$ 25.60, $p < 0.001$). Overall skin conductance levels were higher to the louder tones in both normal controls ($t = 3.51$, $p < 0.001$) and nonschizophrenic patients ($t = 3.26$, $p < 0.002$) and response amplitudes were higher in normal controls (mean response amplitude: $t = 2.76$, $p < 0.01$; initial response amplitude: $t = 3.80$, $p < 0.001$) and schizophrenic patients ($t = 2.26$, $p < 0.03$).

Laterality Effects

Differences between hands were not significant for any of the electrodermal variables (Table 6 (xxi)). Patterns of asymmetry for both skin conductance levels and response amplitude remained the same as for the 70 dB sequence although in the nonschizophrenic patient group there was now a predominance of subjects with higher response amplitudes on the left than the right hand. Differences between asymmetry groups were not found (Tables 6 (xxii) and (xxiii)).

The relationship between rate of habituation and lateral differences in response amplitude noted in normal subjects in relation to the 70 dB sequence and confirming the findings of Gruzelier et al (1981) was not significant in relation to the 90 dB sequence even when skin conductance level was partialled out. This may be due to the fact that four subjects in this group switched asymmetries and that generally the differences between hands were smaller. There was, however, a positive significant correlation between lateral asymmetries in conductance levels and

lateral asymmetries in response amplitude in both normal ($r = 0.51$, $p < 0.001$) and nonschizophrenic patient groups ($r = 0.70$, $p < 0.001$).

Intercorrelations between Electrodermal Variables

As for the 70 dB sequence, there were significant positive correlations between all the nontemporal variables and, for the most part, between temporal variables as well within each subject group (Table 6 (xxiv). The relationship between temporal and nontemporal variables tended again to differ between groups. Factor analysis produced two factors (Table 6 (xxv)). Factor 1 included orienting response frequency, nonspecific electrodermal activity, skin conductance level and response amplitude. Factor 2 included response latency and rise time. Response recovery time loaded almost equally on both factors. As for the 70 dB sequence Factor 1 would again appear to represent a reactivity factor. Identical loadings on two factors were found in both patient groups whereas in the normal group three factors emerged. Factor 1 comprised the orienting and nonspecific response frequencies, trials to habituation and response amplitude. Skin conductance levels and response recovery time loaded onto a second factor and this perhaps accounts for the equal loading of the recovery variable in the analysis including all subjects. Factor 3 included response latency and rise time.

Moderator Variables

Moderator variables were again examined in respect of sex, age, environmental factors, medication, clinical status and severity of illness.

(i) Sex

There were no significant sex differences in any of the three groups in relation to any of the electrodermal variables (Table 6 (xxvi)). Female subjects tended again to be less responsive than male subjects with the incidence of nonresponding higher in women generally and slow habituation more predominant in men in both the normal and nonschizophrenic patient groups.

(ii) Age

The effect of age was still characterised by a significant decline in electrodermal responsivity with increasing age. In normal controls this relationship was significant for orienting response frequency ($r = -0.30$, $p < 0.03$), rate of habituation ($r = -0.28$, $p < 0.05$), mean response amplitude ($r = -0.47$, $p < 0.001$) and initial response amplitude ($r = -0.43$, $p < 0.004$). Similarly, in the nonschizophrenic group increasing age was associated with a significant decline in orienting response frequency ($r = -0.35$, $p < 0.02$), rate of habituation ($r = -0.34$, $p < 0.02$), skin conductance level ($r = -0.40$, $p < 0.01$) and initial response amplitude ($r = -0.37$, $p < 0.01$). The relationship between age and electrodermal responsivity was not significant in the schizophrenic group although a similar trend to the other two groups was evident. These results again show a similar pattern to those obtained in respect of the 70 dB tones. The only exception was the level of significance in relation to initial response amplitude in both control groups. This suggests that as it is the response to Trial 1 which tends to be larger than responses on subsequent trials, the degree to which a

louder tone is likely to enhance this response is affected by age.

(iii) Clinical Status

(a) Schizophrenic Patient Group

The increase in tone intensity did not alter the general pattern of results with few significant differences between patient subgroups (Table 6 (xxvii)). Nonresponding was found in all but the paranoid subgroup and the trend towards greater hyporesponsivity in chronic, nonparanoid, institutionalised patients was still evident.

The distribution of patients between habituator groups did not differ significantly between subgroups. Shifts in distribution were noted across tone sequences with a decrease in fast habituators in acute patients and in zero-trial habituators in chronic patients, and a more marked bimodal distribution in nonparanoid patients.

Laterality Effects

Response amplitude asymmetries were predominantly in the direction of higher response amplitudes on the right than left hand representing a slight shift in paranoid patients by comparison to the 70 dB sequence. In view of the small number, however, this may be unreliable.

Skin conductance level asymmetries differed slightly between groups with acute, nonparanoid patients showing a predominance of higher skin conductance levels on the right hand, and chronic, paranoid patients showing the

reverse. There was equal representation among the institutionalised and noninstitutionalised groups. This pattern of results was very similar to that obtained for the 70 dB sequence and again these results confirm that the overall findings cut across patient subgroups.

(b) Nonschizophrenic Patient Subgroups

Nonschizophrenic patient subgroups did not differ on any electrodermal variable to the 90 dB tones (Table 6 (xxviii)). Non-depressed patients and those with reactive depression tended to have higher levels of tonic and phasic activity than patients with endogenous depression although a high incidence of non-responding and a trend towards faster habituation was found in all subgroups.

Skin conductance level asymmetries were in the direction of higher levels on the left than the right hand in all subgroups following the pattern noted for the 70 dB sequence. Response amplitude asymmetries, on the other hand, showed a reversal to a predominance of higher response amplitudes on the left than the right hand. This is more in line with other findings than the results obtained in relation to the 70 dB sequence.

Illness Factors

Among schizophrenic patients correlations between electrodermal variables and age of onset, number of hospital admissions and duration of illness indicated that a high rate of hospital admission was associated with longer response recovery times ($r = 0.36$, $p < 0.04$) and the longer the duration of the illness, the lower the level of

skin conductance ($r = -0.28$, $p < 0.05$). In nonschizophrenic patients it was again age of onset that was the more important factor. Patients with a late onset illness were again characterised by a low level of electrodermal reactivity (mean response amplitude $r = -0.38$, $p < 0.02$; initial response amplitude: $r = -0.34$, $p < 0.02$), response magnitude: $r = -0.31$, $p < 0.03$; orienting response frequency ($r = -0.36$, $p < 0.02$) and faster habituation ($r = -0.33$, $p < 0.02$) than patients who had become ill at an earlier age.

(iv) Medication

The effect of medication on responsivity to 90 dB tones followed a similar trend towards greater hyporesponsivity in the schizophrenic patient group as was found in relation to the 70 dB sequence although for the most part differences between medicated and unmedicated patients were not significant (Table 6 (xxix)). The incidence of nonresponding was much higher in medicated (47%) than unmedicated (33%) patients. Unmedicated patients were significantly slower to habituate ($t = 2.11$, $p < 0.04$). This is reflected in the distribution of subjects across habituator groups.

As only very few subjects changed their responding status there is little to be gained from looking at the interaction between institutionalisation, chronicity and medication as this pattern is almost identical to that found for the 70 dB sequence.

In the nonschizophrenic patient group the strong pattern of hyporesponsivity persisted to the 90 dB tones. The incidence of nonresponding was more or less equally distributed between those on and off medication although medication does now appear to have a beneficial effect, in that the number of responders on medication increased from 17 to 19. The effect of medication on habituation was not significant and all patients showed a trend toward faster habituation to the louder sequence.

The only significant difference found was in relation to response rise time ($r = 2.29$, $p < 0.04$). Unmedicated patients had longer rise times than those on medication. In isolation this is difficult to interpret although it might be consistent with the previous finding of increased responding in medicated patients suggesting that anti-depressants are "arousing". This is partly supported by the higher, albeit nonsignificant, response amplitudes in medicated patients. Overall medication increases hypo-responsivity in schizophrenic patients and may serve to increase responsivity in nonschizophrenic patients.

(v) Environmental Factors

The 90 dB sequence followed immediately on from the 70 dB sequence so that experimenter variables, apparatus and time of day effects remained unchanged for all the subjects. In view of the lack of significant differences between the two sequences, examination of these factors in relation to the 90 dB sequence is therefore unwarranted.

General Discussion

From the literature of the last fifteen or so years the idea of a 'psychophysiological style of responding' would appear to have revolved around several aspects of electrodermal responding. In the first place, there is the issue of responding per se which focusses on whether or not a particular stimulus, in this case a nonsignal auditory stimulus, elicits a response of a measurable magnitude. The term nonresponder has been used to refer, on the one hand, to subjects in which no responses were elicited and, on the other, to subjects who failed to give a skin conductance orienting response on the first three trials. These are usually synonymous with each other in that the hallmark of a nonresponder is his hypo- or under-responsivity. There are, however, a few subjects who are, as it were, late in orienting and begin a normal sequence of responding at about the 4th or 5th stimulus trial. These subjects do not strictly fall within the category of hyporesponsivity even though by the above definition they would be nonresponders. In this study two subjects fell in to this category, both of whom were schizophrenic patients.

Before examining the relationship between psychophysiological and cognitive styles it is therefore important to clarify the dimensions along which the style is measured. With reference to psychophysiological measures one obvious dimension is that of electrodermal responsivity or reactivity. The evidence suggests that the distribution of schizophrenic subjects along this dimension is biased towards hyporesponsivity with an abnormally high incidence of nonresponsiveness and fast habituation in those

displaying skin conductance responses. In addition, subjects displaying no or very few responses have lower levels of skin conductance and a lower incidence of nonspecific electrodermal responses. Both these findings were supported by the current study.

Furthermore, status as a responder or nonresponder has been shown to be reliable over time in both normal and schizophrenic subjects (Bernstein, 1967, 1970; Rubens and Lapidus, 1978) with the qualification that changes in responding status may occur alongside other changes such as the nature of stimulus presented, the patient's symptom picture or changes in certain kinds of medication. In the present study, for example, differences were noted in responsivity between the two tone sequences, These differences were minimal but nevertheless reflected an increase in responsivity to the louder tones supporting the idea that tones of louder intensity may no longer be nonsignificant or innocuous stimuli (Gruzelier et al, 1981).

In this study schizophrenic subjects were not retested on a second occasion as a large proportion would have undergone changes in symptom picture or in medication during the follow-up period. Normal subjects were retested two months later when care was taken to reproduce time of testing, location within menstrual cycle and other experimenter variables. Significant differences were not found between test occasions confirming the above studies. The results of the retest study are reported in Chapter 14.
Thus, the findings cut across traditional subgroups within

schizophrenia and indeed in the present study significant differences were not generally found. Furthermore, there is evidence that associates autonomic responsivity with positive symptoms of schizophrenia (Gruzelier and Venables 1972; Gruzelier, 1976; Straube, 1979; Bernstein et al, 1982). This was not specifically explored in the current study but the findings nevertheless pointed to greater hyporesponsivity in chronic, institutionalised patients.

A second aspect of psychophysiological style relates to differences in hemispheric asymmetries in either skin conductance levels or in response amplitude. Asymmetries in levels have been found to be in either direction in schizophrenic patients and are related to general arousal level. So, for example, nonresponders have shown higher left than right hand levels whereas responders showed the opposite asymmetry (see Gruzelier, 1979). This was supported by the current study.

Differences in response amplitude asymmetry also relate to arousal but in the sense of over- and under-activation of cognitive processes in each hemisphere and as such have not always been shown to be directly related to asymmetry in levels. In the current study a positive correlation was noted between the two types of asymmetry.

The earlier findings of larger responses on the right than the left hand as a predominant characteristic of schizophrenia (Gruzelier, 1973, 1979b; Gruzelier and Venables, 1974a) were confirmed by the current results. Electrodermal asymmetries in both directions have been

found, however, and more recently associated with different clinical syndromes (Gruzelier and Manchanda, 1982). Overarousal of left hemisphere processes is associated with positive symptoms and underarousal with negative symptoms of schizophrenia. This was only partially supported by the present study in that paranoid patients tended to have larger responses on the left than right hand. The number of paranoid patients was, however, very small.

The question of whether lateral asymmetry is a stable trait is quite difficult to answer as no studies, as far as I know, have addressed this issue directly. There is evidence to show that shifts in asymmetry do occur as the result of greater attention to task (Gruzelier and Venables, 1973; Gruzelier, 1973) and under the influence of particular medication (Gruzelier and Connolly, 1979). The comparison of normal subjects on two occasions seem to suggest that in response to the same kind of nonsignal stimuli similar results are obtained.

In summary, the literature and the results of the present study have identified two psychophysiological styles pertaining to reactivity and laterality that could be used to explore the relationship between electrodermal and cognitive styles of responding. The reactivity dimension will be explored, in the first instance, by comparing nonresponders and responders. Laterality will be explored by comparing bilateral asymmetries relating to both skin conductance levels, which will also examine the general issue of arousal, and response amplitude.

CHAPTER 7

Field Dependence-Independence

Methodological Considerations

There are three measures of field dependence-independence. The Tilting-Room-Tilting-Chair Test and the Rod and Frame Test both call for judgements of verticality in a contrived conflict between body posture and a changing upright standard of verticality. The Embedded Figures Test (EFT), which has both an individual and a group form, asks subjects to respond to certain cues, namely a simple figure, in the face of other competing cues, that is the complex figure in which it is embedded. Alternative forms of the EFT such as Thurstone's Concealed Figures Test and the Closure Flexibility Test have also been validated as adequate group measures of field dependence (Witkin et al, 1962; Gardner et al, 1960.

In the current study it was decided to use the Closure Flexibility Test (Thurstone and Jeffrey, 1965) in preference to the Witkin Embedded Figures Test for two reasons: Firstly the memory component of the EFT is an important factor. The subject has either to remember a once presented card in the individual version or make constant reference to the front page in the group version. In the Closure Flexibility Test, the standard stimulus which has to be located within the more complex figure is on the same page. Although the memory component is less likely to affect performance in normal control subjects, it is an extremely important factor in patients who, by

virtue of their illness have difficulties concentrating and focussing their attention. Secondly, the Closure Flexibility Test permits a wider spread of scores. There are 24 stimuli in the individual EFT, 25 in the group EFT and 196 in the Closure Flexibility Test. A wide spread of scores was important in determining correlations and differences between subject groups in relation to electrodermal measures.

A small pilot study on a group of normal control subjects ($N = 32$) showed a significant correlation between the EFT and the Closure Flexibility Test both when correct scores ($r = 0.45$, $p < 0.01$) and correct scores as a function of time ($r = 0.63$, $p < 0.01$) were compared. These two comparison measures were chosen as the EFT is scored on correct scores and by time whereas the Closure Flexibility Test can yield this type of data or a standard score computed from both correct and incorrect scores.

Hypotheses

From the research on field articulation (see Chapter 3) there are a number of predictions that can be made in relation to the present study. Overall schizophrenic patients have not been found to be either field dependent or field independent although some differences have been found in relation to diagnostic subgroups, presenting symptoms and prognosis. It is thus expected that, whilst the schizophrenic group as a whole will not be either field dependent or independent, there will be differences between subgroups and that acute, paranoid, noninstitutionalised patients will more field independent than

chronic, nonparanoid, institutionalised patients; and between schizophrenic patients and normal controls whereby normal subjects will be more field independent than schizophrenic patients.

Performance on tests of field articulation has been shown to improve at higher levels of arousal and field independent subjects show more flexible, differentiated autonomic responding to a stimulus array. Given the relationship between both rate of habituation and the incidence of nonspecific responses with hemispheric specialisation, such that fast habituation is associated with a functional left hemisphere dominance and slow habituation with right hemispheric dominance (Gruzelier et al, 1981), it is thus further predicted that field independent individuals would be more electrodermally responsive than those classified as field dependent.

Sex differences have also been found and it is expected that men will be more field independent than women.

Subjects

All 120 subjects took part (see Subjects and General Methodology Section).

Method

Apparatus

Test materials included the Closure Flexibility Test booklet, pencil and stopwatch. An example of a page from the booklet is included in the Appendix.

Procedure

The Closure Flexibility Test was presented in the form of a booklet with the instructions on the front. The instructions are given in the Appendix. After each subject had read the instructions for himself, they were repeated aloud by the examiner to ensure that they had been fully understood. The example was then completed. During the task, subjects were monitored by the examiner to guard against possible omissions. Subjects were given 10 minutes to complete as much of the test as they could. A raw score was obtained for each subject by subtracting the number of incorrect items from the number of correct items. The raw score was then converted into a standard score using the conversion table provided in the Manual.

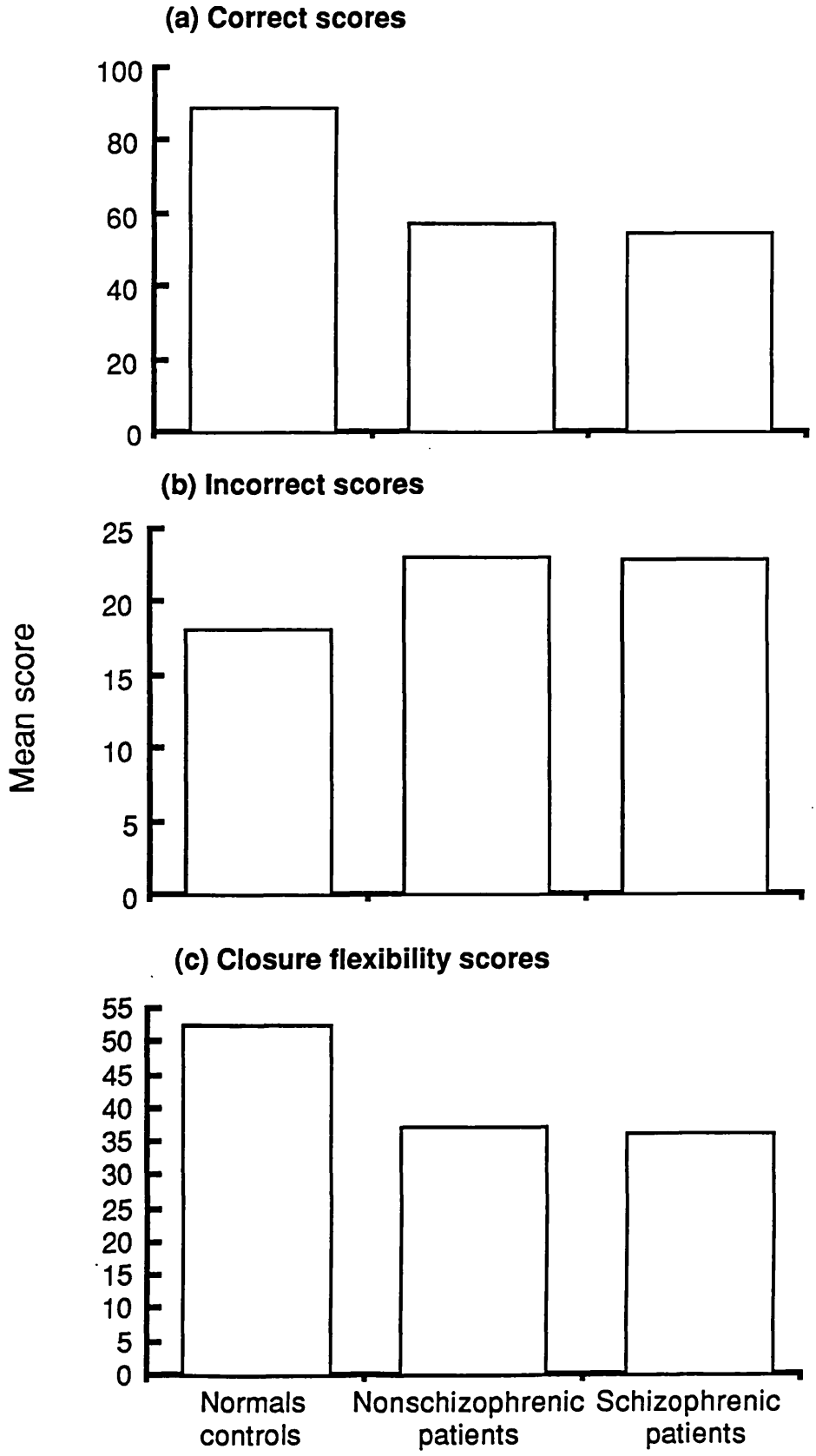
Results

Closure Flexibility scores were analysed using a four-way analysis of variance (Subject Group x Sex x Habituator Group x Asymmetry Group. There was a significant difference in scores between the three subject groups ($F(2,119)$ 20.65, $p < 0.001$), with the normal group having higher scores than both the nonschizophrenic and the schizophrenic patient groups ($p < 0.01$). The two patient groups did not differ, suggesting that schizophrenic and other psychiatric patients were more field dependent than the normal subjects (Table 7 (i) and Figure 7 (i)).

There was no main effect for Habituator Group. Closer inspection of the means (Table 7 (ii)), however, suggested a clearcut difference between what might be called hypo- and hyper-responding subjects. Zero-trial habituators did

Figure 7 (i)

COMPARISON OF CORRECT AND INCORRECT SCORES ON THE CLOSURE FLEXIBILITY TEST



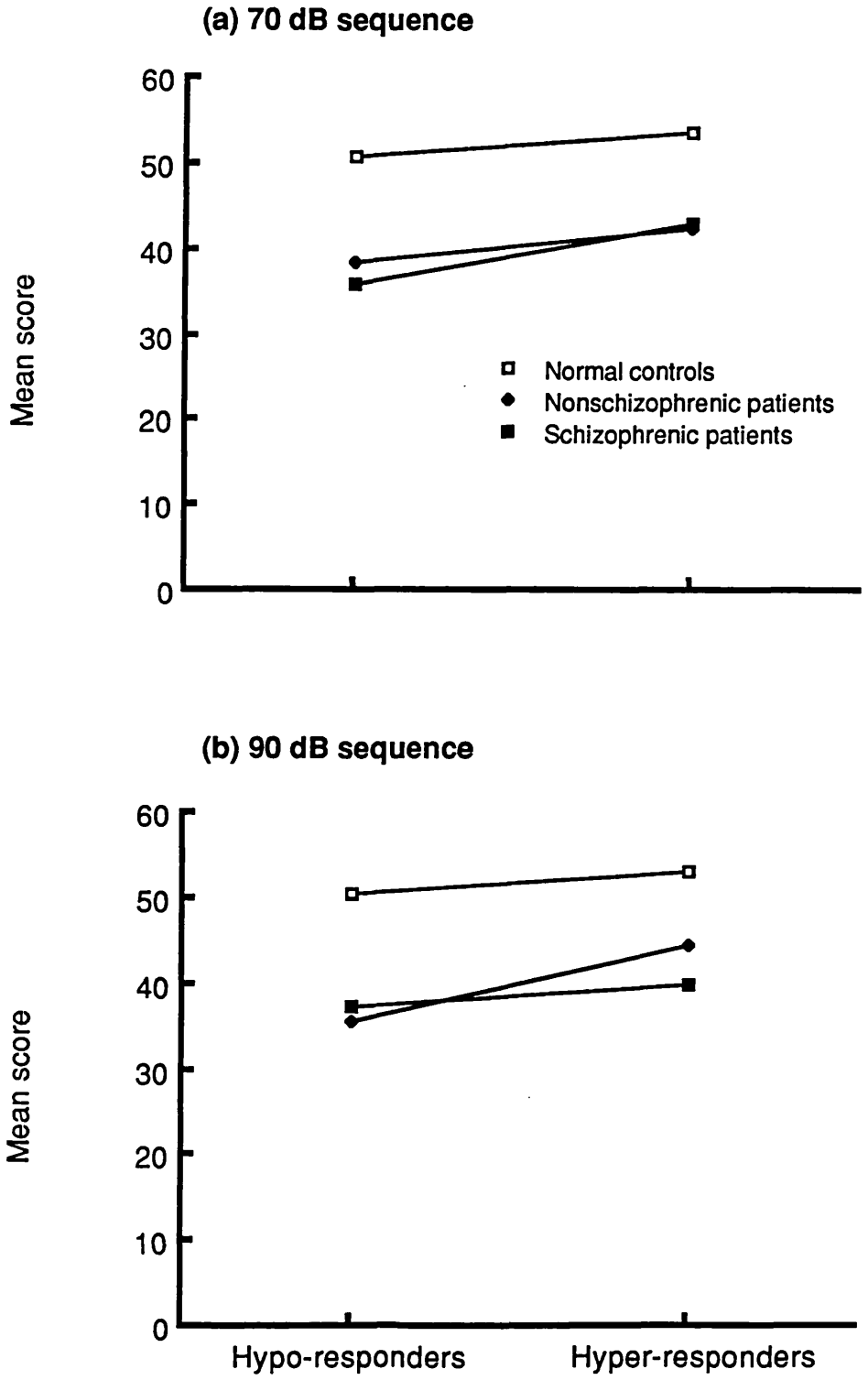
not differ significantly from fast or moderate habituators from slow habituators. If the former and latter groups are pooled to form two groups, one comprising hypo-responding subjects and the other hyper-responding subjects, and are compared using a priori comparisons a significant difference is obtained ($p < 0.001$). This suggests that hyper-responding subjects are more field independent than hypo-responding subjects (Figure 7 (ii)).

Using a priori comparisons further to examine within group comparisons a similar pattern is obtained. Differences between zero-trial habituators and fast habituators on the one hand and moderate and slow habituators on the other were not significant. The only exception to this being in the nonschizophrenic group in which moderate habituators had significantly higher Closure Flexibility scores than all three other habituator groups ($p < 0.03$). Overall hyper-responders had higher scores than hyporesponders. The difference was, however, only significant in the schizophrenic patient group ($p < 0.03$) whereas in the normal control group it was zero-trial and slow habituators who showed a significant difference ($p < 0.05$). A similar trend was evident in relation to the 90 dB tones (Figure 7 (ii)). Overall hyper-responders had significantly higher Closure Flexibility scores than hyporesponders ($p < 0.001$). Within groups, whilst the trend was common to all, a significant difference was only found in nonschizophrenic patients ($p < 0.03$).

The relationship between electrodermal activity and Closure Flexibility was confirmed by correlational

Figure 7 (ii)

CLOSURE FLEXIBILITY SCORES IN HYPO- AND HYPER-RESPONDING SUBJECTS



evidence (Table 7 (iii)). Overall higher Closure Flexibility scores were related to higher levels of both tonic and phasic activity. The pattern of correlations within groups was, however, less consistent. In the normal group there were no significant correlations for either the 70 dB or 90 dB sequences. In the schizophrenic group higher Closure Flexibility scores were related to higher mean response amplitude, response magnitude and initial response amplitude to both the 70 dB and 90 dB tones. The nonschizophrenic patient group showed a similar relationship between mean response amplitude and initial response amplitude which was significant for the 70 dB sequence and approached significance for the 90 dB sequence. And also in this group, high Closure Flexibility scores were related to shorter response latencies to the 70 dB tones, higher skin conductance levels during both the 70 dB and 90 dB sequences and to slower habituation and higher nonspecific electrodermal activity in the 90 dB sequence.

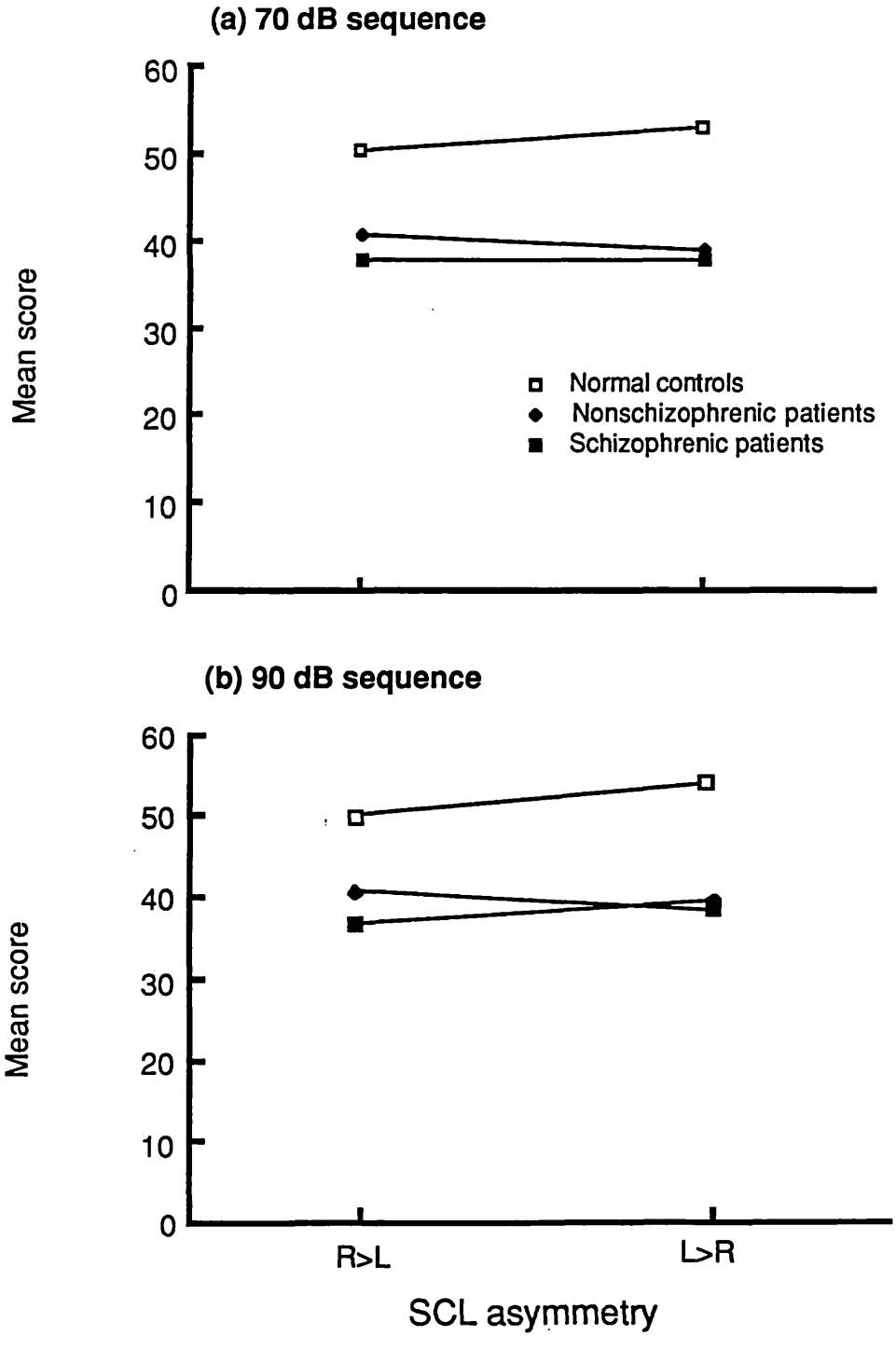
Taken together these results suggest that field independent subjects are more electrodermally responsive than field dependent subjects. However, whilst this trend was present in all three groups, the pattern of the relationship differed across groups.

Sex Effects

There were no significant differences between male and female subjects except in the normal control group (Table 7 (i)) where female subjects scored lower on the Closure Flexibility test and were more field dependent (a priori, $p < 0.05$). This supports previous findings.

Figure 7 (iii)

SKIN CONDUCTANCE LEVEL ASYMMETRY EFFECTS ON CLOSURE FLEXIBILITY SCORES



Laterality Effects

Further comparisons looked at the differences between groups with different skin conductance and response amplitude asymmetries. An interesting pattern emerged here but differences were not significant in respect of either tone sequence. In the normal control and schizophrenic patient groups subjects with higher skin conductance levels on the left hand tended to be more field independent, whereas in the nonschizophrenic patient group the reverse was true (Figure 7 (iii)).

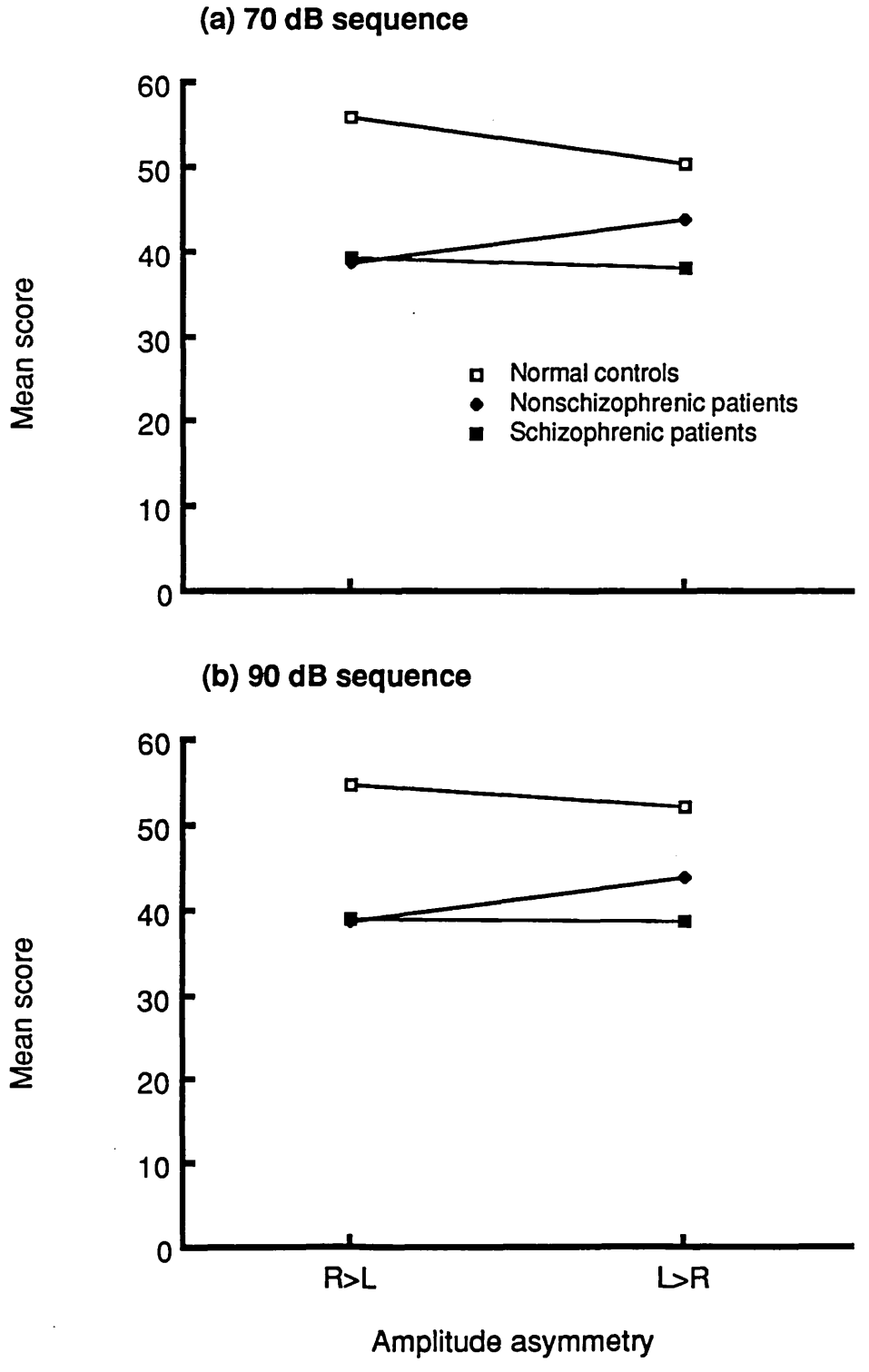
In relation to response amplitude asymmetries the pattern was reversed (Figure 7 (iv). In the normal and schizophrenic patient groups it was subjects with higher response amplitudes on the right hand who were more field independent, whereas in the nonschizophrenic patient group the reverse was true. Again differences were not significant in relation to either tone sequence. These results suggest a dissociation between tonic and phasic activity that was consistent across groups.

Diagnostic Subgroups

Several interesting differences appeared between schizophrenic patient subgroups. Acute patients were more field independent than chronic patients ($t = 3.07$, $p < 0.004$) and noninstitutionalised patients more field independent than institutionalised patients ($t = 2.91$, $p < 0.006$), both findings in line with the relationship between field independence and hyper-responding. Differences between paranoid and nonparanoid patients or between subgroups of the nonschizophrenic patient group were not significant.

Figure 7 (iv)

RESPONSE AMPLITUDE ASYMMETRY EFFECTS ON CLOSURE FLEXIBILITY SCORES



Medication

Medication also appeared to be a significant factor, at least in the schizophrenic patient group (Mann-Whitney: $Z = -2.22$, $p < 0.03$) with subjects on medication being more field dependent than those who were not medicated. In view of the sedative properties of most phenothiazine and antidepressant medications this appears to be consistent with the stated relationship between field dependence and electrodermal responsivity.

Age and Illness Factors

Age was another important factor with older subjects being more field dependent than younger subjects in all three groups (Table 7 (iv)). Factors relating to the onset and course of illness suggest that age of onset is more important in the nonschizophrenic patient group and duration of illness in schizophrenic patients. The earlier the age of onset and the longer the illness the more field dependent subjects were likely to be (Table 7 (iv)).

In view of the fact that Closure Flexibility scores are derived from the relationship of correct to incorrect scores it would seem important to look at these scores independently, particularly as previous findings have suggested that information processing is slowed in schizophrenic patients. As the Closure Flexibility test was time-limited, speed of processing is clearly represented in the total number of items answered whereas accuracy of processing is represented in the number of items correctly answered or in the number of errors as a percentage of total items answered (Figure 7 (i)).

(a) Incorrect Scores

The number of errors made was not significantly different between the three subject groups (Table 7 (v)) although this represented 29% of all items answered in patients and only 17% in normal controls. The relationship to electrodermal responsivity was not significant. The tendency was for hyper-responders to make fewer errors (Table 7 (vi)) and, with respect to lateral asymmetry, for subjects with higher skin conductance levels or response amplitudes on the right then the left hand to also make fewer errors (Tables 7 (vii) and (viii)). This tendency was reversed in normal subjects in relation to response amplitudes to the 90 dB tones and in schizophrenic patients in relation to response amplitudes to the 70 dB sequence. There were no sex differences although female subjects in all three groups tended to make more errors.

(b) Correct Scores

With respect to correct scores there was a significant group difference ($F(2,119)$ 18.11, $p < 0.001$). Normal control subjects had more correct scores than either patient group ($p < 0.01$) who showed no significant difference between them (Table 7 (v). The relationship to electrodermal responsivity also approached significance ($F(3,119)$ 2.56, $p < 0.06$) in relation to the 70 dB tones. Hyper-responders had higher correct scores than hypo-responders in relation to both 70 dB ($p < 0.001$) and 90 dB ($p < 0.01$) sequences (Table 7 (vi)). This was true of all three groups. The only significant within-group difference was, however, between hyper- and hypo-responders to the 70 dB sequence in the schizophrenic patient group ($p < 0.03$).

The relationship between correct scores and electrodermal activity is supported by correlational evidence (Table 7 (ix)). In the normal group high correct scores were significantly related to high initial response amplitude and mean response amplitude to the 70 dB tones and to shorter recovery times to the 90 dB tones. In the schizophrenic group higher correct scores were related to higher mean and initial response amplitudes to both the 70 dB and 90 dB sequences. In the nonschizophrenic patient group higher correct scores were also related to higher mean and initial response amplitudes but to the 70 dB tones only. In addition this group showed a relation between high correct scores and shorter response latencies and rise times during the same sequence, whereas higher skin conductance levels were related to higher correct response scores during both the 70 dB and 90 dB sequences.

Laterality Effects

Skin conductance asymmetry groups did not differ significantly in the number of correct scores obtained (Table 7 (vii)). Subjects with higher skin conductance levels on the left than the right hand tended to have higher correct scores than those with the reverse asymmetry. This was clearly evident in the normal control group in respect of both sequences. In the two patient groups differences were negligible in relation to the 70 dB sequence. Skin conductance level asymmetry in relation to 90 dB tones indicated a similar pattern in the schizophrenic patient group but this trend was reversed in nonschizophrenic patients.

With respect to response amplitude asymmetries the pattern

was reversed (Table 7 (viii)). In the normal group higher scores were obtained by subjects with higher response amplitudes to both tone sequences on the right than the left hand. The reverse was true of nonschizophrenic patients. In the schizophrenic patient group the pattern was not consistent. Higher scores were obtained by subjects with higher response amplitudes on the right than the left hand to the 70 dB tones and on the left than the right hand to the 90 dB tones.

Sex Effects

There was no main or interaction effect for sex. Among both schizophrenic patients and normal controls, men had more correct scores than women. This difference was significant only in the normal group (a priori, $p < 0.05$). The opposite was true of the nonschizophrenic patients.

Diagnostic Subgroups

In the schizophrenic group institutionalised patients had fewer correct scores than noninstitutionalised patients ($t = 2.09$, $p < 0.05$) and chronic patients fewer correct scores than acute patients (Mann-Whitney: $Z = -2.19$, $p < 0.03$). Other differences in both schizophrenic and nonschizophrenic patient groups were not significant. These findings again support the trend for hyper-responders to have higher scores.

Medication

Medication did not appear to have a significant effect although in both patient groups medicated subjects made fewer errors and obtained higher correct scores.

Discussion

Previous research has suggested that a particular mode of field dependence does not characterise patients in the major diagnostic categories such as depression or schizophrenia, although this may be true of patients of a particular diagnostic subcategory or symptomatology (e.g., Witkin et al, 1962). The findings of the present study are in line with this although they suggest that by comparison with normal subjects, patients are more likely to be field dependent than independent.

Differences in diagnostic subgroups were not evident in the nonschizophrenic patient group but among schizophrenic subjects chronic, institutionalised patients were more field dependent than acute, noninstitutionalised patients and factors such as age at onset of illness and duration of illness also biased responding towards a more field dependent mode. These results are in line with the view that field independence is a more adaptive cognitive style than field dependence. From an analysis of correct and incorrect scores this would appear to relate more to speed of processing than to accuracy.

Sex and age differences were also noted. In support of previous findings women were found to be more field dependent than men, although this difference was not significant in the patient groups. Age differences were present in all three groups and indicated a shift towards field dependence with increasing age. It is perhaps important to note in this context that the mechanism underlying sex differences is thought to relate to differences in

spatial ability and to the degree of functional lateralisation which is assumed to be greater in men (Kimura, 1969; McGlone and Davidson, 1973; Waber, 1977). Furthermore, there is a tendency for right or nondominant hemisphere abilities to decline more rapidly with age than those of the left or dominant hemisphere. Both these suggest, and so far the current results support the view, that field dependence is related to right hemisphere processing.

It has been further suggested that cognitive control dimensions may be capable of temporary variations (Gardner et al, 1959) although this view has not generally been supported. Medication could be viewed in this context and the results here suggest that subjects on medication are more likely to be field dependent than field independent.

Moving on to the hypothesised relationship between field articulation and psychophysiological styles of responding, there are two important findings. Firstly, there is clear evidence of a relationship between field dependence and level of responding. Hypo-responders, that is, subjects who either do not respond or produce only a few responses which habituate quickly are more field dependent than independent. This was a consistent, albeit not always significant, finding across all three groups. In view of the larger number of hypo-responders among both patient groups this suggests that differences in field dependence between patient and normal groups reflected a consistent style of both cognitive and psychophysiological responding. It was also consistent with the fact that chronic institutionalised patients who tend to be electrodermally

less responsive were less field independent as well.

The second finding relates to the relationship between field dependence and asymmetries in electrodermal responsivity. The results suggest a disassociation between tonic and phasic activity as shown by Gruzelier et al (1981). On the one hand, field independence appears to be associated with a left hemisphere bias in tonic activity and on the other with a right hemisphere bias in phasic activity. This finding is consistent with the view that both hemispheres are important in field articulation, namely that the disembedding function is located in the right hemisphere whereas the degree of 'perceptual pull' is dependent on left hemisphere activation (Case and Globerson, 1974). It may be therefore that these two processes are reflected in the tonic and phasic components of electrodermal activity.

Together with the above finding in relation to hypo- and hyper-responding, the psychophysiological response style associated with field independence appears to be characterised by a larger number of responses and higher right- than left-hand response amplitudes than that associated with field dependence. This mode of responding has been interpreted to indicate a dominance of right-hemisphere activity (Gruzelier, Eves and Connolly, 1981) and is consistent with structural models of hemisphere specialisation and other findings suggesting that field articulation is dependent on right-hemisphere processing.

It is not, however, consistent with current models of

hemispheric specialisation in attention which propose specialisation of the left hemisphere in selective attention and of the right hemisphere in sustained attention (Dimond, 1979). The mode of action that suggests itself here is that the tonic activity may be reflecting the 'perceptual pull' and acting as a contralateral excitatory influence on phasic activity of the right hemisphere. In this case the results would concur with the view that individuals in whom the balance of activity is biased toward the left hemisphere will show better performance than less well-lateralised individuals in whom the bias is towards the right hemisphere.

The results also suggest that whereas normal and schizophrenic subjects are similar in their style of responding, nonschizophrenic patients show the opposite. In view of the predominance of depressed patients within the nonschizophrenic group, this is in line with the already established differences in hemisphere dysfunction between schizophrenia and depression.

CHAPTER 8

Constricted-Flexible

Methodological Considerations

The Stroop Test developed out of early research on the nature of colour naming and word reading ability (Cattell, 1886; Hollingsworth, 1915; Garrett and Lemon, 1924; Bills, 1931; Ligon, 1932). These studies concluded that word reading in normal literate adults is invariably faster than colour naming. Stroop (1935), however, suggested that the difference in these two abilities could be attributed to Petersen's hypothesis (Petersen et al, 1925) that "one particular response habit has become associated with each word while in the case of colours themselves a variety of response habits have developed (p 281)". This led to the development of what became the prototype of the Stroop Colour-Word Test: three pages with 100 items each in ten columns of ten items. The first page contained colour-words, the second rectangles of colour, the third colour-words printed in a different colour ink. The interference score is measured by the increment in response time in reading coloured words compared to naming colours.

Since Stroop a number of alternative forms of the Stroop test have been developed. Variations have been in both the stimulus and response. Among the other stimulus items which have been used are colour-related words, congruent and incongruent with their background, and neutral words, that is, words which have no colour connotations. All confirmed the interference effect finding significant

delays in colour naming (Kamlet and Egeth, 1969; Daniel, 1969; Dyer and Severance, 1972; Dyer, 1972). The number of colours used, when varied from three to five also makes no difference in scores (Golden, 1974) and the number of items makes little difference except that too large a number introduces significant fatigue problems (Golden, 1973). One presentation that has generally failed to produce interference to colour names is the auditory presentation of incongruent word stimuli in conjunction with nonword colour patches (Thackray and Jones, 1971; Dyer and Severance, 1972). According to Dyer (1973) this is not related to timing effects but indicates that reading is critical in generating naming interference although more recently auditory Stroop effects have been obtained. This literature is reviewed in Chapter 17.

One small but important departure from the traditional methodology has been the presentation of single Stroop stimuli and the measurement of the latency of the single colour-naming response. Thus presentation of Stroop items may be either discrete, that is, one single item leading to collection of a single response time, or massed, that is, several items leading to collection of a single response time. Research indicates that discrete presentation produces smaller interference values than massed presentation (Nielsen, 1974). This may reflect the presence of larger interitem effects in massed than in discrete presentation (Dalrymple-Alford and Budayr, 1966; Klein, 1964; Sichel and Chandler, 1969; Dyer, 1973).

Facilitation has been used to refer to the performance

elicited by congruent items. The evidence seems to indicate that with discrete presentation, congruent colour words produce much lower interference than do incongruent colour words (Dyer 1971; Dalrymple-Alford, 1972; Hintzman et al, 1972; Schmit and Davis, 1974), whereas with massed presentation, congruent colour words are interfering unless subjects are aware of that congruency (Dalrymple-Alford and Budayr, 1966; Nealis, 1973). Subjects cannot, for example, use redundant word information in a mixed serial list and seem to need to make a deliberate strategy change in order to use of congruent information in a massed presentation.

Differences in interference have also been noted using different word types which are either semantically related (Klein, 1964; Scheibe et al, 1967) or sound similar to the colour words (Dalrymple-Alford, 1972b). When other words are substituted for colour words in the Stroop interference condition that do not have colour connotations, that is, neutral words, interference tends to be less than with incongruent colour words (Klein, 1964; Fox et al, 1971; Dalrymple-Alford, 1972a; Keele, 1972; Hintzman et al, 1972; Liu, 1973) but there is disagreement as to whether the neutral word conditions take longer than the colour alone baseline. If the interfering word is semantically related to the colour names this generates the colour-related word condition. It typically has been found that incongruent colour-related words produce more interference than neutral words and less than incongruent colour words. This phenomenon has been called the semantic gradient effect and was first reported by Klein (1964).

The Stroop effect has thus been well established using colours and words. The question is to what extent the naming of other stimulus dimensions besides colour is susceptible to interference from incongruent dimension names integrated with levels of the dimension. Alternative forms using achromatic shades (Smith and Borg, 1964; Dyer, 1971), compass directions (White, 1969), spatial position (Shor, 1971) and movement direction (Shor, 1971; Dyer, 1972) all found interference effects but at a reduced level. This general failure to produce a strong analogue of the Stroop test suggests that processing of colour information is in some way different from these other dimensions. Relevant to this point is the finding by Cramer (1967) that it was more difficult for preschool children to name colours with the patches a mixture of nameable forms than it was to name forms with the forms printed in different nameable colours. Her result suggests that names are assigned with more difficulty to colours than to forms. Similar interference effects were found using letters and digits (Windes, 1968; Morton, 1969) and the same/different dimension (Egeth et al, 1969) suggesting some comparability between these and colour dimensions. A later study by Proctor (1978), however, found that colour words that are also members of the response naming set produce more interference than colour words that are not.

In view of both the early as well as the more recent research, it was decided to use the original form of the Stroop Colour-Word Test. This has also been the format of choice by authors exploring the constricted-flexible

cognitive style dimension.

Two other factors that have a bearing on performance are age and sex. Early studies on the relationship between age and performance on colour naming, word and colour-word reading showed a general improvement with age up to late adolescence with a decline beginning later in life (Ligon, 1932; Stroop, 1935; Comalli et al, 1962; Rand et al, 1963; Schiller, 1966; Peretti, 1969). The nature of the actual age effects on interference itself is, however, somehwat questionable although it may relate to the general development of perceptual-cognitive processes from a diffuse and global state towards greater differentiation as suggested by Werner (1948).

With respect to sex differences there has been widespread agreement among researchers that women tend to perform better on colour naming while performance on word reading shows no sex difference (Ligon, 1932; Stroop, 1935; Jensen, 1965). The question of differences on the colour-word and differences in interference have not been so clearcut with some researchers finding better performance in men (Stroop, 1935) and others in women (Peretti, 1969). Golden (1974) concluded that the differences which have been found are simply due to differences in colour naming and that interference does not differ between the sexes.

Hypotheses

Performance on the Stroop Test involves a number of perceptual-cognitive skills relating to maintaining cognitive set and performance in the presence of distracting

stimuli that have been found to be deficient or to produce a decrement in the performance of schizophrenic patients. As a result these patients have generally been found to be more constricted than normal subjects though not always more than other psychiatric patients. Differences have also been noted between diagnostic subgroups (Chapter 3). It is therefore predicted that schizophrenic patients will be more constricted in their performance on the Stroop task and that, where subgroup differences exist, these are likely to be in the direction of greater interference among noninstitutionalised, acute, paranoid patients.

Previous research has also shown that whilst an increase in Stroop interference is generally associated with high levels of psychophysiological arousal, it may also be related to states of low arousal, suggesting that the relationship between arousal and interference may be curvilinear in the same way that anxiety/arousal and performance are generally thought to relate. Given the relationship between habituation and hemisphere specialisation and that it may be influenced by levels of anxiety (Gruzelier, 1987) together with the fact that interference on the Stroop test is predominantly related to right hemisphere processes, it is further predicted that constricted subjects would be more electrodermally responsive than those who were more flexible.

In line with previous research greater interference on the Stroop Test is expected in older subjects and, in view of the greater superiority of women in colour-naming, in female subjects also.

Subjects

All 120 subjects took part (see Subjects and General Methodology Section).

Method

Apparatus

The Stroop Color-Word Test was used as a measure of the constricted-flexible dimension. The version used in this study comprised three parts. Part 1 was a page of colour names : red, green, yellow and blue. The names were printed in black, in random order, ten words to the line, ten lines to a page. Part 11 was a page of colour strips, rows of large red, green, yellow and blue dots which matched the arrangement of words in Part 1, and the length, position and colour of words in Part 111. In Part 111, the four colours and the four colour names appeared in contradictory combinations, e.g., green printed in blue. No colour name was printed in its own colour.

Procedure

Each subject was tested individually. A one-line practice example was given to each subject before each part following instructions. This was to ensure that each subject used the correct colour names and was able to distinguish the colours correctly. The instructions given to the subjects are contained in the Appendix. Subjects were then asked to read Parts I to III in sequence. After Part 111 had been read, subjects were asked to read Part 1 again. This was to control for possible fatigue and practice effects.

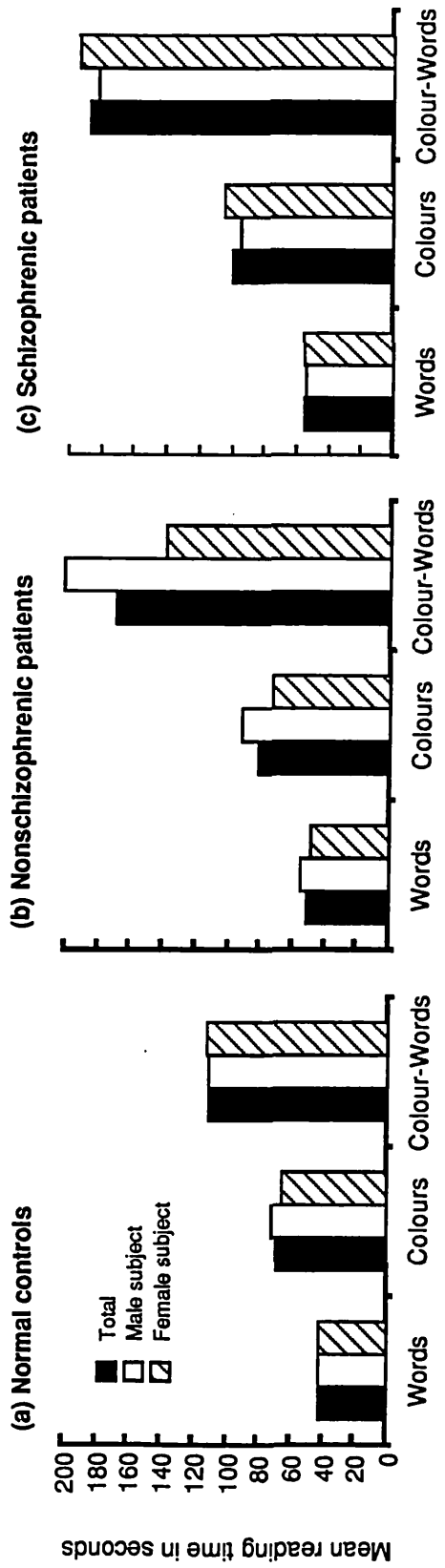
In addition to reading times and errors for each Part, two additional scores were calculated: 1. A 'colours alone' reading time score was calculated which consisted of the reading time for Part 11 which took account of reading errors. The reading errors were penalised by multiplying reading time per two-line unit by the number of errors and adding this value to the reading time for the page. This measure reflected the amount of 'aphasic-like' blocking on reading colours alone. 2. An interference score was calculated using the regression of reading time for Part 111 on reading time for Part 11 (see Appendix for calculation formula). Each subject's interference score was computed as the difference between his actual reading time for Part 111 and his predicted reading time, based on the regression of reading time, Part 111, on reading time, Part 11.

Results

Reading times for Parts 1 and 1V were compared using t-tests and no significant differences were found in any of the three subject groups (Table 8 (i)). This suggested that there were no fatigue or practice effects which might have influenced the Interference scores calculated on the basis of performance on Parts 11 and 111. On both Parts 1 (ANOVA, $F(2,119)$ 7.05, $P < 0.01$) and Part IV (ANOVA, $F(2,119)$ 7.56, $p < 0.01$) reading times were significantly faster in normal than in schizophrenic ($p < 0.001$) or nonschizophrenic ($p < 0.001$) subjects. The difference between the two patient groups was not significant nor were there any significant differences between male and female subjects in any of the three groups (Figure 8 (i)).

Figure 8 (i)

COMPARISON OF TIMES FOR READING COLOURS, WORDS AND COLOUR-WORDS IN MALE AND FEMALE SUBJECTS



The Stroop Interference scores were analysed using a similar four-way analysis of variance (Subject Group x Sex x Habituator Group x Asymmetry Group). Differences between subject groups were not significant. The means suggest that, on average, the greatest interference occurred in nonschizophrenic patients and the least in the normal controls (Table 8 (ii)).

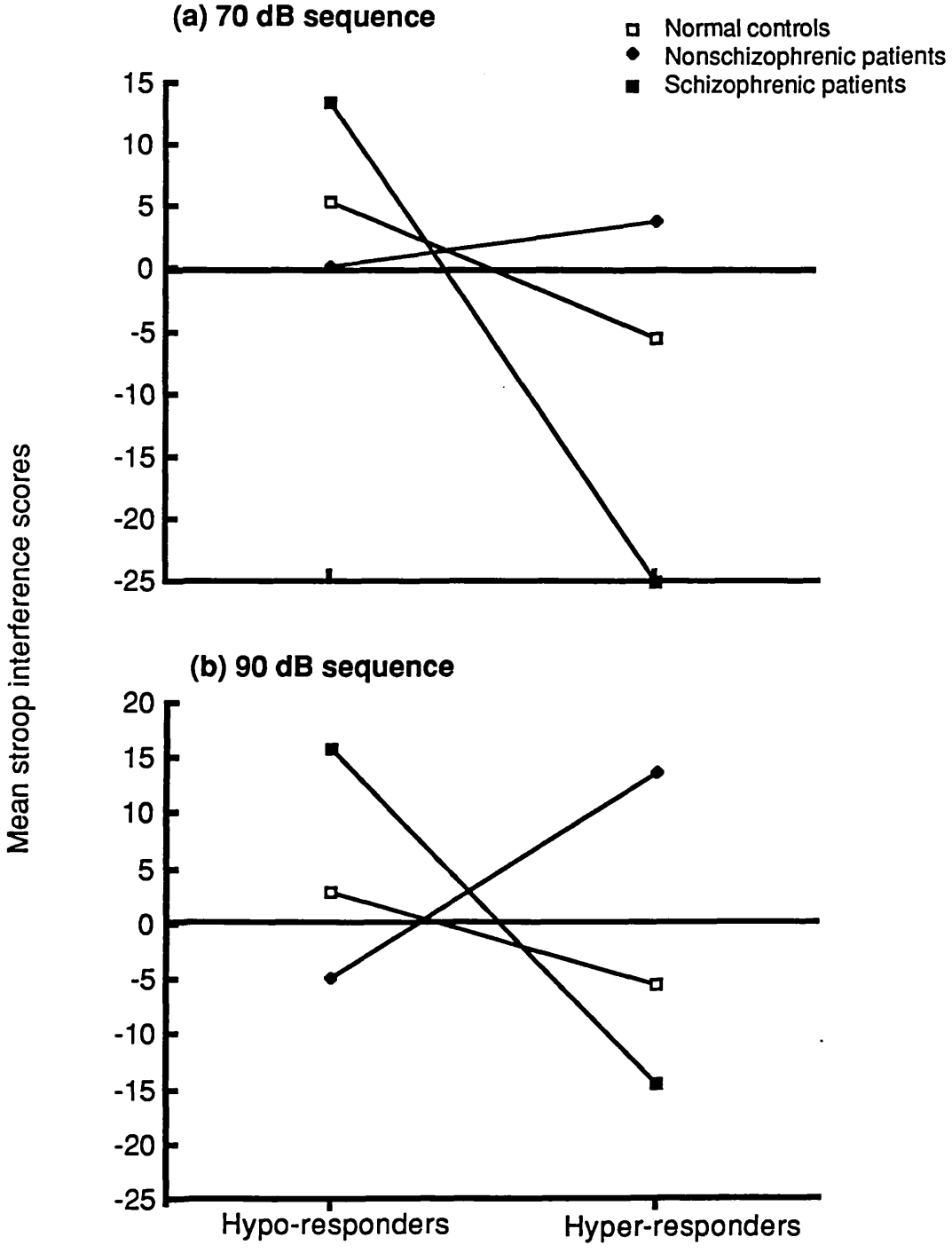
A main effect for habituator group differences was not found (Table 8 (iii)). Using a priori comparisons to compare hypo- and hyper-responding subjects as previously defined in Chapter 7, hypo-responders were, however, found to have higher interference scores than hyper-responders ($p < 0.05$), suggesting the former were more constricted. Further comparisons indicated a similar pattern in both the schizophrenic and normal control groups. The difference was, however, only significant for schizophrenic patients ($p < 0.001$). In the nonschizophrenic patient group it was the hyper-responding subjects who showed higher interference suggesting a reverse pattern, albeit a nonsignificant one, from that shown in the other two groups (Figure 8 (ii)).

A similar trend was evident in relation to the 90 dB sequence. Overall hypo-responders had significantly higher Interference scores than hyper-responders ($p < 0.05$). Within groups, both normal and schizophrenic subjects showed a similar trend but this was again reversed in the nonschizophrenic patient group (Figure 8 (ii)).

Correlations between Stroop Interference scores and

Figure 8 (ii)

STROOP COLOUR-WORD SCORES IN HYPO-AND HYPER-RESPONDING SUBJECTS



electrodermal measures confirmed the trend towards higher interference scores with decreased responsivity (Table 8 (iv)). [A negative interference score indicated less interference therefore a negative correlation is indicative of decreased interference with increasing electrodermal activity.] In the normal control group lower interference scores were significantly related to higher mean and initial response amplitudes and to longer response rise times for both 70 dB and 90 dB sequences. In the schizophrenic patient group lower interference scores were related to a higher frequency of orienting and nonspecific responses, slower habituation and to higher initial and mean response amplitudes and response magnitude. Again this was true of both tone sequences. In the nonschizophrenic patient group the only significant relationship was between lower interference scores and shorter response rise times to the 70 dB sequence only.

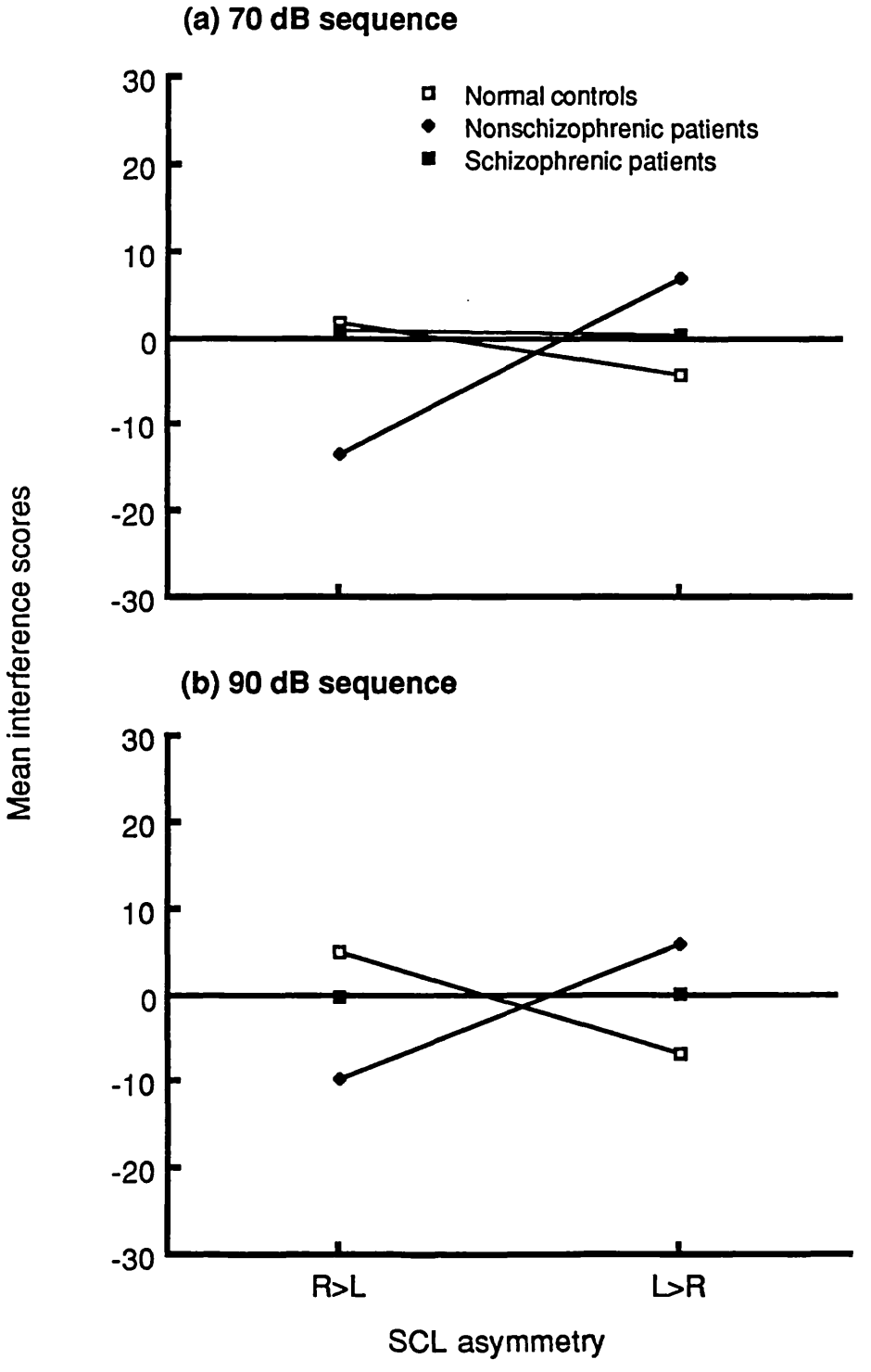
Taken together these results suggest that constricted subjects, that is, those with higher interference scores, are electrodermally less responsive than flexible subjects This trend was, however, only present in schizophrenic and normal subjects. The parallel between psychophysiological and cognitive measures may not therefore be so clearcut.

Laterality Effects

Further comparisons looked at the differences between groups with different response amplitude and skin conductance level asymmetries. Significant differences in skin conductance level asymmetry were not found. Subjects with a right greater than left asymmetry tended to have lower

Figure 8 (iii)

STROOP INTERFERENCE AND SKIN CONDUCTANCE LEVEL ASYMMETRY



interference scores. This overall score was biased, however, by the scores in the nonschizophrenic group as in both the normal and schizophrenic groups it was subjects with higher levels on the left than the right hand who had the lower interference scores (Figure 8 (iii)).

With respect to response amplitude asymmetry significant differences were also not found. On average subjects with higher response amplitudes on the left than the right hand tended to have the lower interference scores. This was evident in both patient groups but the reverse was true in the normal group (Figure 8 (iv)).

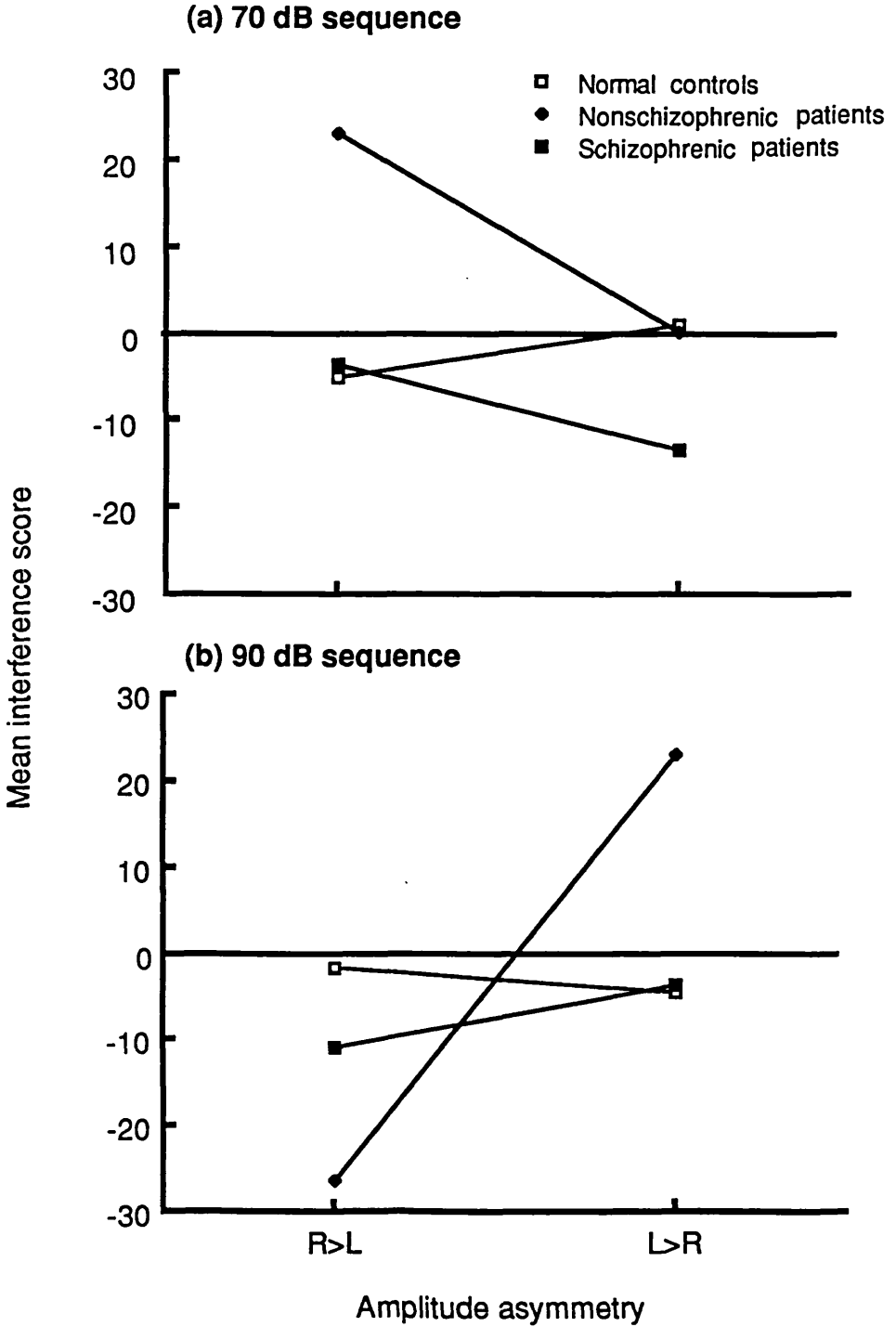
Although comparisons between hypo- and hyper-responding subjects produced similar profiles for skin conductance level asymmetry to both the 70 and 90 dB sequences, all three groups of subjects showed a reversal in response amplitude asymmetries to the 90 dB sequence such that subjects with higher response amplitudes on the right than the left hand had lower interference scores (Figures 8 (iii) and (iv)).

Sex Effects

There was also an interesting significant interaction between sex and skin conductance level asymmetry (ANOVA, $F(1,119)$ 4.53, $p < 0.04$). Male subjects with higher skin conductance levels on the right than the left hand had lower interference scores than those with the opposite asymmetry ($p < 0.05$). The reverse was true of female subjects although the difference here was not significant. Overall a significant difference in interference scores

Figure 8 (iv)

STROOP INTERFERENCE AND RESPONSE AMPLITUDE ASYMMETRY



between men and women was not found. Male subjects had on average higher interference scores than women although in the normal group this trend was reversed. There has been inconsistency in the results reported in the literature with some suggestion that any sex differences found are due to differences in color naming speed rather than to interference per se (Golden, 1974).

In the present study, reading times for colours alone were found to be slower than times for reading words in all three groups (normal controls: $t = 11.74$, $p < 0.001$; nonschizophrenic patients; $t = 13.22$, $p < 0.001$; schizophrenic patients: $t = 10.56$, $p < 0.001$). In a comparison between the three subject groups and sex a significant subject group effect (ANOVA, $F(2,119)$ 16.63, $p < 0.001$) was obtained in which schizophrenic patients were found to be significantly slower than both nonschizophrenic patients ($p < 0.001$) and normal controls ($p < 0.001$). The normal subjects were also significantly faster than the nonschizophrenic patients ($p < 0.001$). In addition, there was a significant interaction between subject group and sex (ANOVA, $F(2,119)$ 3.49, $p < 0.05$) with female subjects in both the normal and nonschizophrenic patient groups reading colours faster than male subjects. The reverse was true in schizophrenic patients (Figure 8 (i)). The general superiority of women in reading colours is in line with previous research but the reversal in schizophrenic patients as well as the interaction effect with skin conductance asymmetry suggests that other factors such as level of arousal may play an important role.

Other Interference Measures

Two other indicators of interference (errors and reading times for the colour-word condition) were also explored and provided similar results. Reading times for the colour-word condition not only exceeded those for reading words alone but for reading colours alone as well in all three groups (normal controls: $t = 14.72$, $p < 0.001$; nonschizophrenic patients: $t = 9.16$, $p < 0.001$; schizophrenic patient group: $t = 12.45$, $p < 0.001$), indicating interference was present in all three groups (Table 8 (v)). On this measure differences were related to both psychopathology (ANOVA, $F(2,119)$ 13.31, $p < 0.001$) with normal subjects having faster times than both patient groups ($p < 0.001$) who did not differ, and to electrodermal responsivity with significant differences noted between habituator groups (ANOVA, $F(3,119)$ 2.85, $p < 0.04$) but not in interaction with subject groups. Overall hyperresponders had significantly faster reading times than hyporesponding subjects ($p < 0.01$). This was found in all three groups although the difference was only significant in the schizophrenic group ($p < 0.001$). A further significant interaction was found between subject group and sex (ANOVA, $F(2,119)$ 3.59, $p < 0.05$). Women had significantly shorter reading times than men in the nonschizophrenic patient group ($p < 0.001$). The opposite was true in the two other groups but differences here were not significant.

Errors made whilst reading colour-word stimuli as another indicator of interference were also compared. Normal subjects made significantly fewer errors (ANOVA, $F(2,119)$ 6.14, $p < 0.003$) than either patient group ($p < 0.001$).

These two groups did not differ (Table 8 (v)). Significant interactions were also found between subject groups and habituator groups on the one hand (ANOVA, F (6,119) 2.22, $p < 0.05$) and gender on the other (ANOVA, F(2,119) 4.87, $p < 0.01$). Looking at the issue of responsivity first hypo-responders tended to make more errors than hyper-responders although this difference was only significant in the schizophrenic group ($p < 0.01$). A similar trend was noted in normal controls but was reversed in nonschizophrenic patients. The interaction with sex was significant with respect to nonschizophrenic patients only, men making more errors than female subjects ($p < 0.001$). These data generally confirm the findings relating to the interference scores based on the regression analysis.

Diagnostic Subgroups

Comparisons between patient subgroups were made for all three interference scores but no significant differences were found. Among schizophrenic patients, however, both medication and illness factors were important. Whilst no significant difference was obtained in relation to the regression interference score or to the number of errors made in the colour-word condition (Part III), subjects on medication had much longer reading times than unmedicated subjects (Mann-Whitney: $Z = 23.21$, $p < 0.03$), indicating greater interference with medication. This finding is in line with the stated relationship between decreased interference and hyper-responsivity. A lower level of interference was also found in schizophrenic patients with many admissions ($r = - 0.31$, $p < 0.03$) but where the illness overall was of shorter duration ($r = 0.27$, $p < 0.05$).

Age Effects

Stroop interference was also significantly enhanced in older subjects supporting previous research. Although a similar trend was found in all three groups, this relationship was only significant in the normal control group ($r = 0.39$, $p < 0.01$).

Discussion

The relationship of the constricted-flexible cognitive control dimension to electrodermal responsivity would appear from the above results to be in the direction of greater interference with decreasing arousal. This was confirmed by both difference and correlational measures, but was contrary to the predicted relationship between interference and arousal. However, in line with the hypothesis greater interference was associated with a right hemisphere bias in phasic activity but with a left hemisphere bias in tonic activity. This suggests a dissociation between tonic and phasic activity in the same direction as that found in Closure Flexibility. Again it implies that both hemispheres may be important for performance on the Stroop Test. The fact that there was a reversal of this relationship in response to 90 dB tones and that the findings for normal controls differed from those for patients suggests that the relationship may be a complex one and complicated by factors such as anxiety which have been shown to influence the relation between responsivity and hemisphere dominance (Gruzelier, 1987).

To the extent that the Stroop Interference task is a measure of an individual's capacity for differential

response to specific aspects of a field in the face of explicitly interfering cues, performance on this task is also a measure of the ability to sustain attention. The findings are therefore compatible with previous research suggesting that sustained attention is associated with increased electrodermal responsivity (Gruzelier et al, 1981). Sustained attention has also been related to greater right hemisphere activation as measured by bilateral differences in electrodermal activity (Gruzelier et al, 1981). This finding was less clearly supported.

The Stroop Test has been used infrequently with schizophrenic patients. Otteson and Holzman (1976) found that it did not differentiate schizophrenic patients from normal subjects although it did differentiate normal subjects from those with some form of psychopathology. Golden (1976) has used the Stroop test as an indicator of brain damage and has found clear differences between both normal and schizophrenic subjects and those with brain damage. Perhaps more relevant to the issue of psychopathology is the fact that the constricted-flexible control dimension also relates to the capacity for response set flexibility. Previous work by Shakow (1963) suggests that schizophrenic patients lacked the ability to maintain a major set; and by McGhie and Chapman (1961) that schizophrenic patients have an impairment in the selective and inhibitory functions of attention. The results here suggest that this kind of attentional deficit is not confined to schizophrenia but is found in other psychiatric patients as well supporting the findings of Otteson and Holzman (1976).

CHAPTER 9

Levelling-Sharpening

Methodological Considerations

The criterion measure for levelling-sharpening is the Schematising Test adapted by Holzman and Klein from a procedure used by Hollingworth (1915). In this test gradually increasing squares of different sizes are presented so that new larger squares are seen against a background of previously seen smaller squares. Levellers who by definition assimilate new stimuli into old memory structures tend not to keep up with the gradual size increase, thus underestimating the size of the larger squares. Sharpeners' estimates, on the other hand, tend to be more accurate.

The schematising test yields two scores for each subject: accuracy and lag. Accuracy is a ranking score, that is, the number of corresponding rankings or hits over the total possible answers. Subjects with low accuracy are considered levellers and those with high accuracy are considered sharpeners. Lag is a log score based on the subject's size estimations relative to the actual sizes presented and measures the subject's ability or failure to recognise the gradually increasing size of the squares. Levellers who tend to underestimate the size of the larger squares do not keep up with the size increase and receive a high positive lag or incremental error score. Sharpeners whose estimates are more in line with the actual sizes presented, receive a score near zero for lag. Subjects who overestimate increases in size receive a high negative lag

score. These subjects, called 'overshooters' tend to be few. As they have not been adequately accounted for they have been traditionally discarded.

Gardner and Long (1960) showed test-retest reliability of Schematising Test performance over a period of 3 years (percentage accuracy: 0.52; mean percentage increment error: 0.36; lag: 0.45) and Gardner and Lohrenz (1969) indicated a split-half reliability (lag: 0.72; percentage ranking accuracy: 0.95). Reported correlations between lag and accuracy have, however, been relatively low (- 0.03 to - 0.43: Vick and Jackson, 1967; Lovinger, 1969; Israel, 1970; Levine, 1976) and suggest that the two scores may not be measuring the same cognitive control but two different functions. Vick and Jackson (1967) suggested that lag may represent individual differences in anchoring effects and accuracy some combination of perceptual contrast set, keenness or acuity of discrimination, and the capacity for prolonged attention to task requirements and instruction. Israel (1970) on the other hand suggests that accuracy scores involve relatively continuous and focussed attention on the task over short periods of time whereas lag scores involve attention to context and long-term change. She sees the latter as a purer measure of assimilation although this score also involves attention to gradual change. Thus accuracy is presumed to correlate with task orientation or attention to task demands and lag to correlate more highly with actual memory assimilation.

All the correlations reported in these studies were based on the assumption of linearity. Levine (1975, 1976),

however, questioned this assumption because of the tripartite interpretation of the lag score from overshooting to sharpening to levelling. By plotting accuracy on lag he obtained a significant curvilinear relationship suggesting that the scores were in fact highly correlated though not necesarily linearly. The plot of accuracy on lag suggested a positively skewed distribution peaking near the zero lag value. Near and around the zero lag value were the highest values for accuracy. As lag score increased positively, the accuracy score dropped. This is the standard view of levelling-sharpening, with sharpeners at or near zero on lag with higher accuracy and levellers with high positive lag and low accuracy. However, as the lag scores increased negatively toward overshooting, accuracy seemed also to drop but not consistently with more scatter of accuracy at this end of the continuum. It is for this reason that overshooters have tended to be left out. Although Levine (1976) is unable to offer any further understanding of this group, he does highlight the need for other measures in order to validate the construct of levelling-sharpening.

Hypotheses

Relationships between both schizophrenia and psychophysiological measures and the levelling-sharpening dimension have been suggested by previous research (see Chapter 3). Schizophrenic patients tended to be characterised by levelling although this was more characteristic of non-paranoid rather than paranoid patients and in neurotic patients levelling tended to be associated with symptoms of negative affect. In view of these findings, it is therefore predicted that schizophrenic patients will be

characterised by levelling rather than sharpening and, where diagnostic subgroup differences exist, these would be in the direction of chronic, institutionalised and nonparanoid patients being levellers and acute, paranoid and noninstitutionalised patients being sharpeners.

Following Israel's (1970) theoretical interpretation of accuracy versus lag scores it was further predicted that subjects with higher levels of electrodermal reactivity would better maintain sustained attention and have higher accuracy scores than subjects lower in electrodermal reactivity. Conversely subjects who readily develop a comparator model of such stimulus input, namely fast habituators, would have superior lag scores to slow habituators and nonresponders. Thus a linear relationship between memory and electrodermal activity would be predicted and a curvilinear relationship between lag score and electrodermal reactivity. Regarding lateral asymmetries subjects with larger right-hand responses would have higher accuracy scores than subjects with larger left-hand responses. The opposite relationship would obtain with lag scores.

Subjects

All 120 subjects took part (see Subjects and General Methodology Section).

Method

Apparatus

The test equipment included 75 slides for presentation in a Rolex slide projector, and individual record sheets.

Procedure

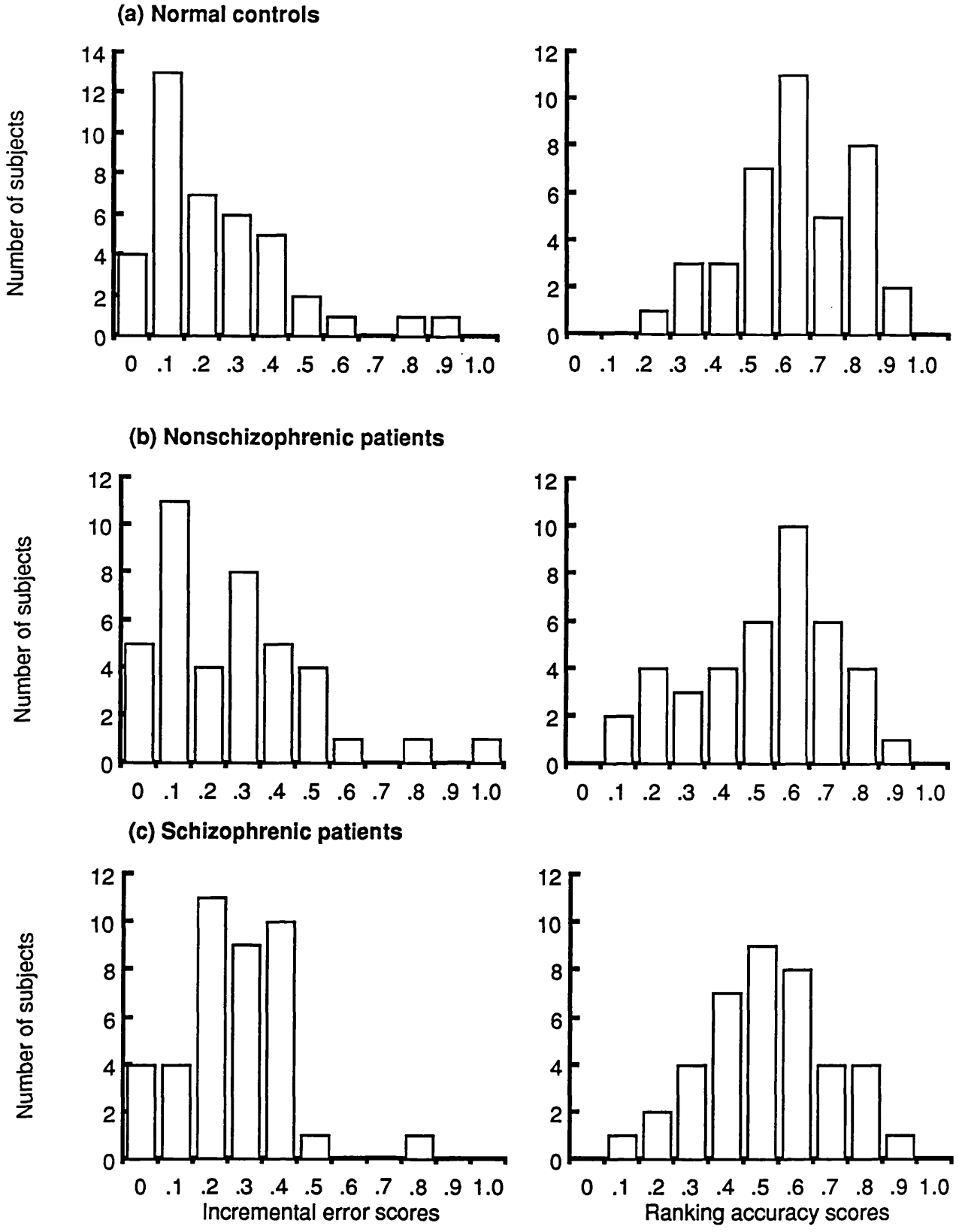
The Schematising Test was used to measure the levelling-sharpening dimension. In its original form a subject was presented with 150 slides of squares of varying sizes. The task took about 30 minutes and was deemed too long for the current study in view of its use with patients as a part of a battery of tests. It has been shown to maintain its test validity if half the test is used (Gardner and Long, 1960; Orlebeke, 1972). For the purposes of this study, therefore, only 75 slides were presented. The sizes and order of presentation of slides are given in the Appendix.

The slides were divided in terms of size into groups of 15. The first 5 slides in each group represented an ascending order, the next 2 sets of 5 slides comprised the same slides but presented in random order. In the second 15 slides, the smallest of the first 5 slides was eliminated and a longer one included at the end of the next five slides. The next 2 sets of 5 slides were presented as before in random order. There were 5 sets of 15 slides spanning a size range of squares from 1.2 inches to 4.6 inches. Each slide was presented for 5 seconds with an 10 second interval between each slide. Prior to showing the slides, subjects were given two standard slides, one containing a 1 inch square and the other an 18 inch square in order to provide some basis for judgement of square size.

The slides were projected onto a white wall in front of the subjects. Each subject was seated at a table and tested individually in a darkened room so that the slides could be seen clearly. Each slide was presented for 5

Figure 9 (i)

DISTRIBUTION OF SCHEMATISING TEST SCORES



seconds with a 10 second interval between slides. The instructions given to each subject are provided in the Appendix. Each subject filled in his/her own record sheet noting down the size estimate for each square shown in the space provided.

Two separate scores were calculated from the subject's estimates: 1) A Ranking Accuracy score which was obtained by dividing the number of stimuli correctly ranked by the maximum number (75). Two stimuli given the same rank were both counted as inaccurate. 2) An Incremental Error or Lag score which comprised the raw mean incremental error value. Details of the calculation are described in the Appendix.

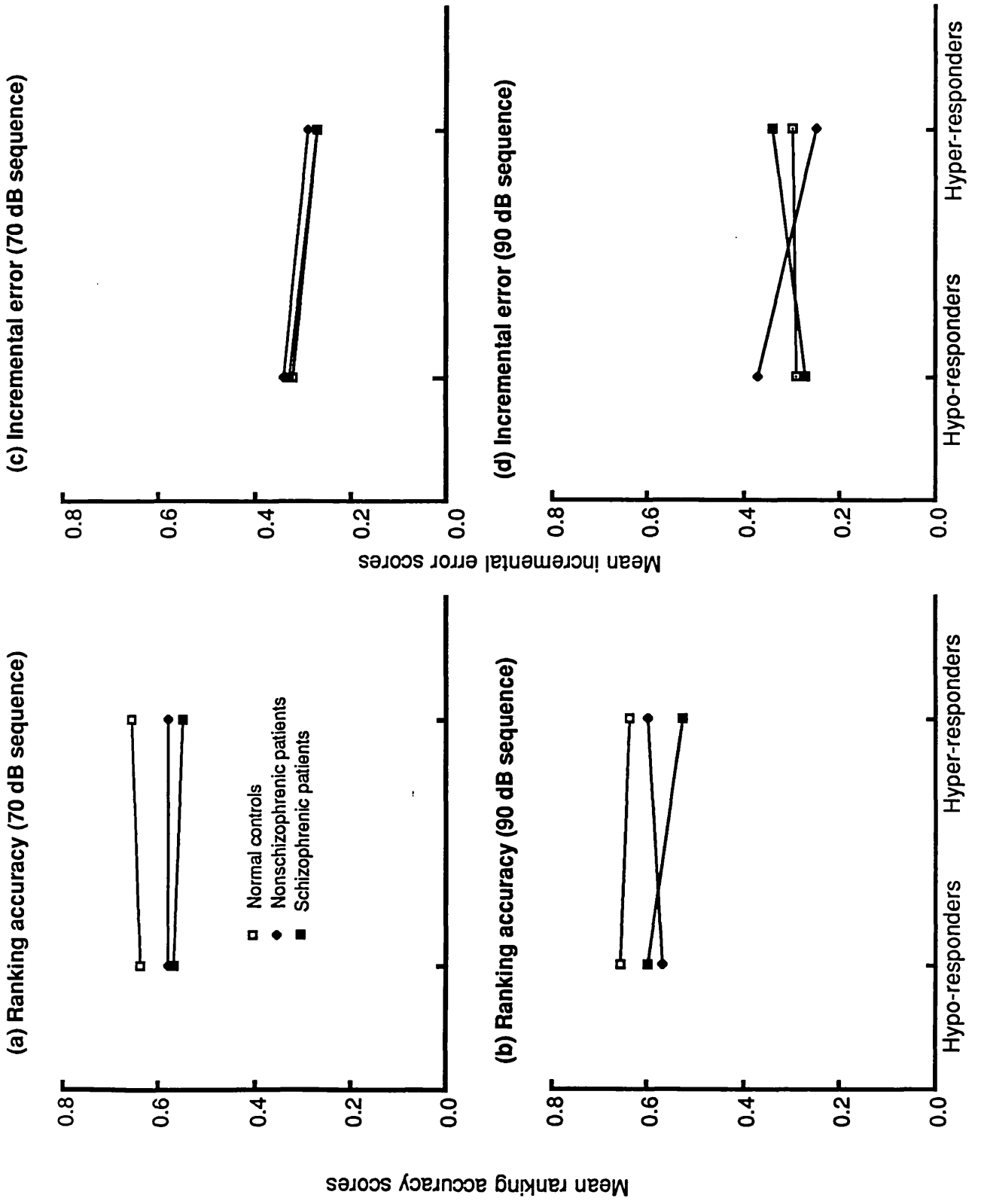
Results

The data were analysed using four-way analyses of variance (Subject Group x Sex x Habituator Group x Asymmetry Group for both Ranking Accuracy and Incremental Error Scores. There were no significant differences between the three subject groups for either accuracy or error scores (Table 9 (i), Figure 9 (i)). The normal control group showed slightly higher accuracy scores but otherwise differences were negligible suggesting that the levelling-sharpening dimension had no relation to psychopathology as represented here by the schizophrenic and depressed patients.

Looking at the relationship to electrodermal responsivity, a distinction could not be made between hypo- and hyper-responders on either measure (Table 9 (ii), Figure 9 (ii)). Correlations between the levelling-sharpening

Figure 9 (ii)

SCHEMATISING TEST SCORES IN HYPO- AND HYPER-RESPONDING SUBJECTS



measures and electrodermal responsivity suggest a tendency towards higher Ranking Accuracy scores, indicating sharpening, in subjects who were more electrodermally responsive (Table 9 (iii)). This supports previous findings of slower habituation in sharpeners (Israel, 1966). A similar tendency was found in relation to the Lag or Incremental Error Score. This was unexpected in view of the low correlations reported between the two measures. A significant correlation was, however, obtained in this study ($r = -0.89$, $p < 0.001$). There were also no 'overshooters' that might have influenced the correlation.

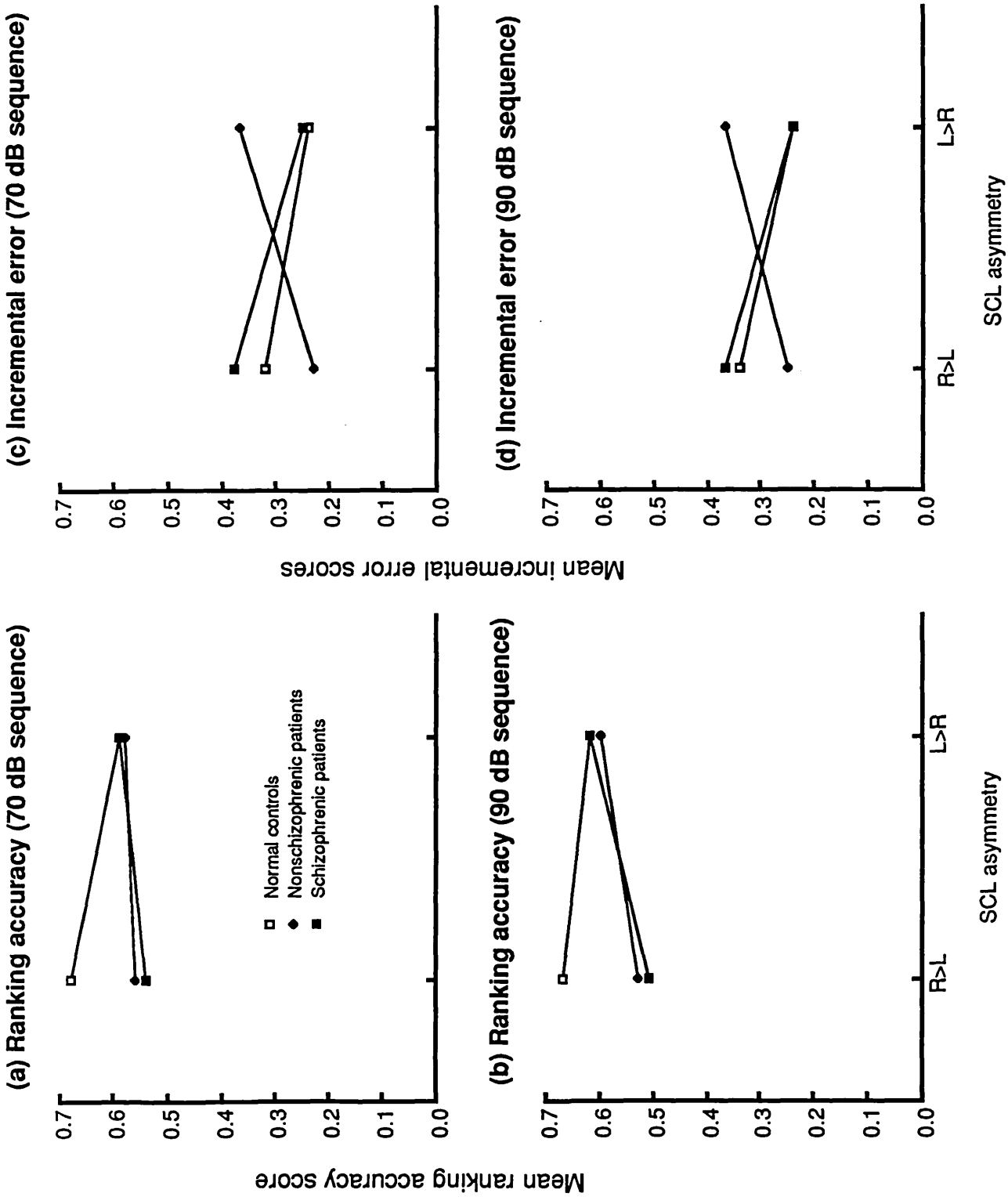
In the normal control group high initial response amplitudes to 70 dB tones were significantly correlated with high Ranking Accuracy scores ($r = 0.28$, $p < 0.05$). In schizophrenic patients high nonspecific electrodermal activity during the 90 dB sequence was related to higher Incremental Error scores ($r = 0.26$, $p < 0.03$). In nonschizophrenic patients a significant positive relation was found between Ranking Accuracy scores and higher skin conductance levels during both 70 dB ($r = 0.36$, $p < 0.01$) and 90 dB sequences ($r = 0.31$, $p < 0.03$). In the same group significant relationships were also found with temporal variables such that high Incremental Error scores related to longer response latencies ($r = 0.43$, $p < 0.04$) and rise times ($r = 0.74$, $p < 0.001$) and shorter recovery times ($r = 0.54$, $p < 0.01$) to 70 dB tones and as well as to longer rise times to 90 dB tones ($r = 0.51$, $p < 0.01$).

Laterality Effects

With respect to electrodermal asymmetry a more definite

Figure 9 (iii)

SCHEMATISING TEST SCORES AND SKIN CONDUCTANCE LEVEL ASYMMETRY



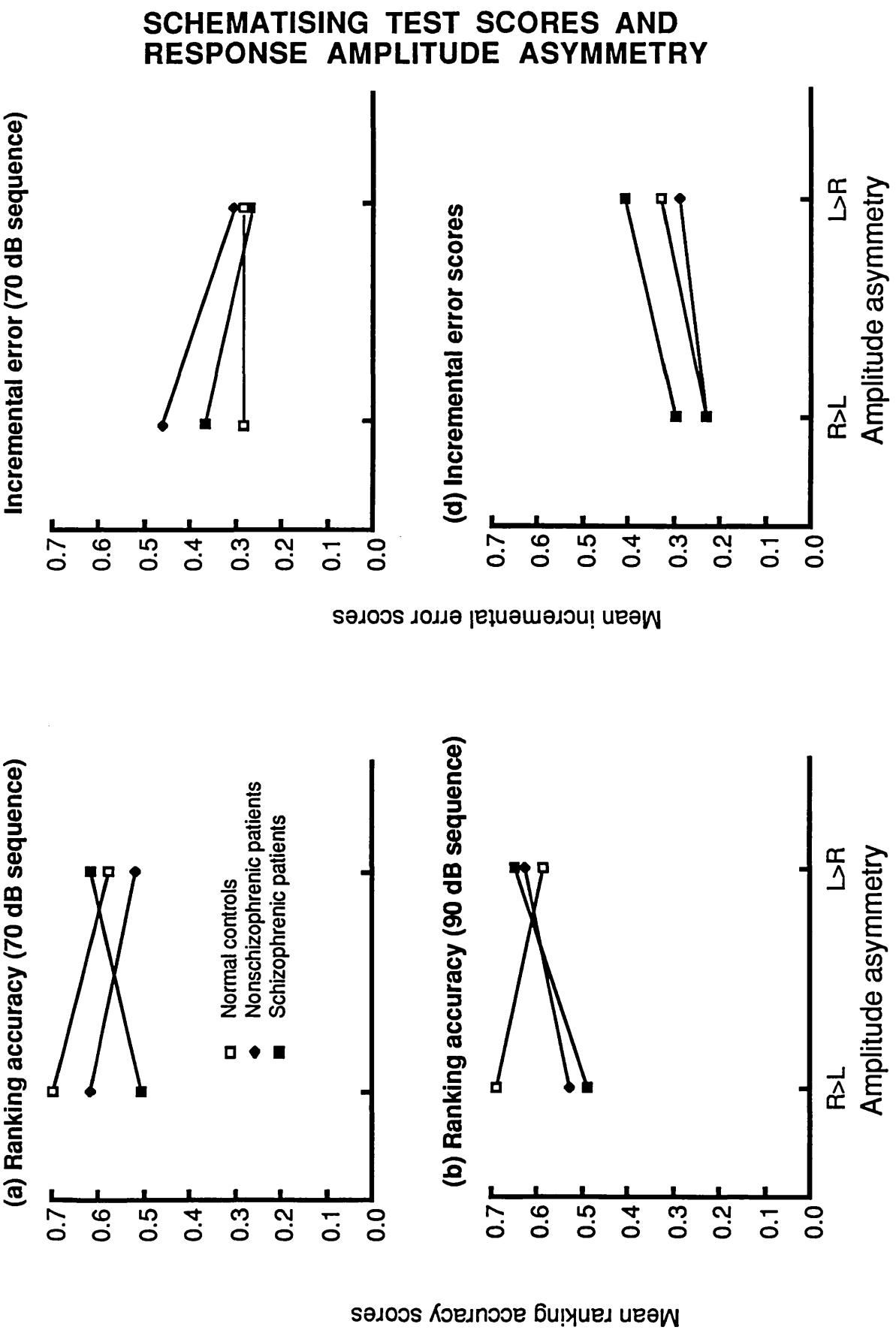
pattern emerged. Although significant main effects for skin conductance level asymmetry were not found, there was a clear trend in the direction predicted for subjects in the normal control group who had higher skin conductance levels on the right than the left hand to have higher Ranking Accuracy scores than those with the reverse asymmetry. This trend was reversed in the two patient groups. Although this pattern of relationships was the same for both tone sequences (Figure 9 (iii)), the group interaction effect approached significance in relation to the 90 dB sequence only ($F(2,119)$ 2.95, $p < 0.06$).

Incremental Error scores tended to be higher in both normal and schizophrenic subjects who had higher skin conductance levels on the right than the left hand, contrary to prediction. The reverse was true of nonschizophrenic patients. The interaction effect (Figure 9 (iii)) here, approached significance only in relation to the 70 dB sequence ($F(2,119)$ 2.62, $p < 0.08$).

The pattern in relation to response amplitude asymmetries was similar (Figure 9 (iv)). Normal subjects with higher response amplitudes on the right than the left hand had higher Ranking Accuracy scores as predicted. This trend was reversed in the schizophrenic patient group in respect of both tone sequences but only in respect of the 90 dB tone sequence in nonschizophrenic patients. The group interaction effect was significant in respect of the 70 dB sequence only ($F(2,119)$ 3.44, $p < 0.04$).

The pattern of Incremental Errors was more consistent

Figure 9 (iv)


SCHEMATISING TEST SCORES AND RESPONSE AMPLITUDE ASYMMETRY
Incremental error (70 dB sequence)
(d) Incremental error scores
R>L
L>R
Amplitude asymmetry
Mean incremental error scores
(a) Ranking accuracy (70 dB sequence)
(b) Ranking accuracy (90 dB sequence)
Normal controls
Nonschizophrenic patients
Schizophrenic patients
Mean ranking accuracy scores
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7

across groups. In all three groups subjects with higher response amplitudes on the right than left hand to the 70 dB sequence had higher incremental errors although the difference was not significant, whereas the reverse relationship obtained in relation to the 90 dB sequence ($F(1,79)$ 4.84, $p < 0.03$).

Demographic and Illness Factors

There were no significant differences in respect of sex, age, medication or patient subgroups. Illness factors seemed equally unimportant although in the schizophrenic patient group Ranking Accuracy Scores were higher in patients with fewer admissions ($r = - 0.03$, $p < 0.02$).

Discussion

Previous studies of the levelling-sharpening dimension have tended to focus on normal, nonpatient groups. Heart rate and electrodermal measures have been used and suggest that sharpeners are characterised by an "attentive orientation" toward external stimuli, focussing on differences rather than similarities between stimuli, and that this is reflected in greater cardiac deceleration (Israel, 1969; Orlebeke and Passchier, 1976) and smaller galvanic skin responses than levelers (Orlebeke and Passchier, 1976; Orlebeke and Feij (1979). Differences in tonic measures of arousal have not been found.

In the present study the relationship between levelling/sharpening and electrodermal measures has been less clear-cut. There is some evidence of a trend towards increased sharpening in subjects who are more electrodermally

reactive but this does not reflect the discontinuity between tonic and phasic measures and its relationship to a two-component theory of attention suggested by Orlebeke and Passchier (1976).

The laterality predictions were confirmed in the normal group in relation to Ranking Accuracy scores. Thus the interpretation of Israel (1970) when combined with the model relating hemispheric specialisation to habituation (Gruzelier et al, 1981) provide a possible explanation for different processes reflected in the memory and lag scores of the Schematising Test. The fact that the relationships held in the 70 dB sequence but not in the 90 dB sequence is consistent with the dynamic nature of electrodermal orienting reactivity asymmetries and may imply that the intense stimuli disrupted the typical relation between hemispheric control and habituation as was found with anxiety by Gruzelier (1987). This may also be a factor in the diverging results in schizophrenic and nonschizophrenic subjects. It is, however, of interest that the relationship between lateral responses and schematising measures were consistently opposite to controls in the nonschizophrenic group. This may reflect altered arousal organisation in depression.

Previous studies relating to psychiatric patients have tended to focus on differences between paranoid and nonparanoid schizophrenic patients. Paranoid patients were found to be sharpeners rather than levelers (Israel, 1966, Hirschfield, 1975). This was not replicated here, perhaps because the patient population used in this study included

both acute and chronic patients whereas the above two studies used chronic patients only. Hirschfield points out that chronic, paranoid patients are not expected to have the disorganising effect of their acute psychotic state to interfere with their cognitive style. The use of both acute and chronic patients may therefore cloud the issue.

Demographic and illness variables have not been reported in the literature and from this study did not appear to be important. In one study, a higher percentage Ranking Accuracy scores was found in women (Gardner and Lohrenz, 1969) but other studies have failed to show any sex differences (Gardner and Moriarty, 1968) or have not reported them.

Overall the current findings do not support a relationship between psychophysiological response style and the levelling-sharpening dimension of cognitive response style.

CHAPTER 10

Focussing-Scanning

Methodological Considerations

There are two tests normally used to measure scanning behaviour: the Picture Sorting Test and the Size Estimation Test. The picture sorting test is linked primarily to the psychodynamic aspects of scanning. This test consists of sexual, aggressive and neutral pictures to be sorted on the basis of preference, including an 'indifferent' category. Extensive scanners, who have been found through clinical tests to have a preference for avoiding commitment and clearcut affective responses, tend on this test to sort more pictures into the indifferent category. Studies using these tests formulate scanning not in terms of a bipolar dimension but simply in terms of extensive versus limited operation of this style.

In the size estimation test extensiveness of scanning is measured by asking subjects to adjust a circle of light to be equal in size to that of different hand-held discs. Gardner and Long (1960) found a test-retest reliability of 0.68 over a three year period and an intra-test (odd-even) reliability of 0.98 was also reported (Gardner, 1961). They also found high correlations between different size estimation tests (Gardner and Long, 1962) although correlations between constant error scores and either mean judgement-time or mean number-of-looks (centrations) on the standard stimulus have not always been significant (Gardner, 1970).

Size estimation refers to a methodology wherein subjects match the size of a comparison to a standard stimulus. It should be noted that a critical difference exists between this methodology and that of size constancy. In a size estimation task, the standard comparison stimuli are located at the same distance from the subject; whereas in size constancy, these distances are different. Hence, unlike size estimation, size constancy requires subjects to take distance into account in order to make an objective match between the standard and the variable.

Results of studies of size estimation on schizophrenic subjects have not always been consistent and methodological reasons have been put forward to account for these. For example, Strauss (1970; 1974), found that schizophrenics' size estimations of specific thematic stimuli are dependent on the sequence in which stimuli are presented. They suggest that some of the inconsistencies may thus result from a failure to control stimulus sequence effects in different studies. Furthermore, Kopfstein and Neale (1971) have suggested that differences are related to the number of trials so that results tend to dissipate when numerous trials are given or when size estimation is presented as a part of a larger battery of tests. Cromwell (1968) noted that increasing the exposure time or surrounding the standard stimulus by a homogeneous field resulted in an increase in size estimation level and concluded that size estimation level is, in part, a function of the amount of information processed. Thus overestimation is associated with a low and underestimation a high rate of information processing. He thus related

findings in schizophrenia to high and low stimulus redundancy and differences in responsiveness or attenuation to information. It should, however, be noted that most studies of schizophrenics using size estimation tasks are based on a task developed by Harris (1957) in which he presented subjects with affect-laden pictures (rejection, acceptance, etc.) and subjects had to remember the size of the stimuli. This is quite distinct from size estimation tasks used to explore the cognitive control of scanning (e.g., Gardner et al, 1959; Silverman, 1964, 1967).

Hypotheses

According to previous research (Chapter 3) psychiatric groups, including schizophrenic patients, show both focussing and scanning, although this would appear to be related to diagnostic subgroups. It is therefore predicted that, whilst the schizophrenic group as a whole will not be characterised by either focussing or scanning, there will be differences between subgroups and that acute, paranoid, and noninstitutionalised patients will show more extensive scanning than chronic, paranoid and institutionalised patients.

There is little prior evidence on which to base predictions about the relationship of electrodermal reactivity to the focussing-scanning dimension. However, as this dimension relates to breadth or extensiveness of attention it is likely to depend on the ability to sustain rather than focus attention. In view of the relationship between electrodermal reactivity and hemispheric specialisation, it is therefore further expected that individuals who are

extensive scanners would have higher levels of electrodermal reactivity and larger right-hand responses than focussers or miminal scanners who would be characterised by fast habituation and larger left-hand responses.

Subjects

All 120 subjects took part (see Subjects and General Methodology Section)

Method

Apparatus

The equipment for this test was the same as that described by Gardner et al (1960). This included a double glass screen, 5" square, mounted on the 9" square end of a box. A 10-watt concentrated arc lamp was focussed on the screen from inside the box to produce a smooth-edged circle of uniform brightness that could vary in diameter from 1.2 inches to 6.5 inches without substantial loss of sharpness in the contour and without penumbra. The size of the circle was adjusted by turning a small knob. Three comparison disks were used: a) a 10 gram 'neutral' gray disk, 48.5 mm in diameter; b) a 65 gram grey disk, otherwise identical to the 'neutral' disk; and c) a 10 gram disk covered with black velvet, 50 mm in diameter. The size difference was introduced to counteract possible tendencies toward perseveration in judgement. Individual record sheets were used to record size judgements.

Procedure

All subjects were tested individually seated at a table

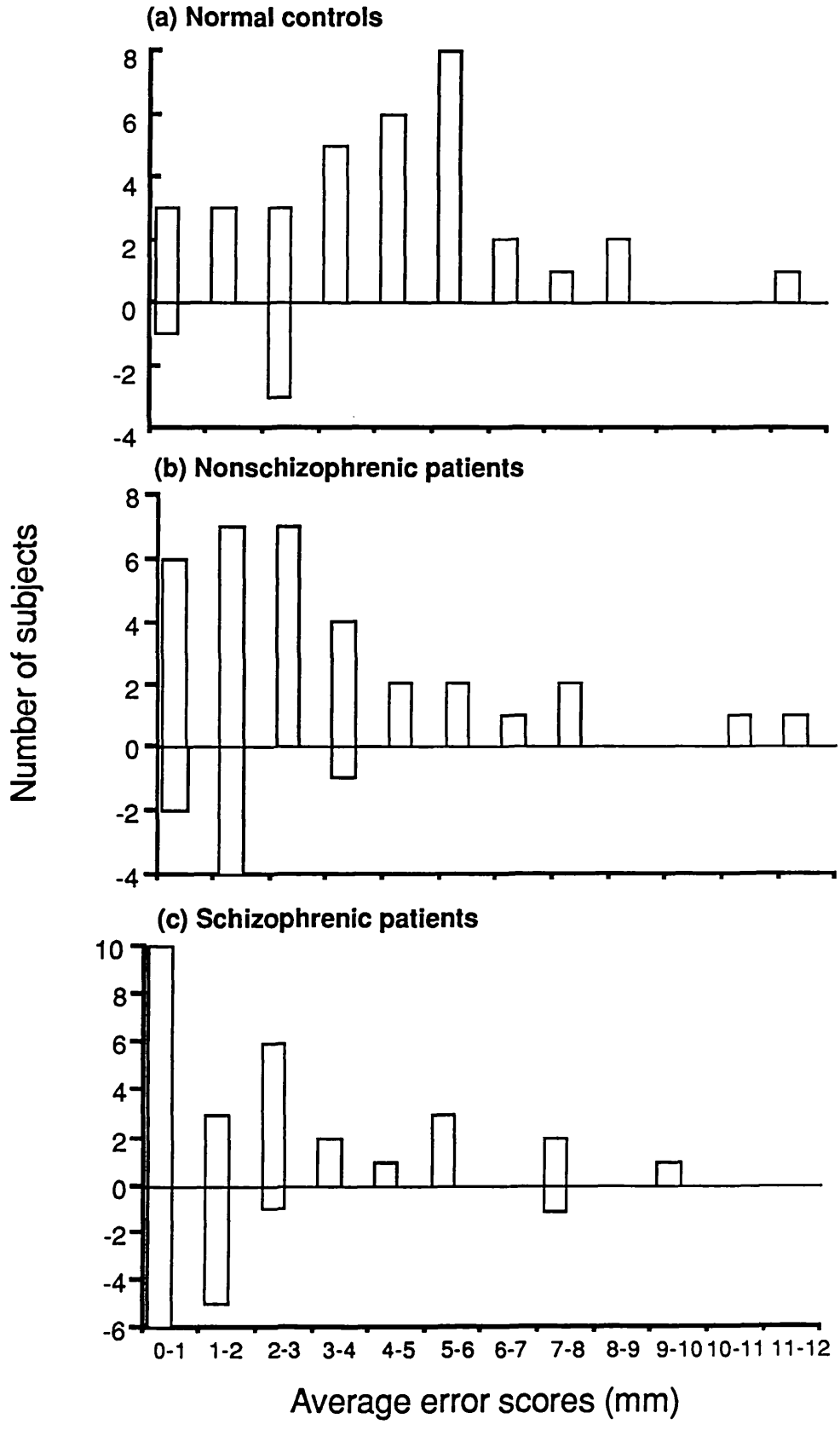
with the light box facing them. The subject was required to adjust the variable circle of light, 14" from his body to the size of the disk which he held in his left hand at approximately the same distance away. Constant checking of adjustments was possible and encouraged when giving the instructions. No time limit was specified. Normal room illumination prevailed. A total of 12 judgements were made in 4 series with a random order of disk sizes in each series. The order of ascending and descending judgements was counterbalanced across subjects and adjustments were made only in the direction determined by the initial ascending or descending movement. Adjustments were made by the examiner at the instruction of the subject. At the end of each adjustment the size of the circle of light was measured using a grid that fitted over the screen with 1 mm markings and recorded on a record sheet (see Appendix for copy of record sheet).

The examiner first switched on the light producing the comparison stimulus and then turned the knob to vary the size of the circle of light. The following instructions were given:

"You see how I can make this circle larger or smaller by turning this knob? I want you to adjust this circle of light to be equal in size to some disks which I will ask you to hold in your left hand. Here is the first disk. I will adjust the size according to your instruction. When the circle of light looks to be the exact size of the disk, tell me to stop. Then let me know if you wish to make any further adjustments."

Figure 10 (i)

DISTRIBUTION OF SIZE ESTIMATION SCORES



An average error score was calculated as the average error in 12 judgements of the three disks.

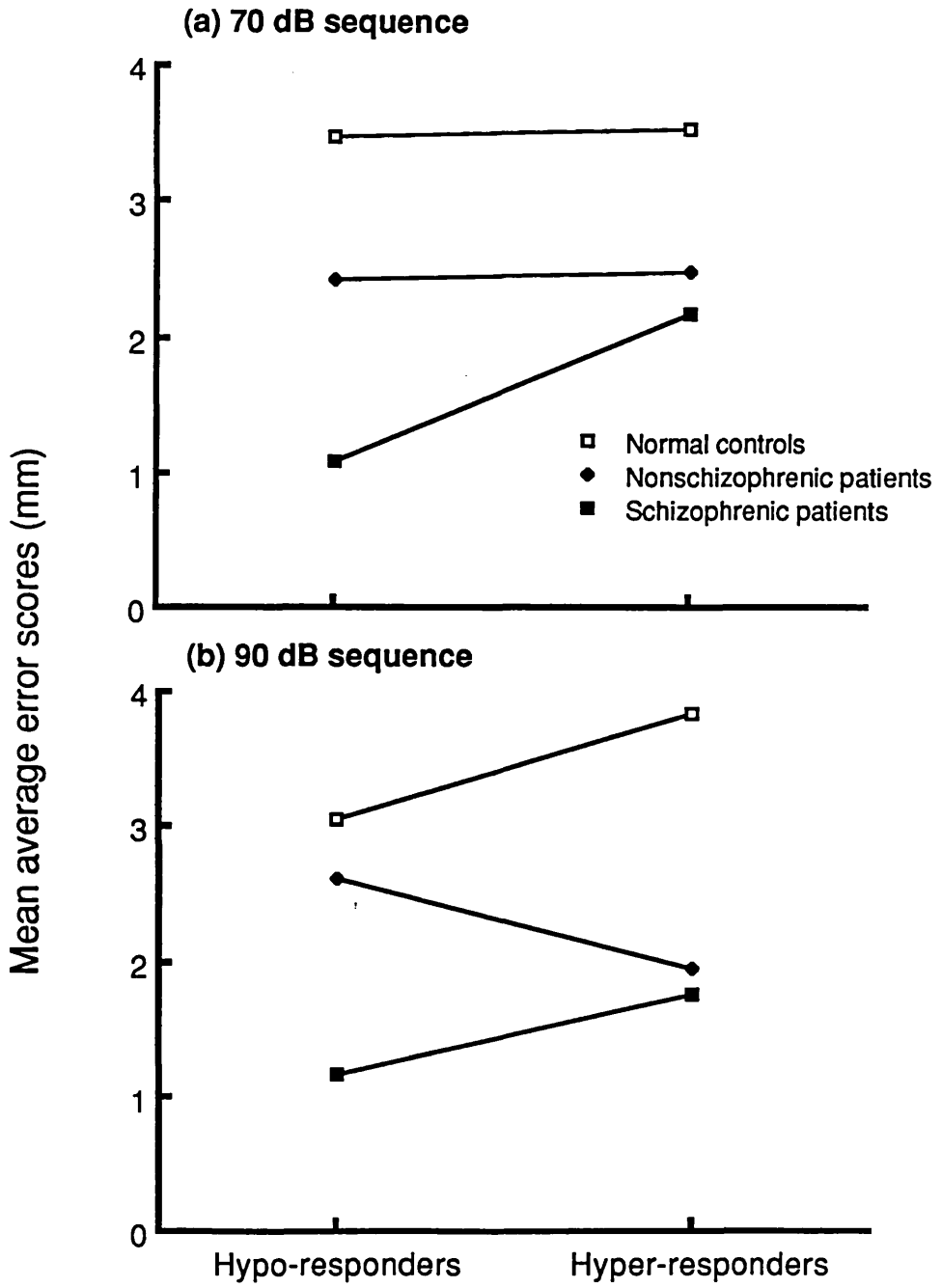
Results

Average error scores were fed into a four-way analysis of variance (Subject Group x Sex x Habituator Group x Asymmetry Group). A main effect for Subject Group ($F(2,119)$ 3.23, $p < 0.05$) revealed that normal control subjects had significantly higher average error scores than schizophrenic subjects (Scheffè, $p < 0.03$) and both patient groups together ($p < 0.01$), but not nonschizophrenic patients alone. Nonschizophrenic subjects scored higher than the schizophrenic subjects but differences were not significant. These results support the findings of Otteson and Holzman (1976). From the means in Table 10 (i) it is apparent that all three groups tended to overestimate rather than underestimate the stimuli (Figure 10 (i)). The schizophrenic group appeared to be the most accurate in their estimations. However, when the ranges for the different groups are compared it becomes obvious that the schizophrenic group showed a greater distribution of scores with more underestimation (11/40) than in either the nonschizophrenic patients (7/40) or normal control subjects (5/40).

Examining the relationship between size estimation and electrodermal reactivity, differences between habituator groups were not significant (Table 10 (ii)). There was, however, a tendency for hyper-responding subjects to overestimate more than hyporesponding subjects in all three groups and in respect of both sequences with the

Figure 10 (ii)

SIZE ESTIMATION IN HYPO-AND HYPER-RESPONDING SUBJECTS



exception of nonschizophrenic patients who showed the opposite relation to the 90 dB sequence (Figure 10 (ii)). Correlations between electrodermal variables and size estimation scores were for the most part nonsignificant (Table 10 (iii)). Overestimation was related to shorter rise times to 70 dB tones ($r = 0.46$, $p < 0.01$) in the schizophrenic group and to shorter response latencies to 90 dB tones in the normal group ($r = 0.50$, $p < 0.002$).

Laterality Effects

Looking at asymmetry group differences subjects with higher skin conductance levels on the right than the left hand to 70 dB tones had higher average error scores showing greater overestimation than those with the reverse asymmetry ($F(1,119)$ 4.74, $p < 0.03$). This was true of all subject groups to both sequences although within-group differences were not significant (Figure 10 (iii)). The differences in relation to the louder tones showed a similar trend ($F(1,119)$ 3.57, $p < 0.06$).

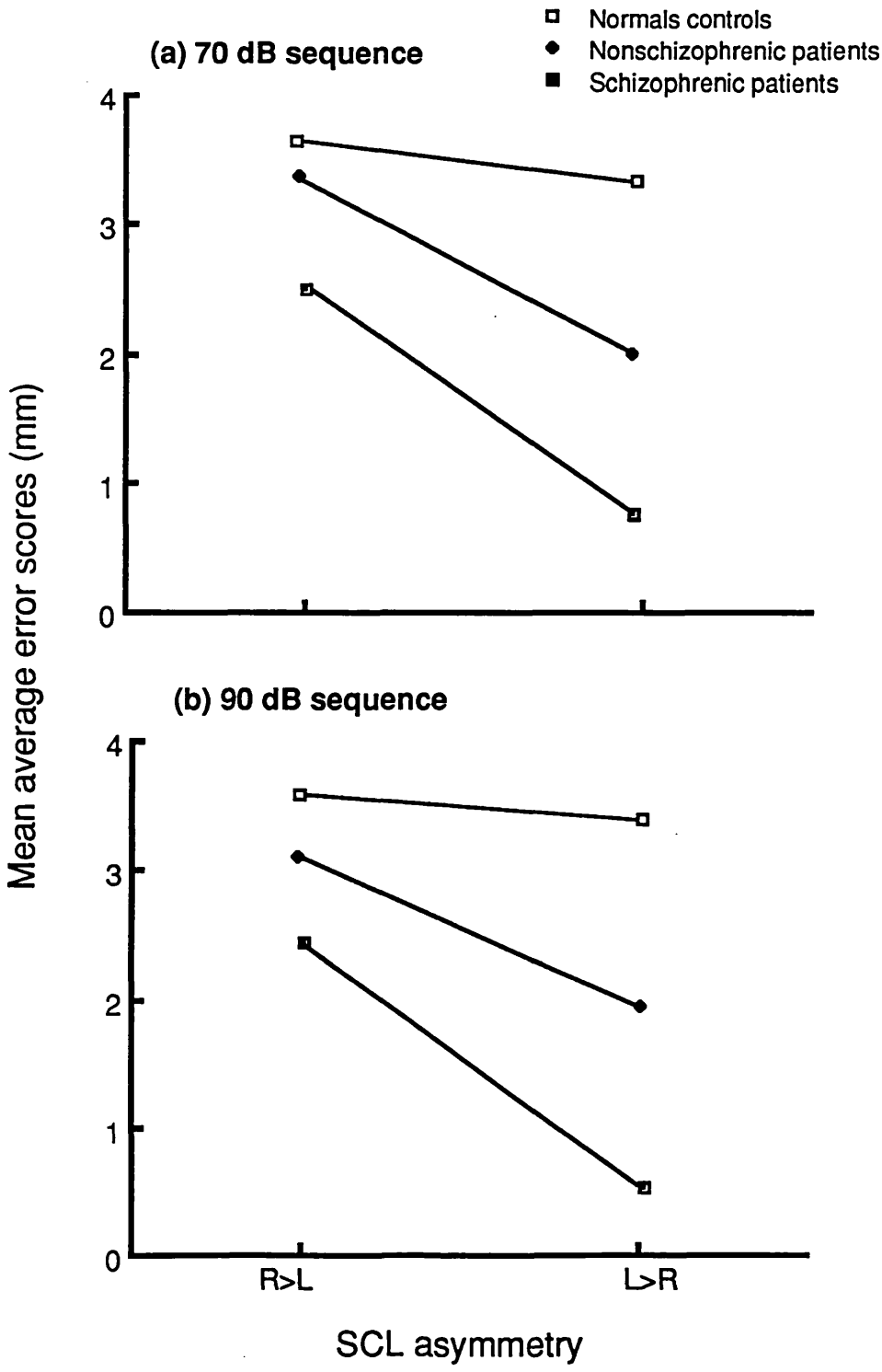
Differences in relation to response amplitude asymmetry were not significant although a similar pattern prevailed with subjects having higher response amplitudes on the right than the left hand showing higher average error scores. This was true of all subject groups except for nonschizophrenic subjects in relation to the 90 dB tones where the pattern was reversed (Figure 10 (iv)).

Diagnostic Subgroups

When comparing schizophrenic subgroups, although the expected trend of acute patients (5/12) underestimating

Figure 10 (iii)

SIZE ESTIMATION AND SKIN CONDUCTANCE LEVEL ASYMMETRY



more than chronic patients (6/23), and noninstitutionalised patients (8/26) more than institutionalised patients (3/14) was present, differences were not significant. Furthermore the tendency for greater underestimation in paranoid patients noted in previous research was reversed.

Illness Factors

In both patient groups duration of illness was a significant factor with underestimation more prevalent in people with long-standing illness (nonschizophrenic patients: $r = -0.26$, $p < 0.05$; schizophrenic patients: $r = -0.39$, $p < 0.01$)). There were no effects of medication.

Sex Effects

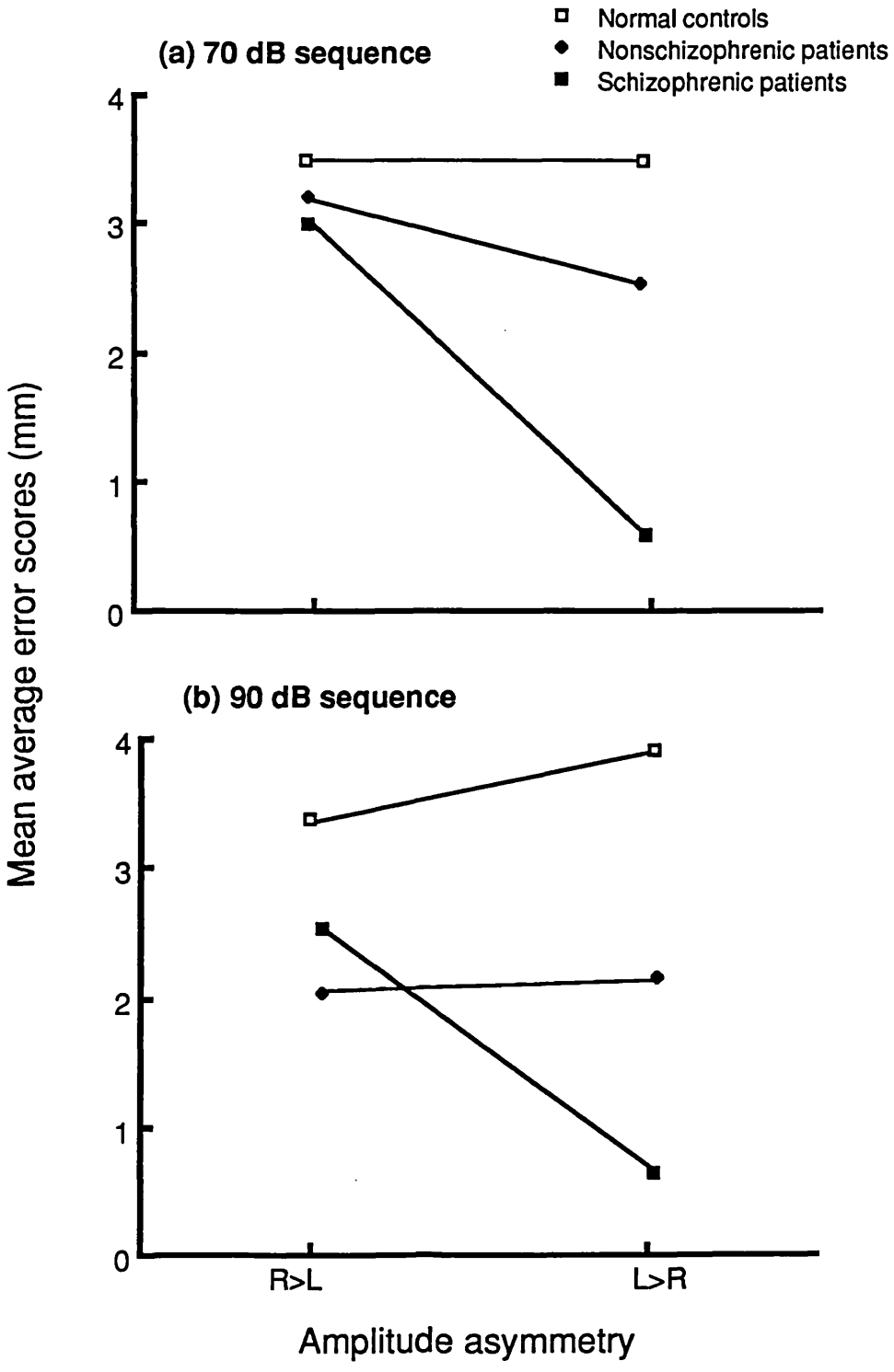
Whilst no main effect for sex was obtained there was an interaction with Subject Group ($F(2,119)$ 3.46, $p < 0.04$). In the normal control group, female subjects had higher average error scores than men whereas in the two patient groups this was reversed. Differences were only significant in relation to the nonschizophrenic group ($p < 0.05$). This is in accordance with previous findings (Otteson and Holzman, 1976).

Age Effects

The relationship with age was quite consistent in all three groups with a tendency towards more underestimation in older subjects (normal controls: $r = -0.44$, $p < 0.02$; nonschizophrenic patients: $r = -0.27$, $p < 0.05$; schizophrenic patients: $r = -0.37$, $p < 0.01$)).

Figure 10 (iv)

SIZE ESTIMATION AND AND RESPONSE AMPLITUDE ASYMMETRY



Discussion

The results here do not firmly support a relationship between the focussing/scanning dimension and electrodermal reactivity per se. They suggest that overestimation or minimal scanning is more likely to be associated with both a higher level of electrodermal responding and with a predominance of right hemisphere influences on electrodermal activity. Earlier findings have suggested that both these measures reflect sustained rather than selective attention (Blakeslee, 1979; Waters et al, 1977; Gruzelier et al, 1981). This is consistent with the view that overestimation occurs as a result of centering attention on the stimulus rather than scanning the visual field so as to see it within the context of other environmental cues. In the case of the size estimation task this would, for example, include the comparison stimulus.

Comparisons between subject groups suggested that there was a significant difference between schizophrenic patients and normal control subjects but not between the two patient groups nor between the nonschizophrenic patients and the normal control group. However, Otteson and Holzman (1976) like various other authors reported no significant differences. In fact, they found a difference on the error scores between normal and patient groups but felt it was more likely to be related to patient inefficiency rather than the extent of scanning because these differences remained even when the portion of the variance attributable to the commonality with other tests in a scanning factor were removed. This aspect will be looked at later using factor analysis. The results in this

study suggest that there may after all be an effect of psychopathology on size estimation.

On the other hand there is a large literature looking at differences between different types of schizophrenic patients. Where differences along the focussing/scanning dimension have been found there seems to be agreement that whereas paranoid schizophrenics tend to underestimate or show extensive scanning, nonparanoid schizophrenics tend to overestimate or show minimal scanning (Silverman, 1964, 1967; Davis et al, 1967; Neale and Cromwell, 1968; Asarnow and Mann, 1978; McCormick and Broekma, 1978). Similarly acute schizophrenics show extensive scanning and chronic schizophrenics minimal scanning (Silverman, 1967; Broen, 1968; Feeney, 1971; Broen, 1973). Whilst trends in the same direction were found for some patients and in the reverse direction for others, differences between subgroups in this study were not significant and tended to concur with the Otteson and Holzman study (1976).

A more important finding than patient subgroup differences was the effect of the duration of illness. This suggests that as a cognitive style variable the focussing/scanning dimension may be an important factor in illness prognosis. Previous findings on premorbidity in schizophrenic patients have suggested that good premorbids tend to underestimate and poor premorbids tend to overestimate (Harris, 1957; Zahn, 1959; Silverman and Gaarder, 1967). The findings here would, however, suggest the reverse. The differences between the present study and previous findings may be due to the fact that premorbidity in

previous studies was defined according to an assessment scale looking at prognosis in patients during a relatively early onset of their illness whereas this study is based on how long the illness has already lasted. The results here are more consistent with the distinction between acute and chronic schizophrenic patients. Both chronic patients and patients with long-standing illness (essentially the same as a poor premorbid, group) tend to underestimate or show minimal scanning.

Medication also appeared to have no effect although McKinnon and Singer (1969) showed a reversal of the degree of scanning in patients in whom chlorpromazine was withdrawn. Their results may have, however, related to withdrawal factors rather than effects of medication per se.

Sex differences have not been widely reported and they were not found to be significant here. Age differences have also not been widely reported. Gardner and Long (1962) suggested there was an increase in focussing with age but the age range was only 17 to 22 years. The age range in the present study was considerably larger but showed the same increase in focussing with age supporting their findings.

CHAPTER 11

Augmenting-Reducing

Methodological Considerations

The Petrie Kinesthetic Figural After-Effect (KFA) Test is the measure of choice in this particular study. The basic procedure used by Petrie was a modified version of one devised by Kohler and Dinnerstein (1947). On this test tactile judgements of size are made between a standard block and a comparison block of varying width. Following a baseline judgement, the subject rubs an interpolated stimulation block which is either larger or smaller than the standard block. The degree to which the subject then underestimates (reduces) or overestimates (augments) the second comparison is taken as a measure of the degree of augmenting or reducing. This form of measurement has been found to be susceptible to influence by a large number of factors that Petrie tried to control for: exposure to most types of drugs (e.g., aspirin, alcohol), excessive stimulation of any kind (e.g., noise), smoking and menstrual cycle for females. It is, however, considered to have both reliability and validity (Barnes, 1976) and the evidence supporting this is summarised below.

Several methods have been used to assess the reliability of the KFA. Petrie et al (1963) and Petrie (1967) reported split-half reliabilities of 0.98 (schoolchildren) and 0.97 (student nurses) and satisfactory internal or within-test reliabilities have also been reported with correlations ranging from 0.70 to 0.88 by other researchers (Broadhurst

and Millard, 1969; Morgan and Hilgard, 1972; Platt et al, 1971; Schooler and Silverman, 1971). Another test of reliability has compared large block and small block stimulation judgement score. Correlations using this method were lower (Broadhurst and Millard, 1969: 0.27). It is suggested that this could be due to contrast effects masking the tendency to augment or reduce (Barnes, 1976).

Petrie considered stimulus intensity modulation to be a relatively stable individual difference which suggests that test-retest reliability should be high. Reliabilities ranging from 0.60 to 0.94 have been reported (Eysenck, 1955; Spitz and Lipman, 1960; Petrie, 1967) but several studies have found test-retest reliability to be very low (Platt et al, 1971; Morgan and Hilgard, 1972). This may be due to different methodologies and to the use in some studies of the same baseline which artificially inflates the scores as the baseline component is constant. The finding that change scores are not reliable from day to day has been shown by Weintraub et al (1973) who also noted that repeated testing tends to reduce the after-effect. Another problem is the use of the tapered wedge as errors of anticipation may occur as subjects typically stop short of the point of objective equality (Costello, 1961; Blitz et al, 1966). This can, however, be controlled for by averaging scores from both ascending and descending judgement trials.

It has also been demonstrated that figural aftereffects decay exponentially over time (Hammer, 1949; Ineda and Obonai, 1953; Singer and Day, 1965) suggesting that

judgement time might be important. Where age differences are found, for example, they tend to disappear when judgement time is controlled for (Over and Criew, 1968). This may also be important in relation to patient populations as schizophrenic patients tend to take longer to make judgements than normal subjects. (Wertheimer and Jackson, 1957; Day et al, 1967).

In summary, within-session reliability of the KFA appears to be satisfactory whereas between-session reliability is more dependent on the index of reliability used. Thus, if change scores alone are used, reliabilities are low, whereas if residual change scores are used and the baseline component is included reliabilities are high.

One method used to determine the validity of augmenting-reducing has been to compare different tests measuring the same central process. For example, Spitz and Lipman (1960) argued that if the KFA is to be taken as a valid measurement of a general property of the brain there should be a high correlation between visual and kinesthetic figural after-effects. This relationship was found by Wertheimer (1955) and Landauer et al (1966) but other reseach has failed to do so (McEwen and Rodger, 1960; Spitz and Lipman, 1960; Day et al, 1967).

Another method used to determine construct validity has been to compare various measures of stimulus intensity control. One alternative method of measurement is the average evoked response (AER). This method uses the cortical evoked response to several different intensities

of stimulation. In general, the amplitude of the AER has been found to increase with increasing intensity of the stimulus. In some subjects, however, there is no increase and often a decrease with increasing stimulus intensity. The relationship between changes in evoked response amplitude and increases in stimulus intensity is expressed in terms of the slope of a linear function relating amplitude to stimulus intensity. With respect to increasing stimulus intensity, a high slope represents relatively large increases in AER amplitude (augmenting) and a low or negative slope reflects relatively small increases or decreases in amplitude (reducing).

The AER method has been used with light flashes in a series of studies by Buchsbaum and his colleagues (Buchsbaum and Silverman, 1968; Silverman et al, 1969; Buchsbaum and Pfefferbaum, 1971). In normal subjects they have found that in augmenters higher intensities of light produce more responsiveness with larger amplitudes for EEG waves and shorter latencies. For reducers, the opposite pattern was observed with high intensities eliciting smaller amplitudes and longer latencies. Inderbitzen et al (1970) found a test-retest correlation of 0.74 using this method after 1 month and Buchsbaum and Pfefferbaum (1971) reported a test-retest corelation of 0.70 after 2 or more months. Significant correlations were also found between evoked response latency, amplitude measures and KFA values (Buchsbaum and Silverman, 1968; Blacker et al, 1968; Silverman et al, 1969; Spilker and Callaway, 1969; Borge, 1973; Buchsbaum and Pfefferbaum, 1971; Buchsbaum, 1978).

The Petrie KFA and AER measures also appear to have similar behavioural correlates with reducers on both measures showing a tolerance for pain (Von Knorring et al, 1974; Buchsbaum, 1975) and similar personality correlates with augmenters tending to be sensation-seekers (Zuckermann et al, 1974; von Knorring, 1980). However, the AER method has been questioned by several authors on both operational (Haier et al, 1983) and methodological (Iacono et al, 1982; Connolly and Gruzelier, 1982; Robinson et al, 1984) grounds such that it has been suggested that studies using different modalities and measures to define augmenters and reducers may not be concerned with the same sensory process (Prescott et al, 1984) or show a valid relationship to KFA measures (Connolly and Gruzelier, 1982). This also has implications for the theoretical underpinning of stimulus intensity control. If reducing is attributed generally to a cortical inhibitory mechanism and in schizophrenia to a protective mechanism for sensory overload then reducing should be found in all modalities which it is not (Pfefferbaum et al, 1980; Raine et al, 1981).

Another alternative is the Vando R-A Scale (Vando, 1969). This is a 54 item paper-and-pencil test with a split half reliability of 0.89 and test-retest correlation of 0.74. High scorers or reducers on this test displayed greater pain tolerance and were higher on extraversion and lower on hypochondriasis measures than augmenters. Also reducers smoked more and slept less hours. All of these findings are in accord with Petrie's theorising.

Overall the evidence supports the validity of the KFA

procedure as a measure of stimulus intensity control. Spilker and Callaway (1969) concluded, however, that the lack of day-to-day consistency in subjects could be taken as evidence against either KFA or AER measures being indicators of any enduring cognitive style. The fact that the KFA and AER score varied together suggested that instead a transient cognitive style may exist. In answer to this, Barnes (1976) drew a parallel between stimulus intensity modulation and Spielberger's (1966, 1972) concept of anxiety. Whereas trait anxiety may be viewed as a personality variable, state anxiety is seen as a transitory situational response. Similarly individuals may be trait augmenters but on occasion function as reducers (state reducers) or vice versa. State/trait differences may also be reflected in different measures. Thus the KFA procedure which is less stable may measure the state aspect of stimulus intensity modulation whereas more stable measures such as the Vando R-A Test may tap the trait aspect. This idea is not inconsistent with Petrie as she also postulated that extreme augmenters could become reducers when overstimulated or on drugs.

Sex differences on the KFA procedure have not generally been found although Petrie (1967) noted that the more extreme cases of perceptual reduction have been found in men rather than in women. Differences have, however, been found in relation to the AER procedure with females having higher amplitudes and slopes than males for visual but not for auditory stimuli (Rodin et al, 1965; Silverman, 1969; Buchsbaum and Pfefferbaum, 1971; Gershon and Buchsbaum, 1977). Furthermore, different response patterns have been

found to characterise men and women on the AER procedure (Buchsbaum and Silverman, 1968). For males, augmenters and reducers differed more at low intensities of stimulation, whereas for females, augmenters and reducers differed more at higher intensities. Silverman et al (1968) also found that greater sensitivity on thermal, light and sound measures was associated with AER reducing in males and AER augmenting in females. One of the factors that might be important in producing sex differences is the female menstrual cycle. Silverman et al (1969) suggested that changes in the amount of carbohydrate active steroids present in the female during the menstral cycle could affect stimulus intensity modulation.

Hypotheses

A consistent finding among schizophrenic patients (see also Chapter 3) has been the tendency towards perceptual reduction rather than augmentation. This is in line with the view that some schizophrenic patients are in a state of sensory overload and that reduction is an attempt to compensate for the perceived overstimulation. Differences in stimulus intensity modulation have, however, been noted among different patient subgroups. It is therefore predicted that whilst the schizophrenic group as a whole will be characterised by perceptual reduction, within-group differences will be found such that acute, nonparanoid patients will show more reduction whereas chronic, paranoid patients will show more augmentation.

Parallels between psychophysiological and behavioural measures of augmenting-reducing have been fraught with

methodological difficulties and the relationship is not clearcut. However, in that both electrodermal hyporesponding and reduction are seen as 'gating' mechanisms it is expected that individuals who show reducing would be less electrodermally responsive than those classified as augmenters. Furthermore, following Silvermans' (1967) hypothesis that augmenting is related to a broad rather than a narrow focus of attention which is associated with a right hemisphere dominance, it would be consistent with the reciprocal relationship between electrodermal reactivity and hemispheric specialisation for reducers to have larger left-hand responses and augmenters to have larger right-hand responses.

Subjects

All 120 subjects took part (see Subjects and General Methodology Section).

Method

Apparatus

The Petrie Kinesthetic Figural After-Effect Test was used to measure augmenting and reducing. The equipment comprised a tapered block of wood 30 inches long. Running the length of the block which was 30 inches long, was a ruler marked in 1 inch and 1/8 inch units. Mounted around the ruler was a pair of parallel sticks used as finger guides. The block tapered from 1/2 inch at its narrow end to 4 inches at its wide end. There were also 4 rectangular blocks 1, 1 1/2, 2 and 2 1/2 inches wide. Each of these blocks was 6 inches long and had a finger guide. On the

table on which the blocks were placed was a large sheet of hardboard with ridges to determine fixed placement of the tapered and rectangular blocks (picture in Appendix). Measurements were recorded on individual sheets.

Procedure

All subjects were tested individually. The subject was seated at the table and blindfolded using blacked out swimming goggles which prevented vision completely before the equipment was placed on the table. The long tapered block was placed by the subject's left hand with the narrow end toward the subject. The measuring block was placed by the subject's right hand. The angles and position of the blocks in relation to the subject are illustrated in the picture in the Appendix.

The subject's right hand was then lifted and his fingers placed in position between the finger guides on the measuring block. The subject was made to feel that the sides were parallel by sliding his hand along the block. The subject's left hand was then placed on the narrow end of the tapered block. The subject's arms were above the table, not resting on it. The subject's thumb and index finger were placed between the finger guides and moved along the block towards the wider end of the block so that the subject could feel that the block tapers, and then returned to the narrow end of the block.

The subject was then asked to find with his left hand on the tapered block the place that felt to him just as wide as the measuring block between the fingers of his other

hand. The position reached by the front end of the central finger guide on the ruler was recorded to the nearest 1/8th inch as the first baseline measurement. His hand was then moved back to either the narrow or wide end of the tapered block and another measurement made. Altogether six successive baseline measurements were recorded.

The subject's hand was then removed from the tapered block and guided to a position, palm upwards, on the table, instructing the subject to let their hand rest in this position. The other hand is removed from the measuring block to a stimulating block, instructing the subject to rub the block by sliding his fingers along its whole length, backwards and forwards, at a moderate pace until he was told to stop. The total time of the first stimulation was 90 seconds. Immediately following 90 seconds of rubbing, the tester removed the subject's hand from the stimulating block and placed it on the measuring block. The other hand was replaced onto the tapered block and 4 more measurements were made and recorded. The subject's left hand was again rested and his right hand stimulated as before by rubbing for 90 seconds. After this stimulation, 4 more measurements were made. The subject then rubbed the stimulating block for 120 seconds and four more measurements were made. A total of 18 measurements were made and recorded. Prior to and during testing the subject was given the instructions contained in the Appendix.

Subjects were tested using the large block stimulation only. The decision to omit the small block stimulation was made for several reasons. Firstly this test constituted

part of a battery that needed to be carried out in one session so that the time allotted for each individual test was restricted. Secondly, although the evidence correlating the two types of stimulation has tended in some studies to be low, this is due to what Barnes (1976) refers to as contrast effects that are masking augmenting and reducing and, in my opinion, appears to be related to what Petrie (1967) calls being 'stimulus-governed'. This is the tendency for some subjects to be reducers on large block stimulation and augmenters on small block stimulation. This was confirmed in a small pilot study (N = 13). In addition, Schooler and Silverman (1971) have suggested that, at least in schizophrenic patients, the two types of stimulation may be measuring different things.

As the main focus of the current study is to look at the relationship between measures of cognitive and psychophysiological style rather than that between any one measure and individual personality or psychopathology, it was considered sufficient to use only one type of stimulation. Large block stimulation was chosen as this was found to elicit a wider range of scores in the pilot study. The order of descending and ascending trials was counterbalanced across subjects. Although Petrie (1967) used only ascending trials, the effect of averaging both ascending and descending trials is to control for errors of anticipation (Barnes, 1976) and thus eliminate bias in the direction of either augmentation or reduction.

An individual KFA score was calculated for each subject using the following method: Average scores were calculated

for the baseline (omitting the first 2 practice trials) and subsequent three sets of post-stimulus trials using both ascending and descending judgement trials. Each post-stimulation average score was subtracted from the baseline and the final KFA score constituted the average of the 3 subtracted scores. Using the Petrie (1967) criteria subjects who underestimated the size of the measurement block by 1.8 inches (6mm) or more were classified as reducers and those who overestimated by 1.8 inches (6 mm) or more as augmenters with those in the middle being classified as moderates.

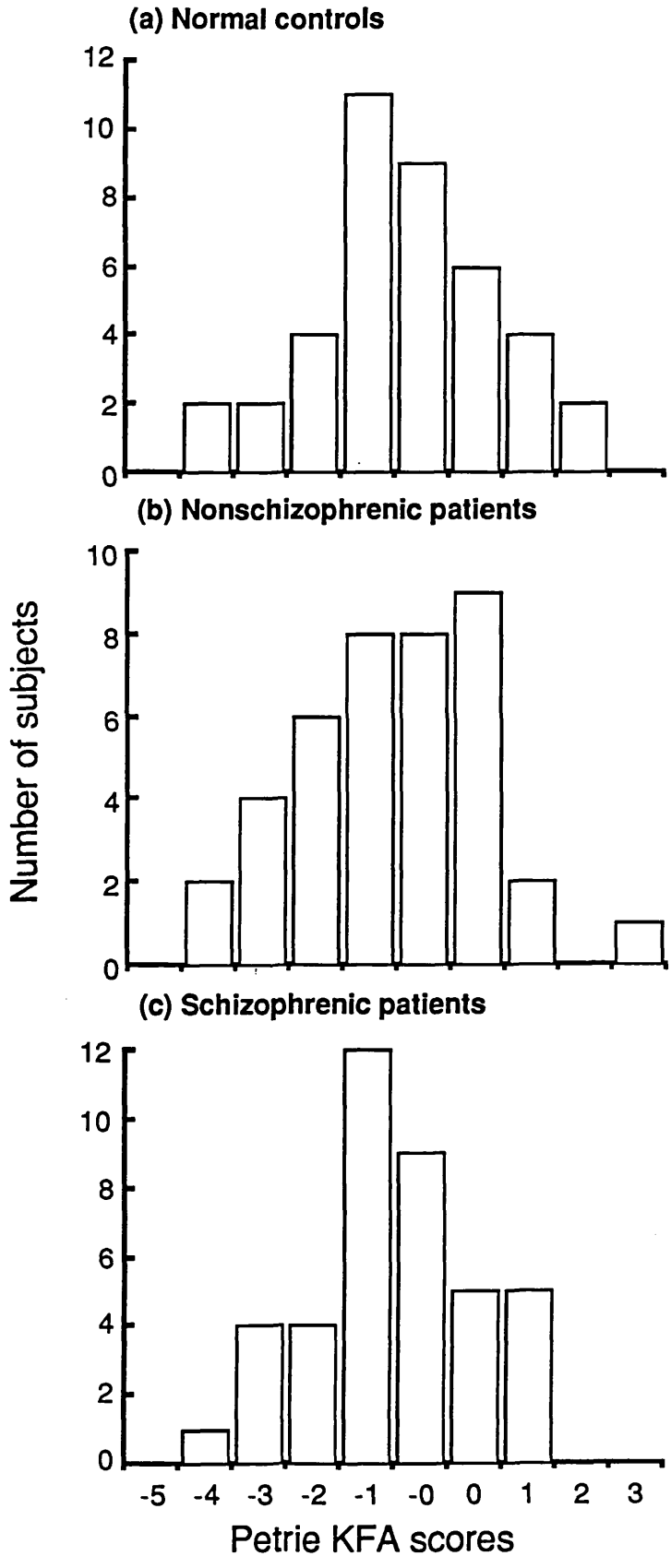
Results

The KFA scores were analysed using a four-way analysis of variance (Subject Group x Sex x Habituator Group x Asymmetry Group). There were no significant main or interaction effects. The means in Table 11 (i) suggest that all groups tended to be reducers with the greatest reduction in non-schizophrenic patients and the least in normal controls. The lack of difference between groups supports findings by Day et al (1967) but not the trend found in some studies that schizophrenics are perceptual reducers. The range of scores (Figure 11 (i)) suggests, however, that schizophrenic patients had a smaller aftereffect than normal controls or nonschizophrenic patients confirming previous studies at least with respect to normal subjects (Kelm, 1962; Wertheimer and Jackson, 1957; Wertheimer, 1955).

The relationship between KFA scores and electrodermal responding was not significant (Table 11 (ii)). Overall hyper-responding subjects tended to show less reduction

Figure 11 (i)

DISTRIBUTION OF PETRIE KFA SCORES

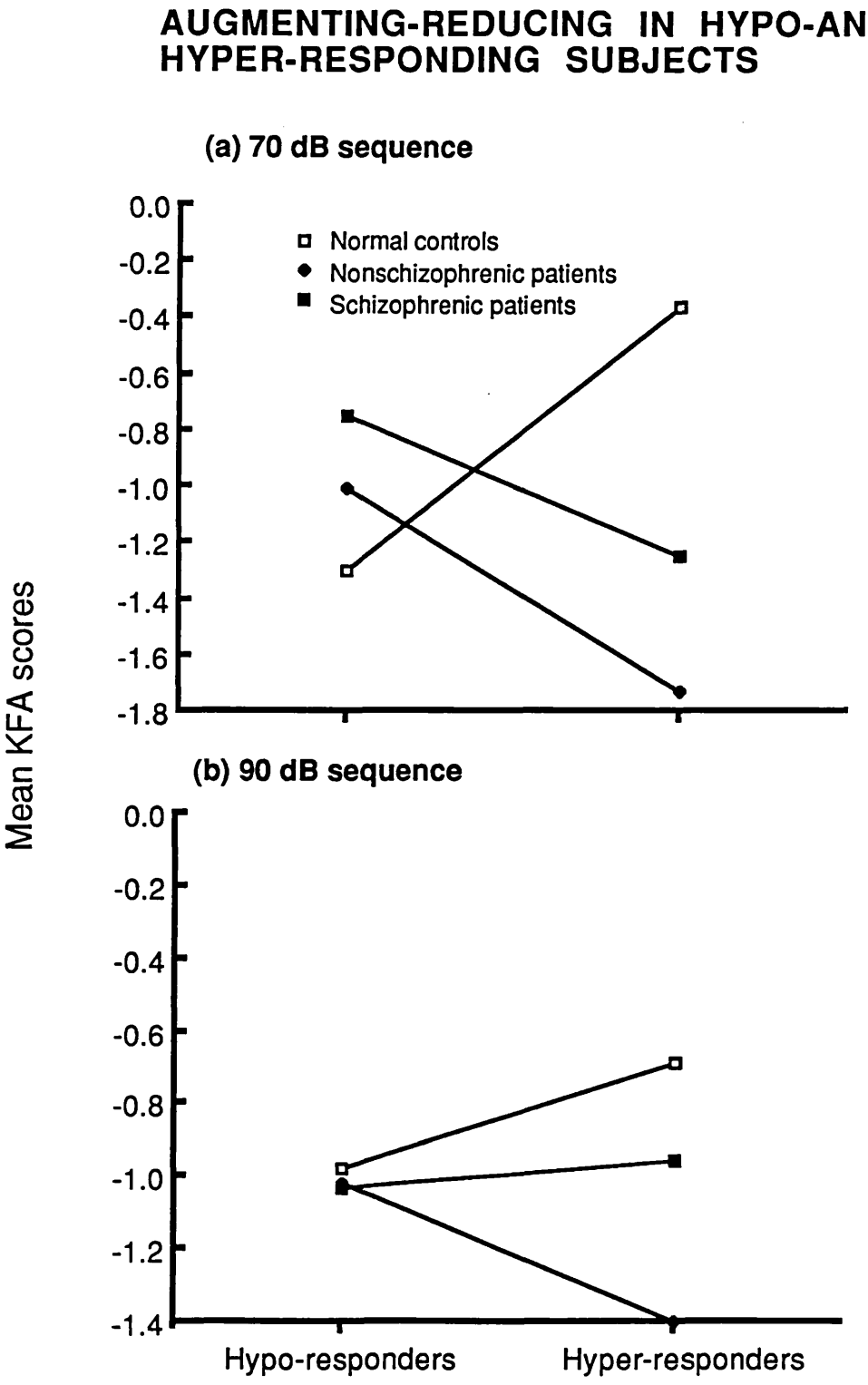


than hypo-responding subjects but differences were not significant or consistent across groups. In the two patient groups, for example, this trend was reversed (Figure 11 (ii)). Thus the finding of Birchall and Claridge (1979) of increased augmenting in subjects with low tonic arousal was only partially confirmed in respect to the two patient groups. A similar pattern was found in relation to the 90 dB sequence except that in the schizophrenic patient group hyper-responders showed less reduction. Correlational evidence (Tables 11 (iii)) also failed to support a relationship between augmenting-reducing and electrodermal responding although a significant relationship was found in schizophrenic patients between long response recovery time to the 90 dB sequence and reduction ($r = -0.36$, $p < 0.04$).

Laterality Effects

An examination of response amplitude and skin conductance laterality effects on KFA scores equally did not reveal any significant differences. Higher skin conductance levels on the right than the left hand were associated with greater reducing in both normal and nonschizophrenic patient groups and with less reducing in schizophrenic patients (Figure 11 (iii)). This was found in both tone sequences. The pattern of response amplitude asymmetries was different. Higher response amplitudes on the right than the left hand to 70 db tones tended to be associated with greater reducing in the normal and schizophrenic groups and less reducing in nonschizophrenic patients. The pattern relating to the 90 dB sequence was reversed with less reduction being associated with higher response

Figure 11 (ii)


AUGMENTING-REDUCING IN HYPO-AND HYPER-RESPONDING SUBJECTS
(a) 70 dB sequence
Normal controls
Nonschizophrenic patients
Schizophrenic patients
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
-1.2
-1.4
-1.6
-1.8
(b) 90 dB sequence
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
-1.2
-1.4
Mean KFA scores
Hypo-responders
Hyper-responders

amplitudes on the right than the left hand in the normal and schizophrenic subjects and with higher response amplitudes on the left than the right in the nonschizophrenic group (Figure 11 (iv)).

An attempt was made to look at differences in electrodermal measures between reducers, augmenters and moderates as defined by Petrie. However, the number of augmenters (N=3) was too small for purposes of analysis and comparisons between reducers (N=29) and moderates (N=88) did not reveal any significant differences (Tables 11 (iv - vi)).

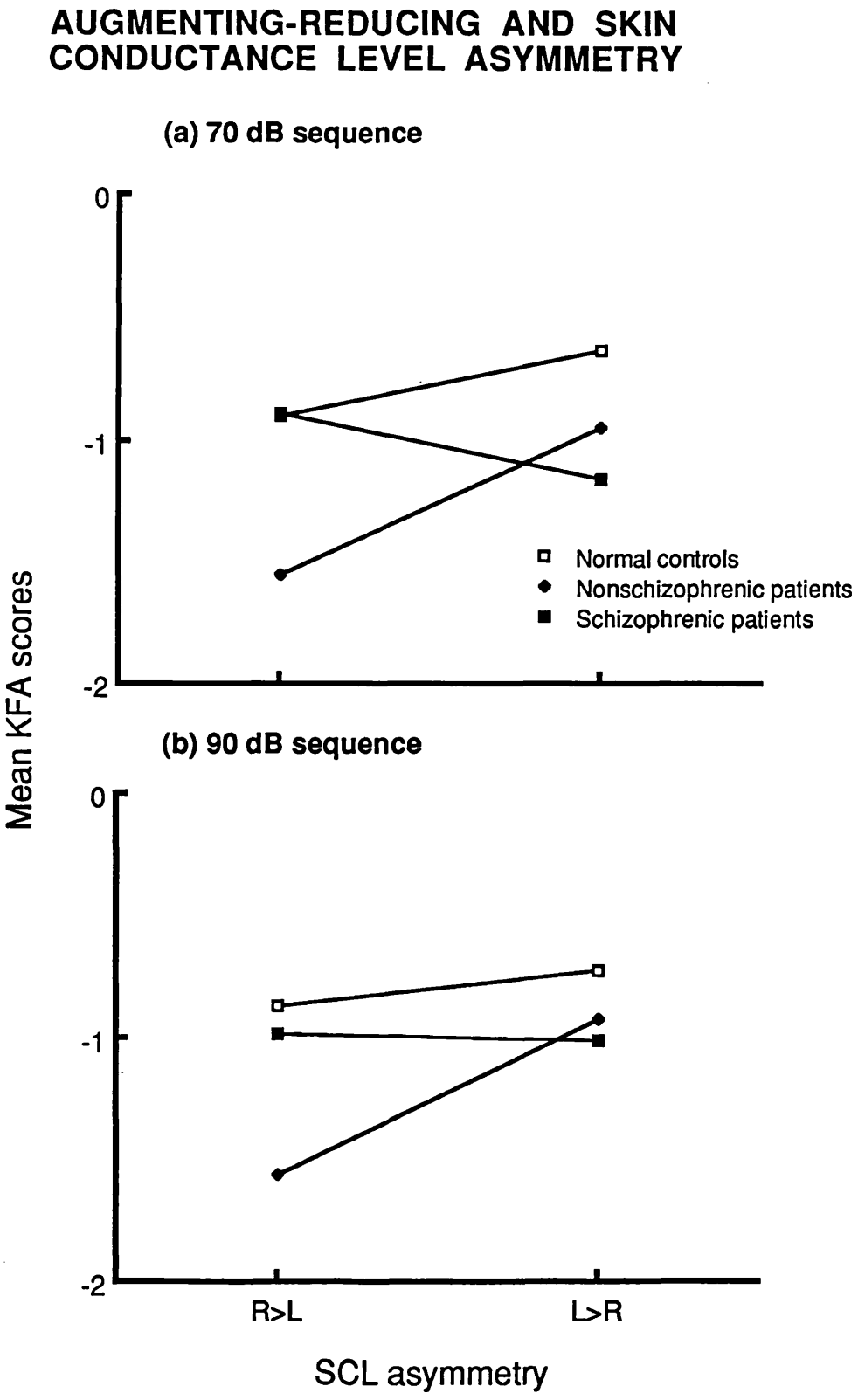
Diagnostic Subgroups

Comparing patient subgroups, again differences were not significant. Among nonschizophrenic patients, those who were depressed reduced more than those who were not, and patients with reactive depression reduced more than those with endogenous depression. This supports the findings of Borge et al (1971). In the schizophrenic group chronic and institutionalised patients showed less reduction than acute or noninstitutionalised patients. This is consistent with findings by Landau et al (1975). Nonparanoid schizophrenics, however, showed less reduction than paranoid patients which is not supportive of previous findings (Buchsbaum and Silverman, 1968). Also contrary to previous findings was the fact that medicated patients in both groups reduced more than unmedicated patients although differences were not significant.

Illness Factors

Age at onset of illness was found to be a significant

Figure 11 (iii)



factor among schizophrenic patients ($r = 0.45$, $p < 0.01$), with more reduction found in patients with an early onset of illness. Duration of illness and the number of hospital admissions were not important. None of these factors were found to be relevant to nonschizophrenic patients.

Age Effects

The relationship between chronological age and augmenting-reducing was significant only in the normal control group ($r = - 0.34$, $p < 0.02$). Reducing was more common in the older age group whereas the reverse was true in respect of augmenting. Previous studies have found no differences in relation to age (Thurner and Seyfried, 1962; Day et al, 1967; Gershon and Buchsbaum, 1977).

Sex Effects

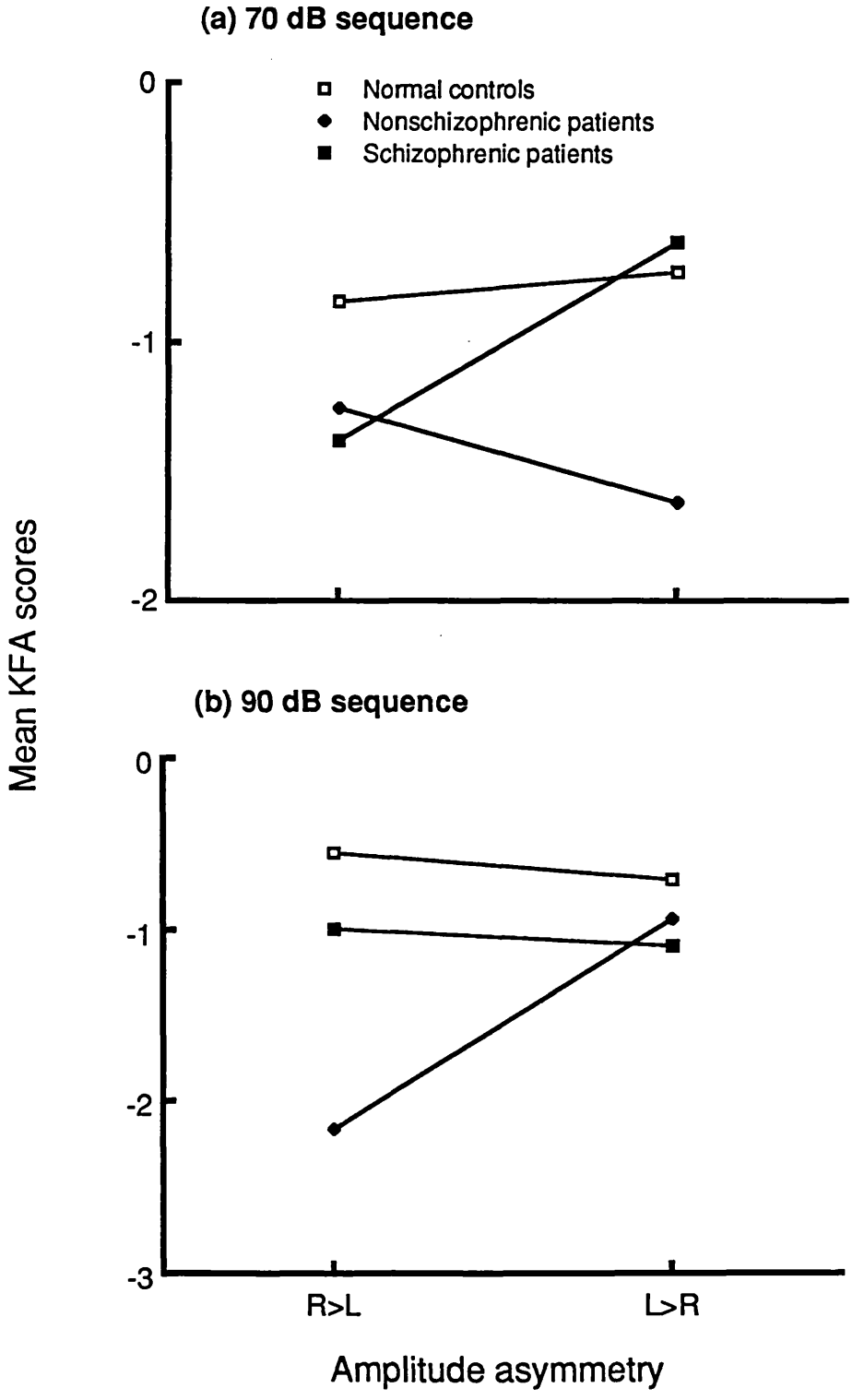
There were no significant sex differences which confirms previous studies using the KFA measure (Spitz and Lipman, 1960; Buchsbaum and Silverman, 1968). Overall the mean KFA scores suggested that whilst females showed more reduction there was greater variance among men. This is in line with the findings of Petrie (1967). Sex differences have been found more frequently with AER measures of augmenting and reducing and it has been suggested that this may be due to changes during the menstrual cycle. As a note was made of where female subjects were in their menstrual cycle this hypothesis could be directly tested. Significant differences were not, however, found in any of the three groups.

Reliability

In order to assess the reliability of the procedure as

Figure 11 (iv)

AUGMENTING-REDUCING AND RESPONSE AMPLITUDE ASYMMETRY



used in this study, a split-half comparison was made between the total scores for judgments 1 and 4 and the scores for judgements 2 and 3. A significant correlation ($p < 0.001$) was found within all three subject groups (normal controls: $r = 0.89$; nonschizophrenic patients: $r = 0.84$; schizophrenic patients: $r = 0.85$). Furthermore, differences between ascending and descending trials were significantly different ($p < 0.001$) in all 3 groups with more reducing on descending trials and more augmenting on ascending trials. This supported the need to use both ascending and descending trials in calculating KFA scores.

Discussion

At first glance the results do not support the presence of a relationship between the cognitive control of augmenting-reducing and electrodermal responding. However, a number of interesting points do emerge that are not entirely inconsistent with previous findings. With respect to arousal level there was a difference between the pattern found in normal subjects and that of the two patient groups. In the normal subjects high arousal was more likely to be associated with augmentation whereas in the two patient groups it was associated with reduction.

The premise in the current study is that both augmenting-reducing and electrodermal response style represent consistent styles of responding within the individual and would therefore co-vary together. It is therefore logical to assume that the sensory regulation mechanism that reduces input in one modality is likely to do so in another and that a parallel exists between a high level of

electrodermal responsivity and augmentation and vice versa. This parallel was, however, only found in normals suggesting that in the patients there is a dissociation between the two variables.

On the basis of the finding that progressive augmentation was found in subjects with low levels of tonic arousal, Birchall and Claridge (1979) suggested that the extent to which an individual augments or reduces may be dependent on the general level of central nervous activation such that low levels of tonic arousal facilitate sensory response and lead to augmentation. In schizophrenia, however, they found the reverse and postulated that there was a dissociation between tonic arousal and arousal modulation. Their findings have not been replicated and are in contradiction to the current findings even though a dissociation is suggested in both.

One explanation for the current findings may relate to differences in stimulus significance. Whereas sensory input is given significance in the KFA procedure by virtue of the instruction to attend to it, the habituation paradigm uses stimuli that are considered to be nonsignal. Their value for a patient population may therefore be different from that of a normal population. Of relevance here is the distinction between weak and strong nervous systems. Transmarginal inhibition is only shown with strong stimulus intensities. In normal circumstances there is a positive correlation between stimulus intensity and response amplitude.

The laterality results in this study also present difficulty in interpretation. Findings linking attention to electrodermal activity on the one hand and augmenting-reducing on the other have shown that both increased electrodermal responsivity and augmentation have been associated with a broad focus of attention whereas lowered responsivity and reducing have generally reflected more focussed or selective attention (Silverman,1967; Waters et al, 1977; Blakeslee, 1979). Furthermore narrowed attention has been associated with left-hemisphere and broadened attention with right-hemisphere attentional dominance (Dimond, 1979) and a reciprocal link between response amplitude laterality and electrodermal habituation has been established by Gruzelier et al (1981). Subjects with higher response amplitudes on the left hand would therefore be expected to show more reduction as both are indicators of selective or focussed attention. This finding was, however, only consistent in nonschizophrenic patients.

CHAPTER 12

Equivalence Range

Methodological Considerations

Range of equivalence is determined traditionally by performance on the Object Sorting Test. Individual differences in conceptual differentiation on this test have been found to be predictably related to conceptual differentiation as measured by other tests such as the Photo Sorting Test, the Behaviour Sorting Test and Pettigrew's Category-Width Test (Gardner and Schoen, 1962). The generality of the equivalence range principle has been extended by findings of consistent individual differences using other forms of the Object Sorting Test (Marrs, 1955). Dickman (1954) used grouping of statements describing everyday behaviours and grouping of Chinese ideographs and Sloane (1959) used grouping of object names, descriptions of people, photographs of faces and drawings of objects.

Sloane, Gorlow and Jackson (1963) compared facets of styles of categorising behaviour using the sorting tests of Sloane (1959). Factor analysis of the scores produced 3 factors: sorting equivalence range, conceptual bandwidth and associational ease. Gardner's Object Sorting Test and Clayton and Jackson's (1961) pencil-and-paper equivalent were correlated (0.74) with the sorting equivalence range factor. Test reliability has been shown over three years with a correlation of 0.75 (Gardner and Long, 1960).

Various tests have been used to measure overinclusive thinking. Goldstein and Scheerer's (1941) Object Sorting Test was originally developed as a measure of concreteness but was later adopted by subsequent investigators as conceptual or categorisation tests (Rapaport, 1945; McGaughran and Moran, 1956; Payne and Friedlander, 1962). Other measures of overinclusive thinking include Benjamin's Proverbs Test (Benjamin, 1946) and the Object Classification Test (Payne et al, 1959), Epstein's Test of Overinclusive Thinking (Epstein, 1953) as well as varieties of card-sorting tests (Chapman, 1958). These various tests of overinclusion have been shown to inter-correlate significantly and yield a common factor when factor-analysed (Payne, 1960) but there is evidence to show that, unlike the tests designed specifically to measure the equivalence range cognitive control, tests of overinclusion may be related to other cognitive controls. For example, a relationship has been found between Epsteins's Overinclusion Test and the Embedded Figures Test as a measure of field dependence (LaTorre, 1978). For the purposes of this study the Object Sorting Test with the format used by Gardner et al (1960) was chosen.

Hypotheses

The cognitive control dimension of equivalence range is not synonymous with traditional definitions of overinclusion as a form of thought disorder. Nevertheless, previous research suggests that, as a disorder of categorisation, over- and underinclusion are both found in schizophrenia, and that the two aspects may be differentially related to diagnostic subgroups, symptomatology or the course of

schizophrenia (see also Chapter 3). It is thus expected that the schizophrenic patients here will not be classified as either over- or underinclusive but will vary such that acute, paranoid and noninstitutionalised patients will be overinclusive and chronic, nonparanoid and noninstitutionalised patients will be underinclusive.

Previous work also suggests a positive relationship between level of psychophysiological arousal and breadth of categorisation leading to the prediction that individuals classified as overinclusive will have slower habituation and higher levels of electrodermal reactivity. As overinclusion is thought to reflect poor selective attention, it is further predicted that overinclusive subjects will have larger right-hand responses and underinclusive subjects larger left-hand responses.

Subjects

All 120 subjects took part (see Subject and General Methodology Section)

Method

Apparatus

An Object Sorting task comprising 73 objects of varying familiarity was used as a measure of categorising ability. The choice of objects followed the format used by Gardner et al (1960) and incorporated a wide variation in colour, material, shape, size and content (see Appendix). Individual record sheets were used to record the category names and contents chosen by the subjects.

Procedure

Each subject was tested individually. The objects were placed on a table in front of the subject in a random arrangement. The subject was first asked to examine the objects and inquire about any they were not familiar with. They were then given the following instructions:

"First of all, I want to you to know that there is no 'answer' to this test. Everyone does it in his own way. I want you to do it in the way that seems most natural, most logical, and most comfortable to you. The instructions are simply to put together into groups the objects which seem to you to belong together. You may have as many or as few objects in a group as you like, as long as the objects in each group belong together for a particular reason. If, after you have thought about all the objects, a few do not seem to belong with any of the others, you may put those objects into groups by themselves. Please sort all the objects."

After all the objects had been grouped the examiner determined the subject's reason for including objects into each group by asking "Why do these objects belong together?"
The test was purposely permissive in order to encourage spontaneous categorising behaviour. The instructions were designed to allow a lack of restriction so that the subject could reveal his own categorising propensities.

Two scores were calculated: The number of object groups each subject formed from the 73 objects. When one large group contained definitive subdivisions, each of the

subdivisions was scored as a separate group. Each object put by itself was scored as an additional group. In addition, an abstract-concrete rating of the reasons was given for categorisation based on a three-point scale. A score of 1 denoted reasons that merely enumerated the objects within a group. A score of 2 denoted reasons that related the objects by a common function or attribute and a score of 3 denoted reasons that related the objects in an unusual, remote or very abstract way.

Results

Scores based on the number of object categories were analysed using a four-way analysis of variance (Subject Group x Sex x Habituator Group x Asymmetry Group). Scores based on the degree of category abstractness were analysed using nonparametric analyses.

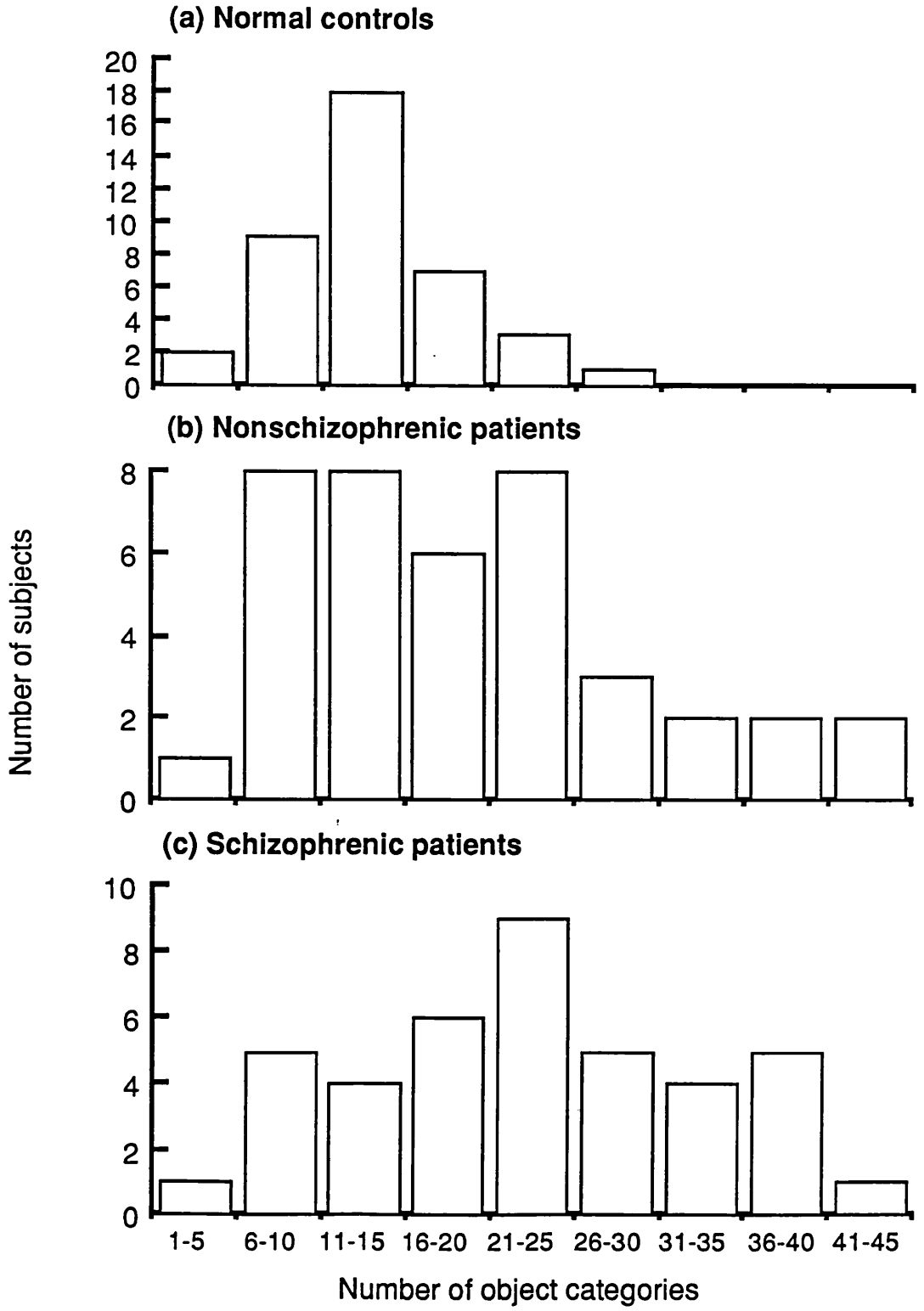
(1) Object Category Scores

Looking first at the number score, a significant main effect for Subject Group ($F(2,119) 12.54$, $p < 0.001$) indicated that the number of object categories was highest in the schizophrenic group and smallest in the normal control group (Table 12 (i)). This suggests that schizophrenic patients tended to under- rather than overinclude which contradicts previous evidence (Figure 12 (i)).

Habituator group differences, whilst not significant, showed a consistent trend with hyper-responders having fewer object categories than hypo-responders (Figure 12 (ii)). The only exception to this was in relation to the 70 dB sequence where the trend was reversed in

Figure 12 (i)

DISTRIBUTION OF OBJECT SORTING SCORES



nonschizophrenic patients (Table 12 (ii)). The pattern of the relationship between electrodermal reactivity and underinclusion was supported by correlational evidence (Table 12 (iii)). In both normal controls and schizophrenic patients skin conductance levels to both sequences were significantly higher in overinclusive subjects. Amplitude measures were similarly higher in overinclusive subjects in the schizophrenic group.

Laterality Effects

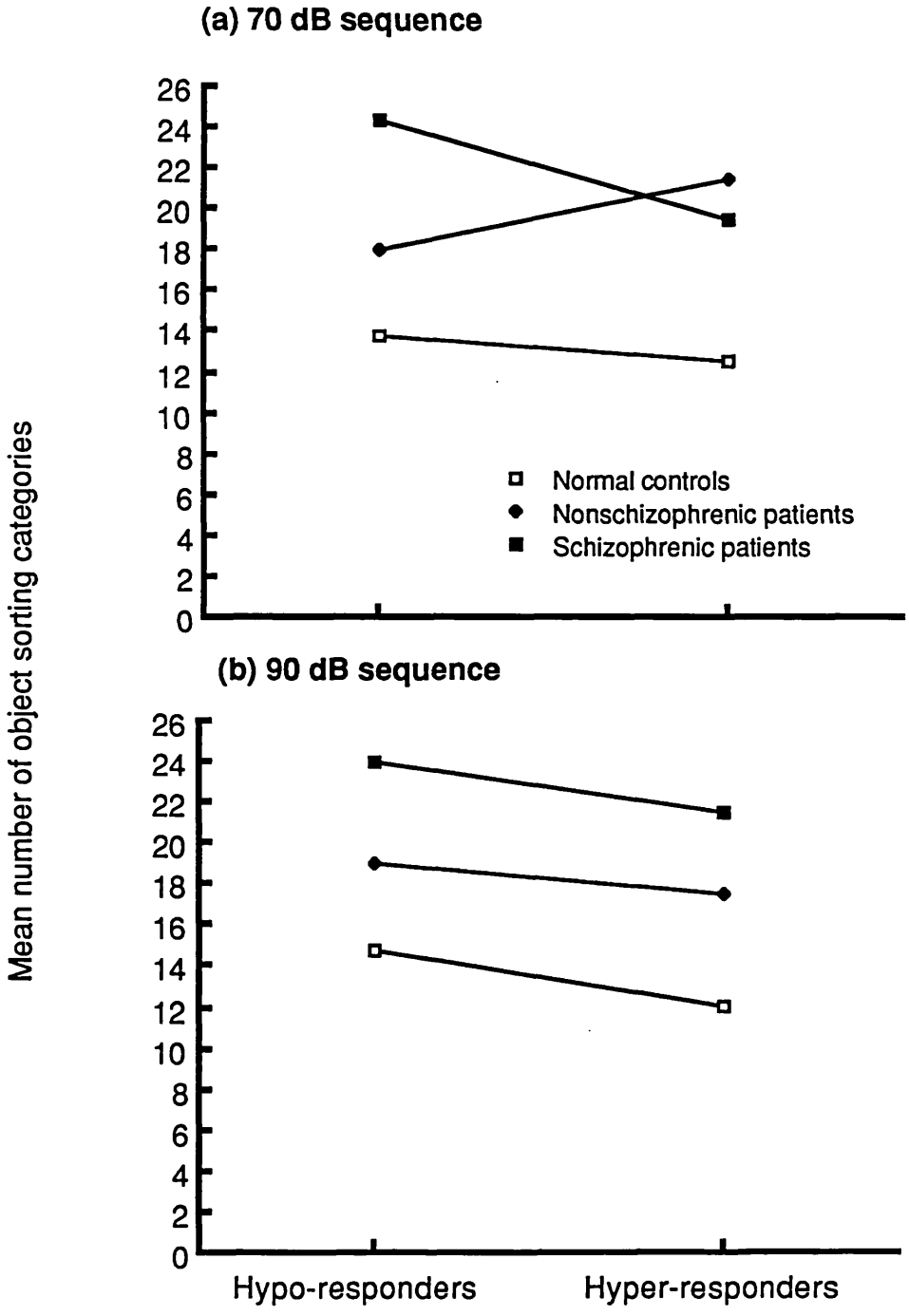
Differences between skin conductance level and response amplitude asymmetry groups were not significant but there was a consistent trend to both tone sequences and in relation to both measures (Figures 12 (iii) and (iv)). Subjects with higher skin conductance levels or response amplitudes on the right than the left hand were more underinclusive than those with the reverse asymmetry in both normal and schizophrenic subjects. This trend was reversed in nonschizophrenic patients.

Diagnostic Subgroups

Within-group comparisons showed significant differences in the schizophrenic patient group only. Institutionalised patients had more object categories than noninstitutionalised patients ($t = 3.47$, $p < 0.001$) and chronic patients more than acute patients ($t = 2.94$, $p < 0.01$). In view of the lower level of electrodermal responsivity in chronic, institutionalised patients these differences are in line with the present finding of greater underinclusion in hypo-responding subjects. For perhaps similar reasons medicated subjects in both patient groups were found to be

Figure 12 (ii)

OBJECT SORTING SCORES IN HYPO- AND HYPER-RESPONDING SUBJECTS



more underinclusive, i.e, had more categories than those who were unmedicated. This was, however, only significant in respect to schizophrenic patients ($t = 2.22$, $p < 0.04$).

Illness Factors

Differences between the two patient groups were, however, noted in relation to illness factors. Whereas the number of admissions was a significant factor in nonschizophrenic patients ($r = 0.29$, $p < 0.04$), in schizophrenic patients duration of illness seemed more important ($r = 0.46$, $p < 0.002$). Both indicators of illness suggested a larger degree of underinclusion (more object categories) with greater chronicity or severity of illness.

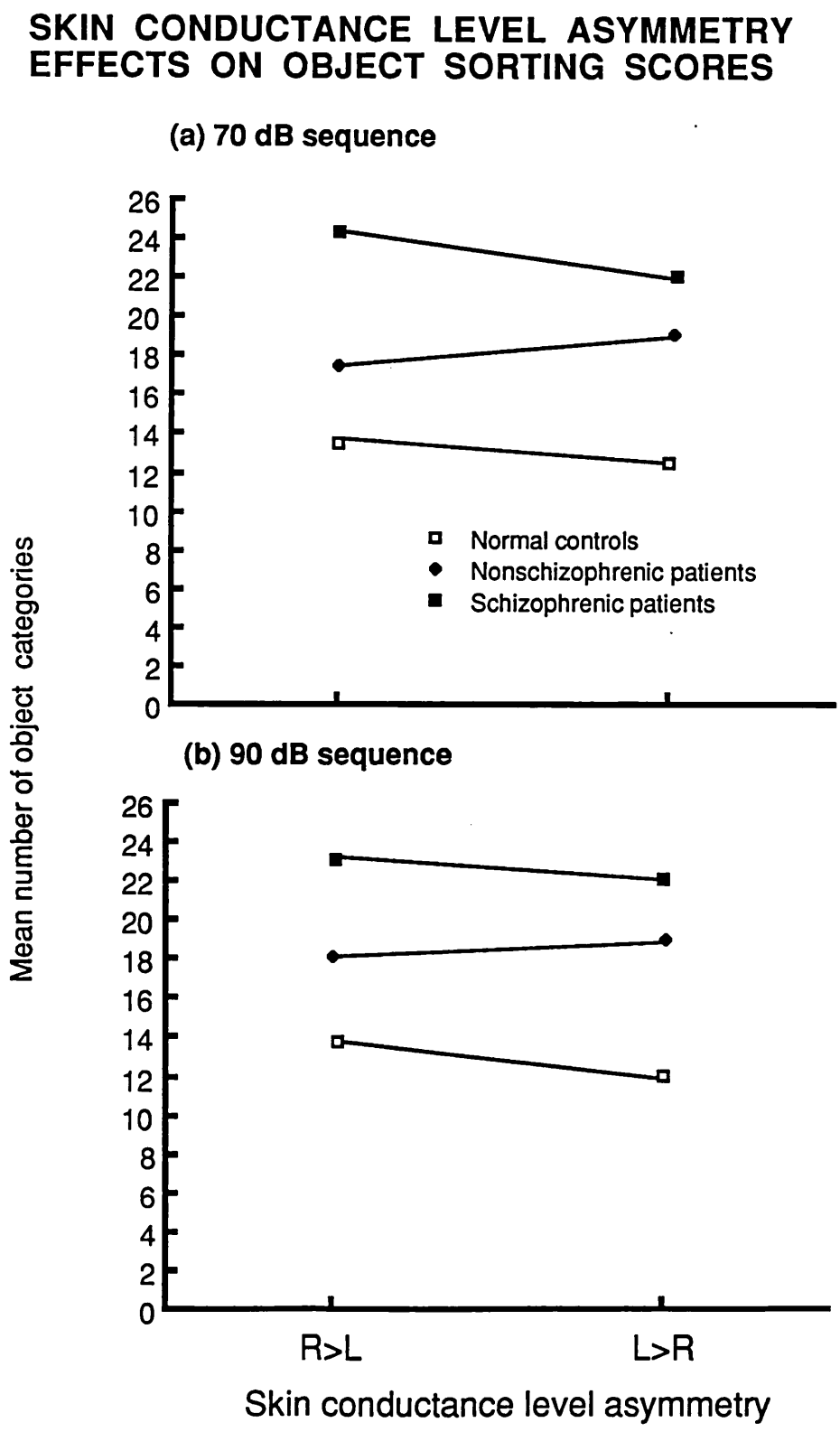
Sex and Age Effects

Demographic variables such as sex and age seemed less important. There were no sex or age differences in any of the three subject groups.

(2) Category Abstractness Scores

With regard to abstractness scores, a significant Subject Group difference was found (Kruskal-Wallis: $X^2 = 22.39$, $p < 0.001$). Normal controls had significantly higher abstract scores than both schizophrenic ($p < 0.001$) and nonschizophrenic patients ($p < 0.02$) with the two patient groups not differing significantly (Table 12 (i)). There appeared to be an inverse relationship between abstract scores and the number of categories such that over-inclusion (fewer categories) tended to be associated with higher abstractness scores indicative of a greater ability to relate objects together. Underinclusive subjects were

Figure 12 (iii)



only able to link a few items and these tended to be at a more concrete level.

Looking at the relationship between the abstract-concrete dimension and electrodermal responsivity, differences between habituator groups were significant only in the normal controls (Kruskal-Wallis: $X^2 = 8.08$, $p < 0.05$) in relation to the 90 dB sequence (Table 12 (iii)). Overall, hyper-responders tended to have higher abstract scores than hypo-responders in respect of both tone sequences even though differences between these groups were not always significant. The relationship between hyper-responsivity and high abstract scores was confirmed by correlational evidence (Table 12 (iii)).

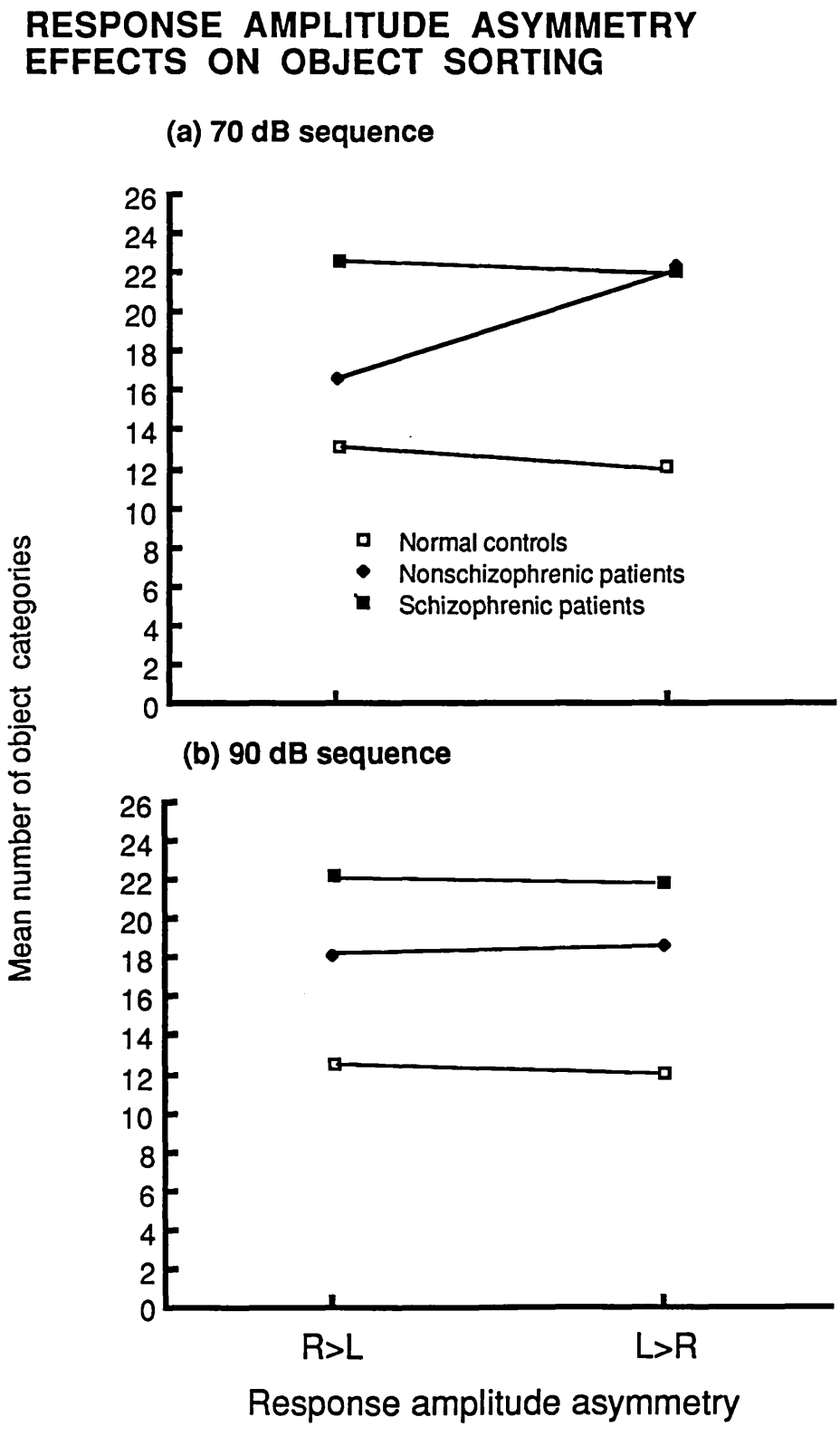
Laterality Effects

Differences between asymmetry groups were not significant. In normal and schizophrenic groups subjects with higher skin conductance levels on the left than the right hand tended to have higher abstract scores than those with the reverse asymmetry. This trend was reversed in the nonschizophrenic patient group in relation to the 90 dB tone sequence. A similar pattern was revealed between abstract scores and response amplitude asymmetries.

Diagnostic Subgroups

Within-group comparisons indicated that institutionalised schizophrenic patients had lower abstract scores than noninstitutionalised patients (Mann-Whitney: $W = 210.5$, $p < 0.03$) and chronic patients lower abstract scores than acute patients ($W = 422.5$, $p < 0.04$). Also within the

Figure 12 (iv)


RESPONSE AMPLITUDE ASYMMETRY
EFFECTS ON OBJECT SORTING
(a) 70 dB sequence
(b) 90 dB sequence
Mean number of object categories
26
24
22
20
18
16
14
12
10
8
6
4
2
0
Normal controls
Nonschizophrenic patients
Schizophrenic patients
R>L
L>R
Response amplitude asymmetry

schizophrenic group the level of abstractness was found to be higher in patients where the age of onset of illness was older ($r = 0.28$, $p < 0.05$) and the illness had been of short duration ($r = -0.31$, $p < 0.03$). This finding is consistent with the view that schizophrenia is associated with impairment in conceptual thinking and abstract reasoning. Significant differences were not found in the nonschizophrenic patient group in relation to either diagnostic subcategory or illness factors.

There were no sex or age differences in any of the three groups.

Discussion

The relationship between equivalence range and electrodermal reactivity is only hinted at in these results although the pattern of the relationship is quite consistent and in line with previous findings (Loveless, 1972; Depue and Fowles, 1974). Narrow equivalence range (fewer object categories, overinclusion) is here associated with electrodermal hyper-responding. However, narrow equivalence range was also related to a predominance of right hemisphere activity as indicated in both skin conductance levels and response amplitude measures. This finding is not in line with the current predictions and is not entirely consistent with the work on different kinds of attention and the relationship to responsivity and prepotency or biases in hemispheric activity mentioned in earlier chapters (Waters et al, 1977; Blakeslee, 1979; Gruzelier et al, 1981). However, it is interesting that different patterns were found for normal and schizophrenic

subjects on the one hand and for nonschizophrenic patients on the other. This may relate to hemispheric differences noted between schizophrenic and depressed patients (Flor-Henry, 1974).

Unlike previous findings schizophrenic patients were not characterised by a narrow but rather by a broad equivalence range. This is consistent with both the relationship to hyporesponding suggested by the present study and evidence that schizophrenic patients tend to be characterised more by hypo- than hyper-responding (Bernstein et al, 1982). It also highlights the differences between equivalence range as a cognitive style and the concept of overinclusion as an aspect of schizophrenic thought disorder. This is further supported by the inverse relationship between equivalence range and the abstract-concrete dimension introduced into current test scoring.

Early research on over- and underinclusion suggests that whereas overinclusion is more characteristic of acute schizophrenia in relapse as well as of patients with florid symptomatology (Payne and Friedlander, 1962; Davis and Blaney, 1976) underinclusion is found more in chronic schizophrenia (Cutting, 1985). This view is supported by the present findings of increased underinclusion in chronic, institutionalised patients although no support was found for the early finding of overinclusion being associated with delusions and paranoid schizophrenia (Payne, 1961; Payne et al, 1964; Payne and Caird, 1967).

Demographic variables such as sex and age are not widely

reported in the literature. Sex differences do not appear to have been found and this is supported by the current findings. Although work related to age has suggested that differences may exist relative to the ability to both differentiate between stimuli and maintain intention or attention, these have not been found here, perhaps because an entirely adult population was used, albeit with a wide age range.

CHAPTER 13

Summary and Integration of The Relationship Between Psychophysiological and Cognitive Response Styles in Schizophrenic and Nonschizophrenic Psychiatric Patients and in Normal Controls

The present study has sought to establish whether or not a relationship exists between psychophysiological and cognitive response styles, whether it is universal or specific to a particular population and whether it holds over time. The rationale underlying this quest is founded on the argument that both styles are related to the deployment of attention and as such represent characteristic ways of determining perceptual-cognitive behaviour.

The study began with the examination of electrodermal responses to sequences of 70 dB and 90 dB tones. In line with previous research the presence of two possible psychophysiological response styles was confirmed: on the one hand the distinction between responding and nonresponding and on the other between response asymmetries biased either to the right or left hemisphere. These two response styles were found in relation to both tone sequences and across both normal and psychiatric populations. However, the apparent universality of these psychophysiological response styles was moderated by biases in the different populations under study. Nonresponding was found to a much greater extent in the two patient groups than in the normal group and suggests that this particular style was affected in some way by the disease process. In

normal controls nonresponding was predominantly found in women suggesting a relationship to hormonal balance.

Similarly, lateral asymmetries showed different patterns of distribution among the groups. Although all three groups showed a predominance of higher response amplitudes on the right than the left hand the difference between these two asymmetry groups was greater among schizophrenic patients. The processes determining lateral bias in responses are thought to relate to functional hemispheric differences in attentional processes and the balance of inhibitory or excitatory influences. Lateral asymmetries in skin conductance levels also showed a varying distribution between groups but not necessarily in parallel to those relating to response amplitude asymmetries. Whereas there was a predominance of higher skin conductance levels on the right than the left hand among normal subjects, this was reversed in the two patient groups, particularly in nonschizophrenic patients. Skin conductance level asymmetries are considered to reflect general levels of arousal and as such confirmed the generally higher level of electrodermal responsivity in the normal as compared to psychiatric patient groups.

Previous attempts to attribute variability to illness or demographic factors have been inconclusive. Here too, clinical status factors such as patient subgroupings, medication and factors related to the course and severity of illness did not appear to influence significantly the overall prevalence of the two styles although they may underlie the differing distribution between groups.

Furthermore the finding of a decline in both tonic and phasic activity with increasing age did not explain group differences as subject groups were controlled for age.

Whilst there was clear evidence of two different psychophysiological response styles, they were not necessarily independent. The reciprocal relationship between rate of habituation and lateral asymmetry identified by Gruzelier et al (1981) was confirmed here in normal subjects. This relationship has furthermore been shown to be discontinuous in patients with high anxiety which raises the issue of whether these response styles are continuous or dichotomous dimensions. There was, for example, no evidence of a truly bimodal distribution nor did nonresponders show discontinuity from fast habituators. The results thus suggested a continuuum of responding along which the pattern of distribution was dependent on patient sampling in terms of either the onset and course of their illness and choice of treatment or the manifest symptomatology.

The next question was whether or not they related to attentional styles based on cognitive measures. This was looked at in relation to six cognitive response controls previously researched and deemed distinct from one another in terms of both underlying processes and measurement. These controls were continuous rather than dichotomous variables and representation along each dimension was found in all three groups. What differed was the range or degree to which extremes of a dimension were present.

Significant group differences were found in three out of

the six cognitive control response measures (equivalence range, field dependence and focussing-scanning). These tended for the most part to differentiate normal subjects from psychiatric patients suggesting that differences were not related to a particular illness but to the general process of psychopathology and confirmed the findings of Otteson and Holzman (1976). An exception to this was in relation to the equivalence range dimension where schizophrenic patients tended to be more underinclusive than both other groups. As overinclusion is usually associated with schizophrenic patients who are in an acute rather than a chronic phase and who are unmedicated rather than medicated the bias towards under- rather than overinclusion may relate to the larger number of chronic, medicated patients in this sample. Furthermore, where a dimension can be conceived of as representing a continuum of adaptability, normal subjects tended to lie at the adaptive end of the continuum. Normal subjects were, for example, more field independent and experienced less interference on the Stroop task than patients. A possible exception to this was the finding of greater overestimation in normal controls in comparison with the two patient groups.

The next task was to establish whether a relationship held between any of the cognitive response controls and the two psychophysiological response styles identified. In relation to the electrodermal responsivity dimension subjects were divided according to whether they habituated within the first two trials (zero-trial + fast habituators) or subsequently (moderate + slow habituators). In this study, significant differences were not found between

Table 13 (i) Relationship Between Cognitive Style Variables and Hypo- and Hyper-Responding (Experiment 1)

	Normal Controls		Nonschizophrenic Patients		Schizophrenic Patients		Total Group	
	Hypo-Responders $\bar{x}$	Hyper-Responders $\bar{x}$	Hypo-Responders $\bar{x}$	Hyper-Responders $\bar{x}$	Hypo-Responders $\bar{x}$	Hyper-Responders $\bar{x}$	Hypo-Responders $\bar{x}$	Hyper-Responders $\bar{x}$
Field Dependence-Independence								
70 dB Sequence	50.79	53.91	38.55	42.57	35.85 *	42.93	40.63 ***	48.26
90 dB Sequence	50.50	53.00	35.50 *	44.50	37.25	40.00	40.25 ***	48.50
Constricted-Flexible								
70 dB Sequence	5.37	- 5.41	0.23	3.92	13.48 ***	- 25.03	5.90 *	- 10.39
90 dB Sequence	3.01	- 5.49	- 4.67	13.81	15.95	- 14.43	3.49 *	- 4.71
Levelling-Sharpening	RA IE	RA IE	RA IE	RA IE	RA IE	RA IE	RA IE	RA IE
70 dB Sequence	0.64 0.32	0.66 0.27	0.58 0.34	0.58 0.29	0.57 0.33	0.55 0.27	0.59 0.33	0.61 0.27
90 dB Sequence	0.66 0.29	0.64 0.30	0.57 0.37	0.60 0.25	0.60 0.27	0.53 0.34	0.60 0.32	0.59 0.30
Focussing-Scanning								
70 dB Sequence	3.48	3.55	2.43	2.48	1.10	2.18	2.24 *	2.92
90 dB Sequence	3.07	3.84	2.63	1.96	1.16	1.77	2.31	2.66
Augmenting-Reducing								
70 dB Sequence	- 1.30	- 0.36	- 1.01	- 1.73	- 0.75	- 1.25	- 1.00	- 1.00
90 dB Sequence	- 0.98	- 0.69	- 1.02	- 1.40	- 1.03	- 0.96	- 1.01	- 0.94
Equivalence Range								
70 dB Sequence	13.84	12.62	18.00	21.57	24.39	19.57	19.12	16.43
90 dB Sequence	14.76	12.05	19.03	17.58	24.00	21.53	19.37	16.79

*** $p < 0.001$ ** $p < 0.01$ * $p < 0.05$

nonresponders and fast habituators suggesting that at least in relation to this group of subjects, the use of a continuous rather than a dichotomous dimension was more appropriate. Clear relationships were established between the electrodermal responsivity dimension and three of the cognitive response measures, primarily on the basis of total group measures (Table 13 (i)). Hyper-responding was related to field independence on the Closure Flexibility Test, to less interference on the Stroop task and to focussing (overestimation) on the Size Estimation Task. These effects were statistically robust and, in the case of the first two dimensions, held in relation to both tone sequences. When individual diagnostic groups were compared only three significant results were obtained, all in line with the group findings. The correlational evidence was also consistent. For the other three dimensions no significant effects were found.

Hyporesponsivity has, as stated in earlier chapters, been identified by a number of authors to be characteristic of both schizophrenic and depressed patients and is sometimes mooted as a possible marker of vulnerability to these diseases. Returning to the idea that some cognitive control dimensions may represent continua of adaptability, the finding of a significant relationship between hyper-responsivity and both field independence and less interference on the Stroop Test is supportive of the idea that hyporesponsivity is an indicator of a maladaptive attentional style. The relationship of hyper-responsivity to overinclusion, albeit not a significant one, might also be included under this category as overinclusion tended to be

Table 13 (iii) Relationship Between Cognitive Style Variables and Skin Conductance Level Asymmetry (Experiment 1)

	Normal Controls		Nonschizophrenic Patients		Schizophrenic Patients		Total Group	
	R > L	L > R	R > L	L > R	R > L	L > R	R > L	L > R
	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$
Field Dependence-Independence								
70 dB Sequence	51.35	54,14	40.92	38.54	38.00	38.00	44.70	41.89
90 dB Sequence	50.41	54.67	41.08	38.37	37.20	39.45	43.40	43.22
Constricted-Flexible								
70 dB Sequence	1.73	- 4.04	- 13.24	6.93	0.95	0.39	1.68	2.34
90 dB Sequence	4.92	- 6.65	- 9.73	5.98	- 0.14	0.14	- 0.38	0.69
Levelling-Sharpening	RA IE	RA IE	RA IE	RA IE	RA IE	RA IE	RA IE	RA IE
70 dB Sequence	0.68 0.32	0.59 0.24	0.56 0.23	0.58 0.37	0.54 0.38	0.59 0.25	0.61 0.32	0.59 0.30
90 dB Sequence	0.67 0.34	0.62 0.24	0.53 0.25	0.60 0.37	0.51 0.37	0.62 0.24	0.58 0.33	0.61 0.34
Focussing-Scanning								
70 dB Sequence	3.65	3.27	3.35	2.05	2.48	0.67	3.20	1.88
90 dB Sequence	3.59	3.42	3.16	2.09	2.45	0.51	3.07	1.97
Augmenting-Reducing								
70 dB Sequence	- 0.90	- 0.63	- 1.55	- 0.95	- 0.89	- 1.16	- 1.03	- 0.95
90 dB Sequence	- 0.87	- 0.73	- 1.56	- 0.93	- 0.99	- 1.01	- 1.08	- 0.90
Equivalence Range								
70 dB Sequence	13.62	12.43	17.08	19.33	24.16	21.95	17.86	18.62
90 dB Sequence	13.68	12.61	18.00	18.96	23.45	21.95	18.25	18.12

*** $p < 0.001$ ** $p < 0.01$ * $p < 0.05$

associated with a higher abstractness score suggesting that overinclusion might represent the more adaptive end of the continuum. An interesting exception to these findings was the reversal of the relationship in respect of the Petrie KFA Test. In both patient groups hyper-responsivity was associated with greater rather then less perceptual reduction. Insofar as hyper-responsivity might be considered the more adaptive mode, then in view of what Silverman referred to as a 'defense against sensory over-load' more reduction could also be seen as more adaptive in schizophrenic patients.

The relationship between cognitive response measures and the second identified psychophysiological response style, lateral asymmetry was not significant. The pattern for normal subjects suggested that a right hemisphere bias in response amplitudes tended to be associated with field independence, lower interference scores (Stroop Test), higher Ranking Accuracy scores (Schematising Test), higher average error scores (Size Estimation Test), greater perceptual reduction (Petrie KFA Test) and more object categories (Object sorting Task). For the most part, this pattern held true for schizophrenic patients as well but tended to be reversed in nonschizophrenic patients (Table 13 (ii)). A very similar pattern was found in relation to skin conductance level asymmetries with the exception of field independence and interference on the Stroop Test where the most adaptive mode appeared to the pattern of higher skin conductance levels on the left than right hand (Table 13 (iii)). As for response amplitude asymmetry this pattern was reversed in nonschizophrenic patients.

Table 13 (ii) Relationship Between Cognitive Style Variables and Response Amplitude Asymmetry (Experiment 1)

	Normal Controls		Nonschizophrenic Patients		Schizophrenic Patients		Total Group	
	R > L	L > R	R > L	L > R	R > L	L > R	R > L	L > R
	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$
Field Dependence-Independence								
70 dB Sequence	56.11	50.46	38.63	44.00	39.24	38.11	47.29	45.42
90 dB Sequence	54.73	52.11	38.89	44.00	39.17	38.70	45.43	46.51
Constricted-Flexible								
70 dB Sequence	- 5.15	0.95	23.25	0.05	- 3.60	- 13.45	0.76	- 3.43
90 dB Sequence	- 1.51	- 4.42	- 26.28	23.25	- 10.63	- 3.45	- 9.47	2.57
Levelling-Sharpening	RA IE	RA IE	RA IE	RA IE	RA IE	RA IE	RA IE	RA IE
70 dB Sequence	0.70 0.28	0.58 0.28	0.62 0.46	0.52 0.30	0.51 0.37	0.62 0.29	0.63 0.36	0.57 0.29
90 dB Sequence	0.69 0.23	0.59 0.33	0.53 0.23	0.63 0.29	0.49 0.30	0.65 0.41	0.58 0.26	0.62 0.34
Focussing-Scanning								
70 dB Sequence	3.56	3.34	3.24	2.55	3.07	0.68	3.39	2.38
90 dB Sequence	3.25	3.96	1.82	2.48	2.50	0.78	2.69	2.74
Augmenting-Reducing								
70 dB Sequence	- 0.98	- 0.73	- 1.25	- 1.62	- 1.38	- 0.61	- 1.22	4.19
90 dB Sequence	- 0.54	- 0.70	- 2.16	- 0.94	- 0.99	- 1.09	- 1.00	0.86
Equivalence Range								
70 dB Sequence	12.83	12.13	16.38	21.86	22.53	21.78	17.74	17.13
90 dB Sequence	12.47	11.72	17.89	18.20	22.22	21.80	17.57	16.02

*** $p > 0.001$ ** $p > 0.01$ * $p > 0.05$

The results thus point to differences both between normals and patients and between the two patient groups. Differences relating to skin conductance level asymmetries could perhaps be seen within the context of general arousal and can thus be related to the responsivity findings. Normal subjects were more hyper-responsive than both patient groups and this might account for any differences found. Furthermore, hypo-responsivity was even more marked in the nonschizophrenic patient group and would thus account for the main patient-nonpatient differences relating to this group and possibly for any differences that were present between schizophrenic and nonschizophrenic patients. In relation to response amplitude asymmetries it is interesting to note that in normal subjects the socalled adaptive end of the various continua was associated with higher response amplitudes on the right than the left hand. This is usually considered to reflect sustained rather than selective attention but is also related to hyper- rather than hypo-responsivity. Whereas patient-nonpatient differences may be accounted for by differences in the latter, those between patient groups may relate more to the wider issue of etiology and proposed differences in the site of hemisphere dysfunction in schizophrenia and depression, the latter being the predominant diagnosis in the nonschizophrenic patient group in this study. In this respect schizophrenic patients are more likely to show a predominance of right greater than left asymmetry and depressed patients by a left greater than right asymmetry, both supported by the present findings. This does suggest, however, that cognitive response style reflects some kind of compensatory mechanism for the dysfunction.

Table 13 (iv) Factor Structure of Cognitive Response Style Variables

	Factor 1	Factor 2	Factor 3
Normal Control Group			
Field Dependence	0.68642	0.08058	
Equivalence Range	- 0.24487	- 0.29364	
Constricted-Flexible	- 0.61448	- 0.02628	
Levelling-Sharpening (RA)	0.47607	- 0.51482	
Levelling-Sharpening (IE)	- 0.52150	0.07287	
Focussing-Scanning	- 0.08324	0.41329	
Augmenting-Reducing	0.47458	0.56015	
Nonschizophrenic Patient Group			
Field Dependence	0.72193	- 0.02879	- 0.01593
Equivalence Range	- 0.57541	- 0.09717	0.11662
Constricted-Flexible	- 0.07500	0.03671	0.19911
Levelling-Sharpening (RA)	0.43198	- 0.13833	0.77513
Levelling-Sharpening (IE)	- 0.08774	0.34264	0.00577
Focussing-Scanning	- 0.53715	0.06141	- 0.21601
Augmenting-Reducing	0.24320	0.79052	0.01152
Schizophrenic Patient Group			
Field Dependence	0.97540	- 0.19379	- 0.07959
Equivalence Range	- 0.40979	0.14428	0.69760
Constricted-Flexible	- 0.43646	0.04133	0.09741
Levelling-Sharpening (RA)	0.29802	- 0.53888	0.17782
Levelling-Sharpening (IE)	- 0.20600	0.36074	0.05431
Focussing-Scanning	0.13734	0.86942	- 0.10780
Augmenting-Reducing	- 0.01930	0.09706	- 0.32564
Total Subject Group			
Field Dependence	0.79663	0.31151	
Equivalence Range	- 0.58839	- 0.08527	
Constricted-Flexible	- 0.21484	- 0.02976	
Levelling-Sharpening (RA)	0.14871	0.68961	
Levelling-Sharpening (IE)	- 0.11293	- 0.27279	
Focussing-Scanning	0.16764	- 0.46043	
Augmenting-Reducing	0.30755	- 0.11721	

The issue of cognitive response style representing constellations of cognitive controls was examined using factor analysis, the method used by Gardner et al (1959) in their original study and subsequently by Otteson and Holzman (1976) to explore and explain the consistencies and individual differences in performance on the different perceptual measures. In normal controls, factor analysis of the variables revealed two factors (Table 13 (iv)): Factor I included the constricted-flexible (Stroop Colour-Word Test) and field dependence-independence (Closure Flexibility) dimensions and the incremental error score of the levelling-sharpening dimension (Schematising Test).

This factor corresponds to a Scanning Factor identified by Otteson and Holzman (1976) which they considered to reflect "the general meticulousness with which a subject performs the task." Factor II included the ranking accuracy score of the levelling-sharpening dimension (Schematising Test) as well as focussing-scanning (Size Estimation Test), augmenting-reducing (Petrie KFA Test) and equivalence range (Object-Sorting Test) dimensions. This factor corresponds, to some extent, to the Levelling-Sharpening Factor obtained by Otteson and Holzman (1976) although the equivalence range and augmenting-reducing dimensions were not included in their study. The distribution of variables between Factors was not consistent across groups although both constricted-flexible and field dependence-independence dimensions were loaded in all three groups on the same factor. As both these measures are related, albeit in different ways, to field articulation, this suggested that they might constitute an

important cognitive response style. Furthermore, both these cognitive controls show a consistent and parallel relationship to both psychophysiological response styles.

Another issue raised by the present findings concerns the question of whether psychophysiological or cognitive response styles should be considered as trait or state variables. On the one hand there is evidence to show that electrodermal variables are stable over time and consistent across situations and on the other that responder status although stable over time in both normal and schizophrenic subjects (Bernstein, 1967, 1970; Rubens and Lapidus, 1978) may change alongside other changes such as the nature of the stimulus presented, the patient's symptom picture or changes in medication. Gardner et al (1959) have also suggested that cognitive control dimensions may be capable of temporary variations. Within the context of the current study there were several variables that might constitute intrasubject variations, especially in the two patient groups. These include firstly, any differences relative to the two tone sequences, secondly, possible effects of medication and thirdly, illness factors such as age of onset, duration of illness and number of admissions. Sex differences do not constitute a variation as such although they do have some bearing on functional differences in hemispheric lateralisation and on hormonal differences. Although differences were noted in respect of some cognitive controls these tended not to affect the overall relationship to electrodermal measures. The same can be said in relation to chronological age differences. Whilst older subjects did perform differently

from younger subjects on both cognitive and psychophysiological response measures these did not appear to affect the relationship between the two types of measures.

The 90 dB tone sequence could be said to represent a change in the nature of the stimulus insofar as greater signal value may be attributed to louder tones. Generally the level of responsivity was higher to the louder tones although changes in reponding-nonresponding were negligible. Changes in response amplitude and skin conductance level asymmetries also occurred, but again minimally and only in the normal group. The relationship of the various cognitive controls to hypo- and hyper-responsivity did not change in relation to the louder tones or consistently to patterns of asymmetries with one exception: The tendency for subjects with higher response amplitudes on the right than the left hand to show greater perceptual reduction on the KFA Test in the normal and schizophrenic groups and less perceptual reduction in nonschizophrenic patients was reversed in all three groups in relation to the 90 dB tones. As the augmenting-reducing dimension is concerned with stimulus intensity control the reversal in amplitude asymmetry seemed logical in the face of the possible change in stimulus significance and the fact that it was consistent across groups albeit in a different direction in the nonschizophrenic group.

The effects of medication were consistent across both cognitive and electrodermal response measures, producing a lower level of responsivity on the one hand and more field dependence, greater Stroop interference, more perceptual

reduction and a tendency towards underinclusion on the other. All of these were consistently correlated with hypo-responsivity. Similar parallels can be drawn in respect of clinical status and illness factors with chronic, institutionalised schizophrenic patients tending to be more field dependent, more underinclusive and more likely to be perceptual augmenters than acute, noninstitutionalised patients. Hypo-responsivity was related to both these variables. Furthermore, in schizophrenic patients long duration of illness was related to field dependence, high Stroop interference, underestimation, perceptual reduction, underinclusion and these in turn, like longstanding illness, to electrodermal hypo-responsivity.

The results of the present study suggest that whilst changes do occur in both psychophysiological and cognitive measures in response to a number of variations the effect of the changes is consistent across both measures and has, for the most part, not affected the relationship between the two measures. What I have looked at here, however, has examined only one aspect of the state-trait issue and whilst changes take place in parallel between the two measures this has not tackled the issue of consistency over time. The state-trait issue was not therefore totally resolved by the current study and a second study was carried out using a group of normal subjects only. This is reported in Chapter 14.

CHAPTER 14

Reliability of Psychophysiological and Cognitive Response Styles: Retesting in Normal Control Subjects

Introduction

The aim of this second study was to examine whether the relationship found between psychological and cognitive response styles in the first study was also reliable over time. This was examined using a group of thirty-eight normal subjects who were tested on the first occasion on both tone sequences and the six cognitive control measures and on the second occasion, two months later, on the two tone sequences. As most electrodermal response measures have shown stability over time, any relationship found between the cognitive and psychophysiological styles on the first session could be re-examined in relation to psychophysiological measures found on the second session.

Subjects

The subjects comprised 38 normal volunteers (19 male, 19 female) with an age range of 21 to 54 years. The subjects were tested on two occasions. The second session occurred two months after the first and care was taken to ensure that all subjects were tested at the same time of day and, in the case of menstruating women, that they were tested at the same point during their menstrual cycle as on the first session. There were no changes between sessions in scores on the General Health Questionnaire.

Method

Apparatus

The reader is referred to the methodology sections of Chapters 5 to 12 for details of the apparatus used.

Procedure

All subjects were tested at Charing Cross Hospital. A sound-attentuated room adjacent to the experimenter and the polygraph was used to record electrodermal orienting responses to the two tone habituation sequences and a separate, adjacent room for testing on the six cognitive control tasks. All subjects were tested individually. The reader is again referred to the methodology sections of Chapters 5 to 12 for details of procedures and methods of analysis used for each of the tests. In the first session subjects were tested on both tone habituation sequences and the six cognitive control tasks: Closure Flexibility Test, Schematising Test, Stroop Colour-Word Test, Petrie Kinesthetic Figural After-Effect Test, Object-Sorting Test and Size Estimation Test. In the second session subjects were tested only on the two tone habituation sequences. All tables relating to this experiment except the summary tables are contained in the Appendix.

Results

I Tone Habituation Paradigm

Overall the findings in relation to the two tone habituation sequences were consistent with those reported in the literature and confirmed the results of the first study in

this thesis. Any differences found between sessions related to the level of significance rather than to any fundamental differences in the direction of correlations.

Intersessional correlations between electrodermal response variables were largely significant suggesting stability over time although nonsignificant correlations were found for response latency and recovery time and nonspecific response frequency to the 70 dB tones and for orienting response frequency and rate of habituation to 90 dB tones (Table 14 (i)). Intersessional correlations for response latency and rise time to 90 dB tones only approached significance. Whilst most electrodermal parameters show stability over time, lower reliabilities have been found for both response habituation and response recovery (Koriat et al, 1973; Siddle and Heron, 1976). This has been thought to relate to the use of different habituation criterion but there is also evidence to show that state anxiety may increase response frequency and levels of tonic activity and retard habituation (Maltzman et al, 1971; Stern and Janes, 1973; Watts, 1975; Gruzelier and Phelan, 1987).

There were no significant between-session differences for any of the electrodermal variables to the 70 dB sequence, although response amplitudes to 90 dB tones were higher in Session I than Session II (ANOVA, $F(1,36)$ 7.87, $p < 0.01$) and nonspecific response frequency increased in Session II (Wilcoxon: $Z = 1.94$, $p < 0.05$). There was an increased rate of nonresponding to both tone sequences in the second session and although differences in orienting response

frequency and the distribution of subjects between habituator groups were not significant this is likely to be related to retesting and was consistent with the general trend of a slight decline in electrodermal reactivity across sessions.

Important for the following analysis of the relationship between psychophysiological and cognitive measures was, however, the absence of a relationship in both Sessions between rate of habituation and lateral differences in response amplitude, even with skin conductance levels partialled out. The significant relationship between lateral asymmetries in skin conductance levels and response amplitude to 70 dB tones in Session I ($r = 0.48$, $p < 0.002$) and to 90 dB tones in Session II ($r = 0.37$, $p < 0.02$) further suggests the possible interdependence of electrodermal levels and response amplitudes. These findings do not support either those of the first study or the study by Gruzelier et al (1981).

A possible explanation may lie in the crossover effects found in relation to skin conductance level asymmetry. There was a significant interaction between Sex x Session x Hand (ANOVA, $F(1,36)$ 5.04, $p < 0.03$) in relation to the 70 dB tone sequence such that whereas women had higher skin conductance levels on the right hand in both sessions, there was a crossover effect in men with higher skin conductance levels on the left hand in Session I and on the right hand in Session II. In relation to the 90 dB sequence a nonsignificant crossover effect was also found in women indicating an increase across sessions in

subjects with higher skin conductance levels on the left than right hand. As the relationship between habituation and lateral asymmetry has been shown to be changed in highly anxious subjects (Gruzelier, 1987) the crossover effects may reflect changes in anxiety/arousal levels in some subjects.

II Cognitive Control Measures

(i) Closure Flexibility Test

Differences in Closure Flexibility scores between hypo- and hyper-responding groups as defined in the first study were not clearcut. Whereas hyper-responders to the 70 dB tones were more field independent than hypo-responders, the reverse was true in relation to the 90 dB sequence. Correlational evidence confirmed the lack of a relationship between Closure Flexibility scores and electrodermal measures (Table 14 (ii)). The only significant result obtained was in relation to the 90 dB tone sequence where in both sessions higher scores were associated with lower levels of nonspecific response frequency suggesting a possible relationship between field independence and hypo-responsivity which contradicts the findings of the first study. Asymmetry differences indicated that subjects with higher skin conductance levels on the right than left hand were more field independent than those with the opposite asymmetry. This confirmed the relationship found in the first study. A similar trend was found in respect of response amplitude asymmetry differences.

Whilst the findings for the Closure Flexibility Test were

not generally significant they tended to confirm the pattern of relationships found in the first study. A notable difference, however, was evident in relation to the louder tones, particularly in Session II, suggesting that increased reactivity to louder tones on repeat testing was a less adaptive response.

(ii) Stroop Colour-Word Test

Significant relationships between Stroop interference as a measure of the constricted-flexible control dimension and psychophysiological response patterns were not found and there was evidence of both tone intensity and cross-session effects. In Session I more interference was shown by hypo-responders to 70 dB tones and hyper-responders to 90 dB tones whereas the reverse was found in Session II. Correlations between Stroop Interference scores and electrodermal measures were, for the most part, not significant but suggested a pattern of decreased interference with increasing electrodermal activity more in line with the first study (Table 14 (iii).

Further comparisons looking at the differences between subjects with different lateral asymmetries were also not significant. Interestingly the pattern of results for skin conductance level asymmetries showed parallels to those relating to levels of responsivity insofar as in Session I more Stroop interference was found in subjects with higher skin conductance levels on the left hand to 70 dB tones and on the right hand to 90 dB tones with the reverse trend found in Session II. This was not surprising as lateral biases in skin conductance levels reflect levels

of arousal. However, there was a general trend for subjects with higher response amplitudes on the right than left hand to have lower interference scores, the only exception to this being in relation to 90 dB tones in Session I. Earlier findings were supported only in respect of response amplitude asymmetries and continued to indicate the importance of sustained attention in the performance of the Stroop task.

(iii) Schematising Test

There was no clear evidence of a relationship between Schematising measures and electrodermal responsivity in either Session, nor could a clear distinction be made between hypo- and hyper-responders on either measure. Correlations between electrodermal responsivity and levelling-sharpening measures were not generally significant, and where they were, suggested a tendency towards higher Ranking Accuracy scores and lower Incremental Error scores, indicating sharpening in more electrodermally reactive subjects (Table 14 (iv)). These findings are consistent with those of the first study.

With respect to electrodermal asymmetry significant differences were not found either for skin conductance level asymmetetry or response amplitude asymmetry. There was, however, a tendency for subjects with higher response amplitudes and higher skin conductance levels on the right than the left hand to have higher Ranking Accuracy scores than those with the reverse asymmetry. A less consistent pattern was found in relation to Incremental Error scores. This trend was again consistent with previous findings.

(iv) Size Estimation Test

The relationship between size estimation scores as a measure of the focussing-scanning dimension and electrodermal reactivity was not significant. There was a tendency for subjects hypo-responsive to 70 dB tones and hyper-responsive to 90 dB tones to have higher average error scores (overestimation), whereas correlations showed a consistent significant relationship to skin conductance levels across sessions and for both tone sequences indicating smaller average error scores (underestimation) with higher skin conductance levels (Table 14 (v)).

Unlike the previous study the relationship between focussing-scanning and lateral asymmetry was neither consistent nor significant. Subjects with higher skin conductance levels on the right than left hand tended overall to have higher average error scores, the only exception being to 90 dB tones in Session II. The pattern of response amplitude asymmetry, however, changed across tone sequences such that higher average error scores (overestimation) were found in subjects with higher response amplitudes on the left hand to the 70 dB tones and on the right hand to 90 dB tones. This was true in respect to both sessions.

The results here do not wholly support the general trend of the first study in which overestimation was associated with higher levels of responding and a predominance of right hemisphere influences on electrodermal activity patterns. Instead they suggest, like other findings in this study, that adaptive responding is characterised not by a particular level of reactivity but by a changing

pattern of reactivity in response to different stimuli, in this case different tone intensities. Differences were also evident across sessions suggesting that prior experience of stimuli was also relevant.

(v) Petrie KFA Test

Whilst a significant relationship was not found between KFA scores and electrodermal responsivity there was a tendency for hypo-responsive subjects to reduce more than hyper-responsive subjects, except in relation to the 90 dB sequence in Session I. Furthermore, correlations between KFA scores and electrodermal measures confirmed the trend towards greater reduction with hypo-responsivity (Table 14 (vi)) supporting the findings of the previous study.

Differences in patterns of lateral sysmmetry were not significant. Across sessions and for both sequences subjects with a right hemisphere bias in skin conductance levels reduced more than those with the reverse asymmetry. This is not consistent with the findings above. A similar pattern was evident in relation to response amplitude asymmetry, subjects with a right hemisphere bias showing greater reduction than those with the reverse asymmetry except in relation to the 70 dB sequence in Session II.

The results here show a similar pattern to those obtained in the first study. However, whereas the relationship between augmenting-reducing and electrodermal responsivity confirmed the parallel in sensory regulation, the laterality findings did not, greater reduction being associated with a right rather than a left-hemisphere dominance.

(vi) Object Sorting Test

Differences in the number of object categories between hypo- and hyper-responsive subjects were not significant in either session, although the latter tended generally to be more underinclusive than the former. This trend was confirmed by correlational evidence (Table 14 (vii).

The pattern in relation to skin conductance level asymmetries was, however, less consistent. In Session I overinclusion was associated with a right hemisphere bias to 70 dB tones and a left hemisphere bias to 90 dB tones, whereas the reverse was true in Session II. By contrast, response amplitude asymmetry differences showed a consistent relationship between underinclusion and a right hemisphere bias. This trend was present to both 70 and 90 dB tones and across sessions although the difference only reached significance for the 90 dB sequence in Session II ($F(1,31)$ 5.79, $p < 0.03$). This pattern of findings was very similar to that obtained in the first study.

The relationship between equivalence range and electrodermal reactivity found here does not support the earlier relation between narrow equivalence (overinclusion, few object categories) and electrodermal hyper-responding but again suggests variation in response to tone intensity and across sessions. There was, however, support for the previous finding of a relation between narrow equivalence and a left hemisphere bias in response amplitude indicative of focussed attention.

General Discussion

Several different issues are highlighted in this study. First of all, there is the issue of replication within a normal population. This is considered in the comparison between the first study and Session I of the second study. In line with the first study both psychophysiological response styles were found although some differences in the pattern were evident. The frequency of nonresponding was slightly lower in this second group although the greater incidence in female subjects was still noted. It is likely that the lower frequency of nonresponding was related to the younger age range in this group of subjects and to the fact that there were no menopausal women, most of whom were nonresponders in the first study. This decline in responding was also reflected in the different distribution of subjects between habituator groups. Lateral asymmetries showed a similar bias towards a right hemisphere dominance to that found in the first study for both skin conductance levels and response amplitudes.

An importance difference, however, was the absence of a significant relationship between rate of habituation and response amplitude asymmetry in this second study. This was firmly established in the first study with an increase in significance when skin conductance levels were partialled out confirming previous findings that hemispheric influences are independent of influences on levels (Gruzelier et al, 1981). This was reflected in the relation between psychophysiological and cognitive measures.

The comparison between psychophysiological response styles

and cognitive control measures at Session I showed no evidence of a significant relationship. However, similar trends were revealed in that hyper-responding to 70 dB tones was related more to field independence, to less interference on the Stroop task, to sharpening, focussing and less perceptual reduction on the Petrie KFA test (Table 14 (viii)). There was, however, a reversal in this trend in relation to the Object Sorting task with hyper-responding associated with under- rather than over-inclusion. In addition, unlike the first study the pattern changed for some measures when responsivity was measured to 90 dB tones: Hyper-responders tended to be more field dependent, experienced more interference on the Stroop task, less perceptual reduction and higher incremental error. As stated earlier in the Chapter, this change suggests that a high level of reactivity to 90 dB tones was not the most adaptive response. Whereas higher levels of responsivity to the quieter tones indicated orienting, to the louder tones this may have represented an 'anxiety response' or an 'over-reaction' where the adaptive response would have been to reduce the level of orienting or stimulus intake.

The relationship between lateral asymmetries in electro-dermal reactivity and cognitive control measures was also not significant but the pattern suggested a similar direction in trends for most of the measures (Tables 14 (ix) and (x)). Summarising, higher response amplitudes on the right hand tended to be associated with field independence, less Stroop interference, sharpening, scanning, perceptual reduction and underinclusion. Reversals in

Table 14 (viii) Relationship Between Cognitive Style Variables and Electrodermal Hypo- and Hyper-Responding (Experiment 2)

	Session 1		Session 2	
	Hypo-Responders	Hyper-Responders	Hypo-Responders	Hyper-Responders
Cognitive Style Dimension	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$
Field Dependence-Independence				
70 dB Sequence	54.75	55.27	54.42	55.87
90 dB Sequence	55.33	54.92	58.21	51.90
Constricted-Flexible				
70 dB Sequence	5.52	- 3.89	- 0.36	0.73
90 dB Sequence	- 2.00	1.03	2.70	2.56
Levelling-Sharpening	RA IE	RA IE	RA IE	RA IE
70 dB Sequence	0.63 0.15	0.64 0.18	0.64 0.24	0.62 0.28
90 dB Sequence	0.62 0.22	0.64 0.27	0.64 0.28	0.63 0.23
Focussing-Scanning				
70 dB Sequence	4.44	4.40	4.64	4.09
90 dB Sequence	4.18	4.53	3.91	4.90
Augmenting-Reducing				
70 dB Sequence	- 1.18	0.03	- 0.69	- 0.16
90 dB Sequence	- 0.27	0.58	- 0.71	- 0.25
Equivalence Range				
70 dB Sequence	11.94	12.36	11.17	13.73
90 dB Sequence	12.89	11.89	11.05	13.32

trends to the 90 dB tones were also noted in that the right hemisphere bias tended to be linked to less sharpening and less perceptual reduction. Similarly, higher skin conductance levels on the right hand to 70 dB sequence were associated with field dependence, focussing, sharpening, more perceptual reduction and overinclusion, and less Stroop interference. The latter two findings represented a reversal in trend by comparison with the first study. Within the second study, reversals were also noted between tone sequences in that the right hemisphere bias was linked to field independence and underinclusion.

The lack of significant findings in Session I of this second study questions the reliability of the relationships found between psychophysiological response styles and some cognitive control measures despite the fact that, for the most part, the pattern of relationships appeared to follow the same trends as in the first study. Where changes did occur, such as the reversals in the relationship of cognitive measures to electrodermal measures to louder tones, this suggested that any relationship between the two types of measure was unlikely to be a linear one in that a high level of responsivity was not in itself always optimal. Whereas it may be appropriate under conditions of stimulus intake, it would be inappropriate if it merely reflected some underlying anxiety. This is further supported by the absence of a relation between habituation and response amplitude asymmetry in the second study, a relation that has been shown to be reversed in highly anxious subjects (Gruzelier, 1987).

Table 14 (ix) Relationship Between Cognitive Style Variables and Skin Conductance Level Asymmetry (Experiment 2)

	Session 1		Session 2	
	Right>Left	Left>Right	Right>Left	Left>Right
Cognitive Style Dimension	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$
Field Dependence-Independence				
70 dB Sequence	54.40	55.48	55.40	54.83
90 dB Sequence	54.27	55.57	53.00	57.11
Constricted-Flexible				
70 dB Sequence	0.10	0.06	3.73	2.32
90 dB Sequence	- 1.54	1.12	1.88	- 1.74
Levelling-Sharpening	RA IE	RA IE	RA IE	RA IE
70 dB Sequence	0.57 0.24	0.68 0.27	0.61 0.26	0.65 0.25
90 dB Sequence	0.60 0.26	0.66 0.26	0.63 0.29	0.64 0.23
Focussing-Scanning				
70 dB Sequence	4.13	4.61	4.16	4.59
90 dB Sequence	4.30	4.49	4.77	4.08
Augmenting-Reducing				
70 dB Sequence	- 0.26	- 0.62	- 0.37	- 0.55
90 dB Sequence	- 0.43	- 0.51	- 0.48	- 0.48
Equivalence Range				
70 dB Sequence	11.73	12.48	12.60	11.91
90 dB Sequence	12.00	12.30	13.16	11.21

Furthermore, the small number of significant findings in both studies raises a number of methodological questions related to the size of the subject population on the one hand and to the choice of test used to measure the various cognitive controls on the other. In this respect, it is interesting to note that the more clearcut and significant relationships between psychophysiological and cognitive response measures in the first study were found where the latter were explored using more researched tests, namely field dependence and the Stroop colour-word test.

The second issue explored in this study was that of consistency over time. This was examined by comparing electrodermal measures and their relationship to cognitive measures in Sessions I and II (Tables 14 (viii), (ix), (x)). Significant between-session differences in electrodermal response measures were not found except for an increase in nonspecific activity to 90 dB tones. Otherwise there was evidence of a slight decline in electrodermal activity in Session II that was also reflected in a changing pattern of response styles. For example there was an increase in nonresponding and the rate of habituation as well as a shift from a right to a left hemisphere bias in response amplitude asymmetry. Insofar as the former has been associated with a slower rate of habituation (Gruzelier et al, 1981) these two trends were not inconsistent. They do, however, suggest an effect of repeat testing.

The tentative pattern of relationships between cognitive and psychophysiological response measures did not, for the

Table 14 (x) Relationship Between Cognitive Style Variables and Response Amplitude Asymmetry (Experiment 2)

	Session 1		Session 2	
	Right>Left	Left>Right	Right>Left	Left>Right
Cognitive Style Dimension	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$
Field Dependence-Independence				
70 dB Sequence	52.92	56.35	53.07	56.31
90 dB Sequence	54.83	54.56	53.07	57.47
Constricted-Flexible				
70 dB Sequence	1.44	2.38	- 1.38	- 4.19
90 dB Sequence	- 2.94	3.11	3.56	- 4.19
Levelling-Sharpening	RA IE	RA IE	RA IE	RA IE
70 dB Sequence	0.56 0.27	0.67 0.27	0.63 0.24	0.61 0.25
90 dB Sequence	0.59 0.26	0.67 0.25	0.65 0.21	0.64 0.26
Focussing-Scanning				
70 dB Sequence	4.50	4.39	5.30	4.08
90 dB Sequence	4.09	4.89	3.95	4.74
Augmenting-Reducing				
70 dB Sequence	- 0.24	- 0.90	- 0.61	0.04
90 dB Sequence	- 0.31	- 0.75	- 0.24	- 0.78
Equivalence Range				
70 dB Sequence	10.23	13.65	11.73	11.92
90 dB Sequence	11.44	13.06	10.67	13.24

most part, change across sessions. Where changes occurred, this was usually in relation to the louder tone sequence. Again whilst this suggests consistency over time, it is difficult to draw a firm conclusion based on primarily nonsignificant findings all the more so in view of the paucity of previous research in this particular aspect of the field.

In an attempt to redress the balance and to examine further the relationship between the two response styles, a third study using both normal and psychiatric patients was carried out. This study, reported in Chapters 15-17, focusses on two cognitive controls only: the field dependence and constricted-flexible dimensions. These were selected on the basis of their common loading on a field articulation factor and the greater evidence for a relationship between these two dimensions and the psychophysiological response measures. Alternative methodologies for both these controls were used in order to see whether further light could be shed on the attentional mechanisms that might underly the various response styles.

CHAPTER 15

Replication of Bilateral Skin Conductance Orienting and Habituation Characteristics in Schizophrenic and Nonschizophrenic Psychiatric Patients and Normal Controls

Introduction

An attempt was made in this third study to further clarify the nature of the cognitive-psychophysiological relationship by using alternative measures of the two cognitive control measures chosen that a) showed a more significant relationship to psychophysiological response styles and b) were consistenty loaded on the same factor and appeared to represent the cognitive style of field articulation. With regard to the constricted-flexible dimension both auditory and visual Stroop effects were examined and in relation to the dimension of field dependence modifications were introduced to allow the examination of effects of time and motivation on subjects' performance.

The habituation paradigm used in this third study was essentially the same as in the two previous studies with two minor exceptions. Tones in both sequences were of 1 second duration and each sequence comprised only 10 tones. This was deemed sufficient to define the four different habituator groups and to produce a sufficent index of electrodermal responsivity and lateral asymmetry.

Subjects

There were sixty subjects divided into three groups: 1. Normal control group (N = 20); 2. Nonschizophrenic patient

group (N = 20); 3. Schizophrenic patient group (N = 20). All three groups were matched for age and sex. There were 15 men and 5 women in each group with a mean age of 35 ranging from 20 - 61 years. All subjects were righthanded.

Table to Show Diagnostic Subcategories in Patient Groups

Subject Group		
Schizophrenic Patients	Acute	9
	Chronic	11
	Paranoid patients	2
	Nonparanoid patients	18
Nonschizophrenic Patients	Reactive depression	7
	Endogenous depression	9
	Personality Disorders	3
	Neurotic Disorders	1

The schizophrenic patients were consecutive admissions, all diagnosed as unambiguously schizophrenic by the hospital psychiatrists and, in some cases, with the help of the Present State Examination (Wing et al, 1974). None of the patients were shown to have brain damage. The patients were heterogeneous as regards the stage of their disorder and their current clinical picture and included both acute and chronic patients, with and without paranoid symptomatology. All the patients had been admitted to Charing Cross Hospital. The nonschizophrenic patient group comprised patients who were also taken from Charing Cross Hospital and included patients with depression, neurotic or personality disorders (see Table above). Five of the schizophrenic patients and five of the nonschizophrenic patients were unmedicated.

The normal control group comprised a heterogeneous group of volunteers employed both within and outside of the hospital. All the subjects in this group were asked to complete the General Health Questionnaire (Goldberg, 1972) and only those subjects scoring within the normal range were included in the study.

Method

Apparatus and Procedure

The reader is referred to the methododolgy section of Chapter 6 for details of the apparatus and procedure used. The only difference between Experiment I and this experiment was that only 10 tones were used in each sequence and all tones were of 1 second duration.

Skin conductance response characteristics were defined as for previous tone habituation sequences used in this thesis (see Chapter 6) with a habituation criterion of a cessation of responding for a minimum of three successive trials. The results were scored manually and analysed using parametric and nonparametric statistics. All tables relating to the results are contained in the Appendix.

Results

I. 70 dB Sequence

(a) Electrodermal Responsivity

Unlike the first study significant between-group differences were not found for any electrodermal variable (Table

15 (i)). However, the pattern of results followed a similar trend with normal controls showing higher levels of electrodermal responsivity and a lower frequency of nonresponding than either patient group. The incidence of nonresponding in normal (10%) and schizophrenic (30%) subjects was within the expected range whereas in non-schizophrenic patients it tended again to be much higher (40%). Nonresponders were distinguished from responders by their lower levels of nonspecific response frequency (Mann-Whitney: Normal controls: $Z = 2.15$, $p < 0.04$; non-schizophrenic patients: $Z = 3.01$, $p < 0.01$; schizophrenic patients: $Z = 2.72$, $p < 0.01$) and skin conductance levels (nonschizophrenic patients: $Z = 3.01$, $p < 0.01$).

Table to Show Distribution Between Habituator Groups

Habituator Group	0-Trial	Fast	Moderate	Slow
Normal Controls	2	7	8	3
Nonschizophrenic Ss	8	5	4	3
Schizophrenic Ss	7	5	5	3

Rate of habituation did not differ significantly between subject groups although normal controls tended to be slower to habituate than both patient groups. Similarly, between-group differences in the distribution of subjects between habituator groups were not significant (see Table above). A clear difference was, however, found between hypo- and hyper-responders, as defined in Experiment I, in relation to nonspecific response frequency, skin conductance levels and both mean and initial response amplitude,

all higher in hyper-responding subjects (Table 15 (ii)).

(b) Lateral Asymmetry

A predominance of subjects with a right hemisphere bias in skin conductance level was present in all three groups (see Table below). Differences in electrodermal response characteristics of the two asymmetry groups were significant in respect of mean skin conductance levels and in normal controls only. Subjects with a left hemisphere bias had higher levels than those with the reverse asymmetry (Mann-Whitney, $Z = 2.26$, $p < 0.03$). The same trend was present in both patient groups (Table 15 (iii)).

Table to Show Distribution of Lateral Asymmetry (70 dB)

Direction of Asymmetry:	Skin Conductance Level		Response Amplitude	
	L > R	R > L	L > R	R > L
Normal Controls	7	13	7	11
Nonschizophrenic Ss	7	13	3	8
Schizophrenic Ss	8	12	8	4

A similar right hemisphere bias in response amplitude was found in a majority of normal controls and nonschizophrenic patients whereas in schizophrenic patients the pattern was reversed with a left hemisphere bias more predominant (see Table above). This indicated a reversal in the pattern of asymmetry in both patient groups by comparision to the first study. Subjects with differing asymmetries did not differ significantly with respect to other electrodermal measures (Table 15 (iv)).

The relationship between rate of habituation and the lateral differences in response amplitude noted in the first study in normal subjects and confirming the findings of Gruzelier et al (1981) was not significant in any of the three groups even with skin conductance levels partialled out. There was, however, a significant correlation between lateral asymmetries in electrodermal levels and response amplitude ($r = 0.36$, $p < 0.01$) suggesting the two measures were not independent of each other. Within groups this relationship was only significant in normal controls ($r = 0.46$, $p < 0.03$).

(c) Intercorrelations Between Electrodermal Variables

Overall the pattern of intercorrelations between electrodermal response variables to the 70 dB sequence confirmed previous findings (Table 15 (v)). Factor analysis revealed three factors: Factor 1 comprised all the temporal variables (response latency, rise and recovery time); Factor 2 rate of habituation and nonspecific response frequency and Factor 3 orienting response frequency, skin conductance levels and response amplitude. Factors 2 and 3 clearly represented reactivity factors although the reasons for their pattern of distribution is not clear. A similar pattern of factors was found within subject groups (Table 15 (vi)).

II 90 dB Sequence

(a) Electrodermal Responsivity

The results for the 90 dB sequence indicated a similar pattern to that found for the 70 dB sequence with no

significant between-group differences but a trend towards higher levels of electrodermal reactivity in normal controls (Table 15 (vii)). The incidence of nonresponding to 90 dB tones was within the expected range indicating an increase in normal controls (20%) and a decrease in both schizophrenic (25%) and nonschizophrenic patients (30%) by comparison to the first sequence. Nonresponders were distinguished from responders by lower levels of nonspecific responses (Mann-Whitney: Normal controls: $Z = 2.54$, $p < 0.02$; nonschizophrenic patients: $Z = 2.25$, $p < 0.03$; schizophrenic patients: $Z = 2.95$, $p < 0.003$) and skin conductance levels (Normal controls: $Z = 2.65$, $p < 0.01$; nonschizophrenic patients: $Z = 2.64$, $p < 0.01$). Overall cross-sequence changes in phasic activity were small with normal controls showing a slight decline and both patient groups a slight increase in phasic responding. However, tonic activity was significantly lower to louder tones for both nonspecific responses (Wilcoxon: Normal controls: $Z = 3.38$, $p < 0.001$; nonschizophrenic patients: $Z = 2.15$, $p < 0.03$; schizophrenic patients: $Z = 2.95$, $p < 0.003$) and skin conductance levels (Schizophrenic patients: $t = 2.68$, $p < 0.02$; nonschizophrenic patients: $t = 2.67$, $p < 0.02$).

Whilst between-group differences in the rate of habituation and the distribution of subjects into habituator groups were not significant, in line with previous results a distinction could be made between hypo- and hyperresponders (Table 15 (viii)).

(b) Lateral Asymmetry

The pattern of lateral asymmetries to 90 dB tones was very

similar to the 70 dB sequence. A predominant right hemisphere bias in skin conductance level was found in all three groups (see Table below) with both tonic and phasic activity tending to be higher in subjects with a left rather than a right hemisphere bias (Table 15 (ix)).

Table to Show Distribution of Lateral Asymmetry (90 dB)

Direction of	Skin Conductance Level		Response Amplitude	
Asymmetry:	L > R	R > L	L > R	R > L
Normal Controls	4	16	7	9
Nonschizophrenic Ss	6	13	6	6
Schizophrenic Ss	7	12	9	5

The pattern of response amplitude asymmetry varied across groups (see Table above) although differences in distribution were not significant. A right hemisphere bias was found in normal controls and a left hemisphere bias in schizophrenic patients. In nonschizophrenic patients no one bias predominated. In support of previous findings, subjects with a right hemisphere bias tended to have higher levels of tonic and phasic activity than those with the reverse asymmetry (Table 15 (x)).

Exploring again the relationship between rate of habituation and lateral differences in response amplitude some support was found for reciprocity of hemisphere influence on response habituation in the direction of slower rates of habituation in subjects with higher response amplitudes on the right than left hand. This relationship was however only significant in schizophrenic ($r = -0.55$, $p < 0.02$)

and nonschizophrenic patients ($r = -0.46$, $p < 0.05$). In both groups the relationship between lateral asymmetries for skin conductance level and response amplitude was also significant (schizophrenic patients: $r = 0.56$, $p < 0.02$) or approached significance (nonschizophrenic patients: $r = 0.40$, $p < 0.08$). However, only in the schizophrenic group did the relation between response habituation and response amplitude asymmetry remain when skin conductance level was partialled out ($r = -0.54$, $p < 0.03$) although in normal controls it approached significance ($r = -0.37$, $p < 0.08$). This does not support the results of the first study where the relationship was present only in the normal group and only in relation to the 70 dB tones which continues to suggest that this reciprocity may be changed or affected by the disease processes of the patients under study as well as the nature of the stimuli presented.

(c) Intercorrelations Between Electrodermal Variables

The pattern of correlations between electrodermal response variables to the 90 dB sequence was very similar to that for the 70 dB sequence (Table 15 (xi)). The distribution between factors was, however, different in that only two factors were present. Factor 1 was clearly a reactivity factor including orienting and nonspecific response frequency, rate of habituation and response amplitude. Factor 2 included skin conductance level and the three temporal variables. These factors were found in each of the three subject groups with a general trend towards a separation between temporal and nontemporal variables although the pattern was not clearcut (Table 15 (xii)).

Discussion

The existence of both psychophysiological response styles was further supported by the present findings. In respect of the responder-nonresponder distinction there was a very similar pattern of distribution to that found in the first study with nonschizophrenic patients having the highest incidence of nonresponding and the normal control group the lowest. As a large proportion of the patients in the nonschizophrenic group had a diagnosis of depression this lends further support to the idea of nonresponding or hypo-responsivity constituting a possible vulnerability marker for this group. The frequency of nonresponding in both normal controls and schizophrenic patients fell within the normal range established in previous research (Bernstein et al, 1982). The trend towards hyper-responsivity in the normal group and hypo-responsivity in both patient groups was supported by the habituation data and showed no significant change in relation to louder tones. The distinction made in the first study between hyper- and hypo-responders in respect of their electrodermal response characteristics was also supported.

The pattern of lateral asymmetries was not, however, consistently replicated. There was a bias towards higher skin conductance levels on the right than the left hand in all three groups and to both tone sequences whereas in the earlier study this pattern had been present only in the normal control group with the reverse asymmetry in the nonschizophrenic group and equal representation in the schizophrenic group. This would not appear to relate to the levels of tonic activity generally. The pattern of

response amplitude asymmetries also showed differences compared to the earlier findings. In relation to the 70 dB tone sequence both normal and nonschizophrenic subjects continued to show a bias towards a right hemisphere asymmetry whereas this was now reversed in the schizophrenic group. Response amplitude asymmetry to 90 dB tones was consistent with this pattern but therefore represented a reversal in asymmetry in both the normal and schizophrenic patient groups by comparison to the first study. Significant differences in other electrodermal variables between the two asymmetry groups were not generally found.

Evidence for the interdependence of the two psychophysiological response styles is not clearcut. In the first study a significant relationship was found between rate of habituation and response amplitude asymmetry but only within the normal control group and only in relation to 70 db tones. In the current study that relationship was significant only in the two patient groups and only in relation to the 90 dB sequence. It is hard therefore to draw any firm conclusion from these findings about the interdependence of the two response styles other than the fact that the relationship is different in patient and non-patient groups and may in some way be changed by the disease process. However, in view of the related finding that normal subjects high on anxiety do not show this relationship (Gruzelier, 1987) and that anxiety may disrupt hemispheric relations (Tucker, 1981) other factors may be operating. The effect of anxiety on the two response styles is explored later in this discussion.

Sex differences in relation to the electrodermal response styles were not explored due to the predominance of male subjects within each group. Similarly, diagnostic categories and illness factors were not examined as in the first study these were not found to be significant factors. The expected decline in electrodermal responsivity with increasing age was, however, supported and significant correlations for the group as a whole were obtained in relation to skin conductance level to both 70 ($r = -0.30$, $p < 0.01$) and 90 dB ($r = -0.23$, $p < 0.04$) sequences. An interesting relationship between age and lateral asymmetry was also found with higher skin conductance levels and response amplitudes on the right rather than the left being associated with the younger age group. Significant correlations were obtained in respect of skin conductance level asymmetries to both 70 dB ($r = -0.30$, $p < 0.01$) and 90 dB ($r = -0.29$, $p < 0.02$) sequences and for response amplitude asymmetry to 70 dB tones ($r = -0.30$, $p < 0.03$). A similar relationship was present in all three groups and is consistent with previous developmental research (Fisher and Cleveland, 1956; Stevens and Gruzelier (unpublished data). As age effects were, however, controlled for, these findings cannot be used to explain or account for group differences.

One further variable that was explored was the effect of anxiety on electrodermal measures. Subjects were asked to complete the Spielberger State-Trait Anxiety questionnaire (Spielberger, 1966) prior to being tested. Significant differences were found between the three groups for both state (Kruskal-Wallis: $X^2 = 16.36$, $p < 0.001$) and trait

anxiety (X^2 = 17.14, $p < 0.001$) with both patient groups showing higher levels of anxiety than the normal controls. The two patient groups did not differ. Interestingly, correlations between the two anxiety measures were only significant in the normal group ($r = 0.61$, $p < 0.01$) suggesting that in patients state anxiety may not depend on some prior disposition to high and low anxiety.

The relationship between trait anxiety and electrodermal responsivity was not generally found to be significant. Two exceptions to this were for schizophrenic patients with high trait anxiety levels to have higher levels of skin conductance to 90 dB tones ($r = 0.39$, $p < 0.05$) and for nonschizophrenic patients with high trait anxiety levels to have longer response recovery times to 70 dB tones ($r = 0.65$, $p < 0.001$). High state anxiety on the other hand was associated in the total subject population with lower levels of responsivity and significant correlations were obtained in relation to orienting response frequency ($r = -0.23$, $p < 0.04$) and response amplitude ($r = -0.27$, $p < 0.02$) to 90 dB tones and for initial response amplitude to both 70 ($r = -0.28$, $p < 0.02$) and 90 dB tones ($r = -0.25$, $p < 0.03$). Within-group correlations suggested a similar relationship was present in all three groups but only reached signficance in the schizophrenic patient group in relation to nonspecific responses to 90 dB tones ($r = -0.43$, $p < 0.03$).

Consistent with these findings is the relationship between anxiety and lateral asymmetry which suggests that higher levels of both trait and state anxiety were more likely to

be associated with either higher skin conductance levels or higher response amplitude on the left than the right hand. Again this was only significant in relation to skin conductance level asymmetry and trait anxiety in the schizophrenic patient group (70 dB: $r = 0.43$, $p < 0.03$; 90 dB: $r = 0.42$, $p < 0.04$) and response amplitude asymmetry to 70 dB tones and both state ($r = 0.56$, $p < 0.04$) and trait anxiety ($r = 0.78$, $p < 0.01$) in nonschizophrenic patients.

Overall the findings are not consistent with previous research which has suggested that high levels of anxiety tend to be associated with high levels of electrodermal responsivity (Katkin and McCubbin, 1969; Epstein and Fenz, 1970; Feij, 1975) albeit not necessarily in response to tones of moderate intensity (Koriat et al, 1973; Neary and Zuckerman, 1976) and not necessarily in the patient population (Lader, 1975). The finding of a low level of responding in subjects with higher levels of anxiety does, however, lend support to an active gating mechanism or sensory reduction mechanism that modulates environmental input.

In conclusion, the presence of the two psychophysiological response styles continues to be supported and would not appear to be accounted for by various demographic and illness variables. Anxiety may, however, be an important factor and its relationship to the cognitive control measures relating to the field dependence and constricted-flexible dimensions will be explored in the following two chapters.

CHAPTER 16

Response to Tachistoscopic Presentation of Embedded Figures in Schizophrenic and Nonschizophrenic Psychiatric Patients and Normal Control Subjects

Introduction

The dimension of field dependence has been extensively researched using three basic measures. Of these, the Embedded Figures Test, has tended to be the most widely used and has been presented in a variety of both individual and group forms, all aiming to test the ability of a subject to attend selectively to particular portions of a stimulus field. However, in addition to measuring certain aspects of selective attention, this particular test is subject to a number of constraints that may influence a subject's test performance. In the first instance, all forms of this test are timed and will inevitably be affected by factors such as speed and accuracy of processing. In the first study, speed was found to be a more important factor than accuracy in that normal controls answered more test items than patients and yet there was no significant difference in the number of errors each group made.

Furthermore, slowness in information processing has been put forward as a possible hypothesis to explain the performance deficit of schizophrenic patients on a variety of cognitive tasks (Yates, 1966) and studies attempting to test this hypothesis have shown that schizophrenics are slowed by increases in task complexity (Yates and Korboot, 1970; Slade, 1971) as well as improve under slowed

conditions (Hemsley, 1971; Hemsley and Hawks, 1974). Cognitive deficits found in schizophrenic patients have also been attributed to distractibility (e.g., Chapman and McGhie, 1962; McGhie et al, 1965a; Hemsley, 1976) and to memory factors (e.g., Koh, Kayton and Berry, 1973; Russel and Beekhuis, 1976; Oltmanns, 1978), both of which are inherent in the embedded figures tests currently used. In order to control for these factors in this current study test items were presented on slides in pairs: one simple figure and one complex figure in which the simple figure was embedded. By presenting only one complex figure at a time both task complexity and the level of distractibility are lowered. In addition, the simultaneous presentation reduces any reliance on memory and the size of the stimulus field to be scanned. Possible effects due to speed of processing were further examined by presenting the slides under both timed and untimed conditions.

Subjects

60 subjects took part (see Chapter 15 for description).

Method

A repeated measures design was used with all subjects receiving all stimuli. The embedded figures were divided into two blocks, matched for level of difficulty, and presented under two conditions, timed (fast presentation) and untimed (slow presentation).

Apparatus

The stimuli comprised 196 complex figures and 28 simple figures from the Closure Flexibility Test (Thurstone and

Jeffrey, 1965) used in the first series of experiments and printed on slides. Each of 4 complex figures was paired individually with 1 of the 28 simple figures according the Closure Flexibility Test. The complex stimuli were divided into 2 subsets according to mode of presentation. Under the fast presentation condition the simple figure was shown for 3 seconds only. Under the slow presentation the simple figure remained paired with the complex figure until the subject gave a verbal response. The fast condition was always presented first. The slides were presented using a slide projector fitted with a timed exposure unit so that the length of exposure of each slide could be determined in advance. The slide projector was also linked to a millisecond timer. The onset of a slide triggered the timer which was then terminated by the verbal response from the subject by means of a throat voice key.

Procedure

Subjects were asked to watch the screen in front of them and decide on appearance of the paired figures whether or not the simple figure was contained within the complex figure. If they decided it was, they were instructed to say 'YES'. Otherwise they were asked to say 'NO'. Under the fast presentation subjects were told the two figures would only be visible for 3 seconds. Under the slow presentation no time limit was stipulated. In both conditions subjects were asked to respond as quickly and as accurately as possible. During presentation the experimenter sat behind subjects. Verbal responses and response latencies were recorded manually. All tables relating to the results are contained in the Appendix.

Results

1) Correct Responses

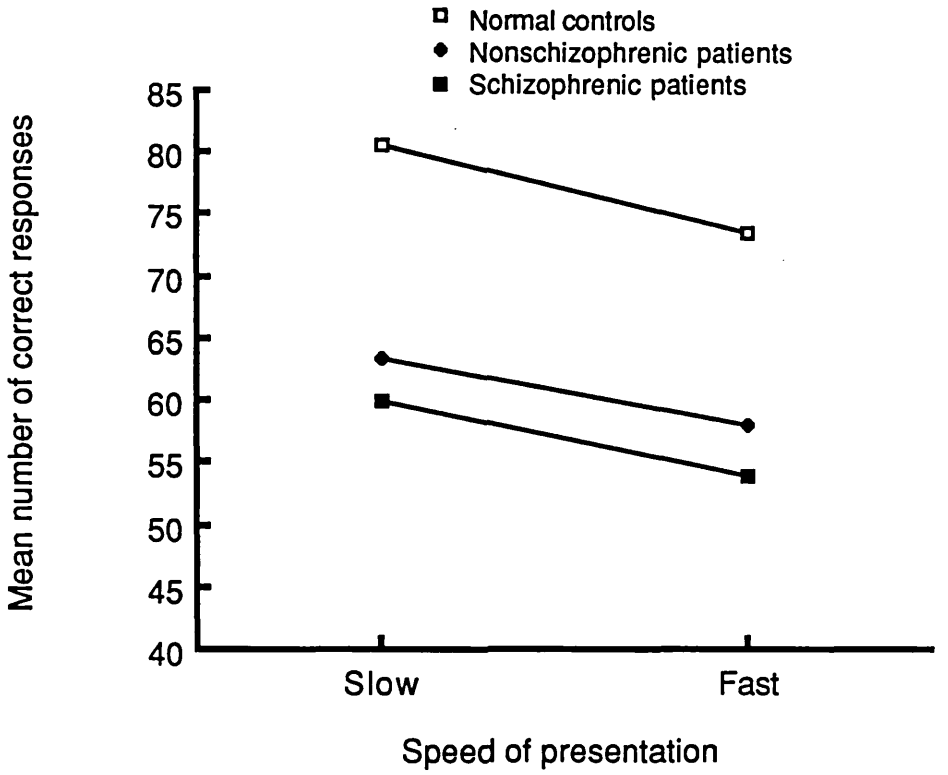
Significant group differences were found in overall correct response scores (ANOVA, $F(2,54)$ 33.55, $p < 0.001$). Under both conditions normal subjects had more correct responses suggesting they were more field independent than both patient groups (Scheffe, $p < 0.001$). The difference between the two patient groups was not significant (Figure 16 (i)). All three groups obtained higher correct scores under the slower condition ($F(1,54)$ 64.48, $p < 0.001$).

Differences between hypo- and hyper-responding subjects in respect of both tone sequences were not significant for either condition (Table 16 (i)). In both patient groups hypo-responders had higher scores than hyper-responders although there was a crossover effect in the schizophrenic group with hypo-responders to 90 dB tones benefitting more from the slow presentation than hyper-responders. In normal subjects this trend was reversed with hyper-responders obtaining higher scores than hypo-responders. Correlations between correct scores and electrodermal measures suggested that field independence was related to both higher tonic and phasic activity (Table 16 (ii)). This was true of normal controls and patients alike even though not all correlations were significant. These relationships obtained under both fast and slow conditions.

Significant differences in the number of correct responses between subjects with different skin conductance level asymmetries were not found in any of the three subject

Figure 16 (i)

CORRECT SCORES ON THE EMBEDDED FIGURES TASK



groups (Table 16 (iii)). Overall subjects with higher skin conductance levels on the left than right hand had more correct responses to both presentations than those with the reverse asymmetry.

Differences between response amplitude asymmetry groups were also not significant (Table 16 (iv)). Normal subjects with higher response amplitudes on the left than the right hand had more correct responses to both presentations than those with the reverse asymmetry whereas the opposite was true in nonschizophrenic patients. Schizophrenic patients showed a less consistent picture with higher scores in subjects with higher response amplitudes on the right hand to 70 dB tones and on the left hand to 90 dB tones.

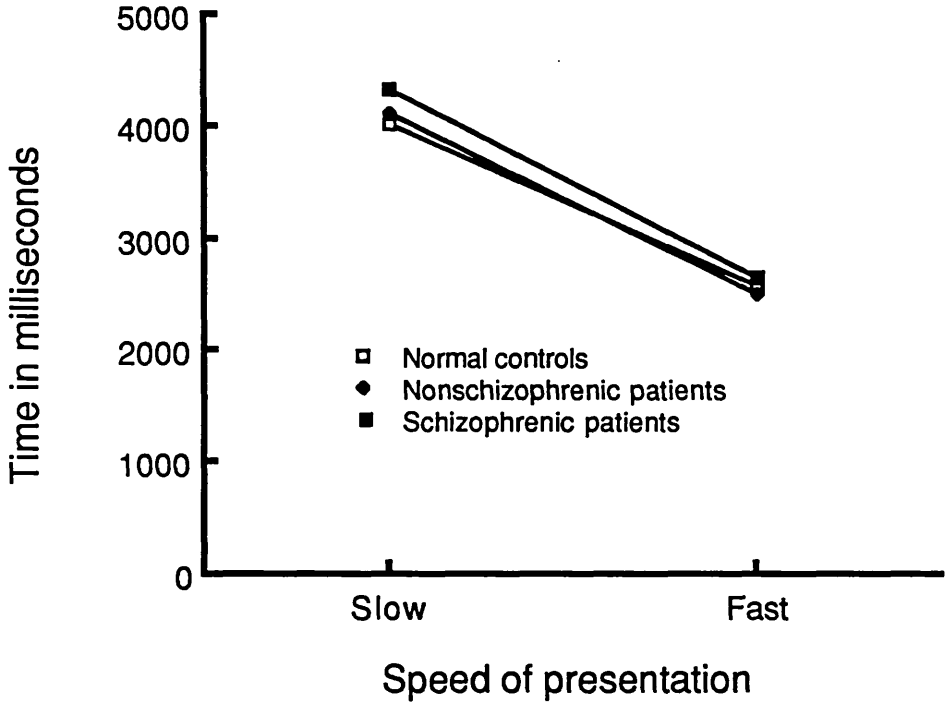
In summary, with a higher correct score indicative of greater field independence, the findings suggested that normal subjects were more field independent than the two patient groups. This supports the view that patient-nonpatient differences in the first study were not due to memory or task complexity factors. Field independence again tended to be related to higher levels of electrodermal responsivity, at least in normal controls. In these two respects the results support those of the first study although differences were noted in relation to skin conductance level and response amplitude asymmetries.

2) Response Latency

There were no significant group differences in response latencies either overall or to the two presentations although schizophrenic subjects tended to have slower

Figure 16 (ii)

RESPONSE LATENCIES TO EMBEDDED FIGURE STIMULI



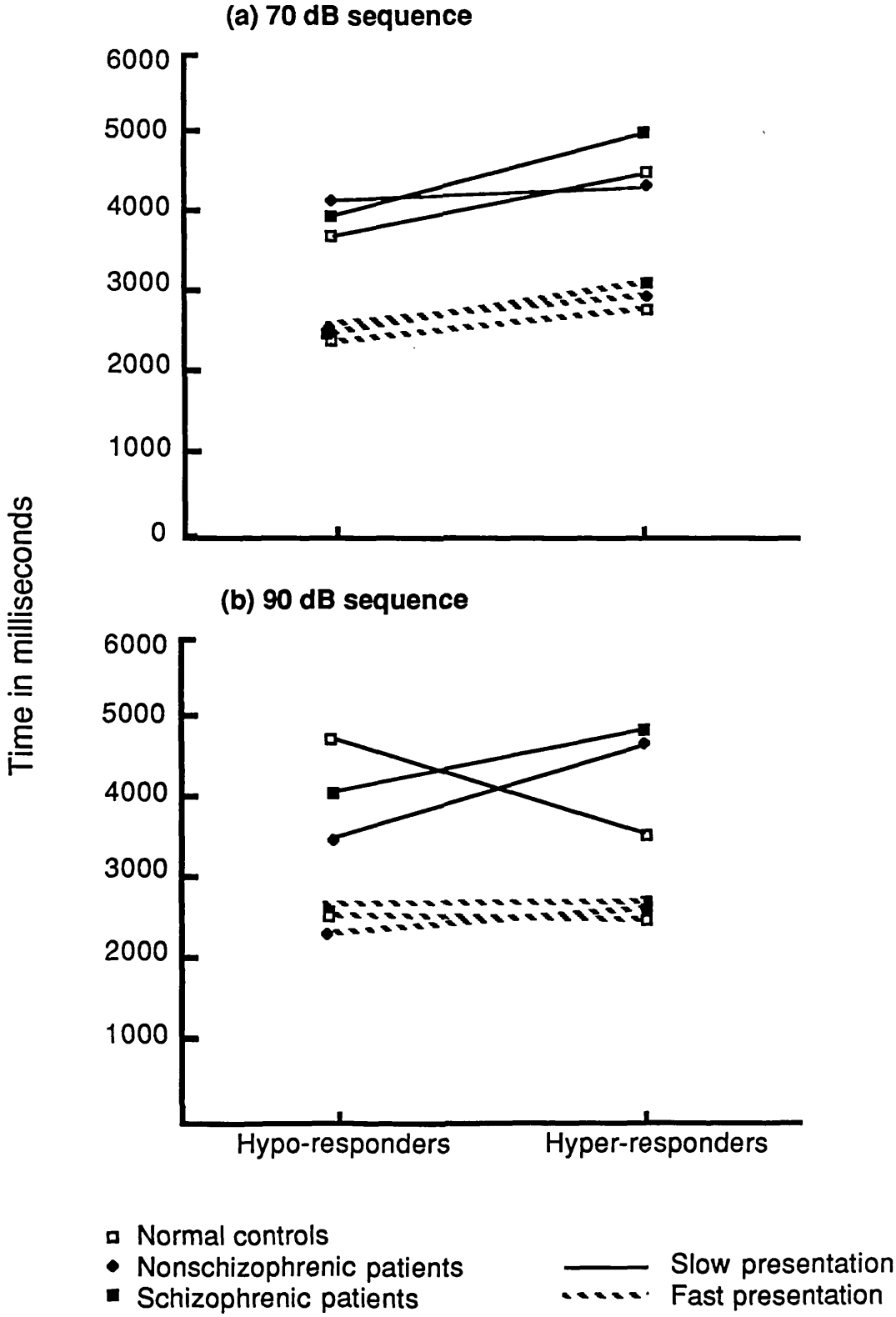
response latencies than the two control groups (Figure 16 (ii)). In all three subject groups response latencies to the slow presentation were significantly slower than to the fast presentation ($F(1,54)$ 60.02, $p < 0.001$).

With respect to the 70 dB sequence differences in response latencies between hypo- and hyper-responding subjects only approached significance ($F(1,54)$ 3.60, $p < 0.06$) with hyper-responders tending to have longer response latencies under both fast and slow conditions (Figure 16 (iii)). Within-group differences were significant for the slow condition in both schizophrenic and normal subjects (a priori, $p < 0.03$). A significant main effect for response group was not found in respect of the 90 dB sequence. In both patient groups hypo-responders generally had shorter response latencies to the embedded figure stimuli whereas in normal controls the reverse was true for the slow presentation. Differences were only significant in the nonschizophrenic group (a priori, $p < 0.03$)). Correlations between response latencies and electrodermal variables were not generally significant but tended to confirm this pattern of relationships (Table 16 (v)).

Differences in response latencies between skin conductance level asymmetry groups were not significant under either condition. The means suggest, however, that the three subject groups showed different patterns of relationship between the two variables (Table 16 (vi)). Whereas longer response latencies tended to be found in schizophrenic patients with a left hemisphere bias and in nonschizophrenic patients with a right hemisphere bias, in normal

Figure 16 (iii)

RESPONSE LATENCIES TO EMBEDDED FIGURES STIMULI IN HYPO-AND HYPER-RESPONDERS



controls the pattern differed between the two conditions. A right hemisphere bias in skin conductance levels tended to be associated with longer response latencies to the slow presentation and faster response latencies to the fast presentation.

With respect to response amplitude asymmetry there were again no significant differences between asymmetry groups. The patterns of relationship between hemisphere bias and response latency varied across subject groups in the same direction to that found for skin conductance level asymmetry (Table 16 (vii)). One interesting exception to this pattern was the interaction with changes in hemisphere bias to different levels of tone intensity in schizophrenic patients. In this group longer response latencies were associated with a left hemisphere bias in response amplitude to 70 dB tones and with a right hemisphere bias to 90 dB tones.

The findings for response latency are less clearcut than those for the correct scores measure and as such do not constitute a measure of field dependence. Interestingly all three groups, not just patients, were affected by speed of presentation, taking longer to respond where time constraints were absent. This supports the hypothesis that differences between patients and normal controls are not due to slowness of processing. Longer response times tended to be associated with higher levels of electrodermal responsivity suggesting this might be related to factors such as anxiety although, in normals, a consistent finding has been the relation between field independence

and higher levels of electrodermal responsivity. Changes in the relation between hemisphere bias and both correct scores and response latencies in schizophrenic patients with changes in tone intensity suggest, however, that this might be worthy of further exploration.

A significant relationship was found between state and trait anxiety and correct scores to both fast and slow presentations (see Table below) suggesting that field independence was related to lower levels of anxiety. There was no relationship between anxiety and response latency measures.

Table to Show Relation Between Anxiety/Field Dependence

Anxiety measure:	State Anxiety		Trait Anxiety	
Correct responses	r	p	r	p
Total score	- 0.37	0.002	- 0.40	0.001
Slow presentation	- 0.41	0.001	- 0.38	0.002
Fast presentation	- 0.35	0.004	- 0.39	0.002

The fact that anxiety measures were higher in patients than normal controls and that field independence was associated with hypo- rather than hyper-responding in patients may reflect the outcome of an active gating mechanism. Hence the change in hemisphere bias in response amplitude to different tone intensities, also reflected in the field dependence score.

Sex differences were not explored in view of the small number of women included in the study. This was also not found to be significant factor in the first study although

the literature generally has found men to be more field independent than women. For the same reason differences between patient subgroups were not explored. In the first study, acute, noninstitutionalised schizophrenic patients were found to be more field independent than chronic, institutionalised patients and this was related to the trend for hyper-responders to be more field independent. This trend appeared to be reversed here but is unlikely to be due to differences in patient sampling as both chronic and acute patients were included.

Age was found to be an important factor in the previous study with older subjects being more field dependent than younger subjects. This was supported, albeit nonsignificantly, in the present study in relation to both overall correct scores ($r = -0.19$, $p < 0.08$) and to correct scores under the fast presentation ($r = -0.20$, $p < 0.07$) in the group as a whole. There was no relationship between age and response latency scores.

Discussion

An attempt has been made in this chapter to explore not just an alternative measure of field independence but possible factors that might influence measurement and highlight differences in relation to either psychopathology or psychophysiological response styles. Using correct scores as a measure of field dependence in line with other similar measures, the results clearly support differences between patients and nonpatients with the former showing a greater degree of field dependence as expected. This supports the findings of the first study (see Chapter 7).

Differences between the two patient groups were not found indicating that the bias towards field dependence was not specific to schizophrenic patients but characteristic of psychopathology in general thus supporting the findings of Witkin et al (1962) and Otteson and Holzman (1976).

In the first study speed of processing was thought to be an important contributory factor in the ability to disembed figures on this task. The results here confirm this not just in patients but in normal controls too with all three groups obtaining higher correct scores during the untimed presentation. In line with the view that schizophrenic patients are slowed in information processing, response latencies tended to be slower in this group but there was no evidence to suggest that schizophrenic patients benefitted more than the other two groups when given more time to repond. In fact, the uniform increase in time taken to respond under the untimed presentation together with an ability to respond more quickly under the timed presentation was present in all three groups and does not lend support to the view that slowed processing might account for the performance deficit of schizophrenic patients on this particular task. The consistent difference between normal and patient groups in this and the previous study, despite changes in mode of presentation, further suggest that distractibility and memory factors probably do not play a significant role in accounting for group differences on this measure of field articulation.

The relationship between field independence and the two psychophysiological response styles suggested that,

overall, field independence was related to higher levels of electrodermal responsivity on the one hand and to a left hemisphere bias in repect of both skin conductance levels and response amplitude asymmetry on the other. These results only partially confirm the previous study.

The relationship between level of responding and field independence was not consistent across groups. Whereas correlational evidence suggested that hyper-responding was more likely to be associated with field independence, in both patient groups the trend was for hypo-responders to have higher scores. This does not support the earlier finding of a consistent relation in all three groups to hyper-responding. Although these differences were not significant it is perhaps worthwhile to consider a possible explanation for their discrepancy with the previous findings. In order to do this, I shall draw on anxiety as a possible moderating variable.

I suggested in the previous Chapter that the finding of a higher level of electrodermal responding in subjects with lower levels of anxiety may lend support to the presence of an active gating mechanism that modulates environmental input. In this study, both patient groups were found to have higher levels of anxiety as well as to be more field dependent and less electrodermally responsive than the normal control group. If hypo-responding in a patient population is considered to be an active compensatory mechanism against the disease process then it could be argued that this is an adaptive process in the same way that field independence is thought to be more adaptive

than field dependence. This line of argument is further supported by the fact that in this study none of the patients were resident in long-stay hospitals whereas a proportion of those in the first study were and this may reflect the ability of this patient group to become less institutionalised.

With regard to the second aspect of psychophysiological response style the main difference between the findings of the two studies was in relation to the response amplitude asymmetry measures. The results here are more consistent with models of attention that suggest the left hemisphere is specialised for selective attention (Dimond, 1979) but do not support previous studies that view field independence, or at least the disembedding function, as dependent on right-hemisphere processing (Cohen, Berent and Silverman, 1973; Case and Globerson, 1974).

Again the differences between asymmetry groups were not significant and too much speculation is unwarranted. It is, however, interesting to note that in the present study, rate of habituation and lateral differences in response amplitude were not related whereas lateral asymmetries between electrodermal levels and response amplitude were. Whilst these findings are consistently reflected in their relationship to field dependence they do not support the reciprocity of hemisphere influences on response habituation and may account for the inconsistency of results in relation to the psychophysiological response styles. The fact that again the nonschizophrenic patients show a different pattern of relationships between field

independence and response amplitude asymmetry is, however, in line with established differences in hemisphere dysfunction between schizophrenia and depression (Flor-Henry, 1976).

The results of this study are not conclusive. The experimental manipulation of the task does not appear to have changed its reliability in measuring differences in field dependence between patient and nonpatient groups and has not supported the hypothesis that differences with respect to the schizophrenic group are due to some aspect of speed of processing, distractibility or memory. The relationship between field independence and psychophysiological response styles has only been partially confirmed and whilst this may relate to methodological or subject population differences it may also be accounted for by changes in the interrelationship between electrodermal variables.

CHAPTER 17

Responses to Auditory and Visual Stroop Stimuli in Schizophrenic and Nonschizophrenic Psychiatric Patients and Normal Control Subjects

Introduction

The Stroop effect is a widely documented phenomenon for the visual modality and is well established using colours and words (Stroop, 1935; Jensen and Rohwer, 1966; Dyer, 1973). Attempts to use alternative visual forms have been less successful although there is now a small literature relating to auditory stimuli (Hamers and Lambert, 1972; Cohen and Martin, 1975; Green and Barber, 1981).

Auditory Stroop effects were obtained by both Hamers and Lambert (1972) and Cohen and Martin (1975) using judgements of whether the pitch of words was high or low. In the study by Hamers and Lambert (1972) the auditory Stroop paradigm was used to investigate bilingualism. Subjects were asked to respond to pitch in the same or a different language from that in which the stimulus words were presented and Stroop-like interference was reported even when subjects responded in a different language from that of the stimulus material.

Cohen and Martin (1975) used the auditory Stroop paradigm to investigate hemisphere asymmetries. Subjects here were required to judge the pitch of pure tones and of congruent and incongruent words sung at high or low frequency and presented monaurally to either the left or right ear. They

found that the degree of interference of the semantic aspects of the stimulus words was greater when presented to the left rather than to the right hemisphere. This pattern of results was also obtained when the same experiment was repeated dichotically with a competing message presented to the opposite ear. Their findings support the view that the left hemisphere is specialised for semantic analysis (linguistic processing), the right for analysis of pitch (nonlinguistic processing). Interference was thus caused because the analysis of the meaning of the word stimuli proceeded more rapidly in the left hemisphere causing the word said to interfere with the slower pitch analysis which was assumed to require callosal transfer. This experiment was carried out on the assumption that verbal analysis is carried out only, or more efficiently, within the left hemisphere. There is evidence that in right-handed individuals, the left hemisphere is superior for tasks requiring the analysis of verbal material and the right hemisphere for the analysis of nonspeech stimuli (Kimura, 1961, 1964). Hemispheric differences may be due either to the fact that only one hemisphere can perform the task so that when input reaches the inappropriate hemisphere it has to be transferred across the corpus callosum to the other hemisphere which will result in a performance decrement due to the loss of information or time, or to the fact that both hemispheres can perform the task but that one is faster and more efficient.

This particular study has important implications for the use of the Stroop task to measure the constricted-flexible cognitive control dimension and its relationship to

attention deployment. The suggested bias towards a greater interference effect when stimuli are presented to the left hemisphere implies that the capacity for response set flexibility necessary to perform this task is dependent on efficient right hemisphere processing to counterbalance the dominance of the semantic analysis of the stimulus in the left hemisphere. This further implies the need for sustained rather than selective attention to perform well on this task. This is consistent with the hypotheses put forward in relation to the visual Stroop task (Bakan and Schotland, 1969; DeWitt and Averill, 1976; Morikawa, 1981)

The issue of whether there is an analogy between the visual and auditory Stroop paradigms was explored by Green and Barber (1981). In their experiments they looked at the influence of speaker gender on the judgements of the word stimuli presented. In a series of four experiments they were able to confirm that there was an auditory Stroop effect for judgements of speaker gender and that this persisted when manipulations to the experimental paradigm included semantically related responses and a pseudo-Stroop effect using control words with the same initial phonemes, both of which suggest parallels with the visual Stroop literature. They did, however, find one major difference with the presence of a large reverse Stroop effect when subjects were asked to respond to the stimulus word spoken and not to the speaker gender. Reverse Stroop interference has been difficult to obtain in visual Stroop tasks except where the word aspect of the stimulus has been attenuated in some way (Gumenik and Glass, 1970). It would appear to relate to the speed with which the

physical atributes of a stimulus and its verbal label can be matched. In the case of the visual Stroop colours can be physically matched faster than words. Green and Barber suggest the reason why reverse auditory but not visual Stroop effects can be obtained is due to the absence of a dominance between primary (naming of the stimulus) and secondary (source of interference effect) activities, that is, the speed advantage of reading over naming.

In summary, these experiments suggest that there is a correspondence between visual and auditory Stroop paradigms and that the use of the auditory modality to further explore the relationship between the constricted-flexible cognitive control dimension and psychophysiological response styles would be justified. The results of the previous experiment suggested that greater Stroop interference was associated with decreasing arousal and, at least in normal subjects, a left hemisphere bias in response amplitude. Both these findings support the notion that right hemisphere processing is important to the efficient performance of the Stroop task. It is therefore expected that the relationship between the constricted-flexible dimension and the psychophysiological response styles will hold in relation the auditory Stroop measure.

In addition to using the auditory Stroop paradigm, a parallel version of the visual Stroop will also be used. This will allow both the discrete presentation of stimuli and comparision between congruent and incongruent items on the basis of response latency both representing departures from the presentation in the first experiment.

I. Auditory Stroop Interference Task

Subjects

60 subjects took part (see Chapter 15 for description).

Method

Apparatus

The stimuli and methodology used in this task followed the experiment by Green and Barber (1981). Stroop-type stimulation was provided by the words 'man' and 'girl and control stimulation by the words 'mill' and 'game'. The Stroop words 'man' and 'girl' spoken respectively in a male and female voice were 'congruent' stimuli, and when spoken, respectively, in female and male voices were 'incongruent' stimuli. Similarly, the control words 'mill' and 'game' in male and female voices, respectively, were 'pseudocongruent' stimuli and 'pseudoincongruent' when in female and male voices, respectively. The stimulus combinations used are summarised in the table below.

Table to Show Auditory Stroop Stimuli

	Stimulus Type	Voice Gender	
		Male	Female
Stroop	Congruent	man	girl
	Incongruent	girl	man
Control	Pseudocongruent	mill	game
	Pseudoincongruent	game	mill

A stimulus set of eight was used comprising the words 'man' 'girl' 'mill' and 'game' in a single male and a

single female voice. Six examples of each member of the stimulus set were used giving a sequence of 48 words. The interstimulus interval from onset of one word to onset of the next was 5 seconds. A familiarisation sequence and practice comprising one example of each member of the stimulus subset preceded the experimental list. The stimuli were recorded onto cassette tape which was played to subjects on a Sony tape recorder, type TE50, and presented binaurally through Koss headphones.

Procedure

Each subject was tested individually. During the experiment subjects were seated on a chair and a throat voice key was placed around their neck. Both the tape and throat key were linked to a millisecond timer. The onset of each stimulus word on tape triggered an electronic switch that started the timer which stopped when the subject gave a verbal response. During the practice sequence the sensitivity of the voice key was adjusted according to the subject's natural voice level. Subjects were instructed to say whether the speaker was male or female as soon as they heard the word while attempting to ignore the word that was actually said in each case. They were asked to respond as quickly and as accurately as possible.

The response latencies to each stimulus were manually recorded by the experimenter who was seated behind the subject. Errors were also monitored. For each subject a mean correct response score, a mean overall response latency, and mean responses latencies to congruent and incongruent stimuli were calculated.

Results

Group means and standard deviations of correct scores, overall response latency and response latencies to congruent and incongruent stimuli are given in Table 17 (i).

1) Correct Responses

The level of error on this task was low suggesting that the task was not difficult for subjects in any of the three groups. Significant differences between hypo- and hyper-responders and between subjects with different response amplitude and skin conductance level asymmetries were not found.

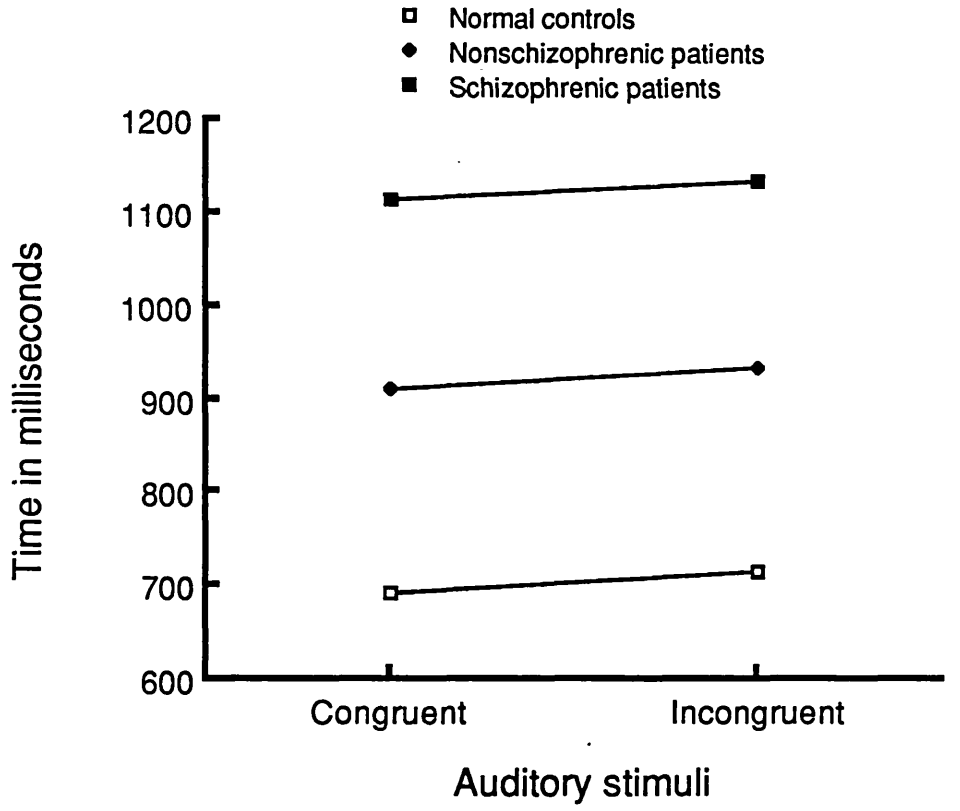
2) Response Latency

Overall, normal controls were quicker to respond to both congruent and noncongruent stimuli than patients (ANOVA, $F(2,54)$ 5.93, $p < 0.01$). The two patient groups did not differ although response latencies tended to be longer in schizophrenic patients (Figure 17 (i)).

In order to assess whether a Stroop effect had been obtained a comparison was made between response latencies to congruent and incongruent words. Although the tendency in all groups was for response latencies to be longer to incongruent words the differences were not significant providing no evidence of a general Stroop effect. A within group comparision, however, showed that there were 11(55%) subjects in each patient group and 15(75%) in the normal control group who had longer response latencies to incongruent than to congruent stimuli. Comparing response latencies between the two stimuli in these subjects only,

Figure 17 (i)

DIFFERENCES IN RESPONSE LATENCY TO CONGRUENT AND INCONGRUENT STIMULI IN THE AUDITORY STROOP TASK



a significant difference was found ($t = 7.17$, $p < 0.001$) suggesting that a Stroop effect had been obtained in some subjects but with overall differences masked by the subjects in whom it did not occur. The degree of Stroop interference was greater in patients than in normal controls but differences were not significant.

(a) Relationship to Electrodermal Responsivity

Hypo- and hyper-responding subjects did not differ significantly in their degree of auditory Stroop interference. There was nevertheless a tendency for hypo-responders among normal controls and nonschizophrenic patients to show greater interference than hyper-responders, a pattern that was reversed in schizophrenic patients (Table 17 (ii)). This tendency was confirmed by correlational evidence to the extent that greater interference was associated with lower skin conductance levels in both normal controls (70 dB sequence: $r = -0.52$, $p < 0.01$; 90 dB sequence: $r = -0.75$, $p < 0.001$) and schizophrenic patients (70 dB sequence: $r = -0.45$, $p < 0.02$; 90 dB sequence: $r = -0.42$ $p < 0.04$).

(b) Relationship to Lateral Asymmetry

Stroop interference tended generally to be greater in normal subjects with a right hemisphere bias in skin conductance levels and in patient groups with the reverse asymmetry. This was consistent across both tone sequences even though differences were not significant (Table 17 (iii)). This pattern was to some extent confirmed with correlational evidence using the laterality index of skin conductance levels (schizophrenic patients: $r = 0.38$,

$p < 0.05$; normal controls: $r = -0.34$, $p < 0.07$) The pattern in relation to reponse amplitude asymmetry was different. Whereas Stroop interference was generally higher in normal subjects with a right hemisphere bias (70 dB tones: $t = -2.18$, $p < 0.05$), in both patient groups there was a nonsignificant reversal in the relationship between interference and response amplitude asymmetry with an increase in tone intensity (Figure 17 (ii)).

(c) Anxiety

In view of the possible change in arousal status with changes in stimulus intensity, the relationship of state and trait anxiety measures to performance on the auditory Stroop task was examined (see Table below).

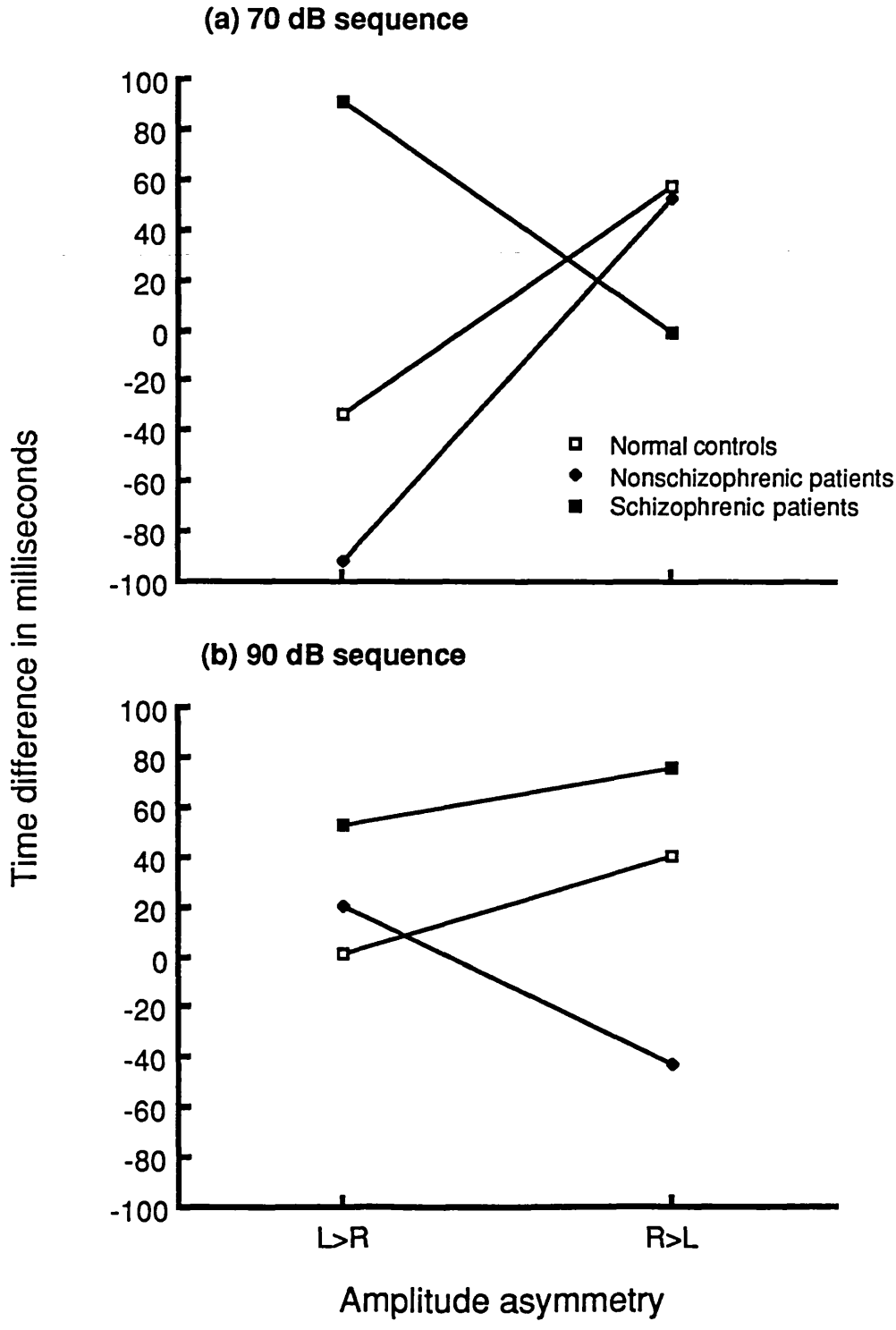
Table to Show Relationship of Anxiety to Stroop Measures

Anxiety measure:	State		Trait	
Stroop Measure	r	p	r	p
Correct scores	- 0.37	0.01	- 0.30	0.01
Response latency	0.41	0.001	0.31	0.01
Stroop interference	- 0.30	0.01	- 0.10	ns

There was a consistent relationship in the group as a whole between both anxiety measures and the correct scores and response latency measures indicating a performance decrement with higher levels of anxiety. The relationship to Stroop interference was, however, reversed and suggested that high state anxiety was likely to lead to less rather than more interference. A possible explanation comes from within-group comparisons which showed that this result was biased by a highly significant correlation in

Figure 17 (ii)

AUDITORY STROOP INTERFERENCE AND RESPONSE AMPLITUDE ASYMMETRY



nonschizophrenic patients ($r = -0.63$, $p < 0.002$). In view of the trend towards hypo-responsivity in this group, it may be that an increase in anxiety/arousal was beneficial to them. Furthermore, the reversals across tone sequences noted in the two patient groups may also be accounted for by the higher level of state anxiety in patients than in normal controls which has been shown to alter hemispheric relationships (Tucker, 1981; Gruzelier et al, 1981).

(d) Demographic Variables

Sex differences and patient subgroup differences were not explored due to the small number of female subjects. Age differences were noted only in relation to correct scores in the schizophrenic patient group ($r = 0.43$, $p < 0.03$) with older subjects having higher scores.

In summary, the results suggest that although a significant Stroop effect was not obtained in all subjects there was a wide effect of congruence which was greater among patients than normal controls. Stroop interference tended to be greater in hypo-responders and subjects with a right hemisphere bias in both skin conductance levels and response amplitude asymmetries. However, this pattern was not consistent across patient groups where interactions with levels of anxiety and stimulus intensity were noted.

II. Visual Stroop Interference Task

Subjects

60 subjects took part (see Chapter 15 for description).

Method

Apparatus

To bring the visual Stroop task in line with the auditory Stroop task, a similar format was used that differed from the version used in the first experiment. Stroop-type stimuli on this task was provided by the words 'blue' and 'red' and control stimuli by the words 'block' and 'ring'. The Stroop words 'blue' and 'red' shown respectively in a blue and red colour were 'congruent' stimuli and when shown respectively in red and blue were 'incongruent' stimuli. Similarly the control words 'block' and 'ring' were shown in blue and red respectively, were 'pseudocongruent' stimuli and 'pseudo incongruent' when shown in red and blue colours, respectively. The stimulus combinations used are summarised in the table below.

Table to Show Visual Stroop Stimuli

	Stimulus Type	Colour	
		Red	Blue
Stroop	Congruent	red	blue
	Incongruent	blue	red
Control	Pseudocongruent	ring	block
	Pseudoincongruent	block	ring

As for the auditory stroop task, a stimulus set of eight

was used comprising the four words in a single red or blue colour. Six examples of each member of the stimulus set were used to give a sequence of 48 words. The interstimulus interval from onset of one word to onset of the next was 5 seconds. A familiarisation sequence and practice list comprising one example of each member of the stimulus subset preceded the experimental list. The stimuli were mounted on slides against a white background. Each slide was projected individually using a slide projector. The projector was linked to a millisecond timer so that the onset of each slide started the timer. Each slide was shown for 3 seconds. The throat voice key was again used to monitor the response latency so that a verbal response from the subject stopped the timer.

Procedure

Each subject was tested individually. Subjects were instructed to say whether the colour of the word was blue or red as soon as they saw it while attempting to ignore the word that was actually seen in each case. They were asked to respond as quickly and as accurately as possible. During the familiarisation sequence the sensitivity of the voice key was adjusted according to the subject's natural voice level. The response latencies to each stimulus were manually recorded by the experimenter who was seated behind the subject. Errors were also monitored. For each subject a mean correct response score, a mean overall response latency, and mean response latencies to congruent and incongruent stimuli were calculated.

Results

Group means and standard deviations of correct scores, overall response latency and response latency to congruent and incongruent stimuli are given in Table 17 (iv).

1) Correct Responses

There was a high rate of correct responding in all three groups indicating that the task was within the ability range of all subjects. Differences in correct scores between hypo- and hyper-responders and between subjects with different skin conductance level or response amplitude asymmetries were not significant.

2) Response Latency

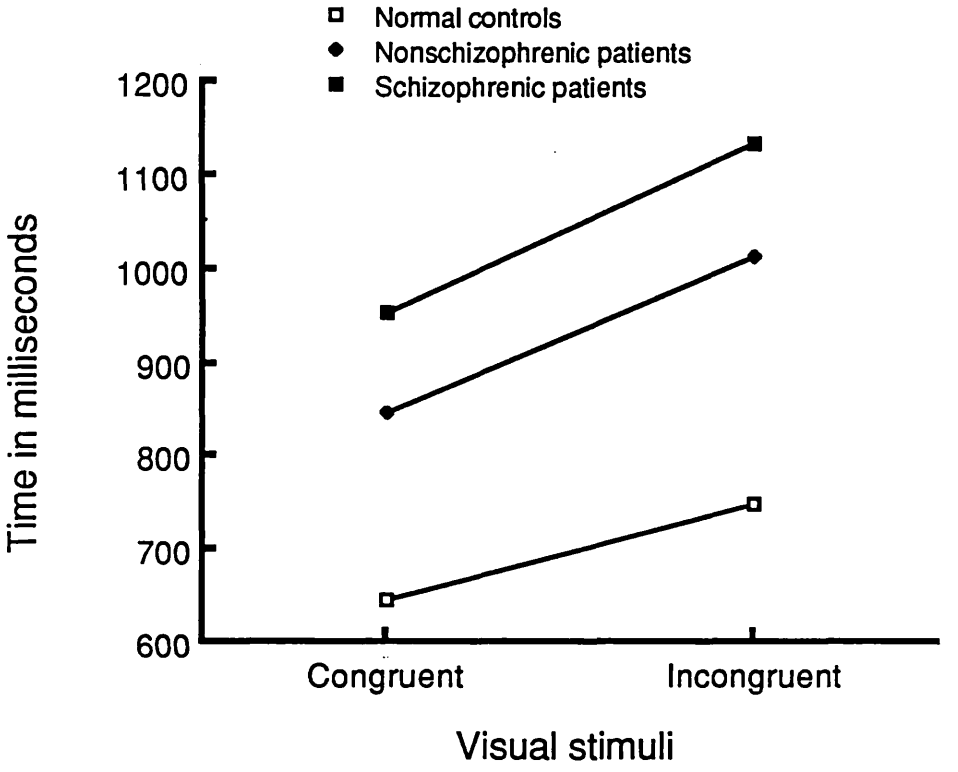
There was a significant group difference in overall response latency (ANOVA, $F(2,54)$ 8.34, $p < 0.001$) with normal controls having shorter latencies than both schizophrenic (Scheffè, $p < 0.01$) and nonschizophrenic patients (Scheffè, $p < 0.05$). The two patient groups did not differ significantly (Figure 17 (iii)). A visual Stroop effect was obtained in all three groups (ANOVA, $F(1,54)$ 76.21, $p < 0.001$). In fact, when comparing individuals, all but two subjects (one normal control, one schizophrenic patient) had longer response latencies to incongruent than to congruent visual stimuli. The degree of interference tended, however, to be greater in patients than in normal controls.

(a) Relationship to Electrodermal Responsivity

Differences between hypo- and hyper-responders were not significant. Evidence of a visual Stroop effect was found

Figure 17 (iii)

DIFFERENCES IN RESPONSE LATENCY TO CONGRUENT AND INCONGRUENT STIMULI IN THE VISUAL STROOP TASK



in both hypo- and hyper-responsive subjects although the effect of congruence was greater in normal and schizophrenic hyper-responders and in nonschizophrenic hypo-responders (Table 17 (v)). Significant correlations to support this pattern were found only in the schizophrenic patient group in relation to skin conductance levels (70 dB sequence: $r = 0.54$, $p < 0.01$; 90 dB sequence: $r = 0.40$, $p < 0.05$).

(b) Relationship to Lateral Asymmetry

In all three groups there was evidence of a Stroop effect in both asymmetry groups and in relation to both tone sequences (Table 17 (vi)). Stroop interference tended to be greater in subjects with a right hemisphere bias in skin conductance levels to 70 dB tones and a left hemisphere bias to the 90 dB tones. This relationship was reversed in nonschizophrenic patients. Whilst differences were not significant this is an interesting finding as it suggests that a reversal in hemispheric relations occurred in all three groups. This will be explored later. Significant correlations were not found to support these relationships

With respect to response amplitude asymmetries there was again evidence of a nonsignificant Stroop effect in both asymmetry groups. Whilst this was found in all three subject groups the pattern of relationships between Stroop interference and hemispheric bias in response amplitude was not consistent across groups. In normal controls Stroop interference tended to be greater in subjects with a right hemisphere bias to 70 dB tones and with a left

hemisphere bias to 90 dB tones. Schizophrenic patients showed the opposite relationship in respect of both tone sequences and it was only in nonschizophrenic patients that Stroop interference was consistently greater in subjects with a right hemisphere bias (Table 17 (vii)).

(c) Anxiety

The results again show that the pattern of relationships between visual Stroop interference and hemispheric bias in response amplitude changed in relation to changes in stimulus intensity, affecting both normal controls and schizophrenic patients. Exploring the possible contribubution of anxiety, a consistent relationship was found between anxiety measures and both correct scores and response latency measures indicating a performance decrement with higher levels of anxiety. The relationship of state anxiety to Stroop interference showed a tendency in the same direction (see Table below). However, anxiety as

Table to Show Relationship of Anxiety to Auditory Stroop

Anxiety measure:	State		Trait	
Stroop measure	r	p	r	p
Correct scores	- 0.22	0.05	- 0.08	ns
Response latency	0.29	0.02	0.29	0.02
Stroop effect	0.19	ns(0.07)	0.07	ns

measured in this study, did not appear to have as great an influence on visual as on auditory Stroop interference.

(d) Demographic Variables

Sex differences and patient subgroup differences were

again not explored due to the small sample sizes. There was no relationship between age and either correct scores or response latencies in any of the three groups.

In summary, the results showed a significant visual Stroop effect in all but two subjects with Stroop interference, as expected, greater in patients than in normal controls. The pattern for the normal control group suggested that interference tended to be greater in subjects who were hyper-responsive and had a right hemisphere bias in skin conductance level and response amplitude although the relationship was changed in response to louder tones. This pattern was not consistent across patient groups.

Discussion

A strong visual Stroop effect was found using a discrete presentation of the visual stimuli was found whereas it did not yield an auditory Stroop effect of the same magnitude even though mean reaction times tended to be faster to congruent than to incongruent words. The reasons for this difference are not clear.

One major difference between the current auditory Stroop and that of some previous experiments reported in the literature has been the use of a vocal rather than a manual response. Green and Barber (1981), for example, reported the use of manual responses to auditorily presented words and suggested that in such a task the grapheme-phoneme translation channel would be used in the opposite direction to that employed in the equivalent visual task where vocal responses to graphemically

presented colour-names are required. However, both Hamers and Lambert (1972) and Green (1979) obtained similar patterns of results for both modalities using both vocal and manual response conditions in their auditory Stroop paradigm which suggests that the differences between the auditory and visual Stroop tasks here are unlikely to be due to the use of vocal rather than manual responses.

Another possibility relates to issues of speed and accuracy. High correct scores were, however, found to both visual and auditory tasks suggesting that the level of task difficulty and therefore the speed-accuracy trade-off was likely to be the same for both.

Despite the various methodological and theoretical issues that relate to the measures of the Stroop effect, it is important to remember that the use of the Stroop task to measure the constricted-flexible cognitive control dimension was based not on an absolute difference between congruent and incongruent stimuli but on the degree of difference or interference that occurred. Although it is important not to ignore why an auditory Stroop effect was not obtained in all subjects and in fewer patients than controls, the fact remains that the absence was common to a proportion of subjects in all three groups.

The results here then focus on two measures: overall reaction times and the degree of Stroop interference. On both these measures normal control subjects were found to show better performance than both patient groups. These results are consistent with previous research that

indicates that schizophrenics tend to have slower reaction times than normal subjects (Huston, Shakow and Riggs, 1937; Rodnick and Shakow, 1940; Yates and Korboot, 1970; Slade, 1971; Hemsley, 1971; Hemsley and Hawks, 1974) and that differences may not necessarily be found between schizophrenic and depressive patients (Hemsley, 1976; Otteson and Holzman, 1976). The fact that differences here were not significant also supports the findings of the previous study reported in Chapter 8.

Sex differences were not explored as these were not found to be important in the previous study and in the literature generally no consistent differences have been found between men and women (Jensen and Rohwer, 1966). There is some evidence (Coltheart, Hull and Slater, 1975) that women tend to process verbal material and to access the internal lexicon by means of phonemic codes while men tend to favour graphemic ones but other studies have cast doubt on this finding (John, 1979).

On both auditory and visual Stroop tasks longer overall reaction times and greater Stroop-like interference tended to be related to higher levels of electrodermal responsivity. This finding is not in line with the previous study where greater interference was associated with lower levels of electrodermal responsivity. Although the reason for this reversed pattern of relationship is not entirely clear, it may relate to the different modes of task presentation. In the first study, the task was self-paced and the speed with which the task was completed was dependent on self-initiated attentional effort. In this

study, both tasks were presented as a timed sequence and it is likely that anxiety levels may have been higher. Whereas in hypo-responsive subjects this may have served to focus attention, in hyper-responsive subjects it was likely to be detrimental to task performance in line with the relationship generally found betwen arousal and performance. Without the availability of anxiety measures from Experiment I this possibility cannot be confirmed.

Longer overall reaction times and greater Stroop-like interference also tended to be related to a right hemisphere bias in both skin conductance levels and response amplitudes in normal subjects. This only partially supports the previous findings as it represents a change from a left to a right hemisphere bias in skin conductance levels. This may, however, be accounted for by the explanation given above and is consistent with the switch in the relationship with lower interference in subjects with higher levels of electrodermal responsivity. Schizophrenic patients showed the same left hemisphere bias on both measures as in the previous study whereas nonschizophrenic patients showed a similar change in patterns as the normal group suggesting that in the schizophrenic group other factors may be important.

The results of the first study were discussed in relation to differences in allocation of attention between the hemispheres. It was suggested that the association between lower interference in subjects with a bias towards greater right hemisphere activation, which is in turn associated with sustained rather than focussed attention, confirmed

the involvement of the importance of right hemisphere functions in performing the Stroop task. Such a view has been further supported by the current findings. Differences in hemisphere activation between the two patient groups were again suggestive of differing loci of hemisphere dysfunction.

Although these results confirmed the relationship between efficient task performance and a right hemisphere activation bias, they also suggest that the relationship between cognitive and psychophysiological response styles may not be constant and that fluctuations in one style, in this instance, level of responsivity, do not necessarily covary. It is, however, important to note that changes in the way the two response styles relate may be affected by the relationship between the electrodermal measures themselves as well as by moderating factors such as anxiety. The fact that a reciprocal relationship was not found in normal subjects but in patients, contrary to the findings of Experiment I is important but may itself, for example, be accounted for by anxiety as well as this may disrupt normal hemispheric relations (Tucker, 1981).

CHAPTER 18

General Discussion and Conclusions: Underlying Mechanism Relating Cognitive and Psychophysiological Response Styles

Studies of perceptual or cognitive dysfunction in schizophrenia have achieved only minimal success in shedding light on the nature of the disorder. At an empirical level, criticisms have been levelled at experimental design, selection procedures, patient subcategories and illness or hospitalisation factors. However, few studies have taken account of the possibility that experimental variability, or the fact that the schizophrenic does not appear to lack any identifiable skill, may be accounted for by intraindividual consistencies that underly the performance not just of schizophrenic patients but of other patients and normal subjects. It could thus be argued that in many studies, cognitive consistencies rather than perceptual dysfunction have been measured. It has also been proposed that such intraindividual consistencies are reflected in psychophysiological response measures and that the common underlying mechanism relates to attention. Accordingly, the present study has explored the nature of the relationship between cognitive and psychophysiological response measures and the relevance of this relationship to schizophrenia.

Two main hypotheses were put forward. It was argued that both cognitive and psychophysiological response styles would be found in schizophrenic patients but that no one

specific response style would be characteristic of schizophrenia. These styles would therefore also be evident in normal controls and other nonschizophrenic, psychiatric patients. It was further hypothesised that, insofar as both response styles reflect particular modes of deploying attention, these would covary together and a relationship could be defined between them.

1. Evidence of Psychophysiological Response Styles

In Experiment 1 two possible psychophysiological response styles were identified in relation to levels of electrodermal responsivity on the one hand and to hemispheric asymmetries in responsivity on the other. However, the attempt to view these two measures as synonymous in some way with the cognitive control dimensions raises two important questions: Firstly, are they continuous or dichotomous dimensions and secondly are they independent?

In order to demonstrate a bimodal distribution in level of responding, there should be equally large proportions of nonresponders as well as responding and nonhabituating subjects (Ohman, 1981). In all three experiments presented here there was evidence of both nonresponding as well as responding and nonhabituating in both patient and nonpatient groups, yet the distribution along the two dimensions could not be said to be truly bimodal.

This raises further questions regarding the discontinuity of nonresponding subjects from responding subjects other than in the frequency of orienting responses or their rate of habituation. In support of previous findings (Gruzelier

and Venables, 1972) responders were consistently found to have higher levels of tonic activity, both nonspecific response frequency and skin conductance levels, in all three subject groups. Contrary to the findings of Patterson (1976) and Patterson and Venables (1978), however, consistent differences were not found between nonresponders and fast habituators, with fast habituators accounting for a large proportion of habituators in all three subject groups. Furthermore, both nonresponding and nonhabituation have been regarded as possible indicators of dysfunction (see Chapter 1). Yet, in the same way that nonresponders were not shown to be a completely distinct group so nonhabituators were not found to differ consistently from other responders. The evidence in these experiments regarding the reactivity dimension was therefore more suggestive of a continuous rather than a bimodal distribution. This was true of both schizophrenic and nonschizophrenic patients as well as normal controls.

A similar discussion in relation to lateral asymmetries has taken place over the continuum represented in terms of the extent to which measures relating to the two hemispheres differ and with bimodality relating to the predominance of one or other hemisphere bias. There is evidence in the literature that lateral asymmetries in both directions have been found in both normal and schizophrenic groups although they tend to be smaller in normal subjects (Fisher and Cleveland, 1959; Dykman et al, 1963; Gruzelier, 1973; Gruzelier and Venables, 1973, 1974a; Gruzelier and Hammond, 1976; Gruzelier et al, 1979; Bernstein et al, 1981). Furthermore, whilst differences

have not been related conclusively to particular patient subgroups there is a growing literature that suggests a distinction on the basis of symptomatology and differentiates between schizophrenic and depressed patients in terms of the possible locus of their dysfunction (Gruzelier and Manchanda, 1982; Gruzelier, 1983, 1984). In all three experiments here subjects with both left and right hemisphere biases in both skin conductance and response amplitude asymmetries were found in all three subject groups. Again these tended to show a continuous rather than a bimodal distribution.

It is, however, questionable whether these two psychophysiological response styles are truly independent. On the one hand, there is evidence of an interaction between skin conductance level asymmetry and the responder/nonresponder status in the direction of higher right than left hand levels in responders and higher left than right hand levels in nonresponders (Gruzelier, 1973). This was, however, not a consistent finding in the present study.

On the other hand, fast habituation has been associated with higher left than right hand reponse amplitudes (Gruzelier, Eves and Connolly, 1981). Insofar as fast habituation is synonymous with a low rate of responding this again throws into doubt the independence of the two styles. This particular relationship was, however, found only in the normal control group in Experiment I in relation to 70 dB sequence and in the two patient groups in Experiment III in relation to 90 dB sequence. This suggests that the relationship may be a tentative one or

that it varies in some way that might be linked to disease process variables.

In the same study a significant relationship was not found between lateral asymmetries in electrodermal levels and response amplitudes. The present findings indicate a similar disparity in that where lateral asymmetries in response amplitudes were related to rate of habituation they were not related to lateral asymmetries in levels and vice versa. This confirms the notion of a reciprocity of hemisphere influences on response habituation in one sense but it also has implications for the role of tonic arousal in theories of habituation (Groves and Thompson, 1966; Sokolov, 1960). In a subsequent analysis of the 1981 data the effect of anxiety on the relation between habituation and lateral asymmetry was examined (Gruzelier, 1987). In subjects who were highly anxious this relationship was found to be reversed such that slow habituation related to a left rather than a right hemisphere bias. This has further bearing on the issue of whether the two psychophysiological response styles should be considered continuous. Furthermore, in the current study, whereas differences were noted between responding and nonresponding subjects in relation to levels of tonic activity, differences in electrodermal measures between the different asymmetry groups were not generally in evidence.

The question of whether the two response styles are independent or not has not been resolved in the present study and deserves further consideration. It will be further discussed in the context of the relationship

between cognitive and psychophysiological response styles later in this Chapter.

The reliability of electrodermal response measures across sessions was explored and confirmed in Experiment 2. Significant between-session changes in the distribution of the two response styles were not found although the slight decline in electrodermal reactivity in Session 2 may have been an effect of repeat testing.

2. Evidence of Cognitive Response Styles

The six cognitive controls under study here are continuous rather than dichomotous variables and representation along each of these dimensions was found in all three groups. All these dimensions were shown in earlier studies (e.g., Gardner et al, 1959) to be factorially independent. However, the concept of cognitive style as an individual's characteristic mode of perceiving, remembering and thinking implies that it is made up of constellations of controls rather than any one individual control. Furthermore, the extent to which any group of controls will load together to produce a consistent cognitive style will depend, to a very large degree, on the number and choice of measures used and this is reflected in the studies reported in the literature.

Factor analysis of the cognitive controls in Experiment 1 indicated a common loading of the constricted-flexible and field dependence dimensions. This appeared to be a field articulation factor and does not support earlier evidence that these measures are theoretically distinct (Gardner et

al, 1959; Gardner and Moriarty, 1968). It is, however, consistent with the finding of Otteson and Holzman (1976). They found a common loading of both dimensions, albeit together with the incremental error score of the levelling-sharpening dimension, which they identified as a 'scanning' factor and considered it reflected "the general meticulousness with which a subject performs a task." This will be explored further in the discussion of the relationship between cognitive controls and psychophysiological response measures.

3. Psychophysiological and Cognitive Response Styles and Schizophrenia

In reviewing the electrodermal findings it is important to distinguish between electrodermal measures generally and the two identified psychophysiological response styles. In relation to the former, significant differences were found between nonschizophrenic patients and both schizophrenic and normal subjects with the former have lower levels of tonic activity and a faster rate of habituation. Between-group differences in responding subjects for both temporal and nontemporal variables were not found.

Despite making the distinction above these findings concur closely with those relating to the responder-nonresponder dimension, with nonschizophrenic patients having a larger proportion of nonresponders than either the schizophrenic or normal group. This finding may be consistent with research suggesting that hypoarousal is characteristic of depressed patients and may provide a biological marker for this group (Ward et al, 1983) as a majority of nonschizo-

phrenic patients in this study were diagnosed as depressed

Differences along the responder-nonresponder dimension were not found in respect of any of the schizophrenic subgroups. Nonresponding tended to be more frequent in nonparanoid, chronic, institutionalised patients and this is consistent with the body of research that suggests that hypo-responding is more frequent in patients with negative symptoms of schizophrenia (Gruzelier and Venables, 1972; Gruzelier, 1976; Straube, 1979; Bernstein et al, 1982).

A distinction between nonschizophrenic and the two other subject groups was found in relation to lateral asymmetry with both normal and schizophrenic subjects showing a predominantly right hemisphere bias and nonschizophrenic subjects a predominantly left hemisphere bias. Although these differences were consistent across all three experiments they were not significant and only partially support previous findings (Gruzelier, 1973, 1979b; Gruzelier and Venables, 1974) and the notion that differences between schizophrenic and depressed patients are related to differential hemispheric dysfunction (Flor-Henry, 1974).

Within-group asymmetry differences were not found, with all subgroups following the main trend towards a right hemisphere bias in schizophrenic and a left hemisphere bias in nonschizophrenic patients. One exception to this pattern was found in paranoid schizophrenic patients. Evidence of left hemisphere activation in this group is consistent with the findings of Gruzelier (1983).

Group differences were found for several cognitive control measures such that insofar as the various dimensions can be conceived as representing continua of adaptability normal subjects tended to lie at the adaptive end of the continuum. Furthermore, variables relating to clinical severity (medication, number of admissions, duration of illness, age of onset) indicated that in both patient groups less efficient performance was found in those with greater clinical severity. These findings support those of Otteson and Holzman (1976) suggesting that differences were not related to 'schizophrenicity' but to psychopathology in general. Analysis of schizophrenic subgroup differences offer support for a similar line of reasoning with nonparanoid, chronic, institutionalised patients performing at the less adaptive end of the cognitive control continua. Differences were, however, significant only in relation to the field dependence and equivalence range dimensions. The findings were generally consistent with those reported in the literature (Chapter 3). Differences in nonschizophrenic patients were not found.

In line with Hypothesis 1 there was clear evidence of the same cognitive controls and psychophysiological response styles in both psychiatric patients and normal control subjects, with no one specific style characteristic of schizophrenia. Furthermore, where differences did exist these were found not to relate to schizophrenia per se but to some more general aspect of psychopathology.

4. Relationship Between Psychophysiological and Cognitive Response Styles

(a) Electrodermal Responsivity

In order to examine the relationship between the responder-nonresponder dimension and cognitive control variables subjects were divided for statistical purposes into hypo- or hyper-responsive groups, that is whether they habituated within the first two trials (zero-trial and fast habituators) or subsequently (moderate and slow habituators). This split is supported firstly by a lack of evidence for fast habituators to be distinguishable as a group on their own as proposed by Patterson and Venables (1978) and secondly by the confirmation that moderate and slow habituators do not differ (Patterson, 1976).

A significant relationship was found between electrodermal reactivity and only a few cognitive controls although, for the most part, there was consistency in the direction of the findings. Greater evidence was found in relation to the two dimensions which shared a common loading on the field articulation factor.

In the first instance, the relationship with field dependence-independence was such that hyper-responsive subjects were generally found to be more field independent than hypo-responsive subjects, a finding that supports the notion that hypo-responsivity is more generally associated with the patient rather than the nonpatient population and thus with less efficient performance. Consistent with this view Stroop-like interference was generally found to be

higher in hypo- than hyper-responsive subjects although this pattern was more prevalent in normal and schizophrenic subjects with the reverse pattern obtaining in the nonschizophrenic group.

There was no firm evidence of a relationship between the dimensions of levelling-sharpening, equivalence range and augmenting-reducing and that of electrodermal responsivity. Despite the lack of significance, however, the trend in the results appeared to be in line with findings in relation to the other cognitive controls such that higher task performance efficiency was associated with hyper- rather than hypo-responding.

The results for the augmenting-reducing dimension suggested a possible parallel between sensory regulation mechanisms with a reduction of input in one modality being mirrored by a reduction in the other, in that hypo-responsive subjects showed a greater reduction than hyper-responsive subjects. This hypothesis was confirmed in normal subjects but appeared to be reversed in patients which may be explained by reference to the work with habitual drug users and sensory overload theories of schizophrenia (see Chapter 3). The assumption here is that whereas in normal subjects an attentive orientation to incoming information is part of 'normal' information processing, in patients, particularly schizophrenics, an active gating mechanism is moderating the input of stimuli in accordance with what the patient is able to process.

The results relating to the focussing-scanning dimension

indicated a consistent trend with overestimation (focussing) associated with hyper- rather than hypo-responsivity. In terms of task performance efficiency this is not consistent with findings in relation to other cognitive controls.

Overall the relationships or relational trends between psychophysiological and cognitive control measures were consistent across subject groups. Where this was not the case directional differences tended to be found in nonschizophrenic patients rather than generally between patient and nonpatient subjects (Table 13 (i)).

Consistency across sessions was explored in Experiment 2. Whilst the direction of the relationship was maintained across sessions, the relationship itself tended not to be significant, a finding probably related to subject sampling as only normal subjects were used and because the distribution along the reactivity dimension was skewed towards moderate levels of responding with few subjects showing extremes of responsivity as was the case when patient subjects were included.

Overall the relationship between cognitive controls and the psychophysiological responsivity measure appears to be consistent in terms of attention deployment. Hyper-responsivity, both in relation to rate of habituation and measures of tonic arousal, reflects an attentive orientation towards external stimuli, that is stimulus intake. An openness to incoming stimuli is equally important for task performance on the cognitive measures

except that efficient task performance will need to control the balance between the intake of relevant and irrelevant stimuli. This may explain why the results in relation to the augmenting-reducing, focussing-scanning and possibly equivalence range dimensions appear to conflict with the field articulation dimension. The task demands here are different and the former do not require either the active exclusion of irrelevant stimuli or perhaps the same level of cognitive processing as the latter tasks. Whereas electrodermal responding reflects stimulus intake, habituation of the response reflects learning and thereby the cessation of responding to irrelevant stimuli. This suggests the need for an interplay between general and specific levels of arousal or attention, a process that is likely to relate to the inhibitory and facilitatory nature of the hemisphere activation patterns. This will be taken up in the following discussion about the relationship between cognitive variables and lateral asymmetry in electrodermal responding.

(b) Hemisphere Asymmetry

In order to explore the relationship between cognitive control variables and lateral asymmetry, subjects were divided according to whether they showed a left or a right hemisphere bias in either skin conductance levels or response amplitude. Unlike the responder-nonresponder dimension, subjects with different lateral asymmetries did not differ on any other electrodermal variables. It was not unexpected therefore that differences in respect of cognitive control measures were not significant. Nevertheless there were some consistent trends which serve to

explain the nature of the possible relationship between the two response measures.

Skin conductance level asymmetry is considered to reflect levels of hemisphere activation in terms of general arousal processes in that a left hemisphere bias has been associated with a low level of electrodermal responsivity and a right hemisphere bias with a high level (Gruzelier, 1973). This association was not consistently confirmed in the present study and this is reflected in the direction of the relational trends between psychophysiological and cognitive variables. Previously the responsivity dimension indicated that better task performance tended to be associated with hyper-responsivity, whereas in relation to skin conductance level asymmetry, it tended, by contrast, to be associated with a left rather than a right hemisphere bias, at least in normal subjects.

Patient differences were, however, in evidence. Field independence was, for example, associated with a left hemisphere bias in schizophrenic subjects and a right hemisphere bias in nonschizophrenic subjects. Whereas in relation to the responsivity dimension, field independence was consistently related to hyper-responsivity, the variation here may be reflecting not differences in responsivity per se but possible differences in lateral dysfunction between the two patient groups. In a similar vein, interference on the Stroop task and underinclusion on the Object Sorting Task were greater in schizophrenic subjects with a right hemisphere bias and nonschizophrenic patients with a left hemisphere bias. Overestimation

(focussing) on the focussing-scanning dimension was found generally in subjects with a right hemisphere bias. In terms of a responsivity parallel this is consistent with the hyper-responsivity findings whereas the results for the augmenting-reducing dimension were not consistent indicating greater reduction in subjects with higher skin conductance levels on the right in normal and nonschizophrenic groups and on the left in schizophrenic subjects.

Lateral asymmetries in response amplitude are thought to reflect different attentional modes such that activation of the left hemisphere is considered indicative of a predominance of inhibitory processes and focussed or selective attention whereas activation of the right hemisphere is indicative of a predominance of excitatory processes and sustained, broad, and vigilant attention. Asymmetries in response amplitude do not necessarily parallel those in skin conductance level. The relationship between response habituation and amplitude asymmetry (Gruzelier et al, 1981) may, however, have an important bearing on the relationship between cognitive and psychophysiological response measures even though it was not consistently confirmed either across subject groups or across experiments.

Consonant with the relationship between slow habituation and a right hemisphere bias in response amplitude, normal subjects with a right hemisphere bias were found to be more field independent, to have a lower level of Stroop interference and to show more sharpening and overestimation than subjects with a left hemisphere bias, a parallel

finding to that in relation to hyper-responsivity. Results in respect of the augmenting-reducing and equivalence range dimensions did not reflect the same hemisphere reciprocity with underinclusion and greater reduction found in subjects who were hypo-responsive but with a right rather than a left hemisphere bias suggesting these tests might differ in their cognitive processing demands from the other tests (see Chapters 11 and 12). Interestingly, in Experiment 1, the habituation/response asymmetry relationship was only confirmed in normal subjects for the 70 dB sequence. This is reflected in the results in that patients tended to show a different relationship in which there were reversals with respect to the louder tone sequence. This latter finding is consistent with the effect of anxiety on the habituation/response asymmetry relationship (Gruzelier, 1987).

Patients differed from normal controls in two ways: Either they showed a relationship between cognitive and psychophysiological variables that was consistent with that between habituation and hemisphere asymmetry but in the reversed direction to normals, e.g. levelling-sharpening in schizophrenic patients and Stroop interference in nonschizophrenic patients; or the two relationships were not consistent with each other, e.g. field dependence, augmenting-reducing, equivalence range in nonschizophrenic patients and Stroop interference in schizophrenic patients. Between-patient differences across tasks probably reflected the nature of the task demands and the specific cognitive processing difficulties they posed for the two patient populations.

These two aspects are best illustrated in relation to the Stroop task. This task is generally agreed to be a right hemisphere processing task (see Chapter 3), implying the need for sustained attention and a predominance of excitatory processes, both consistent with the pattern shown in normals of better performance in subjects who were hyper-responsive and had a right hemisphere bias. However, in both patient groups better performance was found in subjects with a left hemisphere bias and whereas in nonschizophrenic patients this was asssociated with hypo-responsivity, in schizophrenic patients it was related to hyper-responsivity. The latter finding is consistent with current evidence showing that hypo-responsivity in schizophrenics is associated with poor prognosis insofar as it relates to negative symptomatology and chronicity.

Hypo-responsivity in nonschizophrenic patients, however, appears more 'positive' in that it may represent an active inhibition of general stimulus intake allowing attention to be directed to more relevant stimuli. This would be consistent with the left hemisphere bias found in this group of patients. The left hemisphere bias coupled with hyper-responsivity in schizophrenic patients, however, suggests an alternative mechanism. Fast habituation, which is normally associated with a left hemisphere bias, is represented in normal subjects by minimal responding rather than nonresponding as is the case in the two patient populations. Thus in the same way that very high levels of anxiety may produce a reversal in the relationship between habituation and response asymmetry such that slow habituation is associated with a left rather than a

right hemisphere bias, it is possible that where levels of responding are so low as to be dysfunctional there could be a reversal in the opposite direction such that fast habituation becomes associated with a right rather than a left hemisphere bias.

(c) Reliability Issues

Intersession reliability was explored in Experiment 2 (see Chapter 14). In this study the pattern of relationships was even less clearcut than in the first study and reflected the lack of evidence for a reciprocal relationship between habituation and response asymmetry. The nonsignificant results therefore make it impossible to firmly establish reliability over sessions. Further testing would be required that repeats both sets of tasks rather than just the habituation paradigm.

An attempt was made in Experiment 3 (see Chapters 15 to 17) to look at the issues of inter-test reliability in relation to the two cognitive controls that both loaded on the common factor of field articulation and for which there was more clearcut evidence of a relationship to the psychophysiolgical response styles. This was examined using alternative modes of test presentation. With regard to the field dependence-independence dimension the different mode of presentation indicated that changes in information processing demands on speed and accuracy of processing, memory and distractibility did not alter the previously identified group differences in task performance between patient and nonpatient populations. Different results were, however, obtained with regard to

Table 18 (i) Relationship Between Cognitive Style Variables and Hypo- and Hyper-Responding (Experiment 3)

	Normal Controls		Nonschizophrenic Patients		Schizophrenic Patients	
	Hypo-Responders	Hyper-Responders	Hypo-Responders	Hyper-Responders	Hypo-Responders	Hyper-Responders
	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$
Embedded Figures Test						
Slow Presentation						
70 dB } Latency	3427.70	4491.96	4000.16	4317.74	3876.30	5007.18
90 dB } Latency	4368.31	3722.37	3585.88	4636.75	4021.96	4703.63
70 dB } No. Correct	79.67	81.73	63.92	62.86	63.08	55.63
90 dB } No. Correct	78.44	82.73	64.90	62.20	60.73	59.33
Fast Presentation						
70 dB } Latency	2418.95	2710.95	2456.95	2638.11	2397.03	3044.56
90 dB } Latency	2526.40	2622.56	2405.34	2635.37	2607.31	2715.61
70 dB } No. Correct	71.56	75.09	58.42	57.29	55.08	52.14
90 dB } No. Correct	69.44	76.82	59.67	56.50	51.91	56.88
Stroop Colour-Word Test						
Visual Presentation						
70 dB Sequence	101.89	103.36	174.39	151.00	173.50	191.38
90 dB Sequence	76.11	124.46	205.56	141.30	139.82	230.56
Auditory Presentation						
70 dB Sequence	38.22	10.64	36.00	- 1.14	2.92	44.25
90 dB Sequence	59.22	- 6.55	52.89	4.00	5.27	36.78

the pattern of the relationship between field independence and electrodermal measures (Tables 18 (i) to (iii)). Whilst the trend in normal subjects was still in the direction of greater field independence and hyper-responsivity this was reversed in the two patient groups. It was suggested previously that this could be related to the higher levels of anxiety found in patients and could be explained within the context of a compensatory gating mechanism, an explanation that would also be consistent with the relationship found between field independence and a right rather than a left hemisphere bias in patients. The left hemisphere bias of normal field independent subjects which represents a reversal in the relationship by comparison to Experiment 1 may, on the other hand, reflect the processing demands of the task, the change in methodology enhancing the left hemisphere processing component of the task.

In exploring the constricted-flexible dimension with alternative forms of the Stroop, whilst the scores were also based on time, this was in relation to stimuli presented discretely rather than in a sequential group. Although this is closer to the traditional Stroop methodology it does represent a clear difference in methodology and this was reflected in the results (Table 18 (ii)). On the auditory Stroop test, which clearly had a left hemisphere processing component due to the nature of the stimuli, less interference was found in normal subjects who were hyper-responsive and had a left hemisphere bias. This represents a reversal in hemisphere asymmetry from Experiment 1, but in the expected direction. On the visual Stroop task there was a general reversal in normal subjects in the direction

Table 18 (ii) Relationship Between Cognitive Style Variables and Skin conductance Level Asymmetry (Experiment 3)

	Normal Controls		Nonschizophrenic Patients		Schizophrenic Patients	
	Right>Left	Left>Right	Right>Left	Left>Right	Right>Left	Left>Right
	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$
Embedded Figures Test						
Slow Presentation						
70 dB } Latency	4058.44	3928.73	4292.73	3774.40	3959.46	4882.59
90 dB } Latency	4287.19	2916.25	4087.14	4043.60	4066.01	4816.59
70 dB } No. Correct	79.46	83.29	61.92	66.57	57.58	63.88
90 dB } No. Correct	80.63	81.50	62.08	65.83	56.77	66.29
Fast Presentation						
70 dB } Latency	2543.31	2646.10	2626.34	2323.52	2574.52	2778.33
90 dB } Latency	2085.65	2483.86	2536.73	2388.92	2727.60	2523.15
70 dB } No. Correct	72.39	75.57	56.33	60.86	53.09	55.25
90 dB } No. Correct	73.50	73.50	56.58	59.67	52.08	57.29
Stroop Colour-Word Test						
Visual Presentation						
70 dB Sequence	96.57	106.00	198.71	148.69	164.88	191.17
90 dB Sequence	108.50	101.25	168.17	169.62	179.71	163.75
Auditory Presentation						
70 dB Sequence	- 25.71	49.85	58.57	3.85	81.50	- 21.92
90 dB Sequence	17.25	24.50	32.17	8.46	79.71	0.58

of hypo- rather than hyper-responsivity but not in hemisphere asymmetry, the right hemisphere bias (90 dB sequence) consonant with the information processing demands of the task. Results in the two patient groups were divergent. In schizophrenic patients less interference was found in hypo-responsive subjects in respect of both tasks whereas the relationship between a right hemisphere bias and less interference was reversed in respect of the 90 dB sequence. The exact opposite of the findings in schizophrenic patients tended to be found in nonschizophrenic patients, pointing once again to possible differences in the locus of their dysfunction.

The patient-nonpatient differences in relation to these two tasks are interesting in that whereas the pattern of results in normal subject subjects reflected a responsivity to differences in task demands, those in patients did not, but suggested instead a style of responding dependent more on internal (person-related) factors than to external (task-related) factors. This has implications for theories of fixed and dynamic processes in relation to cerebral asymmetries (Cohen, 1982; Gruzelier, 1984; 1987).

In summary less evidence has been found to support Hypothesis II. The relationships between cognitive and psychophysiological response style measures were not always significant even though relational trends tended to be consistent across sessions and changes in the relationship between the two aspects of psychophysiological response style were reflected in the way they related to the cognitive control measures.

Table 18 (iii) Relationship Between Cognitive Style Variables and Response Amplitude Asymmetry (Experiment 3)

	Normal Controls		Nonschizophrenic Patients		Schizophrenic Patients	
	Right>Left	Left>Right	Right>Left	Left>Right	Right>Left	Left>Right
	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$
Embedded Figures Test						
Slow Presentation						
70 dB Latency	4350.75	3571.30	5346.06	3686.98	4343.00	4194.81
90 dB Latency	3776.78	3281.67	5276.73	3895.18	4533.27	4232.58
70 dB No. Correct	79.00	72.09	66.00	55.33	60.38	59.00
90 dB No. Correct	81.89	83.71	65.83	59.00	59.80	60.00
Fast Presentation						
70 dB Latency	2560.41	2654.70	2926.70	2336.72	2525.64	3100.10
90 dB Latency	2649.96	2503.57	2747.56	2487.06	3180.59	2448.76
70 dB No. Correct	85.00	77.00	57.38	53.00	58.29	53.25
90 dB No. Correct	73.56	77.86	57.67	54.33	54.00	57.13
Stroop Colour-Word Test						
Visual Presentation						
70 dB Sequence	98.14	109.00	111.00	183.00	223.00	211.75
90 dB Sequence	106.57	100.00	166.17	202.17	155.89	161.60
Auditory Presentation						
70 dB Sequence	- 33.29 *	57.46	- 91.33	52.88	91.50	- 0.75
90 dB Sequence	1.00 *	40.56	20.83	- 43.00	52.89	76.40

[* $p > 0.05$]

Concluding Comments

The presence of psychophysiological response styles, as defined in this thesis, is based on electrodermal measures to an habituation paradigm using tones that have been traditionally deemed nonsignal (at least with respect to those given in the 70 dB sequence). They are not based on measurements made concurrently with the cognitive tasks and will therefore reflect an individual's way of dealing with incoming stimuli more generally than if they were related to specific cognitive stimuli that might be designed to activate one or other hemisphere.

Thus insofar as the performance of specific cognitive tasks depends on functions that may be lateralised to different hemispheres, these will not be indexed by the current electrodermal measures. Instead, they will reflect the efficiency with which these functions are utilised as this depends on more general abilities relating to the readiness to process information, the allocation of attention and attentional effort and the ability to either focus or sustain attention. It is these abilities that are reflected in the examination of the 'orienting response' in the context of the habituation paradigm. The response itself denotes the focussing of attention on the source of stimulation, with habituation seen as an elementary form of learning and reflecting the ability to reallocate attention and with biases in lateral asymmetries indexing the balance of activation between the hemispheres.

Habituation is linked to a number of important factors.

Fast habituation has two facets which explains in part why it can occur in both patient and nonpatient populations. On the one hand it suggests stimulus rejection or the gating out of stimuli from awareness, either as a result of an active compensatory mechanism or passively due to dysfunction caused by brain damage or disease. On the other hand it may reflect fast habituation, quick learning and flexible allocation of attention. Furthermore there is an interaction between habituation and levels of responsivity and hemisphere activation. Theories of habituation have implied an interaction between tonic and phasic activity such that tonic activity reflects the state of the organism and sets the levels of background arousal activity that facilitates or inhibits the habituation process.

Thus whereas response amplitude asymmetry is likely to reflect the fixed, structural function of the hemisphere being activated in response to task or other external demands, asymmetries in electrodermal responsivity may belong to the dynamic class of cerebral asymmetries (Cohen, 1982; Gruzelier, 1984) and influence the functioning of the fixed structure. The relationship between dynamic and fixed asymmetries is not constant and may be changed by extremes of arousal such as anxiety-induced states (Gruzelier, 1987) or possibly by dysfunctionally low arousal indexed by nonresponding on the other as suggested in this thesis. These changes may not necessarily be negative in that they will lead to a hemispheric processing dominance that may enhance task performance according to the demands of that task (Gruzelier, 1987).

Whilst it is unfortunately not possible to deduce a clear attentional hypothesis about the relationship between cognitive and psychophysiological response styles from the current results, there are trends that support the importance of looking at an individual's characteristic style of responding, particularly in relation to the treatment and prognosis of illness. The results show us that some parallels exist between modes of responding indexed on the one hand by cognitive, on the other by psychophysiological measures and that efficient task performance or information processing is related to a particular mode of responding or attentional style which reflects an appropriate allocation of attentional effort towards relevant stimuli. This may, however, be influenced by certain processes which could be transient as in the case of high anxiety or which may themselves come to determine the course of illness over a longer period of time. For example, efficient task performance is dependent on the allocation of attentional effort towards relevant stimuli. Hypo-responsivity is indicative of a low level of attentional processes and was shown, generally, to produce less efficient task performance. In some subjects and on some tasks, however, hypo-responsvivity was found to be more appropriate, for example, in nonschizophrenic patients such that hypo-responsivity appeared to be used actively to reduce stimulus intake so as to enhance attentional focus on relevant stimuli but not in schizophrenic patients where the reduction in stimulus intake may have been global rather than selective and did not result in enhanced performance.

The exploration of the relationship between psychophysiological and cognitive response styles in schizophrenia has permitted only small progress along the path attempting to define the nature of the variability underlying the performance of schizophrenic patients on psychological tasks. Rather than providing an explanation that dismisses the heterogeneous nature of schizophrenia it has provided the beginnings of an explanation that allows for different results to be found among any group of schizophrenic patients as well as overlapping results with other patient populations and to a lesser extent with normal subjects. This set of studies has confirmed the individual, and also very active, way in which a person will deploy attention such that there does not appear to be a 'schizophrenic' response style but several styles possibly reflecting the various aspects of the 'Schizophrenias'. In my view, this takes the form of an active combat against the prevailing symptoms. Thus, in the schizophrenic patient we do not see a responsivity to task demands as in normal subjects, but a responsivity that may represent an adaptive strategy attempting to deal with internal factors that are determined by the illness, some of which may be common to other illnesses where presenting symptoms are similar.

The trends found in this study perhaps pose more questions than answers and point towards possible further research. Firstly, in the selection of subjects a consecutive admissions procedure was used. This did not allow for selecting either on the basis of level of responding or hemisphere bias. Secondly, research has come to focus more on symptom profiles rather than traditional diagnostic

classification into subgroups and it would be useful to compare subject differences on this basis and perhaps to include other measures such as anxiety which affect electrodermal arousal levels. Thirdly, to follow through in a prospective study the hypothesis generated from this dataset that both cognitive and psychophysiological response styles may reflect prognosis and response to treatment.

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APPENDIX

Table 6 (i) Means and Standard Deviations of Skin Conductance Response Characteristics (70 dB Sequence)

Electrodermal Variables		
Normal Control Group	$\bar{x}$	σ
Orienting Responses	4.51	4.28
Nonspecific Responses	13.86	17.04
Trials to Habituation	4.91	5.68
Skin Conductance Level	12.51	8.03
Nonschizophrenic Patient Group		
Orienting Responses	2.55	3.78
Nonspecific Responses	8.04	14.01
Trials to Habituation	2.00	4.14
Skin Conductance Level	8.39	6.51
Schizophrenic Patient Group		
Orienting Responses	4.68	4.99
Nonspecific Responses	17.64	22.16
Trials to Habituation	4.19	5.64
Skin Conductance Level	11.23	10.91

Table 6 (ii) Means and Standard Deviations of Skin Conductance Response Characteristics in Responding and Nonresponding Subjects (70 dB Sequence)

Electrodermal Variable	Responders		Nonresponders	
Normal Control Group	$\bar{x}$	σ	$\bar{x}$	σ
Orienting Responses	5.62	5.19	0	0
Nonspecific Responses	16.77	17.62	0.57	1.51
Trials to Habituation	6.14	5.73	0	0
Skin Conductance Level	13.65	8.25	7.11	3.87
Response Latency	2.29	0.50		
Response Rise Time	2.12	0.69		
Response Amplitude	0.35	0.32	0	0
Response Recovery Time	4.86	4.28		
Nonschizophrenic Patient Group				
Orienting Responses	5.06	7.52	0	0
Nonspecific Responses	15.58	16.76	0.50	1.57
Trials to Habituation	4.00	5.17	0	0
Skin Conductance Level	11.52	6.21	5.26	5.28
Response Latency	2.24	0.72		
Response Rise Time	2.19	0.79		
Response Amplitude	0.24	0.25	0	0
Response Recovery Time	4.69	4.28		
Schizophrenic Patient Group				
Orienting Responses	6.24	6.65	0	0
Nonspecific Responses	23.34	22.91	0.50	1.11
Trials to Habituation	5.53	5.89	0	0
Skin Conductance Level	12.16	11.76	8.41	7.59
Response Latency	2.37	0.65		
Response Rise Time	2.08	0.85		
Response Amplitude	0.23	0.33	0	0
Response Recovery Time	3.78	3.58		

Table 6 (iii) Means and Standard Deviations of Electrodermal Variables for Left and Right Hands (70 dB Sequence)

Electrodermal Variables	Left Hand		Right Hand	
	$\bar{x}$	σ	$\bar{x}$	σ
Normal Control Group				
Orienting Responses	4.69	4.31	4.59	4.27
Trials to Habituation	5.08	5.70	5.00	5.71
Nonspecific Responses	13.82	16.82	13.90	17.56
Skin Conductance Level	11.34	8.63	13.68	8.79
Response Latency	2.28	0.58	2.33	0.52
Response Rise Time	2.20	0.81	2.13	0.73
Response Amplitude	0.30	0.52	0.25	0.25
Response Recovery Time	4.25	4.22	5.30	4.96
Initial Response Amplitude	0.45	0.55	0.52	0.68
Response Magnitude	0.10	0.13	0.11	0.15
Nonschizophrenic Patient Group				
Orienting Responses	2.55	3.78	2.55	3.78
Trials to Habituation	2.00	4.14	2.00	4.14
Nonspecific Responses	8.20	14.11	7.88	13.96
Skin Conductance Level	9.17	8.26	7.61	5.93
Response Latency	2.23	0.80	2.26	0.68
Response Rise Time	2.17	0.64	2.19	1.00
Response Amplitude	0.13	0.22	0.12	0.21
Response Recovery Time	4.88	4.78	4.57	4.61
Initial Response Amplitude	0.15	0.34	0.14	0.35
Response Magnitude	0.05	0.13	0.05	0.13
Schizophrenic Patient Group				
Orienting Responses	4.58	4.50	4.78	4.53
Trials to Habituation	3.83	5.55	4.55	5.96
Nonspecific Responses	16.52	22.48	18.75	22.55
Skin Conductance Level	10.97	10.48	11.48	11.52
Response Latency	2.27	0.69	2.55	0.86
Response Rise Time	1.99	0.82	2.11	0.95
Response Amplitude	0.15	0.20	0.21	0.43
Response Recovery Time	4.01	3.75	3.47	3.44
Initial Response Amplitude	0.23	0.47	0.30	0.59
Response Magnitude	0.12	0.36	0.12	0.29

Table 6 (iv) Means and Standard Deviations of Electrodermal Variables Within Habituator Groups (70 dB Sequence)

Electrodermal Variables	Zero-Trial Habituators		Habituators		Slow Habituators	
	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ
Normal Control Group	(N = 9)		(N = 20)		(N = 11)	
Orienting Responses	0.56	1.13	3.24	2.10	10.41	2.27
Trials to Habituation	0	0	2.53	1.65	13.50	2.21
Nonspecific Responses	1.67	2.55	9.37	13.43	31.09	16.32
Skin Conductance Level	7.36	3.49	13.97	9.72	14.06	5.61
Response Latency	2.14	0	2.46	0.58	2.05	0.19
Response Rise Time	1.23	0	2.22	0.78	2.05	0.52
Response Amplitude	0.02	0.04	0.36	0.38	0.38	0.23
Response Recovery Time	8.49	0	5.82	5.22	3.18	1.60
Initial Response Amp.	0	0	0.48	0.45	0.09	0.78
Response Magnitude	0.01	0.01	0.07	0.07	0.26	0.15
Nonschizophrenic Patient Group	(N = 24)		(N = 13)		(N = 3)	
Orienting Responses	0.29	0.69	4.69	3.22	11.33	2.08
Trials to Habituation	0	0	2.69	2.21	15.00	0
Nonspecific Responses	1.44	2.96	13.69	12.86	36.33	28.33
Skin Conductance Level	6.67	6.70	10.74	5.33	11.96	7.10
Response Latency	2.35	1.35	2.23	0.49	1.97	0
Response Rise Time	2.10	0.53	2.27	0.92	1.97	0.63
Response Amplitude	0.02	0.05	0.26	0.31	0.36	0.12
Response Recovery Time	7.45	5.80	4.34	4.04	2.44	0.93
Initial Response Amp.	0	0	0.33	0.48	1.00	1.06
Response Magnitude	0.01	0.01	0.10	0.18	0.52	0.22
Schizophrenic Patient Group	(N = 15)		(N = 15)		(N = 10)	
Orienting Responses	1.30	2.76	4.07	2.29	10.65	2.77
Trials to Habituation	0	0	2.47	2.00	13.05	23.91
Nonspecific Responses	8.57	22.56	21.09	18.24	26.05	23.91
Skin Conductance Level	9.80	11.81	8.69	3.74	17.16	14.94
Response Latency	2.48	0.50	2.50	0.73	2.16	0.63
Response Rise Time	2.45	1.45	2.08	0.94	1.96	0.41
Response Amplitude	0.04	0.10	0.14	0.08	0.43	0.53
Response Recovery Time	5.99	7.81	4.00	3.56	2.68	1.01
Initial Response Amp.	0	0	0.14	0.13	0.84	0.79
Response Magnitude	0.02	0.05	0.05	0.04	0.39	0.45

Table 6 (v) Means and Standard Deviations of Electrodermal Variables Within the Fast and Moderate Habituator Groups (70 dB Sequence)

Electrodermal Variables	Fast Habituators		Moderate Habituators	
	$\bar{x}$	σ	$\bar{x}$	σ
Normal Control Group	(N = 10)		(N = 10)	
Orienting Responses	2.10	1.66	4.50	1.34
Trials to Habituation	1.40	0.52	3.78	1.58
Nonspecific Responses	8.40	15.14	10.44	12.05
Skin Conductance Level	15.93	10.08	12.01	9.45
Response Latency	2.03	0.76	2.38	0.40
Response Rise Time	2.35	0.88	2.12	0.73
Response Amplitude	0.50	0.52	0.24	0.15
Response Recovery Time	5.92	6.29	5.74	4.63
Initial Response Amplitude	0.39	0.39	0.57	0.51
Response Magnitude	0.05	0.06	0.09	0.08
Nonschizophrenic Patient Group	(N = 9)		(N = 4)	
Orienting Responses	3.89	3.14	6.50	3.00
Trials to Habituation	1.44	0.52	5.50	1.92
Nonspecific Responses	13.33	13.15	14.50	14.10
Skin Conductance Level	9.64	5.38	13.22	4.95
Response Latency	2.31	0.53	2.08	0.42
Response Rise Time	2.40	1.11	2.00	0.31
Response Amplitude	0.24	0.35	0.32	0.22
Response Recovery Time	4.87	4.80	3.27	1.97
Initial Response Amplitude	0.22	0.44	0.58	0.52
Response Magnitude	0.09	0.21	0.11	0.03
Schizophrenic Patient Group	(N = 11)		(N = 4)	
Orienting Responses	3.91	2.59	4.50	1.47
Trials to Habituation	1.55	0.52	5.00	2.48
Nonspecific Responses	14.53	15.26	39.13	14.70
Skin Conductance Level	7.84	4.03	11.01	1.19
Response Latency	2.43	0.83	2.60	0.65
Response Rise Time	2.28	1.02	1.54	0.36
Response Amplitude	0.15	0.08	0.13	0.06
Response Recovery Time	3.48	2.08	5.42	6.40
Initial Response Amplitude	0.19	0.13	0.02	0.03
Response Magnitude	0.05	0.05	0.04	0.02

Table 6 (vi) Mean Skin Conductance Levels at Trials 1 and 15 for the 70 dB Sequence in Responding and Nonresponding Subjects

Subject Group	Trial 1		Trial 15		Trial Difference	
	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ
Normal Control Group						
Total Group	10.58	5.64	14.42	11.47	- 3.58	7.86
Responders	11.45	5.62	16.04	11.85	- 4.33	8.44
Nonresponders	6.50	3.63	6.75	10.27	- 0.45	2.60
Nonschizophrenic Patient Group						
Total Group	6.58	4.22	9.80	8.15	- 3.23	5.59
Responders	8.82	3.64	13.47	8.19	- 4.66	6.13
Nonresponders	4.33	3.50	6.12	6.87	- 1.80	4.11
Schizophrenic Patient Group						
Total Group	10.58	10.37	11.70	10.63	- 1.13	3.42
Responders	10.75	11.58	12.29	11.06	- 0.47	2.68
Nonresponders	10.06	3.14	9.68	8.99	- 3.11	4.34

Table 6 (vii) Means and Standard Deviations of Skin Conductance Response Characteristics in Relation to Skin Conductance Asymmetry (70 dB Sequence)

Direction of Asymmetry:	Left>Right		Right>Left	
Electrodermal Variables	$\bar{x}$	σ	$\bar{x}$	σ
Normal Control Group	(N = 14)		(N = 26)	
Orienting Responses	4.96	4.63	4.46	4.15
Trials to Habituation	5.00	5.23	5.06	6.05
Nonspecific Responses	12.50	17.65	14.62	17.14
Skin Conductance Level	13.29	11.16	12.09	5.94
Response Latency	2.15	0.36	2.37	0.56
Response Rise Time	2.10	0.64	2.13	0.74
Response Amplitude	0.49	0.48	0.20	0.17
Response Recovery Time	3.51	2.90	5.63	4.79
Initial Response Amplitude	0.62	0.79	0.42	0.49
Response Magnitude	0.17	0.17	0.09	0.12
Nonschizophrenic Patient Group	(N = 28)		(N = 12)	
Orienting Responses	2.46	3.54	2.75	4.45
Trials to Habituation	2.04	4.17	1.92	4.25
Nonspecific Responses	6.41	8.82	11.83	21.97
Skin Conductance Level	8.04	6.44	9.21	6.89
Response Latency	2.39	0.77	1.79	0.17
Response Rise Time	2.34	0.82	1.62	0.18
Response Amplitude	0.09	0.11	0.20	0.37
Response Recovery Time	5.35	4.59	2.24	1.15
Initial Response Amplitude	0.65	0.11	0.33	0.58
Response Magnitude	0.04	0.07	0.09	0.20
Schizophrenic Patient Group	(N = 20)		(N = 19)	
Orienting Responses	4.85	4.52	4.74	4.55
Trials to Habituation	4.13	5.52	4.47	5.97
Nonspecific Responses	17.12	24.59	19.11	20.13
Skin Conductance Level	11.50	11.18	11.48	10.94
Response Latency	2.41	0.58	2.29	0.80
Response Rise Time	2.00	0.85	2.18	0.87
Response Amplitude	0.14	0.12	0.22	0.43
Response Recovery Time	3.39	3.46	4.27	3.82
Initial Response Amplitude	0.28	0.57	0.26	0.48
Response Magnitude	0.11	0.27	0.13	0.29

Table 6 (viii) Means and Standard Deviations of Response Amplitude Measures (70 dB Sequence)

Electrodermal Variables	$\bar{x}$	σ
Normal Control Group		
Mean Response amplitude (excluding nonzero responses)	0.29	0.32
Response Magnitude (including nonzero responses)	0.11	0.14
Response Amplitude to Trial 1	0.49	0.61
Nonschizophrenic Patient Group		
Mean Response amplitude (excluding nonzero responses)	0.12	0.22
Response Magnitude (including nonzero responses)	0.05	0.13
Response Amplitude to Trial 1	0.15	0.35
Schizophrenic Patient Group		
Mean Response amplitude (excluding nonzero responses)	0.18	0.31
Response Magnitude (including nonzero responses)	0.12	0.27
Response Amplitude to Trial 1	0.26	0.52

Table 6 (ix) Means and Standard Deviations of Skin Conductance Response Characteristics in Relation to Response Amplitude Asymmetry (70 dB Sequence)

Direction of Asymmetry:	Left>Right		Right>Left	
Electrodermal Variables	$\bar{x}$	σ	$\bar{x}$	σ
Normal Control Group	(N = 15)		(N = 18)	
Orienting Responses	5.40	4.43	5.88	3.82
Trials to Habituation	5.23	5.83	6.94	5.69
Nonspecific Responses	15.57	19.07	17.82	16.74
Skin Conductance Level	14.60	9.04	12.86	7.71
Response Latency	2.20	0.29	2.34	0.59
Response Rise Time	2.30	0.88	2.00	0.54
Response Amplitude	0.33	0.42	0.32	0.21
Response Recovery Time	4.24	2.92	5.29	5.01
Initial Response Amplitude	0.43	0.45	0.74	0.72
Response Magnitude	0.13	0.15	0.14	0.14
Nonschizophrenic Patient Group	(N = 7)		(N = 8)	
Orienting Responses	4.86	4.14	6.38	4.50
Trials to Habituation	4.43	5.35	5.38	6.30
Nonspecific Responses	9.79	10.94	20.50	21.74
Skin Conductance Level	12.73	8.14	10.51	5.27
Response Latency	1.74	0.39	2.76	0.88
Response Rise Time	1.96	0.36	2.55	1.15
Response Amplitude	0.28	0.20	0.29	0.35
Response Recovery Time	6.60	4.78	4.48	4.70
Initial Response Amplitude	0.33	0.47	0.41	0.54
Response Magnitude	0.10	0.13	0.17	0.23
Schizophrenic Patient Group	(N = 9)		(N = 17)	
Orienting Responses	6.33	5.10	6.44	3.60
Trials to Habituation	4.44	6.17	6.50	5.66
Nonspecific Responses	24.83	30.04	25.76	20.63
Skin Conductance Level	11.57	13.27	14.05	12.08
Response Latency	2.72	0.72	2.13	0.59
Response Rise Time	2.50	1.04	1.71	0.38
Response Amplitude	0.18	0.10	0.28	0.44
Response Recovery Time	4.06	2.12	3.07	3.36
Initial Response Amplitude	0.18	0.13	0.37	0.49
Response Magnitude	0.09	0.08	0.16	0.30

Table 6 (x) Means and Standard Deviations of Temporal Variables (70 dB Sequence)

Temporal Variables	$\bar{x}$	σ
Normal Control Group		
Response Latency	2.29	0.50
Response Rise Time	2.12	0.69
Response Recovery Time	4.88	4.28
Nonschizophrenic Patient Group		
Response Latency	2.25	0.72
Response Rise Time	2.29	0.79
Response Recovery Time	4.69	4.28
Schizophrenic Patient Group		
Response Latency	2.37	0.66
Response Rise Time	2.08	0.85
Response Recovery Time	3.78	3.58

Table 6 (xi) Intercorrelations Between Electrodermal Variables (70 dB Sequence)

Electrodermal Variables	1	2	3	4	5	6	7	8
Normal Control Group								
1. Orienting Responses	-							
2. Trials to Habituation	0.9324***	-						
3. Nonspecific Responses	0.8033***	0.7279***	-					
4. Skin Conductance Level	0.3761**	0.3401*	0.5491***	-				
5. Response Latency	- 0.2647	- 0.2345	- 0.1366	- 0.0599	-			
6. Response Rise Time	- 0.0506	- 0.0051	- 0.2101	- 0.0750	0.3593*	-		
7. Response Amplitude	0.5932***	0.5919***	0.4750**	0.4644**	0.0116	0.3221	-	
8. Response Recovery Time	- 0.2889	- 0.1771	- 0.2932	- 0.3385*	0.5484***	0.0310	- 0.2210	-
Nonschizophrenic Patient Group								
1. Orienting Responses	-							
2. Trials to Habituation	0.8929***	-						
3. Nonspecific Responses	0.8745***	0.7136***	-					
4. Skin Conductance Level	0.4979**	0.4070**	0.5340***	-				
5. Response Latency	- 0.1495	- 0.1249	- 0.0699	- 0.2864	-			
6. Response Rise Time	- 0.1355	- 0.1051	- 0.2476	- 0.3842	0.5941**	-		
7. Response Amplitude	0.9480***	0.8400***	0.7633***	0.3614*	- 0.2867	- 0.1901	-	
8. Response Recovery Time	- 0.4334*	- 0.4225*	- 0.4106*	0.0476	- 0.0961	0.3697	- 0.1838	-
Schizophrenic Patient Group								
1. Orienting Responses	-							
2. Trials to Habituation	0.8394***	-						
3. Nonspecific Responses	0.7750***	0.6158***	-					
4. Skin Conductance Level	0.4398**	0.3720**	0.4767***	-				
5. Response Latency	- 0.2542	- 0.0936	- 0.2644	- 04383*	-			
6. Response Rise Time	- 0.0285	- 0.0261	- 0.4013*	- 0.2669	0.5841**	-		
7. Response Amplitude	0.7862***	0.7161***	0.6650***	0.6851***	- 0.2400	- 0.469	-	
8. Response Recovery Time	- 0.3529*	0.1102	- 0.5388**	- 0.3015	0.1323	0.5581	- 0.1863	-

*** $p < 0.001$ ** $p < 0.01$ * $p < 0.05$

Table 6 (xii) Factor Structure of Electrodermal Variables (70 dB Sequence)

	Factor 1	Factor 2	Factor 3
All Subjects			
Orienting Responses	0.93779	- 0.30059	
Trials to Habituation	0.80060	- 0.19468	
Nonspecific Responses	0.75363	- 0.39704	
Skin Conductance Level	0.53482	- 0.29914	
Response Latency	- 0.28064	0.50576	
Response Rise Time	- 0.22416	0.99913	
Response Amplitude	0.57752	- 0.07113	
Response Recovery Time	- 0.43357	0.35161	
Normal Control Group			
Orienting Responses	0.98856	0.33852	- 0.39500
Trials to Habituation	0.94666	0.25855	- 0.31184
Nonspecific Responses	0.76500	0.26303	- 0.45658
Skin Conductance Level	0.28350	0.53031	- 0.17973
Response Latency	- 0.37874	- 0.08975	0.74768
Response Rise Time	- 0.14030	0.24184	0.45295
Response Amplitude	0.21229	0.97501	0.18178
Response Recovery Time	- 0.44303	- 0.43781	0.59537
Nonschizophrenic Patient Group			
Orienting Responses	1.00436	- 0.22326	- 0.31539
Trials to Habituation	0.81300	- 0.15272	- 0.25817
Nonspecific Responses	0.82794	- 0.29721	- 0.39679
Skin Conductance Level	0.40014	- 0.45984	0.00779
Response Latency	- 0.23786	0.75276	- 0.20287
Response Rise Time	- 0.23980	0.83759	0.35556
Response Amplitude	0.65194	- 0.33607	0.01315
Response Recovery Time	- 0.37046	0.10384	0.75553
Schizophrenic Patient Group			
Orienting Responses	0.51779	- 0.39178	- 0.93382
Trials to Habituation	0.43228	- 0.19440	- 0.90761
Nonspecific Responses	0.66779	- 0.40698	- 0.47747
Skin Conductance Level	0.90448	- 0.39927	- 0.32752
Response Latency	- 0.37171	0.53057	0.17226
Response Rise Time	- 0.24289	1.01103	0.19883
Response Amplitude	0.81672	- 0.13638	- 0.53753
Response Recovery Time	- 0.27748	0.51915	0.35346

Table 6 (xiii) Means and Standard Deviations of Electrodermal Variables for Male and Female Subjects (70 dB Sequence)

Electrodermal Variables	Male		Female	
	$\bar{x}$	σ	$\bar{x}$	σ
Normal Control Group				
Orienting Responses	5.95	4.72	3.40	3.48
Trials to Habituation	7.05	6.32	3.13	4.38
Nonspecific Responses	18.11	20.07	9.83	13.02
Skin Conductance Level	12.78	7.90	12.23	8.36
Response Latency	2.17	0.39	2.46	0.60
Response Rise Time	1.91	0.54	2.39	0.80
Response Amplitude	0.26	0.19	0.31	0.41
Response Recovery Time	3.64	3.53	6.52	4.77
Initial Response Amplitude	0.49	0.50	0.49	0.70
Response Magnitude	0.14	0.16	0.08	0.22
Nonschizophrenic Patient Group				
Orienting Responses	2.90	4.00	2.20	3.61
Trials to Habituation	2.25	4.66	1.75	3.65
Nonspecific Responses	6.80	9.33	9.28	17.18
Skin Conductance Level	7.80	6.06	8.98	7.03
Response Latency	2.55	0.94	1.97	0.29
Response Rise Time	2.52	0.91	1.82	0.24
Response Amplitude	0.15	0.26	0.99	0.17
Response Recovery Time	5.23	5.19	4.09	3.18
Initial Response Amplitude	0.12	0.32	0.17	0.38
Response Magnitude	0.07	0.16	0.03	0.07
Schizophrenic Patient Group				
Orienting Responses	5.08	4.34	4.23	4.70
Trials to Habituation	4.83	5.83	3.55	5.51
Nonspecific Responses	18.87	21.55	16.40	23.23
Skin Conductance Level	10.90	10.45	11.55	11.14
Response Latency	2.16	0.60	2.63	0.66
Response Rise Time	1.99	0.84	2.20	0.86
Response Amplitude	0.22	0.40	0.13	0.17
Response Recovery Time	3.42	3.40	4.23	3.90
Initial Response Amplitude	0.37	0.65	0.15	0.33
Response Magnitude	0.17	0.37	0.07	0.11

Table 6 (xiv) Means and Standard Deviations of Age in Male and Female Subjects: Comparison Between Responding and Nonresponding Subjects (70 dB Sequence)

	Responders		Nonresponders	
	Male	Female	Male	Female
Normal Control Group	(N = 19)	(N = 14)	(N = 1)	(N = 6)
x	39.16	34.93	43.00	51.83
o	14.41	12.68	0	12.66
Nonschizophrenic Patient Group	(N = 11)	(N = 9)	(N = 9)	(N = 11)
x	40.64	39.22	46.56	47.18
o	16.29	14.24	15.58	12.21
Schizophrenic Patient Group	(N = 17)	(N = 13)	(N = 3)	(N = 7)
x	40.88	42.62	56.33	37.57
o	13.30	14.73	1.53	15.63

Table 6 (xv) Means and Standard Deviations of Electrodermal Variables in Schizophrenic Patient Subgroups (70 dB Sequence)

Electrodermal Variables	$\bar{x}$	σ	$\bar{x}$	σ
	Acute Patients (N = 17)		Chronic Patients (N = 23)	
Orienting Responses	5.47	4.53	4.09	4.46
Trials to Habituation	5.68	4.46	3.09	5.14
Nonspecific Responses	22.26	22.42	14.21	21.81
Skin Conductance Level	15.00	12.27	8.43	9.06
Response Latency	2.29	0.68	2.49	0.65
Response Rise Time	2.08	0.92	2.08	0.79
Response Amplitude	0.26	0.44	0.11	0.12
Response Recovery Time	3.68	3.48	3.89	3.83
Initial Response Amplitude	0.36	0.50	0.19	0.53
Response Magnitude	0.15	0.30	0.10	0.49
	Paranoid Patients (N = 6)		Nonparanoid Patients (N = 34)	
Orienting Responses	6.17	3.78	4.41	4.60
Trials to Habituation	4.58	5.73	4.12	5.71
Nonspecific Responses	10.47	10.48	18.90	23.50
Skin Conductance Level	6.00	2.35	12.15	11.57
Response Latency	2.95	0.74	2.27	0.61
Response Rise Time	2.54	0.99	1.97	0.79
Response Amplitude	0.19	0.13	0.17	0.33
Response Recovery Time	3.91	2.62	3.75	3.32
Initial Response Amplitude	0.58	0.98	0.21	0.39
Response Magnitude	0.26	0.48	0.10	0.22
	Institutionalised Patients (N = 26)		Noninstitutionalised Patients (N = 14)	
Orienting Responses	4.75	4.50	4.63	4.56
Trials to Habituation	2.75	4.31	4.96	6.18
Nonspecific Responses	16.56	23.65	18.21	21.77
Skin Conductance Level	10.47	10.74	11.63	11.18
Response Latency	2.71	0.73	2.26	0.61
Response Rise Time	2.00	0.75	2.12	0.91
Response Amplitude	0.11	0.12	0.21	0.37
Response Recovery Time	2.63	1.49	4.36	4.19
Initial Response Amplitude	0.10	0.15	0.35	0.62
Response Magnitude	0.05	0.07	0.16	0.33

Table 6 (xvi) Means and Standard Deviations of Electrodermal Variables in Nonschizophrenic Patient Subgroups (70 dB Sequence)

Electrodermal Variables	Depressed Patients		Nondepressed Patients	
	$\bar{x}$	σ	$\bar{x}$	σ
	(N = 31)		(N = 9)	
Orienting Responses	2.26	3.74	3.56	3.97
Trials to Habituation	2.19	4.62	1.33	1.66
Nonspecific Responses	6.37	13.63	13.78	14.58
Skin Conductance Level	8.04	6.53	9.59	6.70
Response Latency	2.33	0.83	2.04	0.30
Response Rise Time	2.34	0.87	1.77	0.13
Response Amplitude	0.11	0.16	0.17	0.35
Response Recovery Time	5.34	4.72	2.89	2.12
Initial Response Amplitude	0.13	0.31	0.19	0.45
Response Magnitude	0.04	0.09	0.09	0.22

	Patients with Endogenous Depression		Patients with Reactive Depression	
	$\bar{x}$	σ	$\bar{x}$	σ
	(N = 14)		(N = 17)	
Orienting Responses	1.71	3.27	2.71	4.41
Trials to Habituation	1.79	4.23	2.53	5.03
Nonspecific Response	2.54	5.96	9.53	17.20
Skin Conductance Level	6.39	7.20	9.40	5.78
Response Latency	2.06	0.88	2.53	0.80
Response Rise Time	2.49	1.14	2.23	0.67
Response Amplitude	0.10	0.14	0.11	0.18
Response Recovery Time	8.83	5.61	2.72	0.77
Initial Response Amplitude	0.06	0.12	0.19	0.41
Response Magnitude	0.04	0.09	0.05	0.09

Table 6 (xvii) Means and Standard Deviations of Electrodermal Variables in Patients On and Off Medication (70 dB Sequence)

Electrodermal Variables	On Medication		Off Medication	
Schizophrenic Patient Group	$\bar{x}$	σ	$\bar{x}$	σ
Orienting Responses	4.73	4.85	4.54	3.67
Trials to Habituation	3.98	5.72	4.67	5.67
Nonspecific Responses	15.06	20.60	23.63	25.35
Skin Conductance Level	10.71	10.02	13.12	9.05
Response Latency	2.45	0.72	2.28	0.60
Response Rise Time	2.00	0.73	2.22	1.04
Response Amplitude	0.13	0.16	0.27	0.51
Response Recovery Time	3.59	3.39	4.10	4.06
Initial Response Amplitude	0.18	0.30	0.46	0.82
Response Magnitude	0.07	0.11	0.23	0.46
Nonschizophrenic Patient Group	$\bar{x}$	σ	$\bar{x}$	σ
Orienting Responses	2.49	4.03	1.17	1.33
Trials to Habituation	2.24	4.43	0.67	1.21
Nonspecific Responses	8.51	15.03	5.33	5.50
Skin Conductance Level	8.20	6.38	9.46	7.79
Response Latency	2.25	0.77	2.21	0.51
Response Rise Time	2.21	0.83	2.09	0.63
Response Amplitude	0.12	0.21	0.15	0.25
Response Recovery Time	5.14	4.53	2.31	0.82
Initial Response Amplitude	0.13	0.31	0.23	0.94
Response Magnitude	0.06	0.13	0.03	0.05

Table 6 (xviii) Means and Standard Deviations of Skin Conductance Response Characteristics (90 dB Sequence)

Electrodermal Variables

	$\bar{x}$	σ
Normal Control Group		
Orienting Responses	4.09	3.24
Trials to Habituation	4.43	3.84
Nonspecific Responses	7.75	10.03
Skin Conductance Level	14.31	10.49
Response Latency	2.26	0.51
Response Rise Time	2.25	0.84
Response Amplitude	0.43	0.37
Response Recovery Time	4.77	3.80
Initial Response Amplitude	0.87	1.00
Response Magnitude	0.23	0.25
Nonschizophrenic Patient Group		
Orienting Responses	2.23	3.17
Trials to Habituation	2.50	3.82
Nonspecific Responses	4.38	8.13
Skin Conductance Level	10.37	9.42
Response Latency	2.29	0.66
Response Rise Time	2.13	0.53
Response Amplitude	0.14	0.31
Response Recovery Time	5.37	4.72
Initial Response Amplitude	0.25	0.73
Response Magnitude	0.08	0.21
Schizophrenic Patient Group		
Orienting Responses	3.44	3.27
Trials to Habituation	4.25	4.10
Nonspecific Responses	9.99	13.03
Skin Conductance Level	12.05	9.90
Response Latency	2.21	0.72
Response Rise Time	2.12	0.74
Response Amplitude	0.29	0.36
Response Recovery Time	4.21	4.27
Initial Response Amplitude	0.32	0.45
Response Magnitude	0.13	0.19

Table 6 (xix) Means and Standard Deviations of Electrodermal Variables Within Habituator Groups (90 dB Sequence)

Electrodermal Variables	Zero-Trial Habituators		Habituators		Slow Habituators	
	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ
Normal Control Group	(N = 7)		(N = 23)		(N = 10)	
Orienting Responses	0	0	3.24	1.21	8.90	1.17
Trials to Habituation	0	0	3.35	2.14	10.00	0
Nonspecific Responses	0.07	0.19	5.17	6.65	19.05	11.08
Skin Conductance Level	7.03	4.25	15.02	12.27	17.77	6.42
Response Latency	0	0	2.33	0.53	2.10	0.43
Response Rise Time	0	0	2.30	0.92	2.16	0.67
Response Amplitude	0	0	0.46	0.38	0.61	0.25
Response Recovery Time	0	0	5.48	4.26	3.15	1.63
Initial Response Amp.	0	0	0.81	0.85	1.71	1.11
Response Magnitude	0	0	0.16	0.15	0.53	0.26
Nonschizophrenic Patient Group	(N = 21)		(N = 12)		(N = 7)	
Orienting Responses	0.24	0.63	2.25	1.76	8.14	1.86
Trials to Habituation	0	0	2.50	1.98	10.00	0
Nonspecific Responses	0.64	1.89	2.25	2.55	19.21	9.54
Skin Conductance Level	6.67	8.19	14.00	11.04	15.29	5.25
Response Latency	1.36	0.45	2.54	0.67	2.30	0.27
Response Rise Time	1.56	0.39	2.34	0.51	1.99	0.49
Response Amplitude	0.04	0.02	0.15	0.09	0.50	0.59
Response Recovery Time	6.18	3.98	7.24	5.87	2.74	1.00
Initial Response Amp.	0	0	0.19	0.22	1.10	1.51
Response Magnitude	0.01	0.01	0.04	0.04	0.38	0.40
Schizophrenic Patient Group	(N = 12)		(N = 16)		(N = 12)	
Orienting Responses	0	0	2.94	1.81	7.54	1.39
Trials to Habituation	0	0	3.56	2.45	9.42	1.38
Nonspecific Responses	0.13	0.31	7.94	9.13	22.58	14.23
Skin Conductance Level	8.62	10.93	10.92	5.60	16.97	12.00
Response Latency	0	0	2.37	0.83	2.07	0.62
Response Rise Time	0	0	2.17	0.84	2.06	0.66
Response Amplitude	0	0	0.45	0.40	0.48	0.35
Response Recovery Time	0	0	5.80	5.33	2.36	1.01
Initial Response Amp.	0	0	0.54	0.57	0.33	0.28
Response Magnitude	0	0	0.11	0.11	0.28	0.26

Table 6 (xx) Means and Standard Deviations of Electrodermal Variables Within Fast and Moderate Habituator Groups (90 dB Sequence)

Electrodermal Variables	Fast Habituators		Moderate Habituators	
	$\bar{x}$	σ	$\bar{x}$	σ
Normal Control Group	(N = 10)		(N = 13)	
Orienting Responses	2.40	0.52	3.88	1.19
Trials to Habituation	1.50	0.47	4.77	1.79
Nonspecific Responses	6.15	8.56	4.42	5.06
Skin Conductance Level	10.71	7.83	18.33	14.24
Response Latency	2.44	0.52	2.23	0.54
Response Rise Time	2.22	0.67	2.36	1.09
Response Amplitude	0.44	0.49	0.47	0.30
Response Recovery Time	6.43	5.22	4.74	3.39
Initial Response Amplitude	0.75	1.03	0.84	0.74
Response Magnitude	0.14	0.17	0.18	0.14
Nonschizophrenic Patient Group	(N = 7)		(N = 5)	
Orienting Responses	1.29	0.76	3.60	1.95
Trials to Habituation	1.14	0.38	4.40	1.67
Nonspecific Responses	1.29	1.87	3.60	2.97
Skin Conductance Level	11.35	3.69	17.71	16.89
Response Latency	2.67	0.57	2.39	0.82
Response Rise Time	2.41	0.61	2.23	0.36
Response Amplitude	0.14	0.08	0.17	0.10
Response Recovery Time	5.78	6.16	8.40	6.06
Initial Response Amplitude	0.10	0.10	0.32	0.30
Response Magnitude	0.01	0.01	0.07	0.04
Schizophrenic Patient Group	(N = 7)		(N = 9)	
Orienting Responses	1.39	0.76	4.22	1.20
Trials to Habituation	1.14	0.38	5.44	1.42
Nonspecific Responses	2.36	2.94	12.29	10.08
Skin Conductance Level	9.83	6.65	11.77	4.87
Response Latency	3.10	1.11	2.01	0.35
Response Rise Time	2.84	1.33	1.88	0.26
Response Amplitude	0.49	0.39	0.43	0.42
Response Recovery Time	10.40	6.30	3.24	2.39
Initial Response Amplitude	0.47	0.59	0.60	0.59
Response Magnitude	0.05	0.07	0.15	0.13

Table 6 (xxi) Means and Standard Deviations of Electrodermal Variables for Left and Right Hands (90 dB Sequence)

Electrodermal Variables	Left Hand		Right Hand	
	$\bar{x}$	σ	$\bar{x}$	σ
Normal Control Group				
Orienting Responses	4.08	3.30	4.10	3.23
Trials to Habituation	4.38	3.86	4.48	3.84
Nonspecific Responses	7.88	10.19	7.63	10.00
Skin Conductance Level	13.37	11.90	15.24	10.47
Response Latency	2.22	0.55	2.30	1.51
Response Rise Time	2.20	0.83	2.32	1.06
Response Amplitude	0.40	0.34	0.45	0.43
Response Recovery Time	4.50	3.91	5.04	4.75
Initial Response Amplitude	0.83	0.94	0.93	1.11
Response Magnitude	0.21	0.24	0.24	0.29
Nonschizophrenic Patient Group				
Orienting Responses	2.23	3.17	2.23	3.17
Trials to Habituation	2.50	3.82	2.50	3.82
Nonspecific Responses	4.35	8.16	4.40	8.15
Skin Conductance Level	11.28	11.42	9.46	8.89
Response Latency	2.39	0.77	2.26	0.65
Response Rise Time	2.13	0.48	2.11	0.63
Response Amplitude	0.12	0.24	0.15	0.37
Response Recovery Time	6.08	5.20	5.35	5.20
Initial Response Amplitude	0.24	0.67	0.26	0.80
Response Magnitude	0.07	0.18	0.09	0.25
Schizophrenic Patient Group				
Orienting Responses	3.40	3.27	3.48	3.29
Trials to Habituation	4.18	4.21	4.33	4.17
Nonspecific Responses	9.95	13.18	10.03	12.92
Skin Conductance Level	11.56	9.67	12.53	11.69
Response Latency	2.18	0.70	2.27	0.80
Response Rise Time	2.12	0.78	2.33	1.13
Response Amplitude	0.22	0.23	0.35	0.54
Response Recovery Time	4.58	4.68	3.75	4.15
Initial Response Amplitude	0.30	0.47	0.58	1.62
Response Magnitude	0.10	0.14	0.15	0.26

Table 6 (xxii) Means and Standard Deviations of Skin Conductance Response Characteristics in Relation to Skin Conductance Asymmetry (90 dB Sequence)

Direction of Asymmetry:	Left>Right		Right>Left	
Electrodermal Variables	$\bar{x}$	σ	$\bar{x}$	σ
Normal Control Group	(N = 18)		(N = 22)	
Orienting Responses	4.03	3.17	4.14	3.37
Trials to Habituation	4.00	3.71	4.77	4.00
Nonspecific Responses	7.64	10.90	7.84	9.51
Skin Conductance Level	15.37	13.10	13.43	7.28
Response Latency	2.23	0.51	2.29	0.52
Response Rise Time	1.99	0.70	2.52	0.85
Response Amplitude	0.50	0.38	0.37	0.36
Response Recovery Time	4.74	4.83	4.80	2.63
Initial Response Amplitude	0.92	0.82	0.84	1.14
Response Magnitude	0.24	0.20	0.22	0.29
Nonschizophrenic Patient Group	(N = 27)		(N = 13)	
Orienting Responses	2.04	2.90	2.62	3.75
Trials to Habituation	2.33	3.68	2.85	4.22
Nonspecific Responses	4.56	8.81	4.00	6.82
Skin Conductance Level	9.75	8.92	11.68	10.66
Response Latency	2.29	0.80	2.29	2.25
Response Rise Time	2.11	0.58	2.15	0.49
Response Amplitude	0.10	0.19	0.22	0.47
Response Recovery Time	5.08	4.77	6.12	5.04
Initial Response Amplitude	0.15	0.37	0.45	1.17
Response Magnitude	0.05	0.16	0.13	0.30
Schizophrenic Patient Group	(N = 20)		(N = 20)	
Orienting Responses	3.48	3.63	3.40	2.97
Trials to Habituation	4.20	4.32	4.30	3.98
Nonspecific Responses	10.93	15.73	9.05	9.96
Skin Conductance Level	11.79	11.20	12.30	8.69
Response Latency	2.19	0.81	2.23	0.63
Response Rise Time	2.18	0.91	2.06	0.59
Response Amplitude	0.29	0.38	0.28	0.36
Response Recovery Time	3.37	3.78	4.93	4.67
Initial Response Amplitude	0.39	0.50	0.25	0.40
Response Magnitude	0.12	0.14	0.13	0.23

Table 6 (xxiii) Means and Standard Deviations of Skin Conductance Response Characteristics in Relation to Response Amplitude Asymmetry (90 dB Sequence)

Direction of Asymmetry:	Left>Right		Right>Left	
Electrodermal Variables	$\bar{x}$	σ	$\bar{x}$	σ
Normal Control Group	(N = 18)		(N = 15)	
Orienting Responses	5.17	3.00	4.70	2.84
Trials to Habituation	5.28	3.57	5.47	3.70
Nonspecific Responses	9.86	11.24	8.80	9.50
Skin Conductance Level	17.73	13.04	13.59	7.10
Response Latency	2.23	0.46	2.29	0.57
Response Rise Time	2.08	0.91	2.47	0.73
Response Amplitude	0.42	0.24	0.61	0.44
Response Recovery Time	4.08	3.86	5.00	3.84
Initial Response Amplitude	0.83	0.67	1.35	1.27
Response Magnitude	0.25	0.21	0.30	0.31
Nonschizophrenic Patient Group	(N = 10)		(N = 9)	
Orienting Responses	3.90	3.04	4.56	4.07
Trials to Habituation	4.40	3.60	4.89	4.89
Nonspecific Responses	7.00	10.56	7.17	7.83
Skin Conductance Level	15.26	12.96	12.18	4.33
Response Latency	2.21	0.64	2.26	0.88
Response Rise Time	2.03	0.35	2.05	0.54
Response Amplitude	0.21	0.26	0.30	0.52
Response Recovery Time	6.12	5.59	5.58	4.77
Initial Response Amplitude	0.37	0.55	0.66	1.38
Response Magnitude	0.13	0.25	0.19	0.35
Schizophrenic Patient Group	(N = 10)		(N = 18)	
Orienting Responses	5.05	3.02	4.83	2.80
Trials to Habituation	6.10	3.87	6.06	3.52
Nonspecific Responses	10.15	9.48	16.19	15.23
Skin Conductance Level	9.94	4.23	15.50	10.70
Response Latency	2.48	0.48	2.09	0.78
Response Rise Time	2.33	0.63	1.98	0.79
Response Amplitude	0.30	0.20	0.44	0.44
Response Recovery Time	4.13	3.95	4.26	4.59
Initial Response Amplitude	0.47	0.42	0.45	0.54
Response Magnitude	0.14	0.12	0.20	0.24

Table 6 (xxiv) Intercorrelations Between Electrodermal Variables (90 dB Sequence)

Electrodermal Variables	1	2	3	4	5	6	7	8
Normal Control Group								
1. Orienting Responses	-							
2. Trials to Habituation	0.9395***	-						
3. Nonspecific Responses	0.7180***	0.6791***	-					
4. Skin Conductance Level	0.5497***	0.5456***	0.4496**	-				
5. Response Latency	- 0.3719*	- 0.3233*	0.1158	- 0.0341	-			
6. Response Rise Time	- 0.0764	- 0.0764	- 0.1716***	- 0.2025	0.3638*	-		
7. Response Amplitude	0.6376***	0.5619***	0.3846**	0.2060	- 0.3099*	0.1263	-	
8. Response Recovery Time	- 0.0864	- 0.1356	- 0.2570	- 0.3120	0.2827	0.7943***	0.1325	-
Nonschizophrenic Patient Group								
1. Orienting Responses	-							
2. Trials to Habituation	0.9085***	-						
3. Nonspecific Responses	0.7817***	0.7695***	-					
4. Skin Conductance Level	0.5061***	0.5200***	0.4496**	-				
5. Response Latency	0.0932	0.3011	- 0.0472	0.2095	-			
6. Response Rise Time	- 0.1168	- 0.0489	- 0.3210	0.2702	0.3579	-		
7. Response Amplitude	0.8993***	0.8518***	0.7163***	0.4980***	0.0764	0.4432*	-	
8. Response Recovery Time	- 0.0951	- 0.2256	- 0.3006	- 0.1692	- 0.4549	0.4286	0.3890	-
Schizophrenic Patient Group								
1. Orienting Responses	-							
2. Trials to Habituation	0.9768***	-						
3. Nonspecific Responses	0.7936***	0.8311***	-					
4. Skin Conductance Level	0.4178**	0.4182**	0.3430	-				
5. Response Latency	- 0.2690	- 0.2100	- 0.3296	- 0.2857	-			
6. Response Rise Time	0.0457	- 0.1647	- 0.6053***	0.0477	0.4767*	-		
7. Response Amplitude	0.7288***	0.7085***	0.5734***	0.4595**	- 0.2842	0.0989	-	
8. Response Recovery Time	- 0.1656	- 0.2689	- 0.5390**	0.0627	0.3333	0.7154***	- 0.1654	-

*** $p < 0.001$ ** $p < 0.01$ * $p < 0.05$

Table 6 (xxv) Factor Structure of Electrodermal Variables (90 dB Sequence)

	Factor 1	Factor 2	Factor 3
All Subjects			
Orienting Responses	0.98620	- 0.24160	
Trials to Habituation	0.97103	- 0.25524	
Nonspecific Responses	0.70980	- 0.42411	
Skin Conductance Level	0.38870	- 0.13315	
Response Latency	- 0.20550	0.50513	
Response Rise Time	- 0.12777	0.99278	
Response Amplitude	0.49634	0.11053	
Response Recovery Time	- 0.48116	0.42380	
Normal Control Group			
Orienting Responses	0.89808	- 0.51861	- 0.35790
Trials to Habituation	0.85681	- 0.55637	- 0.27890
Nonspecific Responses	0.51079	- 0.61061	- 0.17272
Skin Conductance Level	0.12267	- 0.56634	- 0.11907
Response Latency	- 0.13164	0.13260	0.74012
Response Rise Time	0.17173	0.52176	0.61952
Response Amplitude	0.56964	0.07216	0.07128
Response Recovery Time	- 0.09243	0.61387	0.25063
Nonschizophrenic Patient Group			
Orienting Responses	0.95083	0.03850	
Trials to Habituation	0.96003	0.06108	
Nonspecific Responses	0.89148	- 0.11734	
Skin Conductance Level	0.31266	0.58222	
Response Latency	- 0.11333	0.72112	
Response Rise Time	- 0.19145	0.39477	
Response Amplitude	0.62074	- 0.06044	
Response Recovery Time	- 0.47337	0.22858	
Schizophrenic Patient Group			
Orienting Responses	0.98889	- 0.24856	
Trials to Habituation	0.96558	- 0.31501	
Nonspecific Responses	0.66095	- 0.47530	
Skin Conductance Level	0.42008	- 0.20752	
Response Latency	- 0.36270	0.89095	
Response Rise Time	- 0.15271	0.87969	
Response Amplitude	0.43213	0.16667	
Response Recovery Time	- 0.62795	0.63659	

Table 6 (xxvi) Means and Standard Deviations of Electrodermal Variables of Male and Female Subjects (90 dB Sequence)

	Male		Female	
	$\bar{x}$	σ	$\bar{x}$	σ
Normal Control Group				
Orienting Responses	4.68	3.41	3.40	2.99
Trials to Habituation	5.43	3.86	3.43	3.65
Nonspecific Responses	8.78	11.37	6.73	8.66
Skin Conductance Level	14.45	10.46	14.16	10.80
Response Latency	2.15	0.49	2.39	0.51
Response Rise Time	2.36	0.91	2.14	0.76
Response Amplitude	0.43	0.31	0.43	0.43
Response Recovery Time	3.98	2.86	5.72	4.64
Initial Response Amplitude	0.84	0.91	0.91	1.10
Response Magnitude	0.27	0.29	0.20	0.22
Nonschizophrenic Patient Group				
Orienting Responses	2.40	3.23	2.05	3.17
Trials to Habituation	2.95	4.06	2.05	3.61
Nonspecific Responses	4.08	7.70	4.68	8.73
Skin Conductance Level	9.21	8.20	11.54	10.59
Response Latency	2.23	0.70	2.36	0.64
Response Rise Time	2.29	0.55	1.95	0.48
Response Amplitude	0.20	0.40	0.09	0.21
Response Recovery Time	5.87	5.20	4.86	4.44
Initial Response Amplitude	0.37	0.95	0.13	0.40
Response Magnitude	0.10	0.24	0.06	0.18
Schizophrenic Patient Group				
Orienting Responses	3.28	3.11	3.60	3.50
Trials to Habituation	4.15	3.91	4.35	4.38
Nonspecific Responses	10.10	13.35	9.88	13.04
Skin Conductance Level	11.22	8.00	12.87	11.65
Response Latency	2.22	0.85	2.20	0.61
Response Rise Time	2.13	0.82	2.11	0.69
Response Amplitude	0.38	0.47	0.20	0.22
Response Recovery Time	3.73	3.91	4.69	4.72
Initial Response Amplitude	0.36	0.50	0.28	0.42
Response Magnitude	0.15	0.24	0.10	0.12

Table 6 (xxvii) Means and Standard Deviations of Electrodermal Variables in Schizophrenic Patient Subgroups (90 dB Sequence)

Electrodermal Variables	$\bar{x}$	σ	$\bar{x}$	σ
	Acute Patients		Chronic Patients	
	(N = 17)		(N = 23)	
Orienting Responses	3.94	3.27	3.07	3.30
Trials to Habituation	5.41	4.53	3.39	3.62
Nonspecific Responses	11.91	13.70	8.57	12.62
Skin Conductance Level	16.26	10.37	8.93	8.47
Response Latency	2.22	0.60	2.19	0.88
Response Rise Time	2.11	0.64	2.13	0.86
Response Amplitude	0.35	0.44	0.24	0.29
Response Recovery Time	2.51	0.81	5.67	5.44
Initial Response Amplitude	0.26	0.42	0.35	0.49
Response Magnitude	0.17	0.25	0.10	0.12
	Paranoid Patients		Nonparanoid Patients	
	(N = 6)		(N = 34)	
Orienting Responses	3.17	2.14	3.49	3.46
Trials to Habituation	4.00	2.68	4.29	4.33
onspecific Responses	6.42	7.74	10.62	13.74
Skin Conductance Level	7.89	3.99	12.78	10.47
Response Latency	2.78	1.34	2.11	0.56
Response Rise Time	2.33	1.32	2.07	0.57
Response Amplitude	0.44	0.42	0.26	0.35
Response Recovery Time	7.44	6.48	3.24	2.95
Initial Response Amplitude	0.72	0.69	0.24	0.36
Response Magnitude	0.14	0.13	0.13	0.20
	Institutionalised Patients		Noninstitutionalised Patients	
	(N = 26)		(N = 14)	
Orienting Responses	3.73	3.42	2.89	3.04
Trials to Habituation	4.77	4.42	3.29	3.36
Nonspecific Responses	11.29	14.07	7.57	10.90
Skin Conductance Level	12.59	10.10	11.03	9.80
Response Latency	2.09	0.57	2.56	1.05
Response Rise Time	2.08	0.55	2.19	1.04
Response Amplitude	0.32	0.40	0.23	0.28
Response Recovery Time	3.33	3.15	5.89	5.69
Initial Response Amplitude	0.32	0.51	0.31	0.35
Response Magnitude	0.15	0.22	0.08	0.10

Table 6 (xxviii) Means and Standard Deviations of Electrodermal Variables in Nonschizophrenic Patient Subgroups (90 dB Sequence)

Electrodermal Variables

	Depressed Patients (N = 31)		Nondepresssed Patients (N = 9)	
	$\bar{x}$	σ	$\bar{x}$	σ
Orienting Responses	1.90	2.95	3.33	3.81
Trials to Habituation	1.94	3.39	4.44	4.75
Nonspecific Responses	3.69	8.16	6.72	8.02
Skin Conductance Level	9.81	9.46	12.31	9.57
Response Latency	2.29	0.74	2.28	0.38
Response Rise Time	2.23	0.54	1.75	0.35
Response Amplitude	0.11	0.19	0.23	0.54
Response Recovery Time	5.35	4.68	5.41	5.38
Initial Response Amplitude	0.16	0.37	0.58	1.39
Response Magnitude	0.06	0.16	0.15	0.34

	Patients with Endogenous Depression (N = 14)		Patients with Reactive Depression (N = 17)	
	$\bar{x}$	σ	$\bar{x}$	σ
Orienting Responses	1.36	2.68	2.35	3.16
Trials to Habituation	1.14	2.71	2.59	3.81
Nonspecific Responses	1.18	2.49	5.76	10.48
Skin Conductance Level	8.10	10.20	11.22	8.87
Response Latency	2.54	0.96	2.14	0.57
Response Rise Time	2.16	0.55	2.28	0.50
Response Amplitude	0.07	0.12	0.15	0.24
Response Recovery Time	8.14	5.80	2.97	1.18
Initial Response Amplitude	0.09	0.26	0.21	0.44
Response Magnitude	0.04	0.10	0.07	0.20

Table 6 (xxix) Means and Standard Deviations of Electrodermal Variables in Patients On and Off Medication (90 dB Sequence)

Electrodermal Variables

	Off Medication		On Medication	
	$\bar{x}$	σ	$\bar{x}$	σ
Nonschizophrenic Patient Group	(N = 6)		(N = 34)	
Orienting Responses	1.17	1.94	2.41	3.32
Trials to Habituation	1.00	1.55	2.76	4.09
Nonspecific Responses	2.17	2.58	4.76	8.72
Skin Conductance Level	13.26	13.54	9.86	8.68
Response Latency	2.29	0.29	2.29	0.71
Response Rise Time	2.71	0.72	2.02	0.44
Response Amplitude	0.09	0.12	0.15	0.34
Response Recovery Time	4.04	1.40	5.53	4.99
Initial Response Amplitude	0.11	0.13	0.28	0.79
Response Magnitude	0.02	0.03	0.09	0.23
Schizophrenic Patient Group	(N = 12)		(N = 28)	
Orienting Responses	4.54	3.13	2.96	3.17
Trials to Habituation	6.25	4.14	3.39	3.84
Nonspecific Responses	13.79	14.00	8.36	12.49
Skin Conductance Level	13.12	9.05	11.59	10.36
Response Latency	2.28	0.49	2.15	0.88
Response Rise Time	2.03	0.67	2.17	0.80
Response Amplitude	0.38	0.52	0.24	0.26
Response Recovery Time	2.41	0.76	5.17	5.04
Initial Response Amplitude	0.28	0.57	0.33	0.41
Response Magnitude	0.19	0.29	0.10	0.12

Table 7 (i) Means and Standard Deviations of Closure Flexibility Scores

Subject Group	Closure Flexibility Scores	
	$\bar{x}$	σ
Normal Control Group		
Total Group	52.33	11.06
Male Subjects	55.50	9.58
Female Subjects	49.15	11.76
Nonschizophrenic Patient Group		
Total Group	39.25	8.85
Depressed Subjects	38.25	7.81
Nondepressed Subjects	42.56	11.71
Reactive Depression	39.82	7.52
Endogenous Depression	36.43	8.03
Medicated Subjects	38.38	8.43
Unmedicated Subjects	44.17	10.38
Male Subjects	38.35	7.04
Female Subjects	40.15	10.46
Schizophrenic Patient Group		
Total Group	38.33	8.90
Acute Subjects	42.88	9.32
Chronic Subjects	34.96	7.02
Paranoid Subjects	38.17	6.85
Nonparanoid Subjects	38.35	9.30
Institutionalised Subjects	33.21	5.25
Noninstitutionalised Subjects	41.08	9.31
Medicated Subjects	38.86	9.59
Unmedicated Subjects	41.75	6.06
Male Subjects	39.05	8.73
Female Subjects	37.60	9.24

Table 7 (ii) Means and Standard Deviations of Closure Flexibility Scores for Habituator Groups

Habituator Group:	Zero-Trial	Fast	Moderate	Slow
Normal Control Group				
70 dB Sequence				
$\bar{x}$	48.56	52.80	49.80	57.27
σ	15.07	10.63	10.08	7.63
90 dB Sequence				
$\bar{x}$	47.71	53.80	53.85	52.10
σ	14.55	10.90	11.41	8.63
Nonschizophrenic Patient Group				
70 dB Sequence				
$\bar{x}$	38.67	38.22	50.50	32.00
σ	7.72	8.06	11.62	6.25
90 dB Sequence				
$\bar{x}$	35.95	40.57	45.20	43.57
σ	6.91	6.45	12.72	10.44
Schizophrenic Patient Group				
70 dB Sequence				
$\bar{x}$	35.47	36.36	41.50	43.50
σ	7.02	6.53	5.97	12.44
90 dB Sequence				
$\bar{x}$	36.75	37.57	39.67	39.33
σ	8.67	12.83	7.07	8.60

Table 7 (iii) Correlations Between Closure Flexibility Scores and Electrodermal Variables

Electrodermal Variables	70 dB Sequence r	90 db Sequence r
Normal Control Group		
Orienting Responses	0.22	0.01
Trials to Habituation	0.24	0.09
Nonspecific Responses	0.12	- 0.17
Skin Conductance Level	0.12	0.15
Response Latency	- 0.10	0.13
Response Rise Time	- 0.13	0.12
Response Amplitude	0.16	0.11
Response Recovery Time	- 0.12	- 0.25
Initial Response Amplitude	0.25	0.11
Response Magnitude	0.24	- 0.01
Nonschizophrenic Patient Group		
Orienting Responses	0.15	0.25
Trials to Habituation	0.04	0.31*
Nonspecific Responses	0.25	0.28*
Skin Conductance Level	0.44**	0.50***
Response Latency	- 0.42*	0.23
Response Rise Time	- 0.23	0.05
Response Amplitude	0.37**	0.26
Response Recovery Time	0.08	0.10
Initial Response Amplitude	0.38**	0.25
Response Magnitude	0.23	0.21
Schizophrenic Patient Group		
Orienting Responses	0.18	0.13
Trials to Habituation	0.26*	0.18
Nonspecific Responses	0.19	0.12
Skin Conductance Level	0.06	0.06
Response Latency	0.11	0.03
Response Rise Time	- 0.03	- 0.01
Response Amplitude	0.31*	0.41**
Response Recovery Time	0.09	- 0.24
Initial Response Amplitude	0.43**	0.48***
Response Magnitude	0.34*	0.27*

*** $p < 0.001$ ** $p < 0.01$ * $p < 0.05$

Table 7 (iv) Correlations Between Closure Flexibility Scores, Age and Illness Factors

	Closure Flexibility Scores	Correct Scores	Incorrect Scores
	r	r	r
Normal Control Group			
Age	- 0.53***	- 0.43***	0.32*
Nonschizophrenic Patient Group			
Age	- 0.39**	- 0.52***	- 0.10
Age of Onset	- 0.35*	- 0.53***	- 0.14
No. of Admissions	- 0.16	- 0.14	0.03
Duration of Illness	- 0.13	- 0.07	0.06
Schizophrenic Patient Group			
Age	- 0.26*	- 0.27*	- 0.04
Age of Onset	0.09	0.07	- 0.04
No. of Admissions	- 0.21	- 0.23	- 0.05
Duration of Illness	- 0.39**	- 0.39**	- 0.01

*** $p < 0.001$ ** $p < 0.01$ * $p < 0.05$

Table 7 (v) Means and Standard Deviations of Correct and Incorrect Scores on the Closure Flexibility Test

	Closure Flexibility Scores			
	Correct Scores		Incorrect Scores	
	$\bar{x}$	σ	$\bar{x}$	σ
Normal Control Group				
Total Group	89.48	22.12	18.13	13.19
Male Subjects	98.90	26.19	18.05	15.01
Female Subjects	80.05	29.46	18.20	11.49
Nonschizophrenic Patient Group				
Total Group	57.33	22.29	23.05	20.12
Depressed Subjects	54.48	23.28	23.16	19.61
Nondepressed Subjects	67.11	15.87	22.67	23.06
Reactive Depression	54.00	21.82	19.06	8.82
Endogenous Depression	55.07	25.76	28.14	27.25
Medicated Subjects	55.29	20.78	23.56	21.13
Unmedicated Subjects	68.83	28.99	20.17	14.08
Male Subjects	50.50	19.90	19.05	10.64
Female Subjects	64.15	22.94	26.45	26.33
Schizophrenic Patient Group				
Total Group	55.08	24.03	22.93	10.73
Acute Subjects	65.82	29.03	21.71	8.74
Chronic Subjects	47.13	15.87	23.83	12.11
Paranoid Subjects	48.50	19.79	17.67	7.06
Nonparanoid Subjects	56.24	24.77	23.85	11.07
Institutionalised Ss.	44.71	12.78	25.86	13.64
Noninstitutionalised Ss.	60.65	26.89	21.35	8.69
Medicated Subjects	52.46	25.83	23.82	11.85
Unmedicated Subjects	61.17	18.74	20.83	7.55
Male Subjects	56.35	22.65	22.70	11.60
Female Subjects	53.80	25.86	23.15	10.09

Table 7 (vi) Means and Standard Deviations of Correct and Incorrect Scores on the Closure Flexibility Test for Hypo- and Hyper-Responding Subjects

	Hypo-Responders		Hyper-Responders	
	Correct Scores	Incorrect Scores	Correct Scores	Incorrect Scores
Normal Control Group				
70 dB Sequence				
$\bar{x}$	84.74	17.58	93.76	18.62
σ	32.47	13.34	25.77	13.37
90 dB Sequence				
$\bar{x}$	83.77	15.06	93.69	20.39
σ	32.24	8.44	27.30	15.13
Nonschizophrenic Patient Group				
70 dB Sequence				
$\bar{x}$	56.03	23.85	63.43	19.29
σ	20.67	21.64	29.99	10.64
90 dB Sequence				
$\bar{x}$	54.25	26.03	64.50	16.08
σ	19.78	21.36	27.55	10.64
Schizophrenic Patient Group				
70 dB Sequence				
$\bar{x}$	48.85	23.42	66.64	22.00
σ	15.18	10.60	32.67	11.31
90 dB Sequence				
$\bar{x}$	53.63	24.21	56.38	21.76
σ	26.78	9.60	20.32	11.46
Total Subject Group				
70 dB Sequence				
$\bar{x}$	60.63	22.18	79.67	19.86
σ	26.42	16.72	31.60	12.12
90 dB Sequence				
$\bar{x}$	61.91	22.58	73.45	19.98
σ	25.17	14.44	24.74	12.79

Table 7 (vii) Means and Standard Deviations of Correct and Incorrect Scores on the Closure Flexibility Test in Relation to Skin Conductance Level Asymmetry

	Correct Scores		Incorrect Scores	
Direction of Asymmetry:	Right>Left	Left>Right	Right>Left	Left>Right
Normal Control Group				
70 dB Sequence				
$\bar{x}$	85.46	96.93	16.92	20.36
σ	30.28	26.24	12.14	15.18
90 dB Sequence				
$\bar{x}$	82.86	97.56	17.05	19.44
σ	30.68	25.63	12.95	13.74
Nonschizophrenic Patient Group				
70 dB Sequence				
$\bar{x}$	57.33	57.32	18.33	25.07
σ	19.95	23.58	10.93	22.84
90 dB Sequence				
$\bar{x}$	59.23	56.41	19.15	24.93
σ	22.85	22.40	11.03	23.23
Schizophrenic Patient Group				
70 dB Sequence				
$\bar{x}$	54.58	54.35	22.90	23.55
σ	29.38	18.34	11.80	9.83
90 dB Sequence				
$\bar{x}$	52.70	57.45	23.45	22.40
σ	27.66	20.20	12.04	9.53

Table 7 (viii) Means and Standard Deviations of Correct and Incorrect Scores on the Closure Flexibility Test in Relation to Response Amplitude Asymmetry

	Correct Scores		Incorrect Scores	
Direction of Asymmetry:	Right>Left	Left>Right	Right>Left	Left>Right
Normal Control Group				
70 dB Sequence				
$\bar{x}$	100.39	84.40	18.06	18.80
σ	27.87	24.35	14.86	14.08
90 dB Sequence				
$\bar{x}$	97.47	86.89	19.07	16.44
σ	30.61	24.94	14.29	13.02
Nonschizophrenic Patient Group				
70 dB Sequence				
$\bar{x}$	46.88	75.14	14.88	26.29
σ	21.22	27.12	9.28	28.32
90 dB Sequence				
$\bar{x}$	52.78	72.10	19.78	24.30
σ	13.79	29.09	11.64	23.36
Schizophrenic Patient Group				
70 dB Sequence				
$\bar{x}$	60.88	55.89	25.94	24.56
σ	31.20	15.03	12.70	6.89
90 dB Sequence				
$\bar{x}$	54.61	62.60	20.78	28.60
σ	23.27	30.63	8.64	13.47

Table 7 (ix) Correlations Between Correct and Incorrect Scores on the Closure Flexibility Test and Electrodermal Variables

Electrodermal Variables	Correct Scores		Incorrect Scores	
	70 dB r	90 dB r	70 dB r	90 dB r
Normal Control Group				
Orienting Responses	0.23	0.02	0.09	0.13
Trials to Habituation	0.25	0.14	0.08	0.12
Nonspecific Responses	0.13	- 0.10	0.14	0.11
Skin Conductance Level	0.20	0.21	0.15	0.13
Response Latency	- 0.13	0.09	- 0.01	- 0.06
Response Rise Time	- 0.12	0.06	0.06	- 0.13
Response Amplitude	0.27*	0.18	0.24	0.18
Response Recovery Time	- 0.23	- 0.39**	- 0.12	- 0.23
Initial Response Amplitude	0.29*	0.12	0.06	0.03
Response Magnitude	0.23	0.04	- 0.02	0.16
Nonschizophrenic Patient Group				
Orienting Responses	0.13	0.20	- 0.07	- 0.07
Trials to Habituation	0.06	0.16	- 0.06	- 0.12
Nonspecific Response	0.26*	0.10	- 0.01	- 0.24
Skin Conductance Level	0.35**	0.43**	- 0.13	- 0.12
Response Latency	- 0.58**	0.19	- 0.05	- 0.10
Response Rise Time	- 0.43*	0.10	- 0.19	0.04
Response Amplitude	0.29*	0.19	- 0.14	- 0.12
Response Recovery Time	0.11	0.01	0.01	- 0.15
Initial Response Amplitude	0.32*	0.17	- 0.12	- 0.11
Response Magnitude	0.23	0.16	- 0.12	- 0.09
Schizophrenic Patient Group				
Orienting Responses	0.28*	0.18	0.07	0.03
Trials to Habituation	0.39**	0.19	0.09	- 0.03
Nonspecific Response	0.26*	0.15	0.10	0.07
Skin Conductance Level	0.05	0.05	0.03	0.03
Response Latency	0.20	0.14	0.26	0.33
Response Rise Time	- 0.02	0.07	0.01	0.17
Response Amplitude	0.32*	0.39**	0.04	- 0.03
Response Recovery Time	- 0.03	- 0.15	- 0.25	0.12
Initial Response Amplitude	0.41**	0.54***	- 0.04	0.13
Response Magnitude	0.32*	0.26	- 0.04	- 0.01

*** $p < 0.001$ ** $p < 0.01$ * $p < 0.05$

Table 8 (i) Means and Standard Deviations of Reading Times For Parts I and IV of the Stroop Colour-Word Test

	Reading Times			
	Part I		Part IV	
	$\bar{x}$	σ	$\bar{x}$	σ
Normal Control Group				
Total Group	41.80	7.06	42.66	8.95
Male Subjects	41.93	7.05	43.33	9.47
Female Subjects	41.68	7.25	42.10	8.62
Nonschizophrenic Patient Group				
Total Group	51.53	12.88	52.65	16.46
Depressed Subjects	53.71	12.55	52.68	16.35
Nondepressed Subjects	44.00	11.64	46.72	21.91
Reactive Depression	53.15	13.43	54.41	18.88
Endogenous Depression	54.39	11.85	50.57	13.06
Medicated Subjects	52.63	13.27	53.38	16.92
Unmedicated Subjects	45.25	8.72	48.67	14.29
Male Subjects	54.80	14.13	55.78	19.08
Female Subjects	48.25	10.86	49.37	12.86
Schizophrenic Patient Group				
Total Group	54.33	16.90	56.55	21.31
Acute Subjects	45.94	8.94	46.12	7.58
Chronic Subjects	60.52	18.80	64.26	24.84
Paranoid Subjects	57.00	9.68	55.59	21.89
Nonparanoid Subjects	53.85	17.94	62.00	18.35
Institutionalised Ss.	60.57	20.26	52.04	15.40
Noninstitutionalised Ss.	50.96	14.08	64.93	28.11
Medicated Subjects	58.50	18.08	61.61	23.36
Unmedicated Subjects	44.58	7.86	44.75	7.30
Male Subjects	53.40	16.46	54.90	18.27
Female Subjects	55.25	17.70	58.20	24.35

Table 8 (ii) Means and Standard Deviations of Stroop Interference Scores

	Stroop Interference Scores	
	$\bar{x}$	σ
Normal Control Group		
Total Group	- 0.29	18.61
Male Subjects	- 3.39	15.64
Female Subjects	2.81	21.13
Nonschizophrenic Patient Group		
Total Group	0.88	55.52
Depressed Subjects	2.84	57.97
Nondepressed Subjects	- 5.90	48.54
Reactive Depression	4.41	75.28
Endogenous Depression	0.93	27.80
Medicated Subjects	3.97	57.40
Unmedicated Subjects	- 16.64	43.10
Male Subjects	7.61	69.33
Female Subjects	- 5.86	37.74
Schizophrenic Patient Group		
Total Group	- 0.00	37.33
Acute Subjects	- 8.53	26.34
Chronic Subjects	6.31	43.22
Paranoid Subjects	- 4.48	28.53
Nonparanoid subjects	0.79	39.98
Institutionalised Subjects	12.10	51.58
Noninstitutionalised Subjects	- 6.52	25.78
Medicated Subjects	3.30	41.52
Unmedicated Subjects	- 7.69	24.84
Male Subjects	2.27	31.79
Female Subjects	- 2.27	42.89

Table 8 (iii) Means and Standard Deviations of Stroop Interference Scores for Habituator Groups

Habituator Group:	Zero-Trial	Fast	Moderate	Slow
Normal Control Group				
70 dB Sequence				
$\bar{x}$	11.26	- 0.07	- 5.85	- 5.01
σ	25.13	19.59	12.60	13.50
90 dB Sequence				
$\bar{x}$	12.97	- 3.97	- 2.36	- 3.20
σ	23.69	17.95	20.33	9.31
Nonschizophrenic Patient Group				
70 dB Sequence				
$\bar{x}$	- 4.72	13.43	- 11.04	23.87
σ	48.66	81.11	12.09	64.63
90 dB Sequence				
$\bar{x}$	- 11.13	14.71	21.96	7.98
σ	45.67	43.22	48.81	92.01
Schizophrenic Patient Group				
70 dB Sequence				
$\bar{x}$	11.53	16.14	- 11.89	- 30.28
σ	43.26	30.71	18.00	18.75
90 dB Sequence				
$\bar{x}$	18.86	10.97	- 13.06	- 15.46
σ	48.86	31.26	19.41	29.69

Table 8 (iv) Correlation Between Stroop Interference Scores and Electrodermal Variables

Electrodermal Variables	70 dB Sequence r	90 db Sequence r
Normal Control Group		
Orienting Responses	- 0.23	- 0.17
Trials to Habituation	- 0.26	- 0.13
Nonspecific Responses	- 0.13	0.01
Skin Conductance Level	- 0.23	- 0.21
Response Latency	- 0.22	- 0.25
Response Rise Time	- 0.48**	- 0.26
Response Amplitude	- 0.29*	- 0.31*
Response Recovery Time	0.12	0.06
Initial Response Amplitude	- 0.28*	- 0.30*
Response Magnitude	- 0.20	- 0.17
Nonschizophrenic Patient Group		
Orienting Responses	0.09	0.14
Trials to Habituation	0.06	0.10
Nonspecific Responses	0.10	0.09
Skin Conductance Level	0.08	0.09
Response Latency	0.16	- 0.18
Response Rise Time	0.39	- 0.11
Response Amplitude	- 0.03	- 0.04
Response Recovery Time	- 0.04	- 0.17
Initial Response Amplitude	- 0.12	- 0.08
Response Magnitude	- 0.04	- 0.10
Schizophrenic Patient Group		
Orienting Responses	- 0.45**	- 0.36**
Trials to Habituation	- 0.43**	- 0.38**
Nonspecific Responses	- 0.24	- 0.28
Skin Conductance Level	- 0.20	- 0.21
Response Latency	0.15	0.16
Response Rise Time	0.11	0.21
Response Amplitude	- 0.24*	- 0.35*
Response Recovery Time	0.11	0.23
Initial Response Amplitude	- 0.26*	- 0.30*
Response Magnitude	- 0.30*	- 0.43**

*** $p < 0.001$ ** $p < 0.01$ * $p < 0.05$

Table 8 (v) Means and Standard Deviations of Reading Times For Parts II and III and Error Scores for Part III of the Stroop Colour-Word Test

	Reading Times				Error Scores	
	Part II		Part III		Part III	
	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ
Normal Control Group						
Total Group	68.31	16.23	111.36	3.06	1.70	2.24
Male Subjects	71.38	17.49	110.63	22.62	1.75	2.47
Female Subjects	65.25	14.66	112.10	24.05	1.65	2.06
Nonschizophrenic Patient Group						
Total Group	82.00	22.36	170.01	76.24	5.93	7.64
Depressed Subjects	67.33	16.53	184.73	80.04	7.07	8.28
Nondepressed Subjects	83.36	22.22	119.33	24.22	2.00	2.24
Reactive Depression	80.53	25.92	183.35	101.78	8.47	9.95
Endogenous Depression	86.79	17.66	186.39	45.02	5.34	5.57
Medicated Subjects	83.42	21.39	176.49	80.08	6.41	8.01
Unmedicated Subjects	74.00	28.59	133.33	33.34	3.17	4.54
Male Subjects	91.50	25.60	201.35	92.49	9.10	9.37
Female Subjects	72.50	13.44	138.68	36.20	2.75	3.28
Schizophrenic Patient Group						
Total Group	99.33	32.56	187.78	69.46	5.38	6.93
Acute Subjects	87.35	25.33	159.44	49.07	4.94	5.96
Chronic Subjects	108.17	34.93	210.94	74.04	5.70	7.69
Paranoid Subjects	124.83	48.11	229.17	108.16	7.83	11.60
Nonparanoid Subjects	94.82	27.62	180.47	59.69	4.94	5.93
Institutionalised Ss	96.92	36.80	208.68	58.16	5.86	7.05
Noninstitution. Ss	103.79	23.31	176.52	73.42	5.12	7.00
Medicated Subjects	105.93	34.97	203.48	75.49	6.29	7.65
Unmedicated Subjects	83.92	19.68	151.13	31.98	3.25	4.43
Male Subjects	94.60	26.66	181.60	59.89	4.95	5.31
Female Subjects	104.05	37.66	193.95	78.96	5.80	8.38

Table 9 (i) Means and Standard Deviations of Schematising Test Scores

	Schematising Test Scores			
	Ranking Accuracy Score		Incremental Error Score	
	$\bar{x}$	σ	$\bar{x}$	σ
Normal Control Group				
Total Group	0.65	0.18	0.30	0.20
Male Subjects	0.65	0.20	0.27	0.16
Female Subjects	0.65	0.16	0.32	0.24
Nonschizophrenic Patient Group				
Total Group	0.58	0.21	0.33	0.32
Depressed Subjects	0.57	0.20	0.35	0.35
Nondepressed Subjects	0.60	0.24	0.26	0.22
Reactive Depression	0.60	0.14	0.30	0.21
Endogenous Depression	0.53	0.26	0.40	0.47
Medicated Subjects	0.32	0.18	0.33	0.34
Unmedicated Subjects	0.56	0.16	0.32	0.18
Male Subjects	0.59	0.22	0.40	0.42
Female Subjects	0.57	0.20	0.26	0.17
Schizophrenic Patient Group				
Total Group	0.56	0.18	0.31	0.16
Acute Subjects	0.56	0.20	0.30	0.13
Chronic Subjects	0.57	0.17	0.31	0.17
Paranoid Subjects	0.53	0.21	0.30	0.20
Nonparanoid Subjects	0.57	0.17	0.31	0.15
Institutionalised Subjects	0.57	0.19	0.35	0.18
Noninstitutionalised Subjects	0.56	0.18	0.28	0.14
Medicated Subjects	0.57	0.17	0.31	0.15
Unmedicated Subjects	0.55	0.19	0.30	0.17
Male Subjects	0.56	0.20	0.31	0.17
Female Subjects	0.57	0.16	0.31	0.14

Table 9 (ii) Means and Standard Deviations of Schematising Test Scores for Habituator Groups

Habituator Groups:		Zero-Trial	Fast	Moderate	Slow
Ranking Accuracy Scores					
Normal Control Group					
70 dB	$\bar{x}$	0.67	0.62	0.60	0.70
	σ	0.18	0.14	0.21	0.20
90 dB	$\bar{x}$	0.72	0.61	0.63	0.66
	σ	0.13	0.20	0.15	0.23
Nonschizophrenic Patient Group					
70 dB	$\bar{x}$	0.58	0.58	0.62	0.52
	σ	0.18	0.27	0.24	0.27
90 dB	$\bar{x}$	0.54	0.64	0.62	0.59
	σ	0.21	0.22	0.17	0.23
Schizophrenic Patient Group					
70 dB	$\bar{x}$	0.55	0.60	0.53	0.56
	σ	0.17	0.21	0.10	0.19
90 dB	$\bar{x}$	0.61	0.59	0.48	0.57
	σ	0.19	0.16	0.23	0.13
Incremental Error Score					
Normal Control Group					
70 dB	$\bar{x}$	0.33	0.31	0.27	0.27
	σ	0.27	0.22	0.17	0.18
90 dB	$\bar{x}$	0.35	0.24	0.32	0.28
	σ	0.29	0.20	0.21	0.13
Nonschizophrenic Patient Group					
70 dB	$\bar{x}$	0.29	0.45	0.36	0.19
	σ	0.21	0.58	0.09	0.13
90 dB	$\bar{x}$	0.38	0.32	0.35	0.18
	σ	0.41	0.18	0.20	0.09
Schizophrenic Patient Group					
70 dB	$\bar{x}$	0.29	0.38	0.29	0.26
	σ	0.14	0.19	0.20	0.10
90 dB	$\bar{x}$	0.23	0.33	0.38	0.31
	σ	0.12	0.16	0.22	0.13

Table 9 (iii) Correlation Between Schematising Test Scores and Electrodermal Variables

Electrodermal Variables	Ranking Accuracy 70 dB r	Ranking Accuracy 90 dB r	Incremental Error 70 dB r	Incremental Error 90 dB r
Normal Control Group				
Orienting Responses	0.14	0.04	- 0.01	0.01
Trials to Habituation	0.15	0.03	- 0.02	- 0.03
Nonspecific Responses	0.22	- 0.02	- 0.14	0.03
Skin Conductance Level	0.07	0.06	- 0.11	- 0.15
Response Latency	0.29	0.22	0.07	0.05
Response Rise Time	0.03	0.14	0.29	- 0.09
Response Amplitude	0.11	0.06	- 0.03	- 0.11
Response Recovery Time	- 0.04	- 0.21	- 0.16	- 0.03
Initial Response Amplitude	0.28*	0.11	- 0.13	- 0.04
Response Magnitude	0.24	0.04	- 0.09	- 0.06
Nonschizophrenic Patient Group				
Orienting Responses	0.14	0.07	- 0.01	- 0.16
Trials to Habituation	0.07	0.15	0.02	- 0.14
Nonspecific Responses	0.11	0.19	- 0.17	- 0.24
Skin Conductance Level	0.36**	0.31*	- 0.24	- 0.20
Response Latency	0.12	0.21	0.43*	0.04
Response Rise Time	0.08	- 0.03	0.74***	0.51**
Response Amplitude	0.11	0.22	- 0.06	- 0.18
Response Recovery Time	0.02	- 0.20	0.54***	0.01
Initial Response Amplitude	0.09	0.21	- 0.07	- 0.14
Response Magnitude	0.12	0.17	- 0.20	- 0.18
Schizophrenic Patient Group				
Orienting Responses	- 0.02	- 0.07	0.11	0.21
Trials to Habituation	0.08	- 0.10	- 0.04	0.22
Nonspecific Responses	- 0.11	- 0.14	0.20	0.26*
Skin Conductance Level	- 0.09	- 0.13	0.05	0.02
Response Latency	0.28	0.23	- 0.13	- 0.08
Response Rise Time	0.24	0.28	- 0.09	- 0.10
Response Amplitude	0.17	0.12	- 0.04	- 0.15
Response Recovery Time	0.09	0.10	- 0.26	- 0.07
Initial Response Amplitude	0.13	0.24	- 0.21	- 0.09
Response Magnitude	0.15	0.08	- 0.19	- 0.11

*** $p < 0.001$ ** $p < 0.01$ * $p < 0.05$

Table 10 (i) Means and Standard Deviations of Size Estimation Scores

	Size Estimation (Error) Scores			
	$\bar{x}$	σ	minimum	maximum
Normal Control Group				
Total Group	3.52	3.15	- 4.25	11.25
Male Subjects	2.82	2.96	- 4.25	6.67
Female Subjects	4.21	3.26	- 1.46	11.58
Nonschizophrenic Patient Group				
Total Group	2.44	3.16	- 3.00	11.38
Depressed Subjects	2.73	3.43	- 3.00	11.38
Nondepressed Subjects	1.43	1.74	- 1.50	3.75
Reactive Depression	2.60	3.68	- 1.83	11.38
Endogenous Depression	2.88	3.23	- 3.00	10.42
Medicated Subjects	2.46	3.24	- 3.00	11.38
Unmedicated Subjects	2.34	2.93	- 0.58	7.88
Male Subjects	3.30	3.69	- 1.75	11.38
Female Subjects	1.58	2.30	- 3.00	6.58
Schizophrenic Patient Group				
Total Group	1.38	3.13	- 7.58	9.92
Acute Subjects	2.27	3.53	- 2.42	9.92
Chronic Subjects	0.89	2.74	- 7.58	5.46
Paranoid Subjects	1.09	1.00	0.00	2.46
Nonparanoid Subjects	1.54	3.38	- 7.58	9.92
Institutionalised Ss.	1.05	1.57	- 1.96	3.92
Noninstitutionalised Ss.	1.71	3.72	- 7.58	9.92
Medicated Subjects	1.54	2.29	- 1.96	7.38
Unmedicated Subjects	1.34	4.67	- 7.58	9.92
Male Subjects	2.01	3.25	- 2.42	9.92
Female Subjects	0.95	2.99	- 7.58	7.42

Table 10 (ii) Means and Standard Deviations of Size Estimation Scores for Habituator Groups

Habituator Group:	Zero-Trial	Fast	Moderate	Slow
Normal Control Group				
70 dB Sequence				
$\bar{x}$	3.25	3.68	3.84	3.29
σ	3.70	3.68	2.40	3.19
90 dB Sequence				
$\bar{x}$	2.93	3.17	3.89	3.78
σ	5.10	2.67	2.62	2.96
Nonschizophrenic Patient Group				
70 dB Sequence				
$\bar{x}$	2.16	3.14	0.53	5.07
σ	2.86	3.36	1.65	5.51
90 dB Sequence				
$\bar{x}$	2.89	1.89	3.69	0.73
σ	2.79	4.00	4.73	1.53
Schizophrenic Patient Group				
70 dB Sequence				
$\bar{x}$	0.53	1.87	3.99	1.46
σ	3.55	2.11	4.66	2.50
90 dB Sequence				
$\bar{x}$	0.52	2.26	2.48	1.23
σ	2.78	2.28	1.97	4.37

Table 10 (iii) Correlations Between Size Estimation Scores and Electrodermal Variables

Electrodermal Variables	70 dB Sequence r	90 dB Sequence r
Normal Control Group		
Orienting Responses	0.09	0.17
Trials to Habituation	0.09	0.10
Nonspecific Responses	- 0.05	0.03
Skin Conductance Level	- 0.12	- 0.15
Response Latency	- 0.03	- 0.50**
Response Rise Time	0.02	- 0.05
Response Amplitude	0.20	0.10
Response Recovery Time	0.06	0.13
Initial Response Amplitude	- 0.07	0.16
Response Magnitude	0.01	0.16
Nonschizophrenic Patient Group		
Orienting Responses	- 0.07	- 0.14
Trials to Habituation	0.01	- 0.21
Nonspecific Responses	- 0.09	- 0.20
Skin Conductance Level	- 0.16	- 0.17
Response Latency	- 0.13	- 0.19
Response Rise Time	- 0.12	0.08
Response Amplitude	- 0.11	- 0.14
Response Recovery Time	0.12	0.22
Initial Response Amplitude	- 0.15	- 0.14
Response Magnitude	- 0.13	- 0.16
Schizophrenic Patient Group		
Orienting Responses	0.15	0.08
Trials to Habituation	0.14	0.11
Nonspecific Responses	0.19	0.27*
Skin Conductance Level	0.04	0.10
Response Latency	- 0.33	- 0.13
Response Rise Time	- 0.46**	- 0.22
Response Amplitude	- 0.08	0.01
Response Recovery Time	- 0.14	0.01
Initial Response Amplitude	- 0.07	0.07
Response Magnitude	- 0.07	- 0.03

*** $p < 0.001$ ** $p < 0.01$ * $p < 0.05$

Table 11 (i) Means and Standard Deviations of Petrie Kinesthetic Figural After-Effect (KFA) Scores

	Petrie KFA Scores	
	$\bar{x}$	σ
Normal Control Group		
Total Group	- 0.81	1.66
Male Subjects	- 0.93	1.54
Female Subjects	- 0.69	1.80
Nonschizophrenic Patient Group		
Total Group	- 1.13	1.75
Depressed Subjects	- 1.21	1.89
Nondepressed Subjects	- 0.85	1.20
Reactive Depression	- 1.61	1.79
Endogenous Depression	- 0.73	1.96
Medicated Subjects	- 1.28	1.72
Unmedicated Subjects	- 0.31	1.49
Male Subjects	- 1.27	2.00
Female Subjects	- 1.00	1.50
Schizophrenic Patient Group		
Total Group	- 1.00	1.54
Acute Subjects	- 1.22	1.50
Chronic Subjects	- 0.83	1.58
Paranoid Subjects	- 1.43	2.09
Nonparanoid Subjects	- 0.92	1.44
Institutionalised Ss.	- 0.82	1.55
Noninstitutionalised Ss.	- 1.09	1.55
Medicated Subjects	- 1.02	1.35
Unmedicated Subjects	- 0.93	1.98
Male Subjects	- 1.02	1.75
Female Subjects	- 1.00	1.34

Table 11 (ii) Means and Standard Deviations of Petrie KFA Test Scores for Habituator Groups

Habituator Group:	Zero-Trial	Fast	Moderate	Slow
Normal Control Group				
70 dB Sequence				
$\bar{x}$	- 0.87	- 1.69	- 0.72	- 0.04
σ	1.75	1.87	1.26	1.50
90 dB Sequence				
$\bar{x}$	- 1.66	- 0.50	- 1.22	0.01
σ	2.17	1.69	1.26	1.48
Nonschizophrenic Patient Group				
70 dB Sequence				
$\bar{x}$	- 1.23	- 0.42	- 1.54	- 1.99
σ	1.96	1.02	2.01	1.29
90 dB Sequence				
$\bar{x}$	- 1.03	- 0.98	- 0.87	- 1.77
σ	2.06	1.48	1.40	1.33
Schizophrenic Patient Group				
70 dB Sequence				
$\bar{x}$	- 0.78	- 0.97	- 1.39	- 1.19
σ	1.64	1.92	0.63	1.28
90 dB Sequence				
$\bar{x}$	- 0.92	- 1.23	- 0.85	- 1.04
σ	1.35	2.12	1.60	1.47

Table 11 (iii) Correlations Between Petrie Kinesthetic After-Effect Scores and Electrodermal Variables

Electrodermal Variables	70 dB Sequence r	90 db Sequence r
Normal Control Group		
Orienting Responses	0.20	0.05
Trials to Habituation	0.22	0.16
Nonspecific Responses	0.17	0.12
Skin Conductance Level	0.03	0.08
Response Latency	0.05	0.12
Response Rise Time	- 0.02	0.10
Response Amplitude	- 0.01	0.01
Response Recovery Time	- 0.01	0.05
Initial Response Amplitude	0.03	0.12
Response Magnitude	0.14	0.01
Nonschizophrenic Patient Group		
Orienting Responses	- 0.09	- 0.17
Trials to Habituation	- 0.01	- 0.15
Nonspecific Responses	- 0.05	- 0.04
Skin Conductance Level	- 0.11	- 0.04
Response Latency	0.02	0.11
Response Rise Time	0.32	0.19
Response Amplitude	0.03	- 0.03
Response Recovery Time	0.08	- 0.27
Initial Response Amplitude	0.11	- 0.01
Response Magnitude	- 0.07	- 0.03
Schizophrenic Patient Group		
Orienting Responses	0.01	0.01
Trials to Habituation	- 0.13	- 0.01
Nonspecific Responses	0.02	0.06
Skin Conductance Level	0.10	0.05
Response Latency	- 0.25	- 0.18
Response Rise Time	- 0.28	- 0.22
Response Amplitude	0.02	- 0.03
Response Recovery Time	- 0.27	- 0.36*
Initial Response Amplitude	0.13	- 0.04
Response Magnitude	0.18	0.08

*** $p < 0.001$ ** $p < 0.01$ * $p < 0.05$

Table 11 (iv) Means and Standard Deviations of Electrodermal Variables for Augmenters and Reducers on the Patrie KFA Test (70 dB Sequence)

Electrodermal Variables	Reducers		Augmenters	
	$\bar{x}$	σ	$\bar{x}$	σ
Normal Control Group				
Orienting Responses	4.30	3.89	5.75	8.13
Trials to Habituation	4.30	5.72	7.50	10.61
Nonspecific Responses	15.00	16.55	18.50	20.51
Skin Conductance Level	12.86	8.12	13.07	0.40
Response Latency	2.14	0.13	2.30	0.00
Response Rise Time	2.31	0.16	3.31	0.00
Response Amplitude	0.45	0.51	0.14	0.20
Response Recovery Time	2.54	1.35	5.25	0
Initial Response Amplitude	0.66	0.15	0.24	0.33
Response Magnitude	0.12	0.16	0.29	0.37
Nonschizophrenic Patient Group				
Orienting Responses	3.22	4.41	0	0
Trials to Habituation	3.07	5.50	0	0
Nonspecific Response	8.00	10.69	0	0
Skin Conductance Level	9.21	7.03	1.96	0
Response Latency	2.30	1.19		
Response Rise Time	2.05	0.36		
Response Amplitude	0.11	0.14	0	0
Response Recovery Time	5.94	4.66		
Initial Response Amplitude	0.08	0.13	0	0
Response Magnitude	0.50	0.10	0	0
Schizophrenic Patient Group				
Orienting Responses	3.67	3.44	0	0
Trials to Habituation	4.04	4.81	0	0
Nonspecific Response	13.21	14.81	1.00	0
Skin Conductance Level	10.28	0.47	16.96	0
Response Latency	2.76	0.22		
Response Rise Time	2.55	1.15		
Response Amplitude	0.13	0.20	0	0
Response Recovery Time	4.92	4.60		
Initial Response Amplitude	0.22	0.40	0	0
Response Magnitude	0.07	0.12	0	0

Table 11 (v) Means and Standard Deviations of Electrodermal Variables for Augmenters and Reducers on the Petrie KFA Test (90 dB Sequence)

Electrodermal Variables	Reducers		Augmenters	
	$\bar{x}$	σ	$\bar{x}$	σ
Normal Control Group				
Orienting Responses	3.80	2.98	5.50	4.95
Trials to Habituation	3.70	3.24	5.50	6.37
Nonspecific Responses	6.35	8.83	7.50	8.49
Skin Conductance Level	13.98	8.70	16.92	0.86
Response Latency	1.97	0.27	2.35	0.04
Response Rise Time	2.01	0.47	2.83	0.21
Response Amplitude	0.52	0.40	0.38	0.02
Response Recovery Time	3.29	1.53	6.34	2.83
Initial Response Amplitude	0.97	1.18	0.90	0
Response Magnitude	0.29	0.37	0.21	0.20
Nonschizophrenic Patient Group				
Orienting Responses	2.65	3.48	0	0
Trials to Habituation	2.86	4.13	0	0
Nonspecific Response	3.61	5.16	0	0
Skin Conductance Level	10.86	9.54	1.78	0
Response Latency	2.15	0.78		
Response Rise Time	2.07	0.50		
Response Amplitude	0.12	0.14	0	0
Response Recovery Time	7.40	5.66		
Initial Response Amplitude	0.18	0.30	0	0
Response Magnitude	0.06	0.11	0	0
Schizophrenic Patient Group				
Orienting Responses	3.25	3.23	1.00	0
Trials to Habituation	4.09	4.12	1.00	0
Nonspecific Response	8.13	9.45	2.50	0
Skin Conductance Level	12.30	11.43	18.02	0
Response Latency	2.57	0.88		
Response Rise Time	2.40	0.95		
Response Amplitude	0.24	0.32	0	0
Response Recovery Time	6.04	5.52		
Initial Response Amplitude	0.31	0.48	0	0
Response Magnitude	0.08	0.08	0	0

Table 11 (vi) Means and Standard Deviations of Electrodermal Variables for Moderates on the Petrie KFA Test (70 and 90 dB Sequences)

Electrodermal Variables	70 dB Sequence		90 dB Sequence	
	$\bar{x}$	σ	$\bar{x}$	σ
Normal Control Group				
Orienting Responses	4.69	4.34	4.09	3.34
Trials to Habituation	5.13	5.58	4.61	4.00
Nonspecific Responses	13.10	17.74	8.27	10.74
Skin Conductance Level	12.35	8.44	14.24	11.35
Response Latency	2.34	0.58	2.36	0.56
Response Rise Time	2.00	0.67	2.30	0.95
Response Amplitude	0.24	0.23	0.40	0.38
Response Recovery Time	5.68	4.77	5.15	0.55
Initial Response Amplitude	0.45	0.61	0.84	0.91
Response Magnitude	0.11	0.14	0.22	0.22
Nonschizophrenic Patient Group				
Orienting Responses	2.28	3.49	2.08	3.07
Trials to Habituation	1.48	3.22	2.40	3.76
Nonspecific Response	8.38	15.95	4.98	9.57
Skin Conductance Level	8.19	6.33	10.45	9.58
Response Latency	2.23	0.49	2.40	0.56
Response Rise Time	2.27	0.96	2.17	0.58
Response Amplitude	0.14	0.26	0.16	0.37
Response Recovery Time	3.97	4.08	4.08	3.75
Initial Response Amplitude	0.19	0.43	0.31	0.90
Response Magnitude	0.06	0.30	0.09	0.26
Schizophrenic Patient Group				
Orienting Responses	5.30	4.84	3.61	3.38
Trials to Habituation	4.41	6.09	4.45	4.19
Nonspecific Response	20.22	24.84	11.10	14.55
Skin Conductance Level	11.43	11.78	11.72	9.50
Response Latency	2.17	0.54	2.02	0.56
Response Rise Time	1.89	0.62	1.99	0.62
Response Amplitude	0.20	0.35	0.31	0.39
Response Recovery Time	3.30	3.08	3.25	3.23
Initial Response Amplitude	0.30	0.58	0.33	0.46
Response Magnitude	0.15	0.32	0.16	0.22

Table 12 (i) Means and Standard Deviations of Object Sorting Scores

	Object Sorting Scores			
	Number of Object Sorting Categories		Category Abstractness Score	
	$\bar{x}$	σ	$\bar{x}$	σ
Normal Control Group				
Total Group	13.20	5.18	1.55	0.38
Male Subjects	13.70	5.75	1.55	0.48
Female Subjects	12.70	4.64	1.55	0.26
Nonschizophrenic Patient Group				
Total Group	18.64	9.44	1.26	0.50
Depressed Subjects	19.67	9.85	1.24	0.53
Nondepressed Subjects	15.22	7.40	1.32	0.43
Reactive Depression	20.56	10.38	1.18	0.56
Endogenous Depression	18.64	9.49	1.31	0.50
Medicated Subjects	18.64	9.93	1.26	0.52
Unmedicated Subjects	18.67	6.86	1.24	0.42
Male Subjects	10.80	10.85	1.24	0.56
Female Subjects	16.37	7.31	1.28	0.45
Schizophrenic Patient Group				
Total Group	22.70	9.86	1.05	0.44
Acute Subjects	17.82	9.44	1.22	0.42
Chronic Subjects	26.30	8.69	0.92	0.43
Paranoid Subjects	26.00	9.01	0.93	0.29
Nonparanoid Subjects	22.12	10.01	1.07	0.47
Institutionalised Ss.	29.21	7.37	0.83	0.41
Noninstitutionalised Ss.	19.19	9.32	1.16	0.43
Medicated Subjects	24.86	9.43	1.01	0.49
Unmedicated Subjects	17.67	9.33	1.13	0.33
Male Subjects	23.10	8.84	1.00	0.35
Female Subjects	22.30	11.00	1.14	0.52

Table 12 (ii) Means and Standard Deviations of Object Sorting Scores for Habituator Groups

Habituator Group:		Zero-Trial	Fast	Moderate	Slow
Number of Object Catgories					
Normal Control Group					
70 dB	$\bar{x}$	15.11	12.70	10.60	14.46
	σ	5.49	6.90	4.62	2.54
90 dB	$\bar{x}$	18.57	12.10	10.62	13.90
	σ	6.68	3.28	4.59	3.70
Nonschizophrenic Patient Group					
70 dB	$\bar{x}$	18.08	17.75	18.75	25.33
	σ	10.23	7.96	8.10	9.87
90 dB	$\bar{x}$	19.71	17.00	19.00	16.57
	σ	9.16	13.61	7.11	9.25
Schizophrenic Patient Group					
70 dB	$\bar{x}$	23.53	25.56	26.50	16.80
	σ	8.35	10.50	10.34	9.93
90 dB	$\bar{x}$	24.17	23.71	24.67	19.17
	σ	9.54	8.28	9.98	11.14
Category Abstractness Score					
Normal Control Group					
70 dB	$\bar{x}$	1.38	1.67	1.65	1.47
	σ	0.21	0.60	0.30	0.24
90 dB	$\bar{x}$	1.34	1.45	1.82	1.46
	σ	0.33	0.26	0.47	0.22
Nonschizophrenic Patient Group					
70 dB	$\bar{x}$	1.31	1.14	1.21	1.26
	σ	0.53	0.41	0.46	0.81
90 dB	$\bar{x}$	1.16	1.59	1.14	1.36
	σ	0.44	0.68	0.53	0.49
Schizophrenic Patient Group					
70 dB	$\bar{x}$	1.05	0.95	0.72	1.27
	σ	0.48	0.35	0.41	0.43
90 dB	$\bar{x}$	1.00	1.06	0.86	1.22
	σ	0.51	0.23	0.37	0.50

Table 12 (iii) Correlations Between Object Sorting Scores and Electrodermal Variables

Electrodermal Variables	Number of Object Sorting Categories		Category Abstractness	
	70 dB	90 db	70 dB	90 dB
	r	r	r	r
Normal Control Group				
Orienting Responses	0.02	- 0.10	0.11	0.15
Trials to Habituation	0.04	- 0.16	0.13	0.18
Nonspecific Responses	- 0.05	0.02	0.16	0.07
Skin Conductance Level	- 0.38**	- 0.41	0.42**	0.40**
Response Latency	0.03	- 0.02	0.14	0.06
Response Rise Time	0.01	0.11	0.12	- 0.09
Response Amplitude	- 0.17	0.02	0.31*	0.04
Response Recovery Time	0.04	0.10	- 0.26	0.03
Initial Response Amplitude	0.05	0.05	0.30	0.01
Response Magnitude	0.21	0.10	0.11	- 0.03
Nonschizophrenic Patient Group				
Orienting Responses	0.03	- 0.08	- 0.02	0.08
Trials to Habituation	0.13	- 0.09	- 0.11	0.08
Nonspecific Responses	- 0.12	- 0.22	0.07	0.13
Skin Conductance Level	- 0.10	- 0.08	0.23	0.23
Response Latency	0.21	- 0.14	- 0.04	0.33
Response Rise Time	0.09	0.04	0.17	0.25
Response Amplitude	- 0.06	- 0.16	0.11	0.16
Response Recovery Time	- 0.03	- 0.32	0.13	- 0.12
Initial Response Amplitude	- 0.09	- 0.13	- 0.10	0.16
Response Magnitude	- 0.04	- 0.11	0.01	0.12
Schizophrenic Patient Group				
Orienting Responses	- 0.20	- 0.26	0.24	0.17*
Trials to Habituation	- 0.16	- 0.24	0.15	0.26
Nonspecific Responses	- 0.14	- 0.09	0.10	0.11
Skin Conductance Level	- 0.32*	- 0.29*	0.28*	0.23
Response Latency	0.15	0.29	- 0.13	- 0.29
Response Rise Time	0.05	0.08	- 0.01	- 0.02
Response Amplitude	- 0.17	- 0.31*	0.28*	0.29
Response Recovery Time	0.04	0.34*	- 0.12	- 0.16
Initial Response Amplitude	- 0.38**	- 0.20	0.30	0.17
Response Magnitude	- 0.31*	- 0.35**	0.27*	0.34*

*** $p < 0.001$ ** $p < 0.01$ * $p < 0.05$

Table 14 (i) Between-Session Correlations for Electrodermal Response Variables

Electrodermal Variables	70 dB Sequence r	90 dB Sequence r
Orienting Responses	0.29 *	0.12
Trials to Habituation	0.51***	0.04
Nonspecific Responses	0.16	0.28*
Skin Conductance Level	0.72***	0.72***
Response Latency	0.08	0.26
Response Rise Time	0.41*	0.24
Reponse Amplitude	0.41**	0.30*
Response Recovery Time	- 0.21	0.37*
Initial Response Amplitude	0.66***	0.46**
Response Magnitude	0.48***	0.50***

*** $p < 0.001$ ** $p < 0.01$ $p < 0.05$

Table 14 (ii) Correlations Between Closure Flexibility Scores and Electrodermal Response Variables

Electrodermal Variables	70 dB Sequence r	90 dB Sequence r
Session 1		
Orienting Responses	- 0.09	- 0.24
Trials to Habituation	- 0.08	- 0.15
Nonspecific Responses	- 0.02	- 0.30*
Skin Conductance Level	- 0.01	0.06
Response Latency	0.06	0.05
Response Rise Time	- 0.04	0.06
Reponse Amplitude	0.15	- 0.02
Response Recovery Time	0.01	- 0.10
Initial Response Amplitude	0.11	- 0.06
Response Magnitude	- 0.02	- 0.28
Session 2		
Orienting Responses	- 0.06	- 0.11
Trials to Habituation	- 0.03	- 0.18
Nonspecific Responses	- 0.01	- 0.29*
Skin Conductance Level	0.06	- 0.05
Response Latency	0.29	0.01
Response Rise Time	- 0.14	- 0.06
Reponse Amplitude	0.15	- 0.20
Response Recovery Time	- 0.14	- 0.20
Initial Response Amplitude	0.20	- 0.03
Response Magnitude	0.21	- 0.04

*** $p < 0.001$ ** $p < 0.01$ * $p < 0.05$

Table 14 (iii) Correlations Between Stroop Interference Scores and Electrodermal Response Variables

Electrodermal Variables	70 dB Sequence r	90 dB Sequence r
Session 1		
Orienting Responses	- 0.03	- 0.06
Trials to Habituation	- 0.11	- 0.07
Nonspecific Responses	0.06	0.05
Skin Conductance Level	0.12	- 0.17
Response Latency	- 0.03	0.22
Response Rise Time	0.12	- 0.02
Reponse Amplitude	0.02	0.05
Response Recovery Time	0.14	0.11
Initial Response Amplitude	- 0.10	0.04
Response Magnitude	0.07	0.04
Session 2		
Orienting Responses	- 0.08	0.08
Trials to Habituation	- 0.11	- 0.05
Nonspecific Responses	- 0.01	0.18
Skin Conductance Level	0.12	0.13
Response Latency	- 0.21	- 0.20
Response Rise Time	- 0.03	- 0.30*
Reponse Amplitude	- 0.22	- 0.04
Response Recovery Time	0.18	- 0.14
Initial Response Amplitude	- 0.23	- 0.13
Response Magnitude	- 0.12	- 0.02

*** $p < 0.001$ ** $p < 0.01$ * $p < 0.05$

Table 14 (iv) Correlations Between Schematising Test Scores and Electrodermal Response Variables

	70 dB Sequence		90 dB Sequence	
Type of Score:	Accuracy	Error	Accuracy	Error
Electrodermal Variables				
	r	r	r	r
Session 1				
Orienting Responses	0.13	0.05	0.04	0.22
Trials to Habituation	0.16	0.04	0.03	0.05
Nonspecific Responses	0.34*	- 0.04	0.09	0.17
Skin Conductance Level	0.09	0.01	0.08	- 0.03
Response Latency	0.23	0.09	0.02	- 0.11
Response Rise Time	- 0.08	0.23	- 0.04	0.02
Reponse Amplitude	0.40**	- 0.08	0.10	0.06
Response Recovery Time	- 0.06	0.03	- 0.26	- 0.18
Initial Response Amplitude	0.38**	- 0.05	0.23	0.04
Response Magnitude	0.34*	- 0.01	0.06	0.14
Session 2				
Orienting Responses	- 0.10	- 0.01	- 0.06	- 0.02
Trials to Habituation	- 0.05	0.03	- 0.05	- 0.13
Nonspecific Responses	- 0.06	- 0.01	- 0.19	0.08
Skin Conductance Level	0.09	- 0.10	0.03	- 0.08
Response Latency	- 0.11	0.38*	- 0.07	- 0.04
Response Rise Time	0.10	0.18	0.24	0.16
Reponse Amplitude	0.21	- 0.11	0.10	0.02
Response Recovery Time	0.03	0.06	- 0.10	- 0.07
Initial Response Amplitude	0.15	- 0.14	0.13	- 0.12
Response Magnitude	0.30*	- 0.22	0.08	0.05

*** $p < 0.001$ ** $p < 0.01$ * $p < 0.05$

Table 14 (v) Correlations Between Size Estimation Scores and Electrodermal Response Variables

Electrodermal Variables	70 dB Sequence r	90 dB Sequence r
Session 1		
Orienting Responses	0.10	0.14
Trials to Habituation	0.05	0.08
Nonspecific Responses	0.01	0.07
Skin Conductance Level	- 0.25	- 0.31*
Response Latency	0.03	- 0.11
Response Rise Time	0.38*	- 0.06
Reponse Amplitude	- 0.08	- 0.15
Response Recovery Time	0.01	0.12
Initial Response Amplitude	- 0.12	- 0.02
Response Magnitude	- 0.02	0.14
Session 2		
Orienting Responses	- 0.03	- 0.02
Trials to Habituation	- 0.05	0.09
Nonspecific Responses	- 0.16	0.16
Skin Conductance Level	- 0.42**	- 0.47**
Response Latency	0.05	0.01
Response Rise Time	0.24	0.16
Reponse Amplitude	- 0.27	0.13
Response Recovery Time	0.17	0.30*
Initial Response Amplitude	- 0.24	- 0.15
Response Magnitude	- 0.30*	0.05

*** $p < 0.001$ ** $p < 0.01$ * $p < 0.05$

Table 14 (vi) Correlations Between Petrie Kinesthetic Figural After-Effect Scores and Electrodermal Response Variables

Electrodermal Variables	70 dB Sequence r	90 dB Sequence r
Session 1		
Orienting Responses	0.21	0.09
Trials to Habituation	0.30*	0.23
Nonspecific Responses	0.25	0.22
Skin Conductance Level	0.02	0.04
Response Latency	- 0.01	0.19
Response Rise Time	- 0.04	- 0.05
Reponse Amplitude	0.09	- 0.10
Response Recovery Time	- 0.13	0.11
Initial Response Amplitude	0.03	0.06
Response Magnitude	0.15	0.03
Session 2		
Orienting Responses	0.18	- 0.06
Trials to Habituation	0.20	- 0.02
Nonspecific Responses	0.13	0.01
Skin Conductance Level	- 0.14	- 0.05
Response Latency	0.08	0.16
Response Rise Time	- 0.10	- 0.02
Reponse Amplitude	0.02	- 0.31*
Response Recovery Time	0.24	0.12
Initial Response Amplitude	0.14	- 0.10
Response Magnitude	0.11	- 0.25

*** $p < 0.001$ ** $p < 0.01$ * $p < 0.05$

Table 14 (vii) Correlations Between Object Sorting Scores and Electrodermal Response Variables

	70 dB Sequence		90 dB Sequence	
Type of Score:	Number	Abstract-ness	Number	Abstract-ness
Electrodermal Variables	r	r	r	r
Session 1				
Orienting Responses	0.25	0.09	0.19	0.03
Trials to Habituation	0.26	0.11	0.01	0.15
Nonspecific Responses	0.20	0.03	0.22	0.01
Skin Conductance Level	- 0.25	- 0.12	- 0.23	- 0.09
Response Latency	0.13	0.13	- 0.02	0.08
Response Rise Time	0.02	0.04	0.22	0.23
Reponse Amplitude	0.06	0.11	- 0.01	0.08
Response Recovery Time	0.08	0.16	- 0.05	- 0.24
Initial Response Amplitude	0.08	0.17	0.30*	0.24
Response Magnitude	0.23	0.23	0.10	0.15
Session 2				
Orienting Responses	0.17	- 0.26	0.23	- 0.39**
Trials to Habituation	0.13	- 0.10	0.17	- 0.35*
Nonspecific Responses	0.21	- 0.37**	0.13	- 0.32*
Skin Conductance Level	- 0.26	0.15	- 0.28	0.16
Response Latency	- 0.08	0.14	- 0.25	- 0.05
Response Rise Time	0.06	0.28	- 0.10	- 0.01
Reponse Amplitude	- 0.09	0.07	0.20	- 0.10
Response Recovery Time	0.21	- 0.05	0.11	0.11
Initial Response Amplitude	0.04	- 0.02	0.03	0.09
Response Magnitude	0.12	- 0.21	0.34*	- 0.33*

*** $p < 0.001$ ** $p < 0.01$ * $p < 0.05$

Table 15 (i) Means and Standard Deviations of Skin Conductance Response Characteristics (70 dB Sequence)

Electrodermal Variables

Normal Control Group	$\bar{x}$	σ
Orienting Responses	4.08	2.87
Trials to Habituation	5.80	8.73
Nonspecific Responses	16.43	24.68
Skin Conductance Level	4.20	2.47
Response Latency	1.87	0.92
Response Rise Time	1.69	0.71
Reponse Amplitude	0.07	0.08
Response Recovery Time	2.22	1.11
Initial Response Amplitude	0.25	0.22
Nonschizophrenic Patient Group		
Orienting Responses	2.43	2.90
Trials to Habituation	2.85	3.67
Nonspecific Responses	15.05	19.95
Skin Conductance Level	4.50	4.10
Response Latency	1.41	1.37
Response Rise Time	1.29	1.36
Reponse Amplitude	0.07	0.13
Response Recovery Time	2.28	2.72
Initial Response Amplitude	0.12	0.23
Schizophrenic Patient Group		
Orienting Responses	2.90	2.83
Trials to Habituation	2.95	3.56
Nonspecific Responses	12.78	14.73
Skin Conductance Level	4.40	2.90
Response Latency	1.54	1.20
Response Rise Time	1.30	1.08
Reponse Amplitude	0.04	0.06
Response Recovery Time	1.65	2.62
Initial Response Amplitude	0.09	0.13

Table 15 (ii) Means and Standard Deviations of Electrodermal Response Variables in Hypo- and Hyper-Responding Subjects (70 dB Sequence)

Electrodermal Variables	Hypo-Responders $\bar{x}$	Hypo-Responders σ	Hyper-Responders $\bar{x}$	Hyper-Responders σ	
Normal Control Group	(N = 9)		(N = 11)		
Orienting Responses	2.00	1.94	5.77	2.37	
Trials to Habituation	1.11	0.74	9.67	10.41	
Nonspecific Responses	4.39	4.77	26.27	30.04	**
Skin Conductance Level	3.85	2.55	4.49	2.49	
Response Latency	1.59	0.79	2.12	0.44	
Response Rise Time	1.55	0.33	1.80	0.39	
Reponse Amplitude	0.03	0.03	0.11	0.09	**
Response Recovery Time	2.24	0.82	2.44	0.61	
Initial Response Amplitude	0.15	0.16	0.34	0.23	
Nonschizophrenic Patient Group	(N = 13)		(N = 7)		
Orienting Responses	0.73	1.05	5.57	2.57	
Trials to Habituation	0.54	0.78	7.14	2.91	
Nonspecific Responses	2.73	2.92	37.93	17.43	***
Skin Conductance Level	2.41	1.13	8.37	4.88	***
Response Latency	2.91	1.16	1.94	0.50	
Response Rise Time	3.01	1.27	1.53	0.19	
Reponse Amplitude	0.05	0.14	0.12	0.09	**
Response Recovery Time	2.86	1.54	1.49	0.83	
Initial Response Amplitude	0.03	0.06	0.28	0.32	***
Schizophrenic Patient Group	(N = 12)		(N = 8)		
Orienting Responses	1.13	1.37	5.56	2.29	
Trials to Habituation	0.08	0.82	6.50	3.02	
Nonspecific Responses	8.21	11.87	19.63	16.68	*
Skin Conductance Level	3.67	2.53	5.48	3.23	
Response Latency	2.49	1.02	2.15	0.45	
Response Rise Time	1.79	0.84	2.03	0.71	
Reponse Amplitude	0.01	0.01	0.09	0.06	***
Response Recovery Time	3.65	4.74	1.67	0.71	
Initial Response Amplitude	0.03	0.07	0.18	0.15	**

Group Differences: *** $p < 0.001$ ** $p < 0.01$ * $p < 0.01$

Table 15 (iii) Means and Standard Deviations of Electrodermal Response Variables in Relation to Skin Conductance Level Asymmetry (70 dB Sequence)

Electrodermal Variables

	Left>Right		Right>Left	
	$\bar{x}$	σ	$\bar{x}$	σ
Normal Control Group	(N = 6)		(N = 12)	
Orienting Responses	5.50	2.81	4.04	2.55
Trials to Habituation	4.08	3.44	7.63	10.72
Nonspecific Responses	18.67	11.55	18.04	30.61
Skin Conductance Level	6.84	2.87	2.17	1.14
Response Latency	2.47	0.54	1.88	0.71
Response Rise Time	1.94	0.45	1.84	0.45
Reponse Amplitude	0.11	0.06	0.68	0.89
Response Recovery Time	2.75	1.01	2.32	0.77
Initial Response Amplitude	0.28	0.20	0.28	0.22
Nonschizophrenic Patient Group	(N = 3)		(N = 9)	
Orienting Responses	4.67	3.51	3.83	2.62
Trials to Habituation	6.00	4.58	4.33	3.54
Nonspecific Responses	32.67	29.14	21.11	19.81
Skin Conductance Level	8.33	4.03	5.49	4.67
Response Latency	2.95	1.66	2.14	0.57
Response Rise Time	2.01	0.73	2.19	1.44
Reponse Amplitude	0.14	0.14	0.11	0.16
Response Recovery Time	3.83	3.38	3.29	2.46
Initial Response Amplitude	0.37	0.53	0.14	0.11
Schizophrenic Patient Group	(N = 6)		(N = 8)	
Orienting Responses	4.67	2.60	3.69	2.58
Trials to Habituation	4.33	3.39	4.13	3.93
Nonspecific Responses	12.42	9.04	21.25	18.44
Skin Conductance Level	4.61	2.80	4.60	2.82
Response Latency	2.22	0.77	2.03	0.72
Response Rise Time	1.94	0.71	1.77	0.80
Reponse Amplitude	0.07	0.07	0.04	0.05
Response Recovery Time	3.51	4.27	1.49	0.45
Initial Response Amplitude	0.17	0.17	0.10	0.10

Table 15 (iv) Means and Standard Deviations of Electrodermal Response Variables in Relation to Response Amplitude Asymmetry (70 dB Sequence)

Electrodermal Variables

	Left>Right		Right>Left	
	$\bar{x}$	σ	$\bar{x}$	σ
Normal Control Group	(N = 7)		(N = 11)	
Orienting Responses	4.14	3.08	4.77	2.47
Trials to Habituation	3.07	3.22	8.59	10.87
Nonspecific Responses	12.93	13.18	21.63	31.00
Skin Conductance Level	5.88	3.37	3.45	1.26
Response Latency	2.04	1.07	2.10	0.38
Response Rise Time	2.01	0.49	1.79	0.40
Reponse Amplitude	0.08	0.07	0.08	0.09
Response Recovery Time	2.87	0.81	2.21	0.81
Initial Response Amplitude	0.24	0.20	0.31	0.22
Nonschizophrenic Patient Group	(N = 3)		(N = 8)	
Orienting Responses	4.33	1.15	4.31	3.13
Trials to Habituation	5.67	1.15	4.88	4.29
Nonspecific Responses	30.00	18.25	24.75	23.25
Skin Conductance Level	5.42	2.98	6.76	5.33
Response Latency	1.42	0.71	2.18	0.45
Response Rise Time	1.69	0.12	2.23	1.31
Reponse Amplitude	0.07	0.06	0.16	0.18
Response Recovery Time	4.01	1.44	3.23	2.65
Initial Response Amplitude	0.11	0.03	0.24	0.32
Schizophrenic Patient Group	(N = 8)		(N = 4)	
Orienting Responses	4.50	2.96	5.25	2.06
Trials to Habituation	4.56	3.77	4.13	4.25
Nonspecific Responses	13.81	8.95	31.50	0.04
Skin Conductance Level	4.61	2.27	5.95	3.50
Response Latency	1.90	0.67	2.46	0.65
Response Rise Time	1.66	0.58	1.55	0.31
Reponse Amplitude	0.05	0.05	0.09	0.09
Response Recovery Time	1.81	0.70	1.23	0.20
Initial Response Amplitude	0.13	0.09	0.19	0.22

Table 15 (v) Intercorrelations Between Electrodermal Variables (70 dB Sequence)

Electrodermal Variables	1	2	3	4	5	6	7	8
Normal Control Group								
1. Orienting Responses	-							
2. Trials to Habituation	0.805***	-						
3. Nonspecific Responses	0.711***	0.718***	-					
4. Skin Conductance Level	0.486*	0.340	0.662***	-				
5. Response Latency	0.187	- 0.004	0.335	0.477*	-			
6. Response Rise Time	0.114	0.021	0.158	0.185	0.635***	-		
7. Response Amplitude	0.874***	0.784***	0.749***	0.423*	0.159	0.121	-	
8. Response Recovery Time	0.240	0.039	0.086	0.200	0.469	0.765	0.066	-
Nonschizophrenic Patient Group								
1. Orienting Responses	-							
2. Trials to Habituation	0.986***	-						
3. Nonspecific Responses	0.855***	0.854***	-					
4. Skin Conductance Level	0.808***	0.828***	0.670***	-				
5. Response Latency	0.661***	0.647***	0.449*	0.301	-			
6. Response Rise Time	0.703***	0.683***	0.408*	0.177	0.799***	-		
7. Response Amplitude	0.897***	0.915***	0.763***	0.435*	0.339	0.423*	-	
8. Response Recovery Time	0.623**	0.609**	0.362	- 0.017	0.822***	0.910***	0.192	-
Schizophrenic Patient Group								
1. Orienting Responses	-							
2. Trials to Habituation	0.874***	-						
3. Nonspecific Responses	0.789***	0.585**	-					
4. Skin Conductance Level	0.370	0.285	0.384*	-				
5. Response Latency	0.712***	0.556**	0.567**	0.045	-			
6. Response Rise Time	0.749***	0.751***	0.423*	- 0.093	0.866***	-		
7. Response Amplitude	0.933***	0.890***	0.402*	0.471*	0.441*	0.414*	-	
8. Response Recovery Time	0.610**	0.586**	0.343	- 0.164	0.626***	0.656***	0.040	-

*** $p < 0.001$ ** $p < 0.01$ * $p < 0.05$

Table 15 (vi) Factor Structure of Electrodermal Response Variables (70 dB Sequence)

Electrodermal Variables

	Factor 1	Factor 2	Factor 3	Factor 4
Normal Control Group				
Orienting Responses	0.175	0.863	- 0.068	0.117
Trials to Habituation	0.986	0.081	- 0.092	- 0.065
Nonspecific Responses	0.940	0.169	- 0.087	0.086
Skin Conductance Level	0.068	0.404	0.053	0.595
Response Latency	- 0.029	- 0.080	0.046	0.797
Response Rise Time	- 0.085	- 0.173	0.547	0.120
Reponse Amplitude	0.100	0.910	- 0.208	0.024
Response Recovery Time	- 0.047	0.010	0.888	- 0.040
Nonschizophrenic Patient Group				
Orienting Responses	0.887	- 0.434		
Trials to Habituation	0.808	- 0.506		
Nonspecific Responses	0.731	- 0.595		
Skin Conductance Level	0.796	- 0.430		
Response Latency	- 0.231	0.473		
Response Rise Time	- 0.085	0.916		
Reponse Amplitude	0.319	0.018		
Response Recovery Time	- 0.315	0.870		
Schizophrenic Patient Group				
Orienting Responses	0.869	0.217	- 0.045	
Trials to Habituation	0.986	0.051	- 0.141	
Nonspecific Responses	0.256	0.780	- 0.020	
Skin Conductance Level	0.450	0.668	- 0.166	
Response Latency	- 0.073	0.063	0.945	
Response Rise Time	0.229	- 0.699	0.578	
Reponse Amplitude	0.737	0.269	- 0.014	
Response Recovery Time	- 0.145	- 0.382	0.617	
Total Subject Group				
Orienting Responses	- 0.190	0.300	0.725	
Trials to Habituation	- 0.080	0.935	0.157	
Nonspecific Responses	- 0.228	0.781	0.357	
Skin Conductance Level	- 0.218	0.198	0.659	
Response Latency	0.467	- 0.083	- 0.016	
Response Rise Time	0.785	- 0.135	- 0.102	
Reponse Amplitude	0.047	0.099	0.583	
Response Recovery Time	0.836	- 0.106	- 0.188	

Table 15 (vii) Means and Standard Deviations of Skin Conductance Response Characteristics (90 dB Sequence)

Electrodermal Variables

Normal Control Group	$\bar{x}$	σ
Orienting Responses	3.48	3.05
Trials to Habituation	3.30	3.44
Nonspecific Responses	4.70	5.97
Skin Conductance Level	3.89	3.89
Response Latency	1.63	0.99
Response Rise Time	1.38	0.81
Reponse Amplitude	0.11	0.19
Response Recovery Time	3.16	2.84
Initial Response Amplitude	0.29	0.42
Nonschizophrenic Patient Group		
Orienting Responses	3.05	3.55
Trials to Habituation	3.53	4.02
Nonspecific Responses	3.53	4.02
Skin Conductance Level	3.92	4.15
Response Latency	1.32	1.14
Response Rise Time	1.26	1.34
Reponse Amplitude	0.09	0.19
Response Recovery Time	2.11	2.80
Initial Response Amplitude	0.25	0.59
Schizophrenic Patient Group		
Orienting Responses	3.39	2.94
Trials to Habituation	3.24	3.67
Nonspecific Responses	5.63	6.33
Skin Conductance Level	3.54	2.41
Response Latency	1.50	1.15
Response Rise Time	1.31	0.98
Reponse Amplitude	0.04	0.05
Response Recovery Time	1.83	1.52
Initial Response Amplitude	0.08	0.10

Table 15 (viii) Means and Standard Deviations of Electrodermal Response Variables in Hypo- and Hyper-Responding Subjects (90 dB Sequence)

Electrodermal Variables	Hypo-Responders		Hyper-Responders		
	$\bar{x}$	σ	$\bar{x}$	σ	
Normal Control Group	(N = 9)		(N = 11)		
Orienting Responses	1.00	1.00	5.50	2.61	
Trials to Habituation	0.50	0.61	5.59	3.06	
Nonspecific Responses	1.11	1.95	8.63	6.60	**
Skin Conductance Level	1.86	0.71	5.55	4.66	***
Response Latency	2.18	0.05	2.15	0.30	
Response Rise Time	2.39	0.46	1.88	0.35	
Reponse Amplitude	0.01	0.01	0.20	0.23	***
Response Recovery Time	4.50	3.54	3.70	2.26	
Initial Response Amplitude	0.06	0.10	0.48	0.48	**
Nonschizophrenic Patient Group	(N = 10)		(N = 10)		
Orienting Responses	0.40	0.52	5.70	3.28	
Trials to Habituation	0.30	0.48	6.75	3.28	
Nonspecific Responses	0.40	1.27	12.00	9.11	***
Skin Conductance Level	3.14	4.62	4.69	3.69	*
Response Latency	2.28	0.81	1.97	0.45	
Response Rise Time	2.83	1.83	1.57	0.70	
Reponse Amplitude	0.01	0.01	0.17	0.24	***
Response Recovery Time	3.81	3.35	3.16	3.05	
Initial Response Amplitude	0.03	0.08	0.47	0.77	**
Schizophrenic Patient Group	(N = 11)		(N = 8)		
Orienting Responses	1.68	2.07	5.75	2.27	
Trials to Habituation	0.14	0.78	6.81	2.93	
Nonspecific Responses	2.95	2.81	9.31	8.06	
Skin Conductance Level	3.88	2.92	3.06	1.52	
Response Latency	2.26	0.46	2.03	0.34	
Response Rise Time	1.92	0.33	1.96	0.58	
Reponse Amplitude	0.02	0.04	0.06	0.06	
Response Recovery Time	3.33	1.45	2.17	0.63	
Initial Response Amplitude	0.03	0.05	0.15	0.11	*

Group Differences: *** $p < 0.001$ ** $p < 0.01$ * $p < 0.01$

Table 15 (ix) Means and Standard Deviations of Electrodermal Response Variables in Relation to Skin Conductance Level Asymmetry (90 dB Sequence)

Electrodermal Variables	Left>Right		Right>Left	
	$\bar{x}$	σ	$\bar{x}$	σ
Normal Control Group	(N = 4)		(N = 12)	
Orienting Responses	3.60	1.82	4.79	2.96
Trials to Habituation	2.00	1.15	3.83	3.60
Nonspecific Responses	7.00	5.24	5.46	6.62
Skin Conductance Level	5.20	3.22	4.26	4.50
Response Latency	2.16	0.21	1.99	0.68
Response Rise Time	1.72	0.35	1.73	0.48
Reponse Amplitude	0.09	0.11	0.15	0.23
Response Recovery Time	1.97	0.65	4.61	2.72
Initial Response Amplitude	0.38	0.49	0.35	0.45
Nonschizophrenic Patient Group	(N = 6)		(N = 8)	
Orienting Responses	4.16	3.82	4.50	3.52
Trials to Habituation	5.33	3.50	4.81	4.44
Nonspecific Responses	11.92	12.19	6.06	6.52
Skin Conductance Level	7.62	6.09	3.01	1.31
Response Latency	1.33	0.77	2.30	0.69
Response Rise Time	0.46	0.61	2.44	1.26
Reponse Amplitude	0.20	0.31	0.07	0.07
Response Recovery Time	1.05	0.73	4.48	3.12
Initial Response Amplitude	0.62	0.98	0.15	0.19
Schizophrenic Patient Group	(N = 5)		(N = 10)	
Orienting Responses	3.70	2.28	4.50	2.89
Trials to Habituation	2.20	2.75	5.05	3.83
Nonspecific Responses	4.00	2.48	8.60	7.29
Skin Conductance Level	3.88	2.31	3.01	1.58
Response Latency	2.10	0.81	2.18	0.61
Response Rise Time	1.72	0.48	1.96	0.55
Reponse Amplitude	0.05	0.05	0.05	0.05
Response Recovery Time	3.19	1.12	2.30	0.99
Initial Response Amplitude	0.12	0.09	0.97	0.11

Table 15 (x) Means and Standard Deviations of Electrodermal Response Variables in Relation to Response Amplitude Asymmetry (90 dB Sequence)

Electrodermal Variables

	Left>Right		Right>Left	
	$\bar{x}$	σ	$\bar{x}$	σ
Normal Control Group	(N = 7)		(N = 9)	
Orienting Responses	4.21	1.82	4.44	3.46
Trials to Habituation	3.36	2.32	4.72	4.05
Nonspecific Responses	5.93	4.66	5.78	7.43
Skin Conductance Level	4.05	2.73	4.85	5.13
Response Latency	2.24	0.17	1.87	0.75
Response Rise Time	1.76	0.50	1.70	0.41
Reponse Amplitude	0.09	0.09	0.18	0.26
Response Recovery Time	4.55	3.61	3.48	1.61
Initial Response Amplitude	0.31	0.37	0.40	0.50
Nonschizophrenic Patient Group	(N = 6)		(N = 6)	
Orienting Responses	3.17	2.81	6.67	3.39
Trials to Habituation	4.25	3.28	7.17	4.67
Nonspecific Responses	5.92	4.22	14.08	11.81
Skin Conductance Level	2.52	1.09	6.10	4.19
Response Latency	1.69	1.13	2.09	0.67
Response Rise Time	1.79	1.86	1.96	0.74
Reponse Amplitude	0.03	0.03	0.25	0.28
Response Recovery Time	3.59	4.13	3.04	1.86
Initial Response Amplitude	0.06	0.11	0.72	0.93
Schizophrenic Patient Group	(N = 9)		(N = 5)	
Orienting Responses	4.17	2.21	5.40	2.88
Trials to Habituation	3.94	3.31	5.20	4.44
Nonspecific Responses	5.94	5.02	10.50	7.92
Skin Conductance Level	2.96	1.45	4.26	2.28
Response Latency	1.98	0.62	2.44	0.68
Response Rise Time	1.78	0.48	2.04	0.60
Reponse Amplitude	0.03	0.03	0.09	0.06
Response Recovery Time	2.94	1.18	2.04	0.63
Initial Response Amplitude	0.12	0.11	0.10	0.11

Table 15 (xi) Intercorrelations Between Electrodermal Variables (90 dB Sequence)

Electrodermal Variables	1	2	3	4	5	6	7	8
Normal Control Group								
1. Orienting Responses	-							
2. Trials to Habituation	0.955***	-						
3. Nonspecific Responses	0.732***	0.712***	-					
4. Skin Conductance Level	0.822***	0.788***	0.719***	-				
5. Response Latency	0.637***	0.529**	0.533**	0.354	-			
6. Response Rise Time	0.588**	0.602**	0.355	0.285	0.860***	-		
7. Response Amplitude	0.948***	0.726***	0.726***	0.378*	0.194	0.275	-	
8. Response Recovery Time	0.383*	0.377*	0.016	- 0.056	0.503*	0.494*	- 0.071	-
Nonschizophrenic Patient Group								
1. Orienting Responses	-							
2. Trials to Habituation	0.943***	-						
3. Nonspecific Responses	0.840***	0.867***	-					
4. Skin Conductance Level	0.641***	0.602**	0.509*	-				
5. Response Latency	0.599**	0.396*	0.183	0.253	-			
6. Response Rise Time	0.663***	0.512***	0.343	0.153	0.889***	-		
7. Response Amplitude	0.976***	0.905***	0.830***	0.549***	0.276	0.144	-	
8. Response Recovery Time	0.725***	0.557***	0.367	- 0.058	0.783***	0.760***	0.046	-
Schizophrenic Patient Group								
1. Orienting Responses	-							
2. Trials to Habituation	0.939***	-						
3. Nonspecific Responses	0.784***	0.699***	-					
4. Skin Conductance Level	0.227	0.080	0.356	-				
5. Response Latency	0.586**	0.623***	0.428*	- 0.033	-			
6. Response Rise Time	0.801***	0.636***	0.403*	- 0.105	0.955***	-		
7. Response Amplitude	0.571**	0.769***	0.738***	0.281	0.331	0.426*	-	
8. Response Recovery Time	0.494*	0.461*	0.331	0.019	0.679***	0.719***	0.324	-

*** $p < 0.001$ ** $p < 0.01$ * $p < 0.05$

Table 15 (xii) Factor Structure of Electrodermal Response Variables (90 dB Sequence)

Electrodermal Variables

	Factor 1	Factor 2	Factor 3
Normal Control Group			
Orienting Responses	0.900	0.373	0.173
Trials to Habituation	0.905	0.303	0.193
Nonspecific Responses	0.238	0.966	0.025
Skin Conductance Level	0.361	0.494	0.120
Response Latency	- 0.065	0.153	0.815
Response Rise Time	0.129	- 0.137	0.576
Reponse Amplitude	0.821	0.202	- 0.121
Response Recovery Time	- 0.150	- 0.496	0.081
Nonschizophrenic Patient Group			
Orienting Responses	0.971	- 0.047	0.192
Trials to Habituation	0.970	- 0.204	0.108
Nonspecific Responses	0.718	- 0.108	0.646
Skin Conductance Level	0.052	- 0.198	0.559
Response Latency	- 0.119	0.957	- 0.018
Response Rise Time	- 0.202	0.800	- 0.118
Reponse Amplitude	0.577	0.074	0.785
Response Recovery Time	0.143	0.742	- 0.496
Schizophrenic Patient Group			
Orienting Responses	0.778	0.428	0.322
Trials to Habituation	0.817	0.409	- 0.001
Nonspecific Responses	0.578	0.545	0.351
Skin Conductance Level	- 0.026	0.214	0.970
Response Latency	- 0.103	- 0.909	- 0.130
Response Rise Time	- 0.062	- 0.765	- 0.367
Reponse Amplitude	0.480	0.165	0.572
Response Recovery Time	- 0.725	0.173	- 0.081
Total Subject Group			
Orienting Responses	0.989	- 0.135	
Trials to Habituation	0.910	- 0.127	
Nonspecific Responses	0.651	- 0.477	
Skin Conductance Level	0.200	- 0.516	
Response Latency	- 0.231	0.472	
Response Rise Time	- 0.126	0.590	
Reponse Amplitude	0.625	- 0.298	
Response Recovery Time	- 0.051	0.638	

Table 16 (i) Means and Standard Deviations of Correct Responses to Embedded Figures in Hypo- and Hyper-Responding Subjects

	70 dB Sequence			
	Hypo-Responders		Hyper-Responders	
	$\bar{x}$	σ	$\bar{x}$	σ
Normal Control Group				
Overall Responses	151.22	13.45	156.82	14.06
Slow presentation	79.67	7.04	81.73	0.09
Fast presentation	71.56	7.47	75.09	6.44
Nonschizophrenic Patient Group				
Overall Responses	123.33	12.14	120.14	22.65
Slow presentation	63.92	6.78	62.86	13.41
Fast presentation	58.42	6.86	57.29	9.39
Schizophrenic Patient Group				
Overall Responses	118.17	20.41	108.86	15.37
Slow presentation	63.08	10.42	55.63	8.43
Fast presentation	55.08	11.41	52.14	8.32
	90 dB Sequence			
Normal Control Group				
Overall Responses	147.89	14.17	159.55	11.40
Slow presentation	78.44	7.44	82.73	8.43
Fast presentation	69.44	7.75	76.82	8.43
Nonschizophrenic Patient Group				
Overall Responses	126.00	14.02	118.70	18.01
Slow presentation	64.90	7.58	62.20	10.96
Fast presentation	59.67	7.92	56.50	7.47
Schizophrenic Patient Group				
Overall Responses	112.64	17.83	117.63	21.00
Slow presentation	60.73	10.00	59.33	10.90
Fast presentation	51.91	9.26	56.88	11.42

Table 16 (ii) Correlations Between Correct Responses to Embedded Figure Stimuli and Electrodermal Variables

	70 dB Sequence		90 dB Sequence	
Mode of Presentation:	Fast	Slow	Fast	Slow
	r	r	r	r
Normal Control Group				
Orienting Responses	0.48*	0.21	0.69***	0.36
Trials to Habituation	0.36	0.20	0.51**	0.28
Nonspecific Responses	0.50**	0.15	0.42*	0.11
Skin Conductance Level	0.59***	0.33	0.47*	0.27
Response Latency	- 0.09	- 0.16	0.26	- 0.21
Response Rise Time	- 0.40	- 0.25	- 0.10	- 0.35
Response Amplitude	0.51	0.16	0.43*	0.41*
Response Recovery Time	- 0.08	0.08	0.25	0.23
Initial Response Amplitude	0.49*	0.31	0.48*	0.36
Nonschizophrenic Patient Group				
Orienting Responses	- 0.20	0.02	- 0.18	0.06
Trials to Habituation	- 0.16	0.04	- 0.24	- 0.04
Nonspecific Responses	- 0.12	0.14	- 0.09	- 0.09
Skin Conductance Level	0.01	0.16	- 0.01	0.17
Response Latency	- 0.26	- 0.20	- 0.15	- 0.16
Response Rise Time	- 0.26	- 0.14	- 0.19	- 0.03
Reponse Amplitude	0.20	0.04	0.11	0.21
Response Recovery Time	0.36	- 0.29	- 0.08	0.13
Initial Response Amplitude	0.29	0.40*	0.07	0.14
Schizophrenic Patient Group				
Orienting Responses	0.08	- 0.01	0.35	0.25
Trials to Habituation	- 0.01	- 0.18	0.32	0.16
Nonspecific Responses	0.19	0.06	0.23	0.11
Skin Conductance Level	- 0.13	- 0.21	- 0.01	0.09
Response Latency	- 0.57*	- 0.03	- 0.51*	- 0.44
Response Rise Time	- 0.56*	- 0.22	- 0.72**	- 0.61*
Reponse Amplitude	- 0.21	- 0.25	0.36	0.26
Response Recovery Time	- 0.25	0.11	0.10	- 0.16
Initial Response Amplitude	- 0.01	- 0.21	0.55**	0.42*

*** $p < 0.001$ ** $p < 0.01$ * $p < 0.01$

Table 16 (iii) Means and Standard Deviations of Correct Responses to Embedded Figures in Subjects with Different Skin Conductance Level Asymmetry

	70 dB Sequence			
	Left>Right		Right>Left	
	$\bar{x}$	σ	$\bar{x}$	σ
Normal Control Group				
Overall Responses	158.86	12.32	151.85	14.27
Slow presentation	83.29	4.82	79.46	9.30
Fast presentation	75.57	7.61	72.39	6.64
Nonschizophrenic Patient Group				
Overall Responses	127.43	11.30	119.08	18.27
Slow presentation	66.57	7.00	61.92	10.18
Fast presentation	60.86	4.63	56.33	8.70
Schizophrenic Patient Group				
Overall Responses	119.13	17.01	111.55	20.23
Slow presentation	63.88	10.26	57.58	9.69
Fast presentation	55.25	8.31	53.09	11.76
	90 dB Sequence			
Normal Control Group				
Overall Responses	155.00	15.98	154.13	13.69
Slow presentation	81.50	5.92	80.63	8.70
Fast presentation	73.50	10.08	73.50	6.42
Nonschizophrenic Patient Group				
Overall Responses	125.50	11.93	119.50	18.44
Slow presentation	65.83	7.36	62.08	10.31
Fast presentation	59.67	5.05	56.58	8.71
Schizophrenic Patient Group				
Overall Responses	123.57	12.37	109.58	20.45
Slow presentation	66.29	8.28	56.77	9.73
Fast presentation	57.29	6.47	52.08	11.73

Table 16 (iv) Means and Standard Deviations of Correct Responses to Embedded Figures in Subjects with Different Response Amplitude Asymmetries

	70 dB Sequence			
	Left>Right		Right>Left	
	$\bar{x}$	σ	$\bar{x}$	σ
Normal Control Group				
Overall Responses	162.00	10.36	151.09	14.94
Slow presentation	85.00	3.06	79.00	9.90
Fast presentation	77.00	7.46	72.09	6.58
Nonschizophrenic Patient Group				
Overall Responses	108.33	27.14	123.88	14.06
Slow presentation	55.33	15.89	66.00	7.75
Fast presentation	53.00	11.27	57.38	6.99
Schizophrenic Patient Group				
Overall Responses	112.25	23.23	120.43	17.47
Slow presentation	59.00	12.19	60.38	10.04
Fast presentation	53.25	11.33	58.29	10.66
	90 dB Sequence			
Normal Control Group				
Overall Responses	161.57	11.67	155.44	12.61
Slow presentation	83.71	5.82	81.89	8.94
Fast presentation	77.86	6.28	73.56	5.59
Nonschizophrenic Patient Group				
Overall Responses	113.33	18.43	123.50	15.23
Slow presentation	59.00	11.26	65.83	8.61
Fast presentation	54.33	7.66	57.67	7.09
Schizophrenic Patient Group				
Overall Responses	118.63	16.60	113.80	20.14
Slow presentation	60.00	9.39	59.80	10.71
Fast presentation	57.13	10.26	54.00	9.72

Table 16 (v) Correlations Between Response Latencies to Embedded Figure Stimuli and Electrodermal Variables

	70 dB Sequence		90 dB Sequence	
Mode of Presentation:	Fast	Slow	Fast	Slow
	r	r	r	r
Normal Control Group				
Orienting Responses	0.24	- 0.06	0.02	- 0.28
Trials to Habituation	0.15	- 0.03	- 0.04	- 0.18
Nonspecific Responses	0.21	- 0.10	0.01	- 0.32
Skin Conductance Level	0.29	0.18	0.52**	0.07
Response Latency	0.36	0.14	0.04	0.05
Response Rise Time	0.51*	0.62**	- 0.05	0.05
Reponse Amplitude	- 0.17	- 0.16	- 0.25	- 0.31
Response Recovery Time	0.03	0.33	- 0.05	- 0.07
Initial Response Amplitude	- 0.47*	- 0.34	0.04	0.06
Nonschizophrenic Patient Group				
Orienting Responses	0.37*	0.29	0.31	0.30
Trials to Habituation	0.32	0.21	0.33	0.29
Nonspecific Responses	0.41*	0.36	0.10	0.02
Skin Conductance Level	0.19	0.15	0.24	0.24
Response Latency	- 0.27	- 0.17	- 0.04	0.04
Response Rise Time	- 0.13	- 0.08	0.05	0.01
Reponse Amplitude	0.24	0.31	0.04	0.25
Response Recovery Time	- 0.22	- 0.19	0.08	0.06
Initial Response Amplitude	0.38*	0.52**	- 0.05	0.03
Schizophrenic Patient Group				
Orienting Responses	0.23	0.25	0.15	- 0.05
Trials to Habituation	0.28	0.22	0.21	0.07
Nonspecific Responses	0.19	0.02	- 0.01	0.02
Skin Conductance Level	0.22	- 0.08	0.15	- 0.12
Response Latency	- 0.20	0.07	0.61*	0.45
Response Rise Time	0.02	0.42	0.61*	0.54*
Reponse Amplitude	0.32	0.11	0.20	0.06
Response Recovery Time	- 0.45	0.17	- 0.12	- 0.08
Initial Response Amplitude	0.36	0.17	- 0.05	0.10

*** $p < 0.001$ ** $p < 0.01$ * $p < 0.01$

Table 16 (vi) Means and Standard Deviations of Response Latencies to Embedded Figures Stimuli in in Subjects with Different Skin Conductance Level Asymmetries

	70 dB Sequence			
	Left>Right		Right>Left	
	$\bar{x}$	σ	$\bar{x}$	σ
Normal Control Group				
Overall Latencies	3282.84	1061.43	3372.27	1123.29
Slow presentation	3928.73	1642.17	4058.44	2149.85
Fast presentation	2646.10	562.12	2543.31	263.34
Nonschizophrenic Patient Group				
Overall Latencies	3045.81	1391.52	3466.81	1064.80
Slow presentation	3774.40	2243.78	4292.73	1642.21
Fast presentation	2323.52	632.35	2626.34	515.58
Schizophrenic Patient Group				
Overall Latencies	3851.04	1687.97	3155.22	881.92
Slow presentation	4882.59	2503.07	3959.46	1376.67
Fast presentation	2778.33	1173.99	2574.52	887.56
	90 dB Sequence			
Normal Control Group				
Overall Latencies	2690.25	242.88	3503.65	1144.36
Slow presentation	2916.25	242.88	4287.19	2085.65
Fast presentation	2483.36	241.66	2603.14	412.75
Nonschizophrenic Patient Group				
Overall Latencies	3207.76	1313.29	3321.44	1187.94
Slow presentation	4043.60	2179.58	4087.14	1813.94
Fast presentation	2388.92	570.88	2536.73	572.87
Schizophrenic Patient Group				
Overall Latencies	3692.25	1757.50	3294.25	981.95
Slow presentation	4816.59	2696.10	4066.01	1372.91
Fast presentation	2523.15	1000.12	2727.60	1013.29

Table 16 (vii) Means and Standard Deviations of Response Latencies to Embedded Figure Stimuli in Subjects with Different Response Amplitude Asymmetries

	70 dB Sequence			
	Left>Right		Right>Left	
	$\bar{x}$	σ	$\bar{x}$	σ
Normal Control Group				
Overall Responses	3253.91	882.85	3446.19	1262.92
Slow presentation	3571.30	1265.81	4350.75	2350.46
Fast presentation	2654.70	493.12	2560.41	349.06
Nonschizophrenic Patient Group				
Overall Responses	3022.98	765.69	4142.16	1264.73
Slow presentation	3686.98	909.55	5346.06	2116.99
Fast presentation	2336.72	620.85	2926.70	483.95
Schizophrenic Patient Group				
Overall Responses	3638.50	956.20	3444.04	1692.32
Slow presentation	4194.81	1053.19	4343.00	2459.43
Fast presentation	3100.10	1009.54	2525.64	908.58
	90 dB Sequence			
Normal Control Group				
Overall Responses	2897.17	804.95	3207.46	3776.78
Slow presentation	3281.67	1333.60	3776.78	1282.48
Fast presentation	2503.57	373.97	2649.96	460.72
Nonschizophrenic Patient Group				
Overall Responses	3198.98	935.90	4010.82	1604.74
Slow presentation	3895.18	1376.46	5276.73	2573.24
Fast presentation	2487.06	505.60	2747.56	714.53
Schizophrenic Patient Group				
Overall Responses	3354.95	1629.61	3499.53	1019.23
Slow presentation	4232.58	2348.60	4533.27	1852.70
Fast presentation	2448.76	903.63	3180.59	1159.92

Table 17 (i) Means and Standard Deviations of Auditory Stroop Variables

	$\bar{x}$	σ
Normal Control Group		
Correct Responses	47.80	0.41
Overall Response Latency	703.45	150.12
Response Latency to Congruent Stimuli	690.85	181.03
Response Latency to Incongruent Stimuli	713.90	144.75
Nonschizophrenic Patient Group		
Correct Responses	47.65	0.49
Overall Response Latency	911.45	233.61
Response Latency to Congruent Stimuli	909.80	284.10
Response Latency to Incongruent Stimuli	932.80	209.83
Schizophrenic Patient Group		
Correct Responses	47.25	0.79
Overall Response Latency	1119.65	545.80
Response Latency to Congruent Stimuli	1114.10	622.42
Response Latency to Incongruent Stimuli	1133.55	536.73

Table 17 (ii) Means and Standard Deviations of Auditory Stroop Variables in Hypo- and Hyper-Responding subjects

	Hypo-Responders		Hyper-Responders	
	70 dB Sequence			
	$\bar{x}$	σ	$\bar{x}$	σ
Normal Control Group				
Correct Responses	47.78	0.44	47.82	0.41
Overall Response Latency	699.78	128.11	706.46	172.23
Stroop Interference	38.22	38.22	10.64	117.82
Nonschizophrenic Patient Group				
Correct Responses	47.62	0.51	47.71	0.49
Overall Response Latency	919.46	271.79	896.57	157.12
Stroop Interference	36.00	137.90	- 1.14	117.29
Schizophrenic Patient Group				
Correct Responses	47.58	0.52	46.75	0.89
Overall Response Latency	1065.50	638.85	1200.88	393.28
Stroop Interference	2.92	164.97	44.25	135.45
	90 dB Sequence			
Normal Control Group				
Correct Responses	47.78	0.44	47.82	0.41
Overall Response Latency	682.56	120.29	720.56	174.71
Stroop Interference	59.22	67.66	- 6.55	98.10
Nonschizophrenic Patient Group				
Correct Responses	47.60	0.52	47.70	0.48
Overall Response Latency	930.80	307.46	892.10	140.89
Stroop Interference	52.89	141.93	4.00	123.82
Schizophrenic Patient Group				
Correct Responses	47.27	0.65	47.22	0.97
Overall Response Latency	1201.27	693.38	1019.89	293.58
Stroop Interference	5.27	170.16	36.78	133.01

Table 17 (iii) Means and Standard Deviations of Auditory Stroop Variables in Relation to Skin Conductance Level Asymmetry

	Left>Right		Right>Left	
		70 dB Sequence		
	$\bar{x}$	σ	$\bar{x}$	σ
Normal Control Group				
Correct Responses	47.57	0.54	47.92	0.28
Overall Response Latency	784.29	139.63	659.92	141.66
Stroop Interference	- 26.71	116.32	49.85	62.20
Nonschizophrenic Patient Group				
Correct Responses	47.57	0.54	47.69	0.48
Overall Response Latency	813.43	154.17	964.23	256.72
Stroop Interference	58.57	61.65	3.85	152.91
Schizophrenic Patient Group				
Correct Responses	47.13	0.64	47.33	0.89
Overall Response Latency	1036.25	382.40	1175.25	642.70
Stroop Interference	81.50	87.01	- 21.92	173.64
		90 dB Sequence		
Normal Control Group				
Correct Responses	47.50	0.58	47.88	0.34
Overall Response Latency	746.00	167.81	692.81	149.36
Stroop Interference	17.25	64.61	24.50	97.15
Nonschizophrenic Patient Group				
Correct Responses	47.83	0.41	47.62	0.51
Overall Response Latency	842.83	159.87	950.85	266.24
Stroop Interference	32.17	106.23	8.46	141.24
Schizophrenic Patient Group				
Correct Responses	47.14	0.69	47.31	0.86
Overall Response Latency	923.86	229.58	1225.08	641.03
Stroop Interference	79.71	93.83	0.58	169.30

Table 17 (iv) Means and Standard Deviations of Visual Stroop Variables

	$\bar{x}$	σ
Normal Control Group		
Correct Responses	47.65	0.35
Overall Response Latency	686.35	90.48
Response Latency to Congruent Stimuli	645.25	90.30
Response Latency to Incongruent Stimuli	747.95	110.42
Nonschizophrenic Patient Group		
Correct Responses	47.45	0.89
Overall Response Latency	961.85	282.32
Response Latency to Congruent Stimuli	846.95	205.97
Response Latency to Incongruent Stimuli	1013.10	234.13
Schizophrenic Patient Group		
Correct Responses	46.90	1.02
Overall Response Latency	1069.45	445.22
Response Latency to Congruent Stimuli	952.75	395.59
Response Latency to Incongruent Stimuli	1133.40	434.15

Table 17 (v) Means and Standard Deviations of Visual Stroop Variables in Hypo- and Hyper-Responding subjects

	Hypo-Responders		Hyper-Responders	
	70 dB Sequence			
	$\bar{x}$	σ	$\bar{x}$	σ
Normal Control Group				
Correct Responses	47.67	0.71	47.64	0.51
Overall Response Latency	685.67	84.47	678.73	98.51
Stroop Interference	101.89	62.56	103.36	75.06
Nonschizophrenic Patient Group				
Correct Responses	47.35	1.04	47.57	0.53
Overall Response Latency	901.00	229.83	1074.86	351.91
Stroop Interference	174.39	134.61	151.00	85.61
Schizophrenic Patient Group				
Correct Responses	47.00	1.04	46.75	1.04
Overall Response Latency	1043.25	496.80	1108.75	383.72
Stroop Interference	173.50	199.74	191.38	127.52
	90 dB Sequence			
Normal Control Group				
Correct Responses	47.78	0.44	47.55	0.69
Overall Response Latency	659.56	77.68	708.27	97.73
Stroop Interference	76.11	61.76	124.46	67.51
Nonschizophrenic Patient Group				
Correct Responses	47.30	1.06	47.60	0.70
Overall Response Latency	930.40	251.20	993.30	320.89
Stroop Interference	205.56	144.64	141.30	85.22
Schizophrenic Patient Group				
Correct Responses	47.00	0.78	46.78	1.30
Overall Response Latency	1147.09	562.54	974.56	238.30
Stroop Interference	139.82	173.58	230.56	162.86

Table 17 (vi) Means and Standard Deviations of Visual Stroop Variables in Relation to Skin Conductance Level Asymmetry

	Left>Right		Right>Left	
	70 dB Sequence			
	$\bar{x}$	σ	$\bar{x}$	σ
Normal Control Group				
Correct Responses	47.57	0.79	47.69	0.48
Overall Response Latency	734.00	46.20	660.69	99.28
Stroop Interference	96.57	61.00	106.00	73.55
Nonschizophrenic Patient Group				
Correct Responses	47.57	1.13	47.38	0.77
Overall Response Latency	824.00	208.96	1036.08	295.49
Stroop Interference	198.71	158.12	148.69	92.43
Schizophrenic Patient Group				
Correct Responses	46.88	0.84	46.92	1.17
Overall Response Latency	1013.63	424.13	1106.67	473.42
Stroop Interference	164.88	114.80	191.17	204.20
	90 dB Sequence			
Normal Control Group				
Correct Responses	47.75	0.50	47.63	0.62
Overall Response Latency	731.25	35.26	675.13	97.21
Stroop Interference	108.50	66.84	101.25	70.28
Nonschizophrenic Patient Group				
Correct Responses	47.50	0.84	47.62	0.65
Overall Response Latency	852.83	158.05	1027.08	319.55
Stroop Interference	168.17	94.97	169.62	134.00
Schizophrenic Patient Group				
Correct Responses	47.00	0.82	46.85	1.14
Overall Response Latency	885.00	235.49	1168.77	505.56
Stroop Interference	179.71	115.42	163.75	197.03

Table 17 (vii) Means and Standard Deviations of Visual Stroop Variables in Relation to Response Amplitude Asymmetry

	Left>Right		Right>Left	
	70 dB Sequence			
	$\bar{x}$	ó	$\bar{x}$	ó
Normal Control Group				
Correct Responses	47.43	0.79	47.73	0.47
Overall Response Latency	704.86	100.88	672.36	94.28
Stroop Interference	98.14	60.04	109.00	73.14
Nonschizophrenic Patient Group				
Correct Responses	47.67	0.58	47.75	0.46
Overall Response Latency	1261.33	446.26	968.38	244.07
Stroop Interference	111.00	52.43	183.00	95.47
Schizophrenic Patient Group				
Correct Responses	46.88	1.25	46.50	1.00
Overall Response Latency	967.88	251.57	1266.00	463.31
Stroop Interference	223.00	168.79	211.75	136.91
	90 dB Sequence			
Normal Control Group				
Correct Responses	47.57	0.79	47.56	0.53
Overall Response Latency	689.29	97.95	685.11	105.35
Stroop Interference	106.57	58.73	100.00	86.08
Nonschizophrenic Patient Group				
Correct Responses	47.67	0.82	47.67	0.52
Overall Response Latency	1024.33	418.34	1060.67	211.42
Stroop Interference	166.17	170.91	202.17	96.20
Schizophrenic Patient Group				
Correct Responses	46.89	1.27	46.80	0.84
Overall Response Latency	909.00	252.22	1240.40	409.12
Stroop Interference	155.89	232.20	161.60	70.38

CLOSURE FLEXIBILITY TEST : Instructions to Subjects

CLOSURE FLEXIBILITY

(Concealed Figures)

(Form A)

Please fill in:

Name _____

Age _____ Sex _____ Date ___

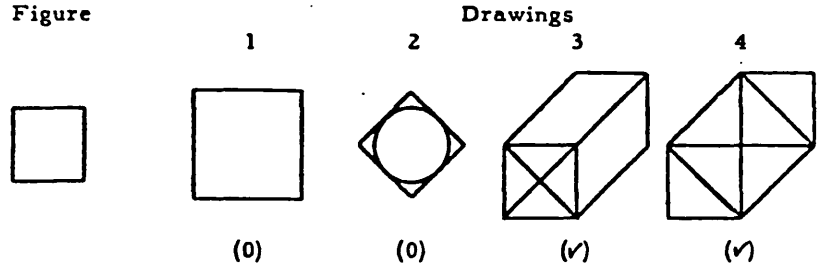
Occupation _____

_____

Developed by: L.L. Thurstone, Ph.D. and T.E. Jeffrey, Ph.D. • The Psychometric Laboratory • The University of North Carolina

Directions:

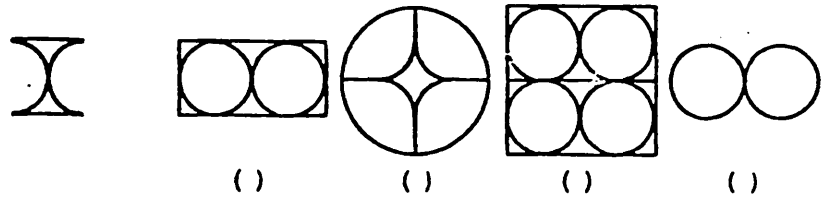
The row of designs below is a sample item of this test. The parts have been labeled to make description easier. These labels do not appear in the test items. The left hand design in each row is the figure. You are to decide whether or not the figure is concealed in each of the four drawings to the right. Put a check mark (✓) in the parentheses under a drawing, if it contains the figure. Put a zero (0) in the parentheses under a drawing, if it does not contain the figure. Look at the row of designs below.



In the row above a zero (0) has been written in the parentheses under drawing 1. The first drawing is a square but it is larger than the figure. A zero (0) has been written under drawing 2. Although the second drawing contains a square of exactly the same size as the figure, it has been turned. Check marks (✓) have been written under the third and fourth drawings since they each contain a square of exactly the same size as the figure and have not been turned. It does not matter that the figure contained in drawings three and four is on a different level from the figure at the left.

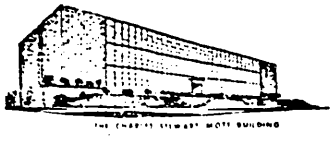
Sample:

Here is another example for practice. Try it.



You should have placed check marks (✓) in the parentheses under the first and third drawings and zeros (0) in the parentheses under the second and fourth drawings.

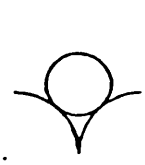
WHEN YOU GET THE SIGNAL TO BEGIN, turn the page and mark more problems of the same kind. Work as fast and as accurately as you can, but do not guess. Wrong answers will count against you. You are not expected to finish in the time allowed. You will have exactly ten minutes to do as much as you can.

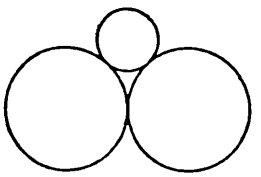


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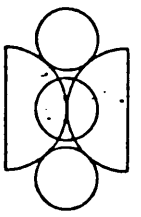
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CLOSURE FLEXIBILITY TEST : Sample Page

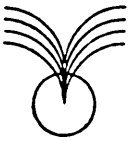




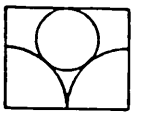
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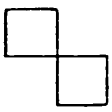
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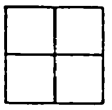


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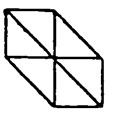


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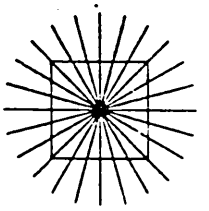




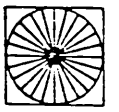
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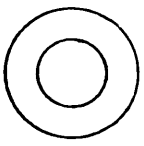
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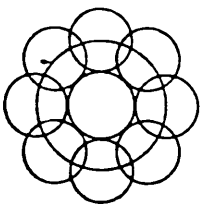


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(✓)

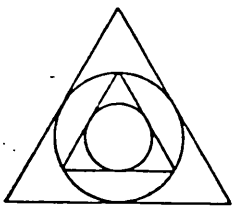




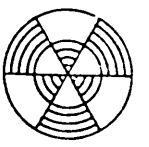
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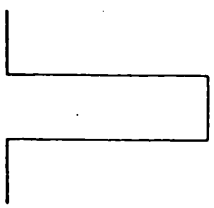
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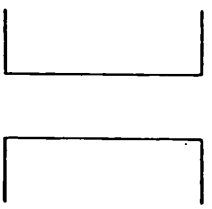


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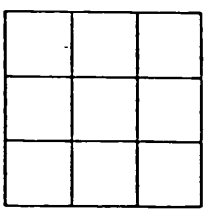


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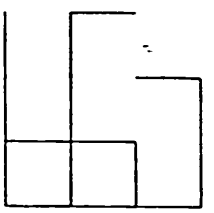




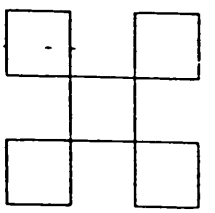
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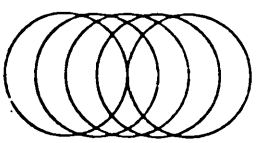


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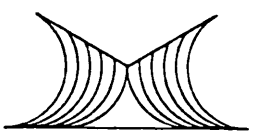


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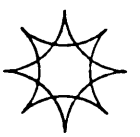




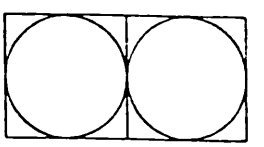
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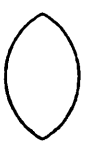
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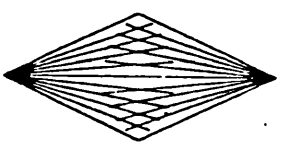


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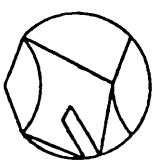


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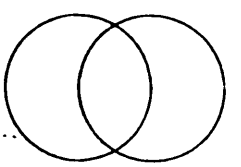




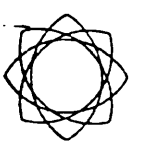
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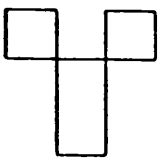
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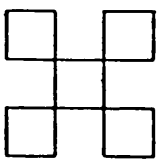


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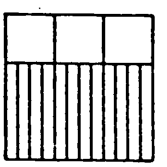


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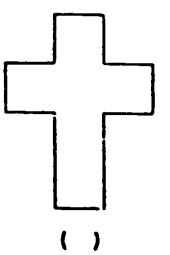




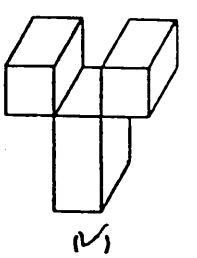
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DO NOT STOP. GO ON TO THE NEXT PAGE.

STROOP COLOUR-WORD TEST

Instructions to Subjects

"This page consists of names of colours. I would like you to read the page aloud as fast and as accurately as you can. For instance, read this practice line.

[Show Part I practice page]

Now when I turn the page, start reading as fast and as accurately as possible.

[Show Part I page]

Now I am going to show you another page consisting of colours. I want you to name the colours as fast and as accurately as possible. To make sure that you have the colour names correct, read the practice line.

[Show Part II practice page]

Now when I give the signal, start reading as fast and as accurately as possible.

[Show Part II page]

This is a different kind of page. It consists of colour names printed in different colours. For instance, the word r-e-d may be printed in the colour blue; you would read blue and ignore the word. I want you to call only the colours and ignore the words, and you are to read the colours off as fast and as accurately as possible. Try the practice line.

[Show Part III practice page]

Now remember, at my signal read the colours off as quickly and accurately as possible, ignoring the words. People do best when they try not to squint or to use artificial devices for ignoring the words.

[Show Part III page]

STROOP COLOUR-WORD TEST

Computation of the Colour-Word Interference Residual Score

1. Let X represent the distribution of scores for Part II Reading Time, Colours Alone, and Y the distribution of scores for Part III Reading Time, Colour-Word Interference.

2. Obtain the regression equation for the regression of Y on X.

$$\tilde{Y} = bX + a$$

$$\text{where} \quad b = \frac{N\Sigma XY - (\Sigma X)(\Sigma Y)}{N\Sigma X^2 - (\Sigma X)^2}$$

$$a = \bar{Y} - b\bar{X} \qquad \text{where} \quad \bar{Y} = \frac{\Sigma Y}{N}$$

$$\bar{X} = \frac{\Sigma X}{N}$$

3. From this equation, obtain a predicted Y score ($\tilde{Y}$) for each S, using his X score.

4. Compute the difference between each S's actual Y score and his predicted Y score ($Y - \tilde{Y}$). This is his colour-word Interference Residual Score.

STROOP COLOUR-WORD TEST : Record Sheet

SUBJECT:.....

PART I

	TIME	ERROR
BLUE RED GREEN YELLOW RED YELLOW GREEN BLUE GREEN BLUE RED YELLOW RED GREEN BLUE YELLOW RED BLUE YELLOW GREEN RED YELLOW RED BLUE YELLOW GREEN BLUE RED GREEN YELLOW BLUE YELLOW GREEN YELLOW BLUE RED GREEN RED GREEN BLUE GREEN BLUE RED GREEN BLUE RED YELLOW BLUE GREEN YELLOW BLUE RED YELLOW BLUE RED BLUE YELLOW RED YELLOW GREEN	I	
YELLOW RED GREEN BLUE YELLOW GREEN RED BLUE RED YELLOW BLUE YELLOW RED GREEN BLUE YELLOW GREEN BLUE GREEN RED BLUE GREEN YELLOW RED GREEN YELLOW RED BLUE GREEN BLUE YELLOW BLUE RED YELLOW GREEN RED BLUE YELLOW GREEN RED	II	

PART II

YELLOW BLUE RED GREEN YELLOW RED BLUE YELLOW RED GREEN BLUE GREEN YELLOW RED GREEN RED YELLOW RED GREEN BLUE BLUE RED YELLOW GREEN BLUE YELLOW GREEN BLUE RED GREEN YELLOW RED BLUE GREEN YELLOW GREEN RED BLUE RED YELLOW BLUE RED YELLOW BLUE RED GREEN BLUE YELLOW RED GREEN GREEN BLUE RED GREEN BLUE RED BLUE YELLOW GREEN YELLOW BLUE GREEN YELLOW RED BLUE YELLOW GREEN YELLOW BLUE GREEN RED BLUE YELLOW RED YELLOW GREEN BLUE RED YELLOW GREEN RED YELLOW RED GREEN BLUE GREEN YELLOW RED BLUE YELLOW BLUE RED GREEN BLUE YELLOW BLUE GREEN RED YELLOW GREEN		

PART III

YELLOW BLUE RED GREEN YELLOW RED BLUE YELLOW RED GREEN BLUE GREEN YELLOW RED GREEN RED YELLOW RED GREEN BLUE BLUE RED YELLOW GREEN BLUE YELLOW GREEN BLUE RED GREEN YELLOW RED BLUE GREEN YELLOW GREEN RED BLUE RED YELLOW BLUE RED YELLOW BLUE RED GREEN BLUE YELLOW RED GREEN GREEN BLUE RED GREEN BLUE RED BLUE YELLOW GREEN YELLOW BLUE GREEN YELLOW RED BLUE YELLOW GREEN YELLOW BLUE GREEN RED BLUE YELLOW RED YELLOW GREEN BLUE RED YELLOW GREEN RED YELLOW RED GREEN BLUE GREEN YELLOW RED BLUE YELLOW BLUE RED GREEN BLUE YELLOW BLUE GREEN RED YELLOW GREEN		

SCHEMATISING TEST

Instructions for Subjects

"I wish to see how well you can judge the size of squares. I am going to show you a number of squares on the screen and I want you to tell me how big they are. The squares may range anywhere between 1 inch and 18 inches. This doesn't mean you will necessarily get a square which is either 1 inch or 18 inches, though you may. The squares will always be somewhere within this range.

To help you judge the size of the squares, I will first show you what a 1-inch square looks like - the smaller end of the range - and what an 18-inch square looks like - the larger end of the range.

[Show slides of 1-inch and 18-inch squares.]

I will show them to you again in a moment. You will see 75 squares during the next half an hour and you have 75 numbered spaces on your sheet. Write your estimate of the size of each square in its own numbered space. Thus, for square number one record its size in inches in the box marked with number 1, etc.

Don't go back over your judgements to change them. In changing them you are more likely to be inaccurate. Please don't make any comment during presentation.

Now to remind you once again of the range in which the squares will fall, I will show you again the smaller and the larger end of the range.

[Show slides of 1-inch and 18-inch squares.]

Now we are ready to begin. You will see each of the following squares for only a few seconds. Look at it all the time it is on the screen and make your estimation when it disappears. The next square you will see will be number one."

SCHEMATISING TEST

Order of Presentation of Squares in the Schematising Test*

1. 1.2	26. 2.8	51. 3.2
2. 1.6	27. 2.4	52. 3.8
3. 2.0	28. 3.8	53. 4.6
4. 2.4	29. 2.0	54. 5.5
5. 2.8	30. 3.2	55. 6.6
6. 2.0	31. 2.4	56. 4.6
7. 1.6	32. 2.8	57. 3.8
8. 2.8	33. 3.2	58. 6.6
9. 1.2	34. 3.8	59. 3.2
10. 2.4	35. 4.6	60. 5.5
11. 1.6	36. 3.2	61. 3.8
12. 2.0	37. 2.8	62. 4.6
13. 2.4	38. 4.6	63. 5.5
14. 2.8	39. 2.4	64. 6.6
15. 3.2	40. 3.8	65. 7.9
16. 2.4	41. 2.8	66. 5.5
17. 2.0	42. 3.2	67. 4.6
18. 3.2	43. 3.8	68. 7.9
19. 1.6	44. 4.6	69. 3.8
20. 2.8	45. 5.5	70. 6.6
21. 2.0	46. 3.8	71. 4.6
22. 2.4	47. 3.2	72. 5.5
23. 2.8	48. 5.5	73. 6.6
24. 3.2	49. 2.8	74. 7.9
25. 3.8	50. 4.6	75. 9.5

* Values for squares represent inches per side

SCHEMATISING TEST : Record Sheet

SUBJECT:

1		26		51		
2		27		52		
3		28		53		
4		29		54		
5		30		55		
6		31		56		
7		32		57		
8		33		58		
9		34		59		
10		35		60		
11		36		61		
12		37		62		
13		38		63		
14		39		64		
15		40		65		
16		41		66		
17		42		67		
18		43		68		
19		44		69		
20		45		70		
21		46		71		
22		47		72		
23		48		73		
24		49		74		
25		50		75		

SIZE ESTIMATION TEST

Instructions to Subjects

"You see how I can make this circle larger or smaller by turning this knob? I want you to adjust this circle of light to be equal in size to some disks which I will ask you to hold in your left hand. Here is the first disk. I will adjust the size according to your instruction. When the circle of light looks to be the exact size of the disk, tell me to stop. Then let me know if you wish to make any further adjustments."

SIZE ESTIMATION TEST : Record Sheet

SUBJECT:				
	10-gram neutral gray disk (48.5 mm)	65-gram gray disk (48.5 mm)	10-gram covered with black velvet (50 mm)	
Descending				
Descending				
Ascending				
Ascending				

PETRIE KINESTHETIC FIGURAL AFTER-EFFECT TEST

Instructions to Subjects

"I am doing some research on touch perception. I am going to ask you some questions and explore your sense of touch in your thumb and index finger on each hand. There are no right or wrong answers. I am interested in the way in which you experience things. The only right answers are what you feel. Let me explain what I am going to do.

I'll place your right hand on a horizontal wooden block of a certain width; then, while you are still holding this block, I will place your left hand on a horizontal block that tapers from a small width at the bottom to a greater width at the top. I'll ask you to find a place on the tapered block that feels just as wide as the block in your right hand. I'll do this a few times, then place your right hand on a different size block and ask you to rub it with these same two fingers. Remember there are no right or wrong answers - the only right answer is what you feel, Because it is essential that you judge by what you feel, not by what you see, I must cover your eyes. Testing will only take a few minutes. While your eyes are covered only a stopwatch, pad, pen and the blocks will be on the table.

[subject is blindfolded using swimming goggles with opaque lenses]

Does that seem comfortable? Can you see anything through the goggles? Let's put the two fingers of your right hand on a block; you can feel that the block is the same width all along. Now let's put your other two fingers on another block; you can feel again that the top slides but this block gets wider and wider. Feel it.

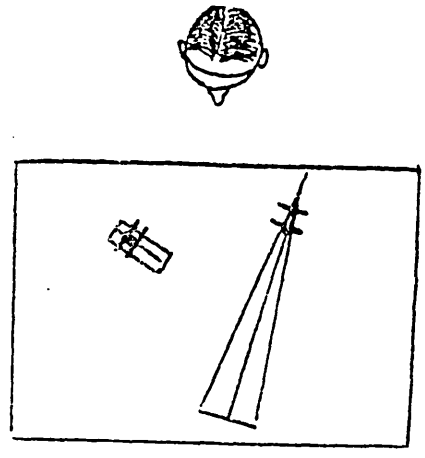
Now show me a spot on the tapered block which feels just as wide as the block in your other hand. Find it as quickly and as accurately as you can. Say 'here' when you have found it and wait a moment until I say 'alright'.

[After 'alright'] Now return your hand to the bottom of the tapered block and show me again a place on the tapered block which feels as wide as the block in your other hand. Remember to say 'here' and wait until I say 'alright.'

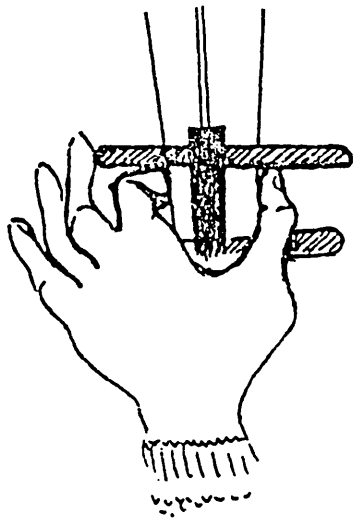
[record 4 measurements] I shall now remove your left hand from the tapered block. You may rest just this hand but be careful not to let the tips of your index finger and thumb touch each other or anything else. Now we are going to pick up this right hand block together. Hold it lightly here for a moment. Now we'll let go of this block, and put your fingers ona different block. When I say ' go ahead' would you please rub this block along its length, back and forth, at a moderate rate. I want you to concentrate on the width of the block, so 1'm not going to talk to you about anything else until you finish rubbing. Don't stop until I tell you to do so.

[after 90 seconds] Now we are going to pick up this right hand block together. Hold it here lightly for a moment. Now I am going to put these fingers onto another block; and I'll again put the fingers of your left hand on the tapered block."

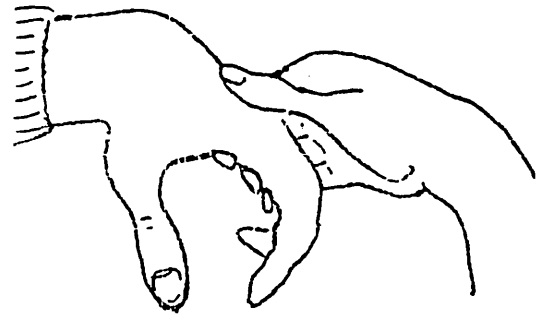
Petrie Kinesthetic Figural After-Effect Test: Equipment



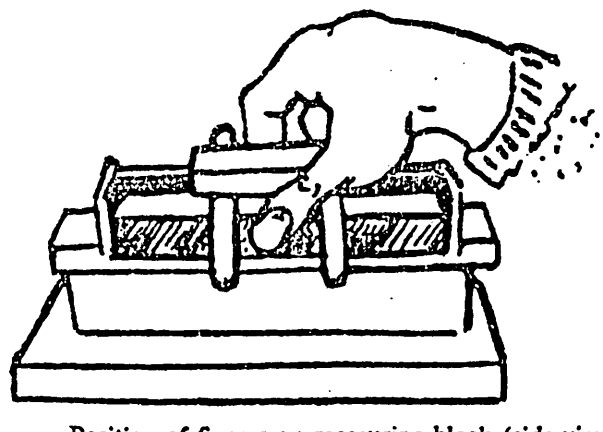
Position of tapered block and measuring block on table.



Position of fingers on tapered block (top view)



Guiding the subject's hands.



Position of fingers on measuring block (side view)

(Figures taken from Appendix A in Petrie (1967))

PETRIE KINESTHETIC FIGURAL AFTER-EFFECT TEST : Record Sheet

SUBJECT:

	Series of Measurements	Practice Trials		(1)		(2)		(1)		(2)		Total		Average		Difference from Baseline Average
				Small Block Presentation				Large Block Presentation								
I	(Baseline)															
II	(After 90-second stimulation)															
III	(After 180-second stimulation)															
IV	(After 300-second stimulation)															
	Rest Period															
V	(After 15-minute rest period)															

OBJECT SORTING TEST

Instructions to Subjects

"First of all, I want to you to know that there is no 'answer' to this test. Everyone does it in his own way. I want you to do it in the way that seems most natural, most logical, and most comfortable to you. The instructions are simply to put together into groups the objects which seem to you to belong together. You may have as many or as few objects in a group as you like, as long as the objects in each group belong together for a particular reason. If, after you have thought about all the objects, a few do not seem to belong with any of the others, you may put those objects into groups by themselves. Please sort all the objects."

[After all the objects had been grouped]

"Why do these objects belong together?"

OBJECT-SORTING TEST

List of Objects

1. Half bar soap
2. Yellow pencil
3. White jar lid
4. Small glass jar
5. Flashlight bulb
6. Penny
7. Small white plastic knife
8. White plastic button
9. Nail
10. Metal knife
11. Small blue candles
12. Small blue candles
13. Small light bulb
14. Blue plastic candle holders
15. Blue plastic candle holders
16. Metal fork
17. Small white plastic spoon
18. Small blue plastic spoon
19. Cigarette
20. Cigar wrapped in cellophane
21. Jar rubber
22. Red paper rectangle
23. Red cardboard circle
24. White plastic doll shoe
25. Padlock and key (brass)
26. Block of wood with nail
27. Block of wood painted yellow
28. Block of wood with red paper pasted on one side
29. Medicine dropper
30. Small printed picture
31. Ping-pong ball
32. Piece of white chalk
33. Black and yellow fishing fly
34. Green plastic spool with roll of fine wire
35. Hairpin
36. Screwdriver
37. Piece of red crayon
38. Pipe bowl
39. Pipe stem (fits bowl)
40. Bottle of mercurochrome
41. Rubber stopper with metal ring
42. Picture postcard, black and white
43. Piece of white candle
44. Small corks
45. Small corks
46. Orange lollipop with paper handle
47. Orange vitamin pill
48. Metal staple with paper on head
49. Sugar cube
50. Metal whistle
51. Small pebble
52. Mothball
53. Putty knife (red handle)
54. Blue plastic comb
55. Metal thimble
56. Brass pulley with white plastic wheel
57. White rectangular card
58. 2 German stamps (red and green, attached)
59. Whiskbroom
60. Toy hammer (red handle)
61. Toy metal saw
62. Bicycle bell
63. Piece of chamois
64. Rubber nipple
65. Green plastic earring with metal clip
66. Bowtie on cardboard
67. Suede brush (metal, wood)
68. Piece of fine sandpaper
69. Plastic sunglasses with metal clip
70. Red lipstick container

OBJECT-SORTING TEST : Record Sheet

SUBJECT:	
Category Reason	Category Contents
Total No. of Categories:	