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COGNITIVE DEFICITS IN SCHIZOPHRENIA: THEIR NATURE AND IMPACT ON DAILY LIFE

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by

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To Daniel from whom I learnt most of what I know of schizophrenia

And to my wife Beverley for watering the potterpoos

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IMPORTANT NOTE:
Patients are referred to in this research as 'schizophrenics' merely for the sake of clarity and brevity. In reality they are a diverse group of human beings who have to cope with a condition that is currently labelled schizophrenia. I hope this project makes it a bit clearer just what they are up against, and just how much courage it takes to live with it.

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ABSTRACT

This research provides further support for the existence of differential cognitive impairments in schizophrenia and especially for the presence of disproportionate attentional deficits

The results add credibility to the view that attentional disorders are responsible for many of the problems of everyday living in schizophrenia. Crucially these findings are the first to demonstrate in a schizophrenic sample a clear relationship between attentional deficits measured by objective tests and those measured by independent ratings. This project is also the first to show that attentional deficits account for a substantial proportion of the variance in social and interpersonal functioning even after controlling for the potential contribution of a comprehensive range of other factors, including negative symptoms.

This study shows that schizophrenics are acutely aware of having cognitive difficulties. However the research confirms previous findings with a diverse range of samples showing that the subjective judgements do not correlate with performance on cognitive tests nor with independent ratings of cognitive functioning. However, as

predicted it was also shown that self ratings of cognitive efficacy are related to dysphoric mood, greater use of avoidant coping methods, and a failure to use active coping strategies. This suggests a possible vicious cycle of helplessness which may be amenable to therapeutic interventions.

The present findings indicate the potential value of using comprehensive assessments of cognitive functioning as a part of the routine clinical assessment procedure for schizophrenic patients. Assessments based on existing symptom rating scales do not adequately describe the impairments faced by someone living with schizophrenia, nor how these deficits interfere so profoundly with the tasks of daily life.

Such detailed assessments of cognitive functioning may in the future help to guide cognitive and environmental interventions aimed at improving the well being, coping and functioning of those who have to endure this illness.

COGNITIVE DEFICITS IN SCHIZOPHRENIA: THEIR NATURE AND IMPACT ON DAILY LIFE

INTRODUCTION AND REVIEW OF THE LITERATURE

This study makes a detailed exploration of cognitive deficits in schizophrenia from three perspectives, objective tests of cognitive functioning, independent ratings of cognitive functioning and self-reports of cognitive functioning. Each approach has its advantages and disadvantages, but used together, they should provide a more rounded and ecologically valid picture of cognitive deficits in schizophrenia.

The research also employs multi-dimensional assessments of social functioning and of a range of variables that can interfere with it. The main aim is to clarify the extent to which cognitive deficits disrupt daily living, and their relative importance in this respect. The research also aims to shed light on the mechanisms through which this disruption occurs.

This review is in three sections covering the following areas:

(1) The nature of cognitive dysfunction in schizophrenia as measured by objective tests.

(2) The relationship between cognitive deficits and a range of key variables including symptoms, medication, severity and chronicity of illness, and social functioning.

(3) A review of other ways of assessing cognitive dysfunction (using independent and self ratings), and an evaluation of the ecological validity of objective cognitive tests in schizophrenia

SECTION ONE

THE NATURE OF COGNITIVE DYSFUNCTION IN SCHIZOPHRENIA AS MEASURED BY OBJECTIVE TESTS

There has been a long history of attempts to account for schizophrenia in terms of a fundamental deficit or deficits. Cognitive disorders were seen as central by Kraepelin, (1913) and Bleuler, (1911). The latter proposed that the fundamental deficit was a disorder of association. There is little controversy about the

assertion that schizophrenics perform poorly on cognitive tasks. On average, people with schizophrenia perform more poorly than normal controls on most assessments of cognitive function. On the other hand, the usual finding is one of heterogeneity in the performance of schizophrenics, ranging from little impairment to gross dysfunction. There is also evidence in some studies of a greater variability in performance from one testing occasion to another compared to that of brain damaged patients (Lezak, 1995). However other studies demonstrate high temporal stability for some measures of attentional functioning (Rund, Landro & Orbeck, 1997).

The question of whether there is a consistent profile of impairment, with some functions spared and others compromised, is the subject of considerable debate. Over the past hundred years a large number of potential candidates for the core deficit or group of deficits have been proposed, including disorders of attention, logic, language, perception, memory and also overlapping areas such as communication, social perception, and social problem solving (Cutting, 1985; Frith, 1993). In the recent literature (Bilder, 1996; Landro, 1994; McKenna, Clare & Baddeley, 1995; McKenna, 1994; Paulsen, Heaton, Sadek, *et al.*, 1995; Rossell &

David, 1997; Steffy & Oakman, 1997; Tamlyn, McKenna, Mortimer, *et al.*, 1992; Tollefson, 1996) memory, executive functioning and attention have been singled out as functions which may be disproportionately impaired. This means more impaired than would be expected compared to the overall intellectual decline which is found in schizophrenia.

There is still some dispute about this conclusion due to a number of conceptual and methodological problems in this area of research. For example, Chapman & Chapman, (1973) and Chapman & Chapman, (1978) outline the problems of measuring differential deficits in schizophrenia. Most studies have not matched the reliability, sensitivity and difficulty level of tests of different psychological functions, and this can lead to spurious findings (Blanchard & Neale, 1994). Also there are problems of finding suitable control groups and relevant matching variables (Enns & Burack, 1997).

In a study which helped to reawaken interest in the identification of differential deficits, McKenna, Tamlyn, Lund, *et al.*, (1990) used the Rivermead Behavioural Memory Test, an assessment which is claimed to provide an ecologically valid assessment of overall memory function

(Wilson, Cockburn & Baddeley, 1985). They tested a sample of sixty patients aged eighteen to sixty eight, drawn in approximately equal numbers from acute wards, outpatient clinics, the rehabilitation service and long stay wards. The schizophrenic patients performed much worse than the normal controls. Their scores were comparable to those of moderately to severely brain damaged populations (Wilson, Cockburn & Baddeley, 1985). On the whole the degree of memory impairment was correlated with overall intellectual functioning. However, a proportion of patients who showed no sign of general dementia (measured by the Mini Mental State Exam, and the Middlesex Elderly Assessment of Mental State), also showed moderate to severe memory problems.

Tamlyn, McKenna, Mortimer, *et al.*, (1992) suggest that there are similarities between the memory problems in schizophrenia and those resulting from subcortical as opposed to cortical dementias. They cite evidence that in both schizophrenia and subcortical dementias new material can be learned and once learned it shows normal rates of decay. Memory tested by recall is impaired and it is much improved by cueing. Recognition memory is relatively intact. In subcortical dementias the memory impairment is mainly a result of reduced attention, and hence poor

encoding and retrieval of new material (Hodges, 1994). The material is not lost as in classical amnesia, but it cannot be deliberately recalled. There is some evidence that this may be the case in schizophrenia. A review by Green, (1993) concludes that interventions requiring subjects to process information more thoroughly produce better memory performance. For example Koh, Grinker, Marusarz, *et al.*, (1981) found that asking schizophrenics to sort words for pleasantness resulted in improved recall. The equation of schizophrenic memory disorders with those seen in subcortical conditions is interesting, but not yet proven. For example, implicit memory (priming) and procedural memory are relatively intact in schizophrenia (McKenna, Clare & Baddeley, 1995), but poor in Huntington's Chorea, a form of subcortical dementia (Butters, Wolfe, Granholm, *et al.*, 1986).

Frith, Leary, Cahill, *et al.*, (1991), compared a schizophrenic sample with matched psychiatric outpatient non-psychotic controls and found that although memory impairment is often part of a general intellectual decline, some patients with normal IQ have severe memory problems. Like Tamlyn, McKenna, Mortimer, *et al.*, (1992), Frith also argues that the type of memory problems reflects difficulties in strategy use and organisation,

rather than post encoding amnesia. He implicates the involvement of attentional and /or executive functions in the memory difficulties, which he compares to those seen in Korsakoff's disorder. Frith also found that recognition memory (as opposed to free recall) was spared. A number of other studies have shown that recognition memory is either intact (Calev & Monk, 1982; Johnson, Klingler & Williams, 1977), or less impaired than recall memory (Calev, 1984a; Paulsen, Heaton, Sadek, *et al.*, 1995). On the other hand there is some evidence that for more severely functionally impaired patients with long illness durations, both recall and recognition are equally impaired (Calev, 1984a). In addition there is evidence of accelerated forgetting on delayed recall for this population (Beatty, Jocic, Monson, *et al.*, 1993; Calev, Venables & Monk, 1983). This may indicate an additional element of classical amnesia in some chronic patients and is discussed further in Section Two below.

Several studies have found further evidence that aspects of memory performance which are related to organisation and strategy use are impaired in schizophrenia. Frith, Leary, Cahill, *et al.*, (1991) demonstrated that memory for the source of words (self generated versus experimenter generated) was compromised.

Rizzo, Danion, Van der Linden, *et al.*, (1996) found that temporal context memory was selectively impaired. Huron, Danion, Giacomoni, *et al.*, (1995) tested recognition performance in more detail demonstrating that schizophrenics do have impaired recognition, but only for "remember" responses (conscious recollection) not for "know" (familiarity) responses. They argue that this deficit means that the schizophrenic is driven by unconscious familiarity and implicit memory. They also conclude that the organisational aspects of memory are impaired and that this compromises goal directedness and the planning of future actions.

Fleming, Goldberg & Gold, (1994) put forward a somewhat similar position when they argue that deficits of working memory account for some of the core cognitive deficits in schizophrenia, including the memory problems described above. The concept is based on Baddeley's work on the Supervisory Attentional System (SAS), which he described as a general purpose system involving a wide range of cognitive operations requiring simultaneous storage and processing of information (Baddeley, 1992; Baddeley, 1993; Shallice, 1982). Thus the construct involves attentional, memory and response preparation dimensions. The SAS has limited processing capacity and

is utilised only for specific circumstances such as conscious deliberation due to the failure of automatic processes, situations that require planning, situations involving novelty or inadequately learned chains or acts, or situations where a potent habitual reaction is implicated and must be inhibited. They argue that this model fits the pattern of impairments found in schizophrenia including the reaction time cross over effect (Shakow, 1962), deficient performances on the Continuous Performance Test (Cromwell, 1975; Nuechterlein, Dawson & Green, 1994), on the reverse digit span, on the Wisconsin Card Sorting Test (WCST), and especially on dual attention tasks (Granholm, Asarnow & Marder, 1996).

McKenna, Mortimer & Hodges, (1994) discussed the role of semantic memory which they defined as "the long term storage of knowledge without personal time and place connotations". They consider that related concepts such as a dysfunction of real world knowledge (Cutting & Murphy, 1988), stored regularities (Gray, Rawlins, Hemsley, *et al.*, 1991; Hemsley, 1987) or second order representations (Frith, 1993) may be central to phenomenology of schizophrenia. They argue that the emphasis on executive/frontal and mnestic/temporal

mechanisms in semantic memory shows obvious overlap with the putative areas of disorder in schizophrenia. They used a new semantic test battery (Hodges, Salmon & Butters, 1992) and a range of traditional semantic tests such as verbal fluency, with forty-five schizophrenic patients of varying ages and severity and chronicity of illness. They found substantial impairment on all the semantic tests, which was present even in-patients without overall intellectual impairment. As would be predicted on the basis of previous studies of memory in schizophrenia, McKenna, Mortimer & Hodges, (1994) showed in a preliminary analysis that the pattern of impairment was more consistent with "impaired access" than with "degraded store". This reflects a poorly organised semantic memory store or the use of inadequate organisational strategies in recall. Similar findings were reported by Mitrushina, Abara & Blumenfeld, (1996) using a memory task, and by Joyce, Collinson & Crichton, (1996) using verbal fluency tests. These authors also comment on the similarity between the pattern of deficits on these tests in schizophrenia and in disorders of the frontostriatal system including Huntingtons chorea and Parkinson's disease.

The above review of memory deficits in schizophrenia points to a malfunctioning of executive control systems or to subsystems essential for executive control. Such disturbances are most apparent in-patients with damage to the frontal lobes (Stuss & Benson, 1984). Although there is great variability in the extent and degree of impairment in patients with frontal lobe damage, certain features are highly characteristic. Rylander, (1939) described them as disturbed attention, increased distractibility, and a difficulty in grasping the whole of a complicated state of affairs. He also pointed out that such patients are well able to work along routine lines, but that they cannot learn to master new types of tasks. There is a large literature using putative tests of executive functioning such as the Wisconsin Card Sorting Test (WCST) with schizophrenic samples (Goldberg & Gold, 1995; McKenna, 1994). Schizophrenics almost invariably show poor performance on this test and it is assumed that this reflects frontal dysfunction. Rabbitt, (1997) points out the error of this line of reasoning arguing that it would be a mistake to think that particular tasks would define executive function. Furthermore, tests such as the WCST are complex for any subject to understand and carry out, and this in itself may result in poor performance, rather than a specific

failure of executive functioning (Stratta, Daneluzzo, Prosperini, *et al.*, 1997). Burgess, (1997) points out the paucity of conceptual thinking and theorising in this area saying that executive functions receive little coverage in theoretical neuropsychology texts, but they receive much more attention in rehabilitation texts since executive dysfunction creates such havoc and poor prognosis.

Despite the drawbacks of the WCST, a brief mention will be made of some studies that have used it and that are relevant to the present review. Shallice, Burgess & Frith, (1991) undertook an intensive study of five patients with schizophrenia using a comprehensive range of tests covering most areas of cognitive function. The patients varied greatly in terms of their general intelligence. However, all patients, whatever their overall ability, performed badly on at least some of the tests which are sensitive to frontal lobe lesions. The authors conclude that these results suggest impairment of the supervisory attention system in these patients. Similar results have been reported by Morice & Delahunty, (1996).

The renewal of interest in executive function and dysfunction (Baddeley, Della Salla, Gray, *et al.*, 1997; Burgess, 1997; Phillips, 1997; Rabbitt, 1997) has lead to the development of a number of new assessment instruments. These include the Hayling and Brixton Tests (Burgess & Shallice, 1997) and the Behavioural Assessment of the Dysexecutive Syndrome (BADS) (Wilson, Alderman, Burgess, *et al.*, 1996; Wilson, Evans, Alderman, *et al.*, 1997). The Hayling and Brixton Tests were designed to measure a number of abilities that are commonly impaired in executive dysfunction, such as basic initiation speed and performance on a response suppression task. The BADS was designed as a way of predicting everyday problems with executive functioning. The authors stress the importance of having a functional definition of such problems as opposed to the specification of a syndrome in terms of localisation as in 'frontal lobe syndrome' (Baddeley & Wilson, 1988). The BADS consists of six subtests, which are all designed to simulate real life tasks which are require intact executive functioning for their successful completion.

Evans, Chua, McKenna, *et al.*, (1997) used the BADS to test matched groups of thirty-one schizophrenic patients, thirty-five brain injured patients and twenty-

six controls. Both the schizophrenic and brain injured patients were impaired on most of the tests, and there were no significant differences between the two patient groups. Significant impairment on some, but not all the tests, continued to be found among a subgroup of 16 schizophrenic patients who showed intact general intellectual functioning.

A number of studies have examined the feasibility of improving the performance of schizophrenics on the WCST using interventions such as detailed instructions or monetary reward (Delahunty, Morice & Frost, 1993; Green, Satz, Ganzell, *et al.*, 1992; Metz, Johnson, H, *et al.*, 1994; Young & Freyslinger, 1995). The interventions were effective, and in most studies persisted after the intervention was withdrawn. There again appear to be some parallels between schizophrenia and subcortical dementia in this respect. Hodges, (1994) states that it is easy to overestimate the degree of cognitive impairment in-patients with subcortical dementia, and performance usually improves with persistence. This also appears to be the case in schizophrenia (Green, 1993).

Of all types of cognitive dysfunction in schizophrenia, attention has received the most study over

the past one hundred years (Cromwell, 1975; Huston & Shakow, 1937; Kraepelin, 1913; Lang & Buss, 1965; McGhie & Chapman, 1961; Nuechterlein & Dawson, 1984; Nuechterlein, Dawson & Green, 1994; Steffy & Oakman, 1997; Wishner, 1955). The concept of attention as central to human performance extends back to William James (James, 1890) and the birth of experimental psychology. For many years there has been a debate about the role of attention in mental life. Robertson, Ward, Ridgeway, *et al.*, (1994) point out that while some have regarded attention as a semi-independent controller of action and perception (Pashler, 1992; Posner & Petersen, 1990), others have argued that supramodal attentional control systems do not exist, and that existing attentional systems are highly modality specific (Allport, 1992). At present the balance of opinion favours the former position, with the caveat that modality specific attentional systems also exist side by side with the supramodal systems (Robertson, *et al.*, 1994)
The Supervisory Attentional System (SAS) mentioned earlier in this document is an example of such a supramodal attentional control system.

Posner & Petersen, (1990) argue that attention consists of at least three separate systems, a selection

system responsible for selecting relevant stimuli/processes and inhibiting irrelevant ones, a vigilance system responsible for maintaining readiness to respond in the absence of external cues and an orientation system responsible for engaging, moving and disengaging attention in space. Robertson, *et al.*, (1994) suggest that different aspects of the selection system can be measured such as attentional switching and divided attention. They also conclude that working memory is another separately identifiable component of the attentional system.

Precise interpretation of the vast literature on attentional deficits in schizophrenia is difficult due to the enormous range of different tasks and methodologies used (Goldberg & Gold, 1995; Steffy & Oakman, 1997). Tests are used which are purported to measure a particular function, without any independent validation that they do measure it (Robertson, *et al.*, 1994). Although as Steffy & Oakman, (1997) point out, no one model of attention deficits in schizophrenia fits all the data, certain findings emerge with great regularity (Bernard, Lancon & Bougerol, 1997; Goldberg & Gold, 1995; Tollefson, 1996). These include deficits in sustained and selective attention. For example schizophrenics find it

hard to maintain a preparatory response set (measured by cued simple reaction time tasks), and a deficit in maintaining attention to relevant information while disregarding unimportant material. It is possible that these deficits are due to a lack of mental energy rather than to specific information processing deficits (Schmand, Kuipers, Van der Gaag, *et al.*, 1994). However it is likely be that both factors play a role (Everett, Laplante & Thomas, 1989). As is frequently the case with attentional disorders (Lezak, 1995), speed of processing and responding is also impaired. Finally, there is some evidence that schizophrenics show a deficit in the orientation system, finding it harder to respond to targets in the right visual field if these are not cued (Posner, Early, Reiman, *et al.*, 1988).

Many studies of attention in schizophrenia have not assessed whether the deficits are disproportionate to overall intellectual decline (Steffy & Oakman, 1997). Those that have assessed this have shown that they are disproportionately affected (Goldberg & Gold, 1995). Many of these studies have used the Continuous Performance Test (CPT) to measure attentional functioning in schizophrenics. The CPT presents briefly flashed visual stimuli (numbers or letters) throughout a lengthy series

of trials, each approximately of 1-second duration. Each display is presented for a brief fixed period (usually a half-second), with subjects signalling their detection of infrequently occurring targets (typically one out of five trials) by a button press. There is still some controversy over what exactly the CPT measures. Nuechterlein & Subotnik, (1998) argue that it reflects early perceptual discrimination ability. Others present evidence that it partly reflects motor speed (Walker & Green, 1982), or motor speed and response variability (Van den Bosch, Rombouts & van Asma, 1996). It is most commonly used as a measure of both visual vigilance (sustained attention) and of selective attention, and correlates with other measures of these functions (Steffy & Oakman, 1997). Frith, Leary, Cahill, *et al.*, (1991) found that compared with the matched normal controls the schizophrenic patients made many more omission errors on the CPT. The schizophrenic patients also found it difficult to suppress inappropriate responses and a subgroup made a great many such errors. These problems were not simply a consequence of low IQ since even in a subsample with IQs over 90, the deficits on the CPT remained.

Kenny & Meltzer, (1991) make the point that a number of researchers (e.g. Nuechterlein & Dawson, (1984); Oltmanns, (1978); Oltmanns & Neale, (1975)) have suggested that attentional deficits in schizophrenia may be a principal cause of deficits in higher cortical functions, including recently acquired long term memory recall (Koh, 1978; Neale & Oltmanns, 1980), lack of persistence in problem solving and difficulty with implementing goal directed activity (White, 1965). Oltmanns, (1978) argues that distractibility may interfere with the organisational aspects of memory and with the utilisation by schizophrenic patients of "active mental operations such as rehearsal". Reviews by Gjerde, (1983) and Nuechterlein & Dawson, (1984) have implicated deficits in sustained attention, focussed attention and attention span as possible causes of impaired recall memory in schizophrenia. They argue that these attentional deficits interfere with the processes of encoding, rehearsal and retrieval. A large study by Gold, Hermann, Randolph, *et al.*, (1994) compared neuropsychological performance of patients with schizophrenia to patients with either left or right temporal lobe epilepsy to determine if lateralised, developmental temporal lobe epilepsy provides a model of the cognitive impairments observed in schizophrenia. They

found that the tests that differentiated the schizophrenic group from both temporal lobe epilepsy groups generally involve some kind of manipulation and sequencing of information, as in performing arithmetical computations or in the Trail Making Test and the WCST. In addition they found that the WCST did not contribute to a discriminant function analysis (schizophrenia versus temporal lobe epilepsy) after the attentional measures had been entered. They suggest that impairments at simpler levels of information maintenance and manipulation may underlie the breakdown of more complex cognitive operations. They conclude on the basis of their findings that the attentional impairment cannot be explained solely on the basis of temporal lobe abnormalities, and that there is a distinctive frontal contribution to the impairment observed in schizophrenia in the form of attentional dyscontrol.

Kenny & Meltzer, (1991) also set out to evaluate the role of attention in the cognitive abnormalities of schizophrenia. They administered a comprehensive neuropsychological battery assessing various aspects of attentional functioning, episodic recall memory, remote semantic memory and executive function, to groups of schizophrenics and normals. They found that controlling

for attentional performance by analysis of covariance had very little effect on the differences between schizophrenics and normal controls in regard to recently acquired long-term episodic memory recall or remote semantic memory retrieval. On the other hand, differences between the patients and controls on the percent perseverative response of the WCST were eliminated. On the basis of this, the authors suggest that deficits in attention may not underlie impaired recall of newly acquired information in schizophrenia or in the retrieval of information from remote, semantic memory, even under circumstances requiring more effortful processing. However, the data strongly suggests a contribution of attentional deficits to an aspect of executive dysfunction (perseveration) in schizophrenia. This conclusion is consistent with Shallice's (Shallice, 1982) account of executive dysfunction as an impairment of attentional control.

In conclusion it appears that deficits in executive function in schizophrenia are due to disturbances in attentional functioning. As for memory functioning there is evidence that attentional disorders play a major role here too (Duffy & O'Carroll, 1994; Hawkins, Sullivan & Choi, 1997; Perlick & et al., 1986), though pure amnesia

may also be part of the picture for some patients (Calev, Venables & Monk, 1983; Kenny & Meltzer, 1991).

Summary of Section One

A summary of the main points in Section One is as follows. The level of overall cognitive impairment is variable in schizophrenia, with many individuals showing a large decline in general intelligence after illness onset. However, even in those with intact general intelligence there is often evidence of differentially impaired attentional functioning, which is also apparent before illness onset. Deficits of executive functioning are most likely due to failures in subsystems necessary for executive control. These include attentional subsystems and those involved in response initiation and suppression. Memory deficits are also common in schizophrenia. However, there is some dispute about whether they are due to attentional disturbances (resulting in poor encoding, rehearsal and retrieval), or whether they are a consequence of loss of material from memory. Finally, there appear to be considerable similarities between the pattern of cognitive impairments in schizophrenia and subcortical dementias.

SECTION TWO

THE RELATIONSHIP BETWEEN COGNITIVE DEFICITS AND A RANGE OF KEY VARIABLES

In Section One the focus was on the evidence for the existence of disproportionate cognitive deficits which might be a fundamental part of the illness of schizophrenia. However from one perspective it is clear that performance on objective cognitive tests may be affected by a host of nuisance factors which may act individually or in concert. These variables include the distracting effects of symptoms, the disruptive effects of behavioural problems, the non-specific debilitating effects of having a severe illness, the chronicity of the illness, the side effects of medication, the poverty or overstimulation of the patient's everyday environment, alcohol and drug problems, concurrent physical and mental illnesses, sensory and motor problems, emotional distress, poor motivation, and a lack of interest in the testing procedure. From a second perspective, the demonstration of lawful relationships between particular cognitive deficits and specific variables (such as symptoms) may further our understanding of both domains and help clarify the nature of the illness. The review

below covers both perspectives, looking at each set of relevant variables in turn.

A third question of whether specific cognitive deficits actually cause specific symptoms and the mechanisms by which this may occur is largely beyond the scope of this review. A number of authors have made interesting attempts to build models of this type (Frith, 1993; Gray, 1995; Hemsley, 1977; Hemsley, 1994; McKay, McKenna & Laws, 1996; Mortimer & McKenna, 1994), with rather limited success so far (McKenna, 1994). Finally, this review does not attempt to cover the literature on other variables relevant to the above issues, such as structural or functional cerebral abnormalities (Chua & McKenna, 1995) or neurological soft signs (Malla, Norman, Aguilar, *et al.*, 1997).

THE RELATIONSHIP BETWEEN COGNITIVE IMPAIRMENT AND ILLNESS CHRONICITY

What is the relationship between illness duration and cognitive impairment? Relevant studies are those which look at the course of cognitive functioning after illness onset, but to gain a fuller understanding it is also important to look at premorbid functioning, and the

functioning of those deemed to be at risk of developing schizophrenia. Premorbid functioning in those at high genetic risk for schizophrenia has been intensively studied in a number of prospective longitudinal studies (Asarnow, 1988; Cannon & Mednick, 1993; Erlenmeyer Kimling & Cornblatt, 1978; Erlenmeyer Kimling & Cornblatt, 1984; Erlenmeyer Kimling & Cornblatt, 1987; Erlenmeyer Kimling & Cornblatt, 1992; Erlenmeyer Kimling, Cornblatt, Rock, *et al.*, 1993; Mirsky, Kugelmass, Ingraham, *et al.*, 1995; Rutschmann, Cornblatt & Erlenmeyer Kimling, 1986). Attentional deficits are present from an early age in these samples. Only two of these studies have assessed memory functioning, one finding there was no evidence of recall memory deficits (LaPorte, Kirkpatrick & Thaker, 1994), while the other study found that a subset of high risk children who displayed memory difficulties were more likely to become ill and be hospitalised as adolescents (Erlenmeyer Kimling & Cornblatt, 1987).

Premorbid social competency is variable in these samples, but almost half show normal functioning (Siever, 1995). The remainder either show problems of behavioural withdrawal, or of overactivity and behavioural problems often apparent in the primary school years. These may be

premorbid equivalents of negative and disorganised symptoms respectively (Cannon & Mednick, 1993).

Studies on adults in the general population deemed to be at risk for schizophrenia because they score highly on various measures of schizotypy show similar findings. Deficits on the Continuous Performance Test (CPT), which measures both sustained and selective attention (Steffy & Oakman, 1997) are impaired compared to matched normals, but significantly better than those of schizophrenics (Josiassen, Shagass, Roemer, *et al.*, 1985; Suhr, 1997) (Chen, Hsiao, Hsiao, *et al.*, 1998; Claridge, Clark & Beech, 1992; Franke, Maier, Hardt, *et al.*, 1994; Hazlett, Dawson, Filion, *et al.*, 1997; Lenzenweger, Cornblatt & Putnick, 1991; Obiols, Clos, Corbero, *et al.*, 1992; Obiols, Garcia Domingo, de Trincheria, *et al.*, 1993; Raine, Benishay, Lencz, *et al.*, 1997; Roitman, Cornblatt, Bergman, *et al.*, 1997; Spaulding, Garbin & Dras, 1989). This population is also impaired on the WCST, and on the use of semantic organisational strategies to aid free recall memory, but is not impaired on tests of general intelligence (Lenzenweger & Korfine, 1994; Suhr, 1997; Trestman, Keefe, Mitropoulou, *et al.*, 1995).

First degree relatives of schizophrenics are another relevant risk group. Disorders of attention, abstraction and verbal recall memory have been shown in symptom free members of this population (Faraone, Seidman, Kremen, *et al.*, 1995). Goldberg, Torrey, Gold, *et al.*, (1993) found mild episodic verbal memory deficits in monozygotic twins who were discordant for schizophrenia, and not displaying any evidence of symptoms.

It appears that premorbidly most schizophrenics had relatively normal premorbid IQs and performed relatively well in school, despite findings of subtle deficits in aspects of attention, and possibly in other areas that have as yet received little study such as memory, abstraction and set shifting (Goldberg & Gold, 1995).

Evidence that illness onset results in intellectual decline has existed for many years (Aylward & al, 1984; Payne, 1973), but is still disputed by some (Russell, Munro, Jones, *et al.*, 1997). However the above findings from prospective longitudinal studies should put the issue beyond reasonable doubt. First episode schizophrenics typically show a pattern of impairment that is little different from chronic patients (Albus, Hubmann, Ehrenberg, *et al.*, 1996; Bilder, Lipschutz-

Broch, Reiter, *et al.*, 1991; Hoff, Riordan, O'Donnell, *et al.*, 1992; Saykin, Shtasel, Gur, *et al.*, 1994), with the exception of one study (Mitrushina, Abara & Blumenfeld, 1996). Cross sectional studies of patients of varying chronicity and age also show no difference in overall intellectual impairment, attentional, executive or memory functioning (Goldstein & Zubin, 1990; Heaton, Paulsen, McAdams, *et al.*, 1994; Hyde, Nawroz & Goldberg, 1994; Lindenmayer, Negron, Shah, *et al.*, 1997; Mockler, Riordan & Sharma, 1997).

The relatively small proportion of schizophrenics who have low IQs premorbidly tend to have an earlier onset of illness. This group is important because they have a much worse prognosis after illness onset (Jones, Guth, Lewis, *et al.*, 1994). Apart from this group, age of onset displays little relationship with the severity of cognitive impairment, except that learning abilities may be less impaired with onsets over forty five years old (Heaton, Paulsen, McAdams, *et al.*, 1994).

Thus the decline in cognitive functioning from premorbid levels appears to occur around about the time of illness onset, and cognition does not deteriorate further after that. More detailed studies are required to

plot the course of cognitive decline and its links with the prodromal phase of the first episode (as has been done for the development of symptoms by Hafner, Maurer, Loffler, *et al.*, (1994)).

In contrast to above studies which were specifically designed to assess whether illness duration is related to cognitive impairment (including memory impairment), a number of other studies using less systematically selected samples generally appear to show that chronicity is correlated with memory impairment (Levin, Yurgelun Todd & Craft, 1989; McKenna, Tamlyn, Lund, *et al.*, 1990; Seidman, 1983; Tamlyn, McKenna, Mortimer, *et al.*, 1992), with some exceptions such as Goldberg, Gold, Greenberg, *et al.*, (1993). Some authors argue that chronic schizophrenic patients show additional memory problems in the form of classical amnesia (Beatty, Jocic, Monson, *et al.*, 1993; Calev, Venables & Monk, 1983; Gold, Randolph, Carpenter, *et al.*, 1992; Mitrushina, Abara & Blumenfeld, 1996; Shoqeirat & Mayes, 1988). Calev, Venables & Monk, (1983) found that for patients with more than two years accumulated hospitalisation (described as "chronic patients") and for non-chronic patients (those with less than 2 years accumulated hospitalisation), there was evidence that memory performance was impaired by poor

encoding. However, the chronic patients also displayed a true memory deficit (i.e. a post encoding deficit). This was demonstrated by poor recall even for material that had been thoroughly encoded, a loss from memory of this material over a twenty four to forty eight hour period and a recognition memory deficit. Calev, Venables & Monk, (1983) found that there was no overall correlation between chronicity and memory impairment of any kind. He concluded that it was not chronicity per se which was related to amnesia, but rather the fact that the chronic patients were more severely disturbed. Unfortunately no symptom ratings were included in the study, so this conclusion must be regarded as tentative. Calev, (1984b) again found that most acute patients (defined as in his first study) did not show evidence of post encoding amnesia, except for a small subgroup. Calev, (1984b) comments that this subgroup were also taking antiparkinsonian medication, and that this might be the cause of their amnesia. On the basis of a previous review of the effects of these medications on memory, Calev, (1983) had concluded that this was unlikely. He again concluded, without any evidence from symptom ratings, that this subgroup displayed true amnesia because they were more severely disturbed. However he also states that this subgroup had lower IQs than the other acute

patients, and although he does not mention it as a possibility, this may have been a factor in their poor post encoding memory performance.

Other studies that have concluded that chronicity is related to the presence of classical amnesia suffer from similar limitations (Beatty, Jocic, Monson, *et al.*, 1993; Gold, Randolph, Carpenter, *et al.*, 1992; Shoqeirat & Mayes, 1988). Firstly there was no systematic representative sampling of patients in terms of chronicity. Secondly, it is not clear whether the chronic patients differ systematically from the non-chronic patients in other ways, particularly general intellectual decline, and type and severity of symptoms. Another possible biasing factor may be that the chronic patients tested in these studies were poor prognosis patients with higher levels of negative symptoms. Waddington, Scully, Coakley, *et al.*, (1996)and Waddington, Yousseff & Kinsella, (1995) assessed a group of elderly schizophrenics and found that higher negative symptom scores were predicted strongly by increasing duration of initially untreated psychosis, but not by the duration of illness after the initiation of antipsychotic medication.

THE EFFECTS OF AND PRESCRIBED MEDICATIONS ON COGNITION

The next issue to address is that of the relationship between prescribed medications and cognitive deficits. The range of medications used in schizophrenia is large, as is their mode of action and their potential side effects (Casey, 1995; Goff & Shader, 1995; Hirsch & Barnes, 1995a). Those most commonly used to treat symptoms include anti-psychotic medication (APM), minor tranquillisers, and antidepressant medication (ADM). Those most commonly used to treat the side effects of APM include anti-extrapyramidal syndrome medication (AEPSM) and beta-blockers. A broad distinction is made in the literature between traditional APM which produce extrapyramidal side effects (EPS), and the atypical APMs which are claimed to produce less EPS and less severe side effects of other kinds (Meltzer, 1997; Meltzer, 1995a).

There are several literature reviews concerning the neuropsychological effects of medications used to treat schizophrenia (Casey, 1995; Cassens, Inglis, Appelbaum, *et al.*, 1990; Corrigan & Penn, 1995; Goldberg, Greenberg, Griffin, *et al.*, 1993; Goldberg & Weinberger, 1994; King, 1990; Medalia, Gold & Merriam, 1988; Spohn & Coyne, 1993;

Spohn & et al., 1985; Spohn, Lacoursiere, Thompson, *et al.*, 1977; Spohn & Strauss, 1989). In summary there has been great variability and inconsistency in the reported effects of the traditional APMs on cognitive and psychomotor function in both patients and normal controls. Experimental design rather than any particular cognitive or psychomotor test appears to have determined the sensitivity to the detection of drug effects. In general, the more sedative classes of APMs depress psychomotor function and sustained attention, but higher cognitive functions are relatively unaffected. In the majority of studies, both cognitive function and attention improve with APM. Normal controls are more sensitive than schizophrenics to APM induced impairments. More recently Schroder, Tittel, Stockert, *et al.*, (1996) concluded that traditional APMs do not have consistent or prominent effect on memory. Gilbertson & van Kammen, (1997) found prominent effects of haloperidol (a traditional APM) on memory. It improved new learning, but tended to worsen remote verbal memory. AEPSM adversely affects memory due to its anticholinergic effects. Reviewing the literature Paulsen, Heaton, Sadek, *et al.*, (1995) concluded that higher AEPSM doses are correlated with poorer memory recall and more intrusions, and that schizophrenics on higher doses have a greater tendency to

confabulate producing a similar picture to that often found in patients with Alzheimer's disease or classical amnesia. However, in their own study the AEPSM dose was only of minor importance in accounting for the variance on these measures, so other factors related to illness itself matter also.

The conclusion that illness variables rather than medication side effects account for most of the variance in cognitive impairments receives direct support from studies of medication withdrawn or never medicated patients (Bergman, O'Brien, Osgood, *et al.*, 1995; Finkelstein, Cannon, Gur, *et al.*, 1997; Hoff, Riordan, O'Donnell, *et al.*, 1992; Hoff, Shukla, Aronson, *et al.*, 1990; McCreadie, Latha, Thara, *et al.*, 1997; Rubin, Holm, Moller Madsen, *et al.*, 1995; Saykin, Shtasel, Gur, *et al.*, 1994). Saykin, Shtasel, Gur, *et al.*, (1994) found that first episode APM naive patients (with an average duration of illness of two years) had almost identical neuropsychological profiles to medication free, but previously treated chronic patients (with an average duration of illness of nine years).

An association between tardive dyskinesia and cognitive impairments has been found in schizophrenia,

and there is controversy about whether APM causes both (Casey, 1995; Collerton, Fairbairn & Britton, 1985; DeWolfe, Ryan & Wolf, 1988; Myslobodsky, 1993). Most of the evidence supports the view that cognitive impairment (and not exposure to APM) is the main risk factor for tardive dyskinesia. McCreadie, Latha, Thara, *et al.*, (1997) tested a group of schizophrenics in India who had never received APM. They found evidence of poor memory (using the Weschler Memory Scale), that was related to the severity of negative symptoms. However, there was no association between poor memory and dyskinesia. The studies cited in the previous section showing that there are cognitive impairments similar to those found in schizophrenia in a variety of high risk populations who have never been exposed to medication also supports the view that medication is not a major determinant of the cognitive deficits.

The possibility that rapid treatment by APM in the early stages of illness may in fact ward off cognitive deterioration was mentioned above [(Waddington, Scully, Coakley, *et al.*, 1996; Waddington, Yousseff & Kinsella, 1995). Persistent, untreated psychosis may be inherently biologically toxic, leading to long term morbidity (Wyatt, 1991). Alternative explanations cannot be ruled

out at this stage. For example it is possible that the delay in treatment results from the fact that illnesses with an inherently poor prognosis (i.e. those with an insidious onset) are less obvious and therefore take longer to identify as being in need of help. Alternatively the social and psychological disruption of a long period of untreated psychotic illness may be responsible for the poor outcomes.

The atypical APMs have been hailed as offering greater hope for alleviating both negative symptoms and cognitive impairments in schizophrenia (Green, Marshall BD, Wirshing, *et al.*, 1997; Lee, Thompson & Meltzer, 1994; Meltzer, 1997; Meltzer, 1995b; Mortimer, 1997; Sharma & Mockler, 1998; Weinberger & Gallhofer, 1997; Williams, Baillie, Dickson, *et al.*, 1993; Zahn, Pickar & Haier, 1994). On the whole the studies provide support for the view that one of the atypicals, clozapine, has a direct beneficial effect on cognitive functioning, including measures of attention, working memory, memory and executive functioning. However, other studies (Goldberg, Greenberg, Griffin, *et al.*, 1993) indicate that clozapine has adverse effects on working memory and visual memory due to it's anti-cholinergic effect, and that it also impairs problem solving ability (measured by

the WCST). Many issues await clarification (Mortimer, 1997). For example the question of whether there are differential improvements in different cognitive functions, the timing of these benefits in relation to symptomatic and behavioural improvements, and the way clozapine produces these outcomes are not yet understood. Some authors argue that clozapine has a direct effect on cognitive functioning (Fujii, Ahmed, Jokumsen, *et al.*, 1997; Sharma & Mockler, 1998; Weinberger & Gallhofer, 1997), others that the benefits are partly mediated by improved symptoms and behaviour (Hagger, Buckley, Kenny, *et al.*, 1993; Zahn, Pickar & Haier, 1994) or simply because clozapine impairs peripheral motor functioning less than the traditional APMs (Casey, 1995). Neuropsychological measures are more likely to be used as routine outcome measures in future trials of APMs, including the newer atypicals (Green, Marshall BD, Wirshing, *et al.*, 1997; Purdon, Jones, Chouinard, *et al.*, 1998) in order to clarify these issues.

COGNITIVE IMPAIRMENT AND SYMPTOMS

There are many studies that aim to organise and make sense of both the symptoms of schizophrenia and their relationship to cognitive functioning. The literature is somewhat inconsistent, but some robust findings have emerged. A number of symptom rating scales for schizophrenia have been constructed over the past thirty years, including the Schedule for the Assessment of Positive Symptoms (SAPS) and the Schedule for the Assessment of Negative Symptoms (SANS)(Andreasen, 1982; Andreasen & Olsen, 1982), the Positive and Negative Symptom Scale (PANSS)(Kay, Fiszbein & Opler, 1987) and the Manchester Scale (Krawiecka, Goldberg & Vaughan, 1977). Factor analytic studies using these scales have resulted in a variety of factors and models (Andreasen, Arndt, Miller, *et al.*, 1995; Johnstone, Crow, Frith, *et al.*, 1978; White, Harvey, Opler, *et al.*, 1997). This is because there are several variables which can affect which factor structure is found, including medication status, overall clinical state (psychotic vs. residual vs. remitted), chronicity, age and gender, but unfortunately these have rarely been studied (White, Harvey, Opler, *et al.*, 1997)). The solution which appears most frequently and robustly contains three factors,

negative, disorganised and psychotic (Andreasen, Arndt, Miller, *et al.*, 1995). The negative factor includes symptoms of affective blunting and poverty of speech, the psychotic factor includes hallucinations and delusions, and the disorganised factor includes thought disorder, inappropriate affect and bizarre behaviour. The SANS and the SAPS and the PANSS include a small number of items rating or assessing cognitive functioning. The SANS has a subscale rating attentional functioning. Andreasen, Arndt, Miller, *et al.*, (1995) comment that this subscale is perhaps the most controversial among the symptoms that have been studied to date. Most of their evidence suggests it is most closely related to negative symptoms, but other data also suggest a link with the disorganised factor (Miller, Arndt & Andreasen, 1993). Andreasen, *et al.*, (1995) comment that the forthcoming revision of these scales will include a substantially revised and enlarged attentional section. White, *et al.*, (1997) tested a very large sample of schizophrenics using the PANSS and concluded that attentional and cognitive disorders formed a separate factor, which had some affiliation with negative symptoms. However they also discovered that there were some problems with the PANSS items attempting to measure disorganisation, which probably prevented a disorganised factor emerging. They

also found a reliable dysphoric mood factor consisting of items such as anxiety and depression. This factor had no relationship with the cognitive and attentional items.

A large literature investigating the relationships between symptom ratings and cognitive tests has produced somewhat confusing and rather inconsistent results (Addington, Addington & Maticka-Tyndale, 1991; Allen, Liddle & Frith, 1993; Bilder, Mukherjee, Rieder, *et al.*, 1985; Braff, Heaton, Kuck, *et al.*, 1991; Brekke, Raine & Thomson, 1995; Brown & White, 1992; Buchanan, Strauss, Breier, *et al.*, 1997; Buchanan, Strauss, Kirkpatrick, *et al.*, 1994; Cornblatt, Obuchowski, Schnur, *et al.*, 1997; Cuesta & Peralta, 1995; Dickerson, Ringel & Boronow, 1991; Faustman, Moses JA & Csernansky, 1988; Frith, 1993; Frith, Leary, Cahill, *et al.*, 1991; Green & Walker, 1986; Gureje, Aderibigbe & Obikoya, 1995; Hain, Maier, Klingler, *et al.*, 1993; Hammer, Katsanis & Iacono, 1995; Keilp, Sweeney, Jacobsen, *et al.*, 1988; Kolakowska, Williams, Jambor, *et al.*, 1985; Liddle, 1987; Liddle, 1995; Liddle & Barnes, 1990; Liddle & Morris, 1991; McKenna, Tamlyn, Lund, *et al.*, 1990; Morrison-Stewart, Williamson, Corning, *et al.*, 1992; Mortimer, Lund & McKenna, 1990; Norman, Malla, Morrison-Stewart, *et al.*, 1997; Nuechterlein, Dawson & Green, 1994; Nuechterlein,

Edell, Norris, *et al.*, 1986; Owens & Johnstone, 1980; Pandurangi, Sax, Pelonero, *et al.*, 1994; Pantelis & Nelson, 1994; Schroder, Tittel, Stockert, *et al.*, 1996; Strauss, Buchanan & Hale, 1993; Tamlyn, McKenna, Mortimer, *et al.*, 1992; Walker & Harvey, 1986). On the whole a similar pattern appears to emerge as that found in the symptom rating studies described above. Cognitive deficits are most consistently related to the negative and the disorganised factors. They are much less likely to be correlated with the psychotic factor, although there are exceptions including Norman, Malla, Morrison-Stewart, *et al.*, (1997) and Dickerson, Ringel & Boronow, (1991). A selection of these studies are outlined below, covering the relationship between the three symptom factors and global intellectual impairment, and their relationship with specific impairments of attention, memory, and executive functioning. The relationships are considered from both a cross sectional and a longitudinal perspective.

Mortimer, Lund & McKenna, (1990) investigated the links between general cognitive impairment and symptom dimensions with a diverse sample of schizophrenics. They found highly significant correlations between the Mini Mental State Exam (MMSE)(Folstein, Folstein & McHugh,

1975) and the SANS summary score. On the basis of further statistical analysis, Mortimer considers that this relationship may be artifactual. This issue is discussed further below. The MMSE was also significantly correlated with the disorganised factor. Addington, Addington & Maticka-Tyndale, (1991) administered a battery of neuropsychological tests to a group of acutely ill schizophrenic patients, and rated them using the SANS and the SAPS. The patients were reassessed six months later when they were in partial remission. Overall, the neuropsychological tests were more highly correlated with negative symptoms than with positive symptoms. Only two symptom factors, positive (which consisted of both psychotic and disorganised symptoms), and negative, were used in this study. Brekke, Raine & Thomson, (1995) studied a mixed sample of outpatients with diagnoses of schizophrenia and schizoaffective disorder. They found that poorer visuomotor processing performance was related to higher negative symptom scores. There was also a relationship between increased disorganisation symptoms and deficits in auditory attentional processing. No relationships were found between psychotic symptoms and any of the cognitive tests. On the basis of these findings and psychophysiological measurements, they suggest that disorganised symptoms could reflect an

inability to filter incoming information, and that negative symptoms may be associated with a protective withdrawal by the individual from an overwhelming environment. Cuesta & Peralta, (1995) studied a sample of recently admitted patients using symptom rating scales and a neuropsychological test battery. They found that the disorganised and negative factors were more strongly associated with cognitive disturbances than was the psychotic factor. Both disorganisation and negative symptoms were correlated with disturbances of visual motor processes. In addition the disorganised factor was associated with disturbances in language and verbal memory and in time controlled performance. The authors concluded that no clearly functional interpretations of the associations between the symptom factors and cognitive performance could be deduced from their results because the correlations although statistically significant were small. They argued that the results were best accounted for by the domains of psychopathology model of schizophrenia (Buchanan & Carpenter, 1994), and that the symptom factors and cognitive impairments are best conceptualised as independent dimensions. Tamlyn, *et al.*, (1992) using a diverse sample of schizophrenics found that memory impairment was significantly related to both the negative and the disorganised factor. A complex

study by Schroder, *et al.*, (1996) also found significant correlations between memory assessments and negative and disorganised symptom factors. The psychotic factor was significantly related to only one aspect of memory: delayed object recognition.

A number of studies have selected samples of schizophrenics with enduring negative symptoms ("deficit patients"). Buchanan, Strauss, Kirkpatrick, *et al.*, (1994) tested the hypothesis that deficit patients have impaired frontal lobe functioning. As predicted, they found that deficit patients performed worse than non-deficit patients on purported tests of frontal lobe functioning (such as the WCST), but not on tests said to be dependent on temporal lobe functioning, such as the Weschler Memory Scale (WMS). An earlier correlational study by Morrison Stewart, Williamson, Corning, *et al.*, (1992) had failed to support this hypothesis, finding that the WMS, rather than the WCST, correlated with the negative factor.

It may be possible to gain a better understanding of the link between symptom dimensions and cognitive impairment by examining the kind of errors made. Frith, Leary, Cahill, *et al.*, (1991) found that chronic

schizophrenics performed poorly on the Continuous Performance Test (CPT), verbal fluency, and a test of source memory. (The source memory test assessed patients' ability to distinguish between words presented and words not presented by the experimenter and their ability to distinguish between words that the patient had said in the preceding verbal fluency test and words that the patient has not said.) These results held even for a subgroup that had not suffered a decline of their general intellectual functioning. As in many of the studies cited above, psychotic symptoms had very little effect on performance, but both negative and disorganised symptoms were independently related to poor performance. There were qualitative differences between the two types of symptoms in the way they affected performance. Negative features tended to be associated with a failure to respond atall, and disorganised features were associated with a failure to inhibit inappropriate responses in the CPT, the production of unconventional responses on verbal fluency, and inappropriate attribution of source in the memory task. Frith concludes that these results not only suggest that objective correlates may be found for particular features of schizophrenia, but also raise hopes that the development of more sophisticated psychological tests can reveal the precise nature of the

cognitive deficits underlying these features. Similar patterns of results have been reported by other researchers (Allen, Liddle & Frith, 1993; Liddle & Morris, 1991; Pandurangi, Sax, Pelonero, *et al.*, 1994).

Mortimer, Lund & McKenna, (1990) are more sceptical on this point, arguing that the correlations between cognitive impairments and symptom factors may be an artefact of their joint affiliation with variables such as chronicity and severity of illness. The issue of chronicity was dealt with earlier in this section where it was concluded that duration of illness per se is not an important variable. Mortimer, et al (1990) found that controlling for overall severity of illness made correlations between the cognitive tests and the negative symptom factor become non-significant. The correlation between the cognitive tests and the disorganised factor remained significant. Overall severity of illness was measured using the Global Assessment Scale (GAS)(Endicott, Spitzer, Fleiss, *et al.*, 1976). The GAS does not confine itself to assessing overall symptom severity, but it combines judgements about psychopathology, behavioural disturbance and social functioning which are all rated on one single 0-100 scale. The best level of recent functioning was used. The

drawback of this method is that overall severity of illness is not an independent dimension. The multiple determinants of overall severity ratings, especially the social functioning component, constitute a major research question in their own right (Clifford, 1996). In most samples of schizophrenics, severity ratings are likely to share substantial variance with negative symptoms (Dickerson, Boronow, Ringel, *et al.*, 1996; Laroche, Hodgins & Toupin, 1995), cognitive deficits (Green, 1996) and to a lesser extent with positive symptoms, except in acute psychotic crises when they will play a larger role (Corrigan & Addis, 1995; Hwu, Tan, Chen, *et al.*, 1995). The effect of partialling out severity will depend on the symptom and cognitive profile of the particular sample of patients used in a study. For example, in samples where negative symptoms are a major source of the variability in the severity rating, partialling out severity is likely to remove the correlation between negative symptoms and cognitive tests. This may be why the results of partialling out overall severity are so variable. For example Tamlyn, *et al.*, (1992) found that controlling for severity (measured by the GAS) did not affect the correlation between memory and negative symptoms. Goldberg, Greenberg, Griffin, *et al.*, (1993), Hoff, Riordan, O'Donnell, *et al.*, (1992) and Liddle & Morris,

(1991) also concluded that there was little evidence that overall severity of illness affected neuropsychological test scores.

One area of research that is likely to clarify these relationships is longitudinal research on schizophrenic samples, similar to that carried out on high risk children described earlier. Such studies look at how symptom factors, cognitive functioning, overall severity and other variables covary from the psychotic state to the remitted state and vice-versa (Addington, Addington & Maticka-Tyndale, 1991; Bilder, Lipschutz-Broch, Reiter, *et al.*, 1991; Brekke, Raine & Thomson, 1995; Cornblatt, Obuchowski, Schnur, *et al.*, 1997; Morris, Granholm, Sarkin, *et al.*, 1997; Mortimer, 1997; Mortimer & McKenna, 1994; Neuchterlein, Dawson, Gitlin, *et al.*, 1992; Rund, Landro & Orbeck, 1997; Spaulding, Sullivan, Weiler, *et al.*, 1994). Brekke, Raine & Thomson, (1995) make the additional point that studies to date have rarely tested specific hypotheses about the three factor model of symptoms in relation to cognitive variables, and that this should be done using prospective designs. There are both consistencies and inconsistencies in the findings to date (Addington, Addington & Maticka-Tyndale, 1991; Brekke, Raine & Thomson, 1995). Nuechterlein, Edell,

Norris, *et al.*, (1986) found that cognitive and attentional deficits were associated with higher negative symptoms across acute and remitted clinical phases, and therefore may be core or trait like aspects of these symptoms.

COGNITIVE IMPAIRMENT AND ILLNESS STAGE

In addition to looking for relationships between cognitive performance and symptoms some researchers are attempting to identify specific cognitive impairments which are present in the both the premorbid and remitted states, and that do not covary with symptom severity. A hypothetical cognitive impairment of this type is referred to as a "stable vulnerability factor" and conceptualised as either a non-causal marker of vulnerability to illness, or part of the causal chain leading to symptom formation under certain circumstances (Nuechterlein, Dawson & Green, 1994; Nuechterlein, Edell, Norris, *et al.*, 1986; Nuechterlein & Subotnik, 1998; Rund, Landro & Orbeck, 1997; Spaulding, Sullivan, Weiler, *et al.*, 1994). This model also acknowledges that some cognitive deficits may be related to clinical state. A deficit which is present in the premorbid or remitted

state but which worsens with clinical deterioration is referred to as a "mediating vulnerability factor". A deficit that only appears during clinical deterioration is referred to as an "episode marker". A number of cognitive measures have been proposed as stable vulnerability factors including sustained visual selective attention (CPT)(Cornblatt, Obuchowski, Schnur, *et al.*, 1997; Nuechterlein, Dawson & Green, 1994; Nuechterlein, Edell, Norris, *et al.*, 1986), backward masking (Rund, Landro & Orbeck, 1997), long term memory (Rund, Landro & Orbeck, 1997), and working memory (Morris, Granholm, Sarkin, *et al.*, 1997). There are flaws in this research strategy that make interpretation of some results problematic. Firstly the studies use inconsistent criteria for defining a remitted state (Nuechterlein, Dawson & Green, 1994; Rund, Landro & Orbeck, 1997), presumably because it is very difficult to find samples with no symptoms except in the premorbid period. Most studies use the expanded Brief Psychiatric Rating Scale (Luckoff, Nuechterlein & Ventura, 1986) but they do not analyse the separate influences of exacerbation of the disorganised, psychotic and negative symptom factors on cognitive performance. Since there is evidence that CPT performance does covary to some extent with changes in symptom factor severity, it behaves more

as a mediating vulnerability factor (Nuechterlein, Dawson & Green, 1994; Rund, Landro & Orbeck, 1997). This is consistent with the evidence that deficient CPT performance is correlated with the negative and disorganised factors (Frith, Leary, Cahill, *et al.*, 1991).

The strongest support for the description of attentional disturbances as stable or mediating vulnerability factors rather than episode factors is that attentional deficits are found in asymptomatic high risk populations (see Section One).

Rund, Landro & Orbeck, (1997) identified short term working memory as an episode marker rather than a mediating or a vulnerability marker. They noted that longitudinal studies indicate that failing short term memory is often an early sign of relapse (Nuechterlein, Dawson, Gitlin, *et al.*, 1992). This area of research is difficult to interpret since different researchers use different definitions and measures of working memory. What these tasks have in common is that they involve holding information in memory for periods of seconds while manipulating the information or performing a second task simultaneously. In some studies (Nuechterlein,

Dawson & Green, 1994; Rund, Landro & Orbeck, 1997) tasks such as the memory load version of the CPT, the reverse digit span, and the Short Term Memory test (Peterson & Peterson, 1959) are performed at a normal or near normal level by schizophrenics, except at times of exacerbation of positive symptoms. This conclusion is controversial. For example Fleming, Goldberg & Gold, (1994) argue that a disorder of working memory is a fundamental feature of the illness, and a major part of the attentional, encoding and planning deficits seen in schizophrenia.

COGNITIVE IMPAIRMENT AND PSYCHIATRIC DIAGNOSIS

Another area of research that can help illuminate the role of differential cognitive deficits in schizophrenia is the extent to which are they are specific to this diagnosis. This has received little attention so far (Mitrushina, Abara & Blumenfeld, 1996). Several investigators have compared cognitive deficits in schizophrenia and other mental disorders which share psychosis as a primary behavioural feature (Beatty, Jocic, Monson, *et al.*, 1993; Harvey, Earle Boyer, Wielgus, *et al.*, 1986; Harvey, Earle-Boyer & Levinson, 1988; Harvey, Keefe, Moskowitz, *et al.*, 1990; Moses,

1984; Rund & Landro, 1990; Taylor & Abrams, 1986). Schizophrenic and schizoaffective disorder patients do not differ considerably in their cognitive capabilities (Moses, 1984). However, compared with psychotic affective disorder patients, schizophrenics are considerably more impaired (Manschreck & Ames, 1984). Harvey, Earle Boyer, Wielgus, *et al.*, (1986) and Harvey, Earle-Boyer & Levinson, (1988) reported that deficient memory in schizophrenia resulted from ineffective coding, whereas no deficits in basic memory mechanisms were seen in mania. Memory deficits seen in manic patients appear to be a function of distractibility associated with positive thought disorder, which compromised their recall capacity. Mitrushina, Abara & Blumenfeld, (1996) compared patients from five psychiatric diagnostic groups, (all of whom were psychotic at the time of testing) on a neuropsychological test battery. They found differential impairments in memory (both pre and post encoding deficits) and abstract reasoning in schizophrenia and schizoaffective disorder which were greater than those found in the psychotic depression, mania and psychosis NOS samples. Goldberg, Gold, Greenberg, *et al.*, (1993) compared consecutively admitted patients with diagnoses of schizophrenia, unipolar depression and bipolar depression on a neuropsychological test battery. The

schizophrenics' performance was significantly below that of the other two groups. The schizophrenic group appeared to have deteriorated from a premorbid intellectual level that had been the same as the affective disorder groups. When levels of current IQ were controlled for between the groups, differences on problem solving and visual memory remained. Further analysis indicated that in the schizophrenic group cognitive impairment had greater impact on symptoms than did symptoms on cognitive impairment. The reverse pattern held for the affective disorder groups. The authors concluded that some negative symptoms (e.g. anergia) might be secondary to more basic cognitive failures, whereas the reverse was true for affective disorders.

The possible role of mood and anxiety symptoms on cognitive performance in schizophrenia has been relatively neglected. There is a large literature concerning the effects of both clinical and subclinical levels of depression and anxiety on cognitive performance in non-schizophrenic samples (Watts, 1995; Wells & Mathews, 1994). In general depressed and anxious groups have diminished processing resources, probably resulting in large part from their emotional preoccupations. Cognitive impairments in clinical depression are probably

a function of depressed mood rather than due to the depressive illness per se (Calev, Korin, Shapira, *et al.*, 1986; Wells & Mathews, 1994), and recovery from depression is accompanied by improved cognitive functioning. Anxious subjects tend to compensate for their diminished processing resources by more effortful processing and sometimes outperform normals. Depressed subjects in contrast show a failure to allocate processing resources to cognitive tasks, which compounds the problem created by the reduced resources they have available. There have been very few direct comparisons of the problems of depressed and anxious groups with those of other groups of people with memory difficulties (including classical amnesiacs and schizophrenia). It appears that depressed and anxious samples tend to overestimate their deficits on cognitive tasks, and thus complain more about their cognitive problems compared to other groups (Knight & Godfrey, 1995; Williams, Little & Blockman, 1987).

Both depression and anxiety are common in schizophrenia (McKenna, 1994; Siris, 1995). Few studies have assessed the possible impact of mood disorders on cognitive impairment in schizophrenia, even though they are an important potential confounding variable. In

addition there may be different types of depression in schizophrenia. One type of depression may be an intrinsic part of the illness especially during an acute stage or relapse, and another type can emerge as a chronic or recurring feature of long term patients (Birchwood, Mason, MacMillan, *et al.*, 1993; Siris, 1995). In one of the few studies of cognitive function in schizophrenia that assessed the influence of depressive symptoms Tamlyn, et al (1992) found that cognitive impairment (including memory functioning) was not correlated with the severity of depression.

Other potential confounding variables which are rarely measured in studies on cognitive functioning in schizophrenia include catatonic symptoms (Mortimer, Lund & McKenna, 1990), tardive dyskinesia (Williams, Baillie, Dickson, *et al.*, 1993), coping efforts and coping style (Andres & Brenner, 1989; Andres & Brenner, 1990; Boker, Brenner & Wurgler, 1989; Brenner, Hodel, Genner, *et al.*, 1992; Van den Bosch, 1994; Van den Bosch & Rombouts, 1997; Van den Bosch, Rombouts & van Asma, 1993; Van den Bosch, van Asma, Rombouts, *et al.*, 1992) and degree of co-operation with the testing procedure (Shakow, 1981). Several other important variables which were mentioned at

the start of this Section are covered in more detail in Section Three.

Summary of Section Two

A summary of the main points in this Section is as follows. The affiliations of cognitive deficits are complex. Chronicity per se does not appear to be a major influence. Severity of illness is an important factor and the presence of post encoding memory difficulties may be a function of this. However, severity is the end result of a number of influences and it is important to identify these separately and to understand their contributions. Of the three symptom dimensions in schizophrenia, the negative and disorganised factors show the most robust relationship with cognitive impairments. There is no consistent relationship with the psychotic factor. Attentional disturbances are present both before the onset of illness and in asymptomatic individuals at high risk for schizophrenia. There is tentative evidence that working memory is intact during premorbid and remitted states, and only deteriorates during periods of exacerbation of positive symptoms. Antipsychotic medication generally has a beneficial effect on cognitive functioning, whereas anti-cholinergic medication adversely affects attentional functioning and memory

encoding. Cognitive disorders appear to play a more fundamental role in schizophrenia than in other psychiatric illnesses including psychotic disorders and depression.

SECTION THREE

THE RELATIONSHIP BETWEEN COGNITIVE IMPAIRMENTS AND EVERYDAY FUNCTIONING

COGNITIVE IMPAIRMENTS AND COURSE AND OUTCOME

If cognitive deficits are core aspects of the illness, can they help us understand and predict the course and outcome of schizophrenia? To what extent can cognitive impairments account for the functional consequences of the illness i.e. the problems with sustaining self-care and social and occupational roles that are often so devastating? These questions cannot be properly addressed in isolation but need to be seen in the context of the range of research into the course and outcome in schizophrenia.

The course and outcome of schizophrenia is highly variable. In a review of the area Moller & Zersen, (1995)

point out that it is still not possible to derive a well rounded, comprehensive view of the course and outcome of schizophrenia because of a range of methodological problems with existing studies. These include varying methods of patient selection (because standardised instruments for diagnosis and for describing important characteristics of the sample have often not been used), varying consideration of factors which might influence the course and outcome, varying lengths of follow up, different follow up strategies, varying definitions of relapse (Falloon, Marsha, Boyd, *et al.*, 1983) and the use of a wide variety of often unstandardised outcome measures (Marengo, 1994). There is strong evidence that different areas of outcome such as symptomatology, hospitalisation rates, social and vocational functioning are semi-independent domains (Strauss & Carpenter, 1981). Therefore, in order to convey an accurate picture, outcome measures need to be fine grained and multidimensional. There has been a lot of progress with more precise and reliable methods of measuring symptoms and diagnosis, but work on standard instruments to measure everyday social functioning, activities of daily living and occupational functioning is only just beginning to catch up (Clifford, 1996; Harvey, Curson,

Pantelis, *et al.*, 1996; Munroe-Blum, Collins, McCleary, *et al.*, 1996; Wiersma, 1996).

Individual sufferers vary greatly in their level of impairments, disabilities and handicaps (Wing, 1995). In any one individual, it is difficult to predict the course that the illness will take, when an end state will be reached, and what degree of impairment will then be apparent (Johnstone & Lang, 1994; Rakfeldt & McGlashan, 1996).

There are a large number of potential influences on course and outcome operating at the biological, psychological and social levels, and at different points in the life cycle and illness cycle (Jablensky, 1995; Moller & Zersen, 1995; Warner, 1994). Predictors of course and outcome can be divided into a number of classes including sociodemographic variables and family background, characteristics of premorbid personality, preindex functioning, premorbid cognitive functioning, characteristics of the onset, characteristics of the initial clinical state, brain morphology, psychophysiological and biochemical measures, cognitive decline, differential cognitive deficits, previous and concurrent physical and psychiatric illnesses, illicit

drug and alcohol use, and treatment response (Jablensky, 1995). Factors which may modify the course and outcome include the family and social environment (Brown, Birley & Wing, 1972; Leff & Vaughn, 1985; Mirsky, Kugelmass, Ingraham, *et al.*, 1995), stressful life events (Bebbington, 1995) cultural and ethnic factors (Leff, Sartorius, Jablensky, *et al.*, 1992), the political economy (Warner, 1994), the type and quality of treatment and care (Hirsch & Barnes, 1995b; McGorry, Edwards, Mihalopolous, *et al.*, 1996), the patient's acceptance or compliance with treatment and care (McPhillips & Sensky, 1998), and the patient's coping strategies and their view of the illness (Fowler, Garety & Kuipers, 1995; Kingdon & Turkington, 1994).

The explanatory power of predictors is likely to vary depending on the setting, sample size, homogeneity of patient groups, number of predictor and dependent variables and measurement error, but generally it tends to be low (Jablensky, 1995). It is useful to observe the course of the illness in stages, starting from the premorbid period, followed by the prodromal stage, the onset of the first acute psychotic episode, the early period (the first five to ten years), the middle period, and the late period (Breier, Schreiber, Dyer, *et al.*,

1991). As in most illnesses including organic brain diseases (Lishman, 1987), premorbid factors such as personality, intelligence and general level of functioning are important influences on course and outcome in schizophrenia. The earliest sign of mental disorder is on average four years before the first acute admission. This usually takes the form of non-specific neurotic symptoms, often accompanied or followed by negative symptoms. On average individuals are suffering from positive symptoms of psychosis for two years before first admission (Hafner, Maurer, Loffler, *et al.*, 1994). There is good evidence that the longer the duration of psychosis before first treatment with APM the worse the course and outcome. There is tentative evidence that this may occur because periods of untreated psychosis leads to poorer response to treatment, more likelihood of relapse (Crow, MacMillan, Johnson, *et al.*, 1986; Lieberman & Sobel, 1993; Loebel, Lieberman, Alvir, *et al.*, 1992) and to the development of negative symptoms, cognitive deterioration, and the deficit syndrome (Waddington, Scully, Coakley, *et al.*, 1996). Possible alternative explanations which require further investigation include the fact that cases with rapid onset of psychosis tend to be have better prognosis than those with insidious onset, and that the former are likely to come to the attention

of services sooner and to be offered medication earlier (McGlashan & Johannessen, 1996; McGorry, Edwards, Mihalopolous, *et al.*, 1996). Those with an earlier age of onset of illness appear to fare worse. This may be because those with an earlier age of onset tend to have worse premorbid histories, or that earlier onset during adolescence is more disruptive of the development of a personal identity and social role. The fact that age of onset in males is three years earlier than for females may account for their greater morbidity. The social, functional and intellectual deterioration that occurs tends to take place in the early phase which covers the first five to fifteen years of illness (McGlashan & Johannessen, 1996). The risk of relapse is greatest during the period, but the relationship between relapse and deterioration remains unclear (Johnstone & Lang, 1994). The extent to which such continuing deterioration can be accounted for by a progression of the underlying pathology, or is secondary to the illness itself is unknown. The middle phase is generally a period of functional and social stabilisation with less likelihood of acute episodes. There is some evidence that social and intellectual functioning may improve in elderly patients in the late stage of illness (McGlashan, 1988).

The predictive power of certain variables varies according to the stage of illness. Negative symptoms occurring as measured at time of first admission, or during the early stage of illness tend to be poor predictors of later course and functioning. If measured two or more years after the first acute admission, and after adequate treatment of positive symptoms, they are better predictors of medium term course (Jablensky, 1995). On the other hand, the predictive power of variables such as a high expressed emotion environment, or the rapidity or insidious nature of first onset, become attenuated over time (Jablensky, 1995).

There is clear evidence that APM reduces the probability of acute psychosis, but there is more controversy about their effectiveness in reducing negative symptoms or cognitive impairments (Hirsch & Barnes, 1995a). Surprisingly the jury is still out on the role of APM in improving long term functional (social and occupational) outcomes (Hirsch & Barnes, 1995a; Warner, 1994). Social interventions have a clear benefit of reducing handicap and they probably reduce functional disability and the likelihood of relapse (Breier, Schreiber, Dyer, *et al.*, 1991; Strauss & Carpenter, 1981; Warner, 1994). A wide range of psychological

interventions have been used in attempts to improve both proximal and distal outcomes. Some of these are aimed primarily at functional deficits such as training in activities of daily living, and social skills training (Liberman, DeRisi & Mueser, 1989). Cognitive behavioural family interventions are mainly targeted at reducing relapse rates, and improving social functioning (Falloon, 1985). Individual cognitive behavioural therapy is usually aimed at improving coping with residual symptoms, and boosting confidence and self-esteem. Therapies are have recently been developed which attempt to overcome or compensate for cognitive deficits (Green, 1993; Nuechterlein & Subotnik, 1998; Spaulding, Storms, Goodrich, *et al.*, 1986). These approaches all hold promise and produce modest improvements in the targeted areas over and above medication alone (Kingdon & Turkington, 1998). Most of the follow up periods in the outcome studies are short term (two years or less), and so it is not yet clear whether these approaches can help the overall course of the illness, although one study shows promise of influencing the course of illness over longer periods (Tarrier & Barrowclough, 1995).

COGNITIVE DEFICITS AND FUNCTION

The next subsection examines the extent to which specific cognitive deficits can help explain the functional consequences of the illness (i.e. the problems with performing social and vocational roles and self-care activities) and whether objective cognitive testing can add to the prediction of the course and outcome of schizophrenia. Studies (Cancro, Sutton, Kerr, *et al.*, 1971; Zahn & Carpenter, 1978) using cognitive testing to predict clinical variables (such as severity of symptoms or time to recovery) will not be covered here. This area has been reviewed by Lieberman & Sobel, (1993).

A number of recent studies have found correlations between cognitive functioning and concurrent everyday functioning (Brekke, Raine, Ansel, *et al.*, 1997; Dickerson, Boronow, Ringel, *et al.*, 1996; Dickerson, Ringel & Boronow, 1991; Goldberg, Ragland, Fuller Torrey, *et al.*, 1990; Goldberg, Torrey, Gold, *et al.*, 1993; Kolakowska, Williams, Jambor, *et al.*, 1985; Mueser, Bellack, Douglas, *et al.*, 1991; Mueser, Blanchard & Bellack, 1995; Penn, Spaulding, Reed, *et al.*, 1997; Perlick, Mattis, Stastny, *et al.*, 1992a; Velligan, Mahurin, Diamond, *et al.*, 1997; White, Farley & Charles, 1987).

Earlier studies reviewed by Heaton, Baade & Johnson, (1978)and Heaton & Crowley, (1981)), used rather global measures of cognitive functioning, such as IQ. In a recent review of the area Green, (1996) points out that this approach leads to unhelpful global conclusions such as "smarter patients function better than duller patients". He argues that the challenge in this area is to evaluate whether specific cognitive processes are linked to specific functional outcomes. Kolakowska, Williams, Jambor, *et al.*, (1985) used a comprehensive neuropsychological test battery to assess a large heterogeneous sample of chronic schizophrenics. They found strong associations between cognitive impairment and rated outcome based on a combination of symptom severity and impairment of everyday functioning. Goldberg, Ragland, Fuller Torrey, *et al.*, (1990) tested a small sample of chronic schizophrenics using a similar battery. They reported highly significant correlations between the Global Assessment Scale (GAS) and the neuropsychological tests, which included IQ, attentional measures such as the CPT and Stroop test, and recall memory measures. Similar findings were reported by Goldberg, Torrey, Gold, *et al.*, (1993) using another small sample of schizophrenics. White, Farley & Charles, (1987) using a sample of fourteen chronic schizophrenic

reported significant correlations between what they described as an attentional measure (simple reaction time) and scores on a ward activity scale. Dickerson, Ringel & Boronow, (1991) also found highly significant correlations between neuropsychological test scores and measures of task oriented ward activity.

The above five studies did not test for links between specific cognitive functions and specific concurrent areas of everyday functioning. In contrast the following studies make some attempt to do so. Penn, Spaulding, Reed, *et al.*, (1997) review three studies investigating the relationship between information processing and social functioning in schizophrenia. The most consistent finding was an association between selective attentional performance on a test combining the CPT and the Span of Apprehension Test, and various indices of social functioning, such as participation in ward activities. Dickerson, Boronow, Ringel, *et al.*, (1996) administered a battery of neurocognitive tests and independently assessed symptoms (using the PANSS) and social functioning in eighty-eight stable outpatients with schizophrenia. They reported a significant correlation between neurocognitive and social functioning variables. After partialling out general intellectual

functioning, patients' performance on aphasia, spatial organisation and visual spatial tasks were correlated with their competence at activities of daily living, frequency of social activities and total social functioning. Brekke, Raine, Ansel, *et al.*, (1997) tested a sample of forty subjects diagnosed with a chronic schizophrenia spectrum disorder and living in community-based settings. Higher levels of independent living were associated with better visuo-motor and verbal processing. Increased work functioning was associated with better complex visuo-spatial processing. Mueser, Blanchard & Bellack, (1995) examined the relationship between social skill (SKK) and memory in study which included a group of twenty-one female and eighteen male patients with schizophrenia or schizoaffective disorder. Impaired memory was related to poorer SSKs for women, but not men. There were few or no differences between male and female patients in history of illness, symptomatology, memory, other cognitive factors, or SSK. Reanalysis of data on SSK and memory from an earlier study (Mueser, Bellack, Douglas, *et al.*, 1991) revealed a similar pattern of results. They concluded that the contribution of cognitive factors to impaired social competence in schizophrenia may differ in men and women. Perlick, Mattis, Stastny, *et al.*, (1992b) carried out one of the

few studies which has attempted to control for the possible influence of premorbid adjustment, as well as controlling for symptoms and current general intellectual function. They investigated whether specific neuropsychological functions discriminated schizophrenic patients who had been continuously hospitalised for more than eighteen months, from patients residing in the community without rehospitalisation for over three years. The two groups of twenty-six patients, matched for sex, ethnicity, socio-economic status and chronicity completed a comprehensive neuropsychological battery and responded to an inventory of psychopathology. They found that a composite measure of neuropsychological functioning was more effective than symptomatology, premorbid status, or age of onset, in discriminating between patients who remained continually hospitalised, and those who could return to the community. The most discriminating measures were those of motor co-ordination, perseveration memory, and attention.

Green, (1996) has provided a comprehensive review of the other relevant recent studies in three areas. Firstly, studies of correlations between cognitive functioning and current social skills in role playing tests, or ability to learn social skills in training

sessions (Bowen, Wallace, Glynn, *et al.*, 1994; Corrigan, Wallace, Schade, *et al.*, 1994a; Kern, Green & Satz, 1992; Lysaker, Bell, Zito, *et al.*, 1995; Mueser, Bellack, Douglas, *et al.*, 1991; Weaver & Brooks, 1964). Since Green's review a further relevant paper by McKee, Hull & Smith, (1997) has been published. Secondly, studies assessing the relationships between social problem solving and cognitive functioning (Bellak, Sayers, Mueser, *et al.*, 1994; Bowen, Wallace, Glynn, *et al.*, 1994; Corrigan, Green & Toomey, 1994; Penn, Mueser, Spaulding, *et al.*, 1995; Penn, Van Der Does, Spaulding, *et al.*, 1993). Thirdly, prospective studies that have looked at the ability of specific cognitive measures to predict future social and vocational functioning (Buchanan, Holstein & Breier, 1994; Goldman, Axelrod, Tandon, *et al.*, 1993; Jaeger & Douglas, 1992; Johnstone, Macmillan, Frith, *et al.*, 1990; Lysaker, Bell & Beam-Goulet, 1995; Wykes, 1994; Wykes & Carson, 1996; Wykes & Dunn, 1992; Wykes, Sturt & Katz, 1990). Two other studies ((Nuechterlein, Dawson, Gitlin, *et al.*, 1992; Van Os, fahy, Jones, *et al.*, 1995)), which were not included by Green, (1996), are also relevant to this area.

On the basis of the studies reviewed above and those reviewed by Green, (1996), some provisional conclusions

can be offered. This is despite the wide variation between studies in the cognitive tests and measures of functioning used.

The first conclusion is that secondary verbal memory is a strong predictor or correlate of all types of functional outcome (i.e. community functioning, psychosocial problem solving and psychosocial skill learning ability). Green, (1996) comments that the verbal encoding and mediation of daily activities are likely to be necessary for adequate instrumental role functioning in the community. Unfortunately it is unclear from these studies whether the memory deficits were at the encoding or post encoding stage. On the basis of the evidence cited in Sections One and Two above, it appears that Green's comment that the deficit is one of encoding is probably correct. It is also likely that attentional disorders underpin the encoding deficit. Attentional dysfunction as measured by the CPT was also a significant predictor or correlate of functional outcome, and has been shown to contribute to the variance in certain outcome measures independently of recall memory (Corrigan & Penn, 1995; Corrigan, Wallace, Schade, *et al.*, 1994b).

Therefore the second conclusion is that attentional disorders are probably the most powerful correlates and predictors of functional impairments. The abilities to sustain attention and to separate out relevant from irrelevant stimuli are likely to be important aspects of daily functioning and of the ability to learn new skills. As discussed in Section Two more severely ill patients may suffer additional functional impairments due to post encoding memory loss.

Performance on the WCST was consistently related to community functioning, inconsistently related to skill acquisition, and not related to social problem solving. There are several possible explanations for these patchy results. Green comments that they may be because skills of cognitive flexibility are more relevant to everyday functioning than they are to performance of structured assessments of social problem solving. He also speculates that the reason may be a lack of statistical power in some of the studies. An alternative explanation is that the WCST is a poor assessment tool because poor performance may be due to many different factors (Burgess, 1997; Stratta, Daneluzzo, Prosperini, *et al.*, 1997). A major factor underlying poor performance on this test in schizophrenics is attentional failure (Gold,

Hermann, Randolph, *et al.*, 1994; Kenny & Meltzer, 1991). The test may be a rather unreliable measure of attentional deficits, and this may account for the inconsistent pattern of results.

On the basis of most of the above studies, the possibility that a single generalised deficit could account for difficulties in both cognitive and functional domains cannot be entirely ruled out. On the other hand in the pattern of correlations there is no indication that patients who performed poorly on some measures tended to do so on all. Most of the cognitive measures had adequate ranges and variances, so the failure of some measures to correlate significantly with outcome measures cannot easily be explained by statistical artefacts.

Future studies should attempt to systematically control for a range of other variables that might underlie both cognitive impairments and poor everyday functioning. Most studies take account of age, chronicity, medication, and symptoms, but few control for premorbid functioning and premorbid IQ (Perlick, Mattis, Stastny, *et al.*, 1992b) or for coping efforts (Van den Bosch & Rombouts, 1997). No studies appear to have systematically measured other possible confounding

variables such as social circumstances, physical disability and ill health, and alcohol or drug abuse.

The relationship of symptoms to functional outcomes was surprisingly weak in the above studies. This was especially true of positive symptoms (including both the psychotic and disorganised dimensions). Clearly positive symptoms can be very disruptive of functioning during acute relapses. However, they appear to be much less disruptive for chronic stabilised patients, even those with fairly severe residual psychotic symptoms. On the whole, the relationships between negative symptoms and functioning were also rather weak, especially for community functioning. This is all the more surprising given that most negative symptom scales include items on everyday functioning. These items should artificially inflate the correlation between negative symptom scales and functional outcomes. One possibility is that negative symptoms are predictive of functional outcome to the extent that they are a consequence of cognitive impairment. Negative symptoms caused by other factors such as institutionalisation or demoralisation do not appear to be predictive (Spalletta, Pasini, De Angelis, *et al.*, 1997; Wykes, 1994; Wykes & Carson, 1996).

Another group of studies relevant to this area are those using prospective high-risk methodology (Cannon & Mednick, 1993; Cornblatt & Erlenmeyer Kimling, 1985; Cornblatt & Keilp, 1994; Cornblatt, Lenzenweger, Dworkin, *et al.*, 1992; Dworkin, Cornblatt, Friedmann, *et al.*, 1993). These show that attentional deficits as measured by the CPT are not only risk markers for schizophrenia, but that they are predictive of social deficits in high risk samples who remain clinically symptom free, as well as those who develop schizophrenia. For example, Dworkin, Cornblatt, Friedmann, *et al.*, (1993) found that in subjects at risk for schizophrenia, childhood neuromotor dysfunction predicted adolescent affective flattening, and childhood attentional dysfunction predicted adolescent social deficits. Such results lend weight to the view that neurocognitive dysfunctions are a fundamental component of the vulnerability to functional impairments in schizophrenics and in those at risk for schizophrenia.

ECOLOGICAL VALIDITY OF TESTS

Many existing measures of cognitive functioning have come in for criticism recently on the grounds that they lack ecological validity (Acker, 1989; Corrigan & Toomey,

1995; Wilson, 1993). These authors argue that traditional tests are useful for diagnostic issues, but give little or no information about the way the cognitive impairments affect the person's everyday life in terms of the distress and functional impairments they cause. Ecologically valid tests use carefully constructed everyday tasks to assess specific areas of ability, such as memory, attention and executive functioning. The aim is to produce assessments that have more face validity than traditional tests and are thus more acceptable to patients, relatives and staff, but which also result in a clearer picture of the patient's difficulties in particular areas of everyday life. Recent examples include The Rivermead Behavioural Memory Test (Wilson, et al, 1985), The Test of Everyday Attention (Robertson, *et al.*, 1994), the Behavioural Assessment of the Dysexecutive Syndrome (Wilson, *et al.*, 1996). These tests are clearly of great relevance to the issue of the relationship between specific cognitive impairments and functional outcomes. For example, they might be more predictive of daily functioning than are traditional tests, and they might give a clearer picture of how cognitive difficulties interfere with everyday functioning.

Is there any evidence that tests constructed to be ecologically valid are more highly correlated with functional outcomes than traditional tests are? There are very few relevant studies to date, either for schizophrenia or for samples with organic brain injury or disease. Corrigan & Toomey, (1995) argued that traditional information processing measures based on numbers, words and objects (N-W-O) lack ecological validity when considering social dysfunctions in schizophrenia. They found that specially constructed tests of social information processing were more ecologically valid than N-W-O tests in that they were significantly more powerful predictors of social problem solving. On the other hand, Clark & O'Carroll, (1996) found no relationship between a test of executive function constructed to be ecologically valid (the Modified Six Elements Test which is a subtest of the BADS) and everyday functioning as measured by the REHAB scale (Baker & Hall, 1983). Robertson, *et al.*, (1994), using a large sample of stroke patients, found significant correlations between various subtests of the Test of Everyday Attention and measures of functioning including the Extended Activities of Daily Living Scale (Nourri & Lincoln, 1987). No traditional measure of attention (including the Stroop Test and the PASAT)

correlated consistently with the functional measures. Schwartz & McMillan, (1989) found people with head injuries who were in employment scored more highly on the Rivermead Behavioural Memory Test than those who were unemployed.

It is unlikely that there will ever be a simple correspondence between cognitive impairments and functional outcomes (i.e. problems with activities of daily living, social, educational and occupational functioning). This applies even where the cognitive impairment is relatively circumscribed as in classical amnesia (Lishman, 1987; Marsh, Knight & Godfrey, 1990). As was mentioned earlier, this is because the causal chain from cognitive functioning to everyday functioning is long and variable. Cognitive functioning is only one of many factors that determine social role competence and performance.

A more direct approach to the problem of clarifying how cognitive impairments translate into everyday difficulties is to develop independent ratings and patient self-ratings of the functions in question. A number of rating scales (designed for use by a relative or a staff member who knows the person well) and self

rating questionnaires (assessing the person's view of their own cognitive functioning), have been designed over the past twenty years, covering the areas of memory, attention and executive functioning. A rating scale of everyday memory, for example, may require judgements about the accuracy and speed of various kinds of remembering, and the frequency of different types of memory lapse. These methods have been developed as part of the drive for ecologically valid objective tests. For example, if a test of memory is ecologically valid, it should correlate more highly with ratings of everyday memory problems than a traditional test would. Ratings and objective testing can also provide convergent validity for each other (Cuesta & Peralta, 1995). There are now a large number of rating scales of this type, most of which are available in both a self-rating and an independent rater format. Memory scales include the Everyday Memory Questionnaire (EMQ) (Sunderland, Harris & Baddeley, 1983b), the Subjective Memory Questionnaire (Bennett-Levy & Powell, 1980), the Inpatient Memory Impairment Scale (IMIS) (Knight & Godfrey, 1984), and the Memory Assessment Clinics Scales (MAC) (Crook & Larrabee, 1990; Winterling, Crook, Salama, *et al.*, 1986). Attention rating scales include the Rating Scale of Attentional Behaviour (RSAB)(Ponsford & Kinsella, 1991), the Test of

Attentional Style (Rombouts & Van den Bosch, unpubl), and the Cognitive Failures Questionnaire (Broadbent, Cooper, Fitzgerald, *et al.*, 1982). The Dysexecutive Scale (DEX) has been designed to rate problems with executive function in everyday life (Wilson, *et al.*, 1996).

There is now a fairly large literature on the relationship between objective cognitive tests and ratings of cognitive functioning in normals reviewed by Cohen (1996)and Harris & Morris (1984), normal elderly people reviewed by Gilewski & Zelinski, (1986), and Rabbitt, Maylor, McInnes, *et al.*, (1995) and samples with brain injury and brain disease reviewed by Knight & Godfrey, (1995). Studies of normals have focussed on self-ratings of memory and/or attention, and objective tests of these functions. Low to modest correlations are usually reported, but the interpretation of the results is complicated by a variety of factors. Some authors argue that many of the questionnaires and rating scales are poorly constructed, and that more reliable findings will result from better instruments used in conjunction with ecologically valid objective tests (Gilewski & Zelinski, 1986; Herrmann, 1983). It is clear from a number of studies using self ratings of memory and attention that the scores are biased by anxiety and

depressed mood both in normal populations (Broadbent, Cooper, Fitzgerald, *et al.*, 1982; Crook & Larrabee, 1990; Crook & Larrabee, 1992; Hood, MacLachlan & Fisher, 1987; Nideffer, 1976; Rabbitt, Maylor, McInnes, *et al.*, 1995), in the clinically depressed (Williams, Little & Blockman, 1987), and by symptoms of anxiety and depression in schizophrenia (Van den Bosch, Rombouts & van Asma, 1993). This results in an overestimation of the problems in comparison with independent ratings or objective cognitive tests.

Most of the studies of samples with head injures or brain disease have used both self-ratings and independent ratings of cognitive functioning. The following review focuses on tests constructed for ecologically validity. Wilson, Cockburn, Baddeley, *et al.*, (1989) used the RBMT to test a large mixed sample of head injured and stroke patients. The RBMT summary scores were highly correlated with a checklist of memory lapses recorded by staff over a two-week period. The RBMT scores were also significantly correlated with ratings of memory problems made by relatives, and with memory self ratings. The checklist and rating scales were all modified versions of the Everyday Memory Questionnaire (EMQ) (Sunderland, Harris & Baddeley, 1983b). Other studies using the RBMT

have produced similar results for head injured patients assessed using both the EMQ and the SMQ (Schwartz & McMillan, 1989), and for stroke patients using the EMQ (Lincoln & Tinson, 1989). Only relatives' ratings (EMQ) correlated with RBMT summary scores in a study of temporal lobectomy patients (Goldstein & Polkey, 1992), and a study of stroke patients (Sunderland, Stewart & Sluman, 1996).

In a large validation study of the BADS with brain injured individuals, Wilson, *et al.*, (1996) showed that it was significantly and highly correlated with a rating scale of executive functioning (DEX) completed by relatives/carers. Each subtest of the BADS was also significantly correlated with the independent DEX ratings. Correlations between DEX self-ratings and the BADS summary score and subtest scores were not significant. Evans, Chua, McKenna, *et al.*, (1997) replicated these findings with a smaller sample of head injured individuals. However in this study only three of the six BADS subtests were significantly correlated with the relatives' ratings.

In the validation study for the TEA Robertson, *et al.*, (1994) found a number of significant correlations

between stroke patients' TEA subtest scores and the RSAB completed by relatives. The correlation between objective tests and independent ratings are significant in most of the above studies (Goldstein & Polkey, 1992; Lincoln & Tinson, 1989; Robertson, *et al.*, 1994; Schwartz & McMillan, 1989; Sunderland, et al, 1996; Wilson, *et al*, 1989; Wilson, *et al.*, 1996), but correlations with self ratings are less robust, and often fail to achieve significance (Goldstein & Polkey, 1992; Sunderland, et al, 1996; Wilson, *et al.*, 1996). The most likely reasons for this are that the brain injured individuals have variable levels of insight into their deficits (Feher, Mahurin, Inbody, *et al.*, 1991; Goldstein & Polkey, 1992; Wilson, 1996), and the possibility that self ratings are more influenced by depression and anxiety than by the deficits themselves (Broadbent, et al, 1982 ; Crook and Larrabee, 1990; Crook and Larrabee, 1992; Rabbitt, 1995; Williams, Little & Blockman, 1987).

The jury is still out as to whether tests constructed to be ecologically valid are significantly better predictors of everyday cognitive functioning (Sunderland, et al, 1996), because direct comparisons with traditional tests using statistical significance

testing are rare (Corrigan & Toomey, 1995; Wilson, *et al.*, 1996).

There are few studies of everyday cognitive functioning in schizophrenia. There have been no published studies examining the relationship between objective memory tests and self or independent ratings of memory. There are no published studies which have been designed to test the ecological validity of objective attentional tests either for traditional tests or tests constructed to be ecologically valid. Studies using the SANS could potentially cast some light on this issue because the SANS contains a brief attention rating subscale. However the published studies have not separated out this subscale and have only analysed the correlations between total negative symptom scores and objective cognitive tests (Andreasen, Arndt, Miller, *et al.*, 1995). Van den Bosch, van Asma, Rombouts, *et al.*, (1992) examined correlations between an objective measure of attention (CPT) and self-ratings of attentional functioning. They used Test of Attentional Style which is a multidimensional measure of subjective attentional functioning (Rombouts & Van den Bosch, unpubl), and the Cognitive Failures Questionnaire (Broadbent, et al, 1982). They found no subjective attentional deficit

correlated significantly with CPT performance in schizophrenics. The correlations were only significant in the normal sample.

Evans, *et al.*, (1997) explored the ecological validity of the BADS for chronic schizophrenics. They found that there were no significant correlations between the self-rating version of the DEX and any of the BADS subtests or the overall BADS score. The relatives' version of the DEX was not significantly correlated with the overall BADS score, and it was only significantly correlated with one of the subtests. Evans, *et al.*, (1997) speculate that these negative findings may be because the dysexecutive functioning picked up by the relatives' ratings on the DEX may be due to other schizophrenic symptoms mimicking the effect of executive failures. Unfortunately their study did not include symptom ratings to test this hypothesis. They suggest an alternative interesting possibility that the mechanisms giving rise to poor performance on executive tasks may be different in schizophrenia to those in brain injury. In Section One of this paper it was concluded that poor performance on executive tests in schizophrenia probably reflect deficits in attention, and in response initiation and suppression (Frith, Leary, Cahill, *et al.*, 1991;

Gold, Hermann, Randolph, *et al.*, 1994; Kenny & Meltzer, 1991). Therefore it would appear likely that ecologically valid attentional tests will correlate with independent DEX ratings in addition to their predicted correlation with ratings of attentional performance.

Self and independent ratings of cognitive functioning clearly have a role in assessing the ecological validity of objective tests, but they may also be useful in their own right. There is a debate about whether self-ratings of cognitive functions provides useful information about these functions and about the status of this data both for normal (Harris & Morris, 1984; Rabbitt, Maylor, McInnes, *et al.*, 1995) and brain diseased samples (Richardson & Chan, 1995). One strand of this debate is about whether such questionnaires yield reliable factor scores which reflect the structure of cognition (Cohen, 1996; Crook & Larrabee, 1990; Crook & Larrabee, 1992; Martin & Jones, 1983), or whether they simply provide a global subjective view of functioning (Broadbent, Broadbent & Jones, 1986; Broadbent, Cooper, Fitzgerald, *et al.*, 1982; Sunderland, Watts, Baddeley, *et al.*, 1986).

A number of studies have shown that independent ratings of cognitive functioning differentiate between brain diseased patients and controls. This applies to memory (Godrey & Knight, 1988; Kapur & Pearson, 1983; Knight & Godfrey, 1995; Schwartz & McMillan, 1989; Sunderland, Harris & Baddeley, 1983a) and executive functioning (Evans, Chua, McKenna, *et al.*, 1997). There appears to be no published study of this comparison for attentional functioning (Broadbent, Cooper, Fitzgerald, *et al.*, 1982; Martin & Jones, 1983; Ponsford & Kinsella, 1991; Robertson, *et al.*, 1994).

Self-ratings of cognitive function sometimes differentiate normals from brain injured groups (Schwartz & McMillan, 1989), but the usual finding is that they do not (Evans, *et al.*, 1997; Knight & Godfrey, 1995; Wilson, *et al.*, 1996). Similarly self ratings of cognitive function are sometimes correlated with independent ratings (Goldstein & Polkey, 1992; Kapur & Pearson, 1983; Sunderland, Harris & Baddeley, 1983a) but often they fail to correlate (Feher, Mahurin, Inbody, *et al.*, 1991; Knight & Godfrey, 1995). This may be due to a number of factors that have been referred to earlier. These include the fact that self and other have access to different sources of information when making judgements about

cognitive failures. Secondly, self-ratings may be more biased by mood and personality variables such as self-criticality. The third factor which is probably the most powerful in the brain diseased is loss of insight. This may be most important in dementing illnesses and in diseases and injuries affecting the frontal lobes. Feher, Mahurin, Inbody, *et al.*, (1991) found that the correlation between self ratings and independent ratings of memory (using the Memory Assessments Clinics Scale) was not significant for a sample of patients with Alzheimer's dementia. On further analysis, they found that the discrepancy scores between self and others ratings (reflecting loss of insight) was significantly related to the severity of dementia as measured by objective cognitive tests. Wilson, *et al.*, (1996) found the same pattern for patients with brain disease in that the discrepancy between self rated and independently rated DEX scores correlated significantly with dysexecutive function as measured by the BADS. The degree of insight into cognitive impairments can change over time. For example, Godfrey, Partridge, Knight, *et al.*, (1993) found that insight increased over time for head injured patients, and this was associated with higher levels of emotional dysfunction.

Evans, *et al.*, (1997) found that relatives/carers ratings of schizophrenic patients on the DEX were significantly higher than the normal controls and not significantly different from the head injured group. Schizophrenics' DEX self ratings on the other hand were not significantly different from the normal controls and were significantly lower than those of the head injured patients. This may indicate that the schizophrenic patients had even poorer levels of insight into their difficulties in this area than the head-injured patients did. The study did not calculate other potential indices of insight such as correlations between self and other DEX ratings or the relationship between DEX discrepancy scores and the BADS scores.

Related studies have examined the degree of insight that schizophrenics have into a range of positive and negative symptoms using the Scale to Assess Unawareness of Mental Disorder (SUMD)(Amador, Strauss, Yale, *et al.*, 1993). Amador, Flaum, Andreasen, *et al.*, (1994) showed that insight was variable in schizophrenia, but was generally poorer than for individuals with schizoaffective or mood disorders. Unfortunately the instrument does not cover awareness of attentional, memory or executive dysfunctions. Young, Davila & Scher,

(1993) tested the hypothesis that lack of insight in schizophrenia can be at least partly explained by organic factors, probably mediated by the frontal lobes. The hypothesis was supported in that lack of insight was related to poor performance on the WCST. Similar results were reported by McEvoy, Hartman, Gottlieb, *et al.*, (1996).

The relationship between independent ratings of cognitive functioning and symptoms was discussed earlier. However, only ratings of attentional functioning have been studied in any depth, and these appear to be related to both the negative and disorganised symptom factors. There are no published studies examining the relationship between independent ratings of memory or executive function and symptoms. There are also no published studies looking at the relationship between independent ratings of cognitive functioning and activities of daily living or social functioning. If cognitive deficits underlie problems in these areas of functioning, then independent ratings of attentional, memory and executive impairments should be correlated with them. Furthermore, independent cognitive ratings might well be better predictors of such functional problems than positive and negative symptoms are.

Despite the finding that subjective reports of cognitive impairments are often unrelated to independent ratings or objective tests results, they are still a vital part of the overall picture. For example, in the area of differential diagnosis, Squire & Zouzounis, (1988) showed that memory problems in depression and amnesia are distinguishable with self-report techniques. In the field of rehabilitation, a patient's assessment of their cognitive efficacy will influence which coping strategies they adopt, and will also help to determine their ability to perform everyday tasks (Andres & Brenner, 1989; Andres & Brenner, 1990; Boker, 1992; Boker, Brenner & Wurgler, 1989; Brenner, Hodel, Genner, *et al.*, 1992; Van den Bosch, 1994; Van den Bosch & Rombouts, 1997; Van den Bosch, Rombouts & van Asma, 1993; Van den Bosch, van Asma, Rombouts, *et al.*, 1992). The subjective experience of people with schizophrenia has been almost overlooked in the English language research literature (Strauss, 1989). Few studies have directly examined schizophrenics awareness of cognitive dysfunctions, with the exception of those focussing on loss of insight described above, and a handful of early studies (McGhie & Chapman, 1961). There is some published evidence that people with schizophrenia may be acutely

aware of and distressed by their cognitive impairments. An incidental finding by MacCarthy, Benson & Brewin, (1986) was that schizophrenics reported that memory impairments were very high on their list of everyday problems. Selten, Sijben, van den Bosch, *et al.*, (1993) interviewed schizophrenic patients about their experience of negative symptoms and found that impaired attention was rated as the most distressing of all symptoms.

There is a tradition in the German language literature which emphasises the subjective experience of schizophrenics in terms of the concept of 'basic symptoms' (Gross, 1989). Boker, Brenner & Wurgler, (1989) explain these as 'the deficiencies and impairments in information processing which are experienced and described by patients themselves, both in the pre and post psychotic stages and are likely to be related to schizotropic vulnerability'. In this model physical and mental stress can provoke decompensation, resulting in psychotic and or disorganised symptoms (Gross, 1989). Decompensation is seen as potentially reversible, but the basic symptoms are not. They stress how important it is for the person with schizophrenia to learn to cope and compensate for this vulnerability in partnership with professionals and carers (Boker, 1992). This is an

identical conceptualisation to the stress coping vulnerability model developed in Britain and the USA (Zubin & Spring, 1977). The methods that people with schizophrenia use to cope with the symptoms has received some research attention (Brenner, Boker, Muller, *et al.*, 1987; Carr, 1988; Cohen & Berk, 1985; Falloon & Talbot, 1981; Tarrier, 1987) but general coping style in schizophrenic patients has hardly been researched in a systematic way (Van den Bosch, van Asma, Rombouts, *et al.*, 1992). A number of taxonomies of general coping styles have been derived through research on various groups. One of the most influential is that of Billings & Moos, (1981), who found that coping efforts can be conceptualised along three dimensions. The cognitive and behavioural dimensions consist of active coping strategies such as problem solving and asking other knowledgeable people for advice. The third dimension, avoidance, involves coping strategies such as distraction from the problem or shielding oneself from it in one way or another. Boker, Brenner & Wurgler, (1989) compared the coping strategies of schizophrenics with those of their relatives who were at high risk of developing schizophrenia. Healthy relatives tended to use active coping methods to deal with stress, whereas symptomatic relatives and schizophrenics tended to use avoidant

strategies. The authors speculate that active coping may help prevent decompensation into psychosis. Van den Bosch, *et al.*, (1992) remark that the concept of basic symptoms is too heterogeneous and that the available assessment instruments for measuring them are not yet psychometrically sound. They argue that it may be more productive to focus on the attentional aspects of the concept, and they developed the Test of Attentional Style (TAS) as a better measure of the primary cognitive disorders (Rombouts & Van den Bosch, unpubl). This self-report questionnaire comprises five internally consistent subscales assessing distractibility, overload, processing capacity, attentional control, and conceptual control. Van den Bosch, Rombouts & van Asma, (1993) assessed samples of schizophrenic patients, depressed patients and normal controls using the TAS and the CFQ. They found that the complaints about attention were diagnostically non-specific. Both patient groups reported high levels of complaints compared to the controls. As in other studies, cognitive complaints were correlated with anxiety and mood symptoms. In the schizophrenic group there were no significant correlations between attentional complaints and negative symptoms. On the other hand subjective experiences of cognitive overload were specifically associated with positive symptoms of disorganisation.

This parallels Andreasen's finding (Andreasen, *et al.*, 1995) that independent ratings of attentional dysfunction are correlated with the disorganised factor, but it does not parallel the relationship between independent ratings of attention and negative symptoms.

Van den Bosch, *et al.*, (1992) raise the question of whether the subjective experience of cognitive efficacy may be more predictive of daily functioning than objective cognitive test performance is. They add that the relationship between self-ratings of cognitive functioning and actual daily functioning will probably be mediated by coping style. No study has yet put these hypotheses to the test. Van den Bosch, *et al.*, (1992) examined the relationships between subjective ratings of attention (TAS), coping style and objective test performance (CPT) for schizophrenics, depressives, neurotics and normals. They used the Utrecht Coping List (Schuers, Van de Willige, Tellegen, *et al.*, 1988) which yields six coping dimensions of problem solving, palliative reaction, avoidance, seeking support, depressive reaction, expressing emotions and comforting cognitions. They found that subjective ratings of attention (TAS) were related to coping style, but objective measures (CPT) were not related. In both the

schizophrenic and depressed groups, subjective attentional failures, neurotic symptoms and an avoidant coping style were linked together in a way that suggested a helplessness effect. It is possible that this helplessness reaction would impair daily functioning because the person might avoid effort in those everyday situations that they actually had the cognitive competence to deal with. A different pattern of results was reported by Van den Bosch & Rombouts, (1997) in a similar study. The results again showed that a poor self report of coping style was independent of psychiatric diagnosis (it applied to both depressed and schizophrenic patients), but in this study there were associations with both subjective reports of cognitive difficulties and also objective performance (CPT). Poor cognitive task performance was associated with a dependent coping style, which the authors suggested might point to a "giving up" attitude. Subjective cognitive dysfunction and high levels of mental effort during task performance were associated with an avoidant coping style and with worrying. The authors interpret this pattern as evidence of failing attempts to compensate for actual cognitive deficits.

Taking all the findings on subjective ratings of cognitive dysfunction and coping, it seems more likely that they will correlate in easily understood ways with other self ratings (e.g. self ratings of symptoms, or self ratings of everyday functioning). Relationships between self-ratings and objective measures (e.g. independent ratings of symptoms, independent ratings of daily functioning or objective cognitive tests) of these functions, are likely to be more complex and harder to interpret.

Summary of Section Three

The course and outcome is complex and different domains of functioning (symptoms, social and vocational) are differentially affected. There is considerable heterogeniety both cross sectionally and longitudinally. The relationships between various outcome measures are complex and may change over time. There are a large number of factors which can influence the course and outcome and these may differentially influence the various functional domains. There is now a substantial body of evidence indicating that cognitive impairments, especially attentional deficits are a fundamental aspect of the illness. They correlate with social functioning and activities of daily living, they are predictive of

the ability to learn new skills and they predict the course of the illness. The extent to which they can improve on existing means of prediction, particularly in the long term, awaits clarification.

Research methods assessing the ecological validity of cognitive tests by assessing how well they correlate with independent ratings of everyday cognitive functioning have improved our understanding of organic brain diseases. Application of these methods to schizophrenia may also prove fruitful. It is likely that objective attentional deficits will underpin both independently rated attentional problems and independently rated executive dysfunctions.

A fuller understanding of the role of cognitive impairments should also take into account subjective ratings. Subjective estimates of cognitive efficacy may strongly influence coping efforts, and thus may influence performance on both cognitive tests and everyday functioning. However, subjective ratings are more likely to be biased by negative mood states and loss of insight. Significant correlations with other self-rated variables such as coping and symptoms are to be expected. Easily interpretable and meaningful correlations between self

rated cognitive efficacy and independent ratings or objective tests of the same areas are not to be expected.

PROJECT RATIONALE

There is strong evidence that attentional deficits are a fundamental part of the illness of schizophrenia. Deficits in executive functioning are probably due to the malfunctioning of more basic subsystems such as those of attention and of response initiation and suppression. The same conclusion probably applies to memory functioning, although in more severely ill patients there may be an additional mechanism of loss from information from memory storage

Some studies indicate that deficits in attention are correlated with the disorganised and negative symptom factors, but the findings are inconsistent. There is some evidence that failures of response initiation are related to the negative factor, while failures of response suppression are related to the disorganised factor.

It is argued that deficits in these basic cognitive subsystems may be at least partly responsible for the features of disorganisation and negativity in

schizophrenia. Symptoms are probably the end result of a number of different mechanisms of which cognitive disorders are only one. However cognitive disorders appear to play a more fundamental role in schizophrenia than in other major psychiatric illnesses. In addition there is evidence that negative symptoms resulting from attentional problems are more enduring and prognostic than those resulting from other factors such as environmental understimulation.

Cognitive impairments especially attentional deficits, appear to be a major cause of the everyday problems of social functioning and of activities of daily living in schizophrenia. The current project provides a far more stringent test of this assertion than previous studies have in the following three ways. Firstly it measures a comprehensive range of other variables which may affect daily functioning, secondly it uses ecologically valid tests of cognitive function, and thirdly it assesses the relationship between these tests and independent ratings of everyday cognitive functioning.

Research into subjective estimates of cognitive efficacy shows that in general they are more influenced

by negative mood states than by actual performance. The same conclusion appears to holds for people with schizophrenia. Because negative mood states are common in schizophrenia this may result in a vicious spiral of critical self judgements of cognitive inefficiency, fuelling the use of avoidant as opposed to active styles of coping, resulting in a helplessness effect.

HYPOTHESES

1) (a) The performance of schizophrenics on cognitive tests of attention, of response initiation and suppression and of memory will be significantly impaired compared to a normal control group matched for age and premorbid IQ

   (b) These impairments will still be apparent for a subsample of patients with minimal IQ deterioration compared to a subsample of controls matched for age and current IQ.

2) Cognitive test performance will be correlated with the disorganised and negative symptom factors, but not with the psychotic or dysphoric mood factors.

3) (a) Schizophrenics' level of social functioning will be correlated with their scores on the objective tests of attention, response initiation and suppression and memory.

(b) A range of other variables may be correlated with social functioning including symptoms, problem behaviours, age, chronicity, premorbid IQ, current IQ, medication, medication side effects, physical health status and social circumstances. However it is predicted that the attentional deficits will be more powerful than the other variables in accounting for the variance in social functioning.

4) (a) Independent ratings of patients' everyday cognitive functioning will identify significant deficits. The scores will be comparable to those found for patients with moderate to severe brain damage.

(b) Independent ratings of schizophrenics' attention and executive functioning will be correlated with their performance on the objective tests of response initiation and suppression, attention and memory.

(c) Independent ratings of memory will correlate with objective tests of memory, attention and response initiation and suppression.

5) (a) Independent ratings of attention, memory and executive functioning will correlate significantly with social functioning.

6) (a) Schizophrenics' self-rated cognitive functioning will indicate that they experience significantly more problems than the normal controls.

(b) Schizophrenics' self-reports of memory, attentional and executive functioning will not correlate with their performance on objective tests of these functions. They will correlate significantly with independently rated dysphoric symptoms.

(c) Schizophrenics' self-ratings of cognitive functioning will not correlate with independent ratings of cognitive functioning.

(d) Schizophrenics' cognitive self-ratings will not be significantly correlated with independent ratings of social functioning

7) (a) Schizophrenics and controls will report using different types of strategies to cope with everyday problems. Controls will report using more active cognitive and behavioural coping methods, whereas schizophrenics will report using more avoidant strategies.

(b) In the schizophrenic group, dysphoric symptoms will be associated with greater use of avoidant coping and less use of active cognitive and behavioural coping.

(c) In the schizophrenic group severity of self-rated cognitive problems will be associated with greater use of an avoidant coping style and less use of active cognitive and behavioural coping.

METHOD

SUBJECTS

The patient sample consisted of twenty-eight patients (twenty-three male and five female) meeting DSM 1V (APA, 1994) criteria for schizophrenia. The researcher approached Key Workers, Consultant Psychiatrists and other professionals in one NHS Trust asking for potential referrals to the project. To be eligible, patients were

required to have a primary diagnosis of schizophrenia. Patients were not eligible if they had any of the following: concurrent disease of the central nervous system, a history of alcohol or substance dependence, evidence of current alcohol or substance abuse, mental retardation, or a history of ECT in the past year.

The responsible Consultant Psychiatrist was asked if there was any reason why the patient should not be invited to participate. The Key Worker then approached the patient outlining the project and asking if they were interested. Patients were given an information sheet. Patients who expressed an interest were contacted by the researcher who sought their informed consent in writing.

Twenty-six controls (thirteen males and thirteen females) were recruited from the staff of the same NHS trust. They were also provided with an information sheet and provided written signed consent. The Ethical Committee ruled that the control group could not be screened for psychological or psychiatric problems, therefore it was necessary to assume that it comprised a normal sample.

A full description of the two groups is given in the results section below.

PROCEDURE

Key Workers were asked to provide detailed information about their patient(s). These included age, medication regime and the duration of the schizophrenic illness. Details of all medications were recorded. A standardised method of calculating dosage for the two major classes of drugs, Anti-Psychotic Medication (APM) and Anti-Extra-Pyramidal Side effect Medication (AEPSM), was adopted. This involved calculating for each medication the percentage of the maximum dose it represented. Maximum doses were based on those indicated in the British National Formulary (BMA,RPSGB, 1997). Percentages for medications in the same category (APM or AEPSM) were summed to provide an overall score. Chronicity was calculated as the midpoint between the first report of psychotic symptoms and the first acute hospitalisation.

Key Workers were also asked to provide comprehensive ratings of patients using a number of scales. A proportion of Key Workers was already familiar with some

of these and training was provided for the others. Symptoms were rated using two different scales. The first of these was the Psychiatric Assessment Scale (Krawiecka, Goldberg & Vaughan, 1977) which is better known to nursing staff as either the Manchester Scale or the KGV. This was specifically designed to assess the range of symptoms of chronic schizophrenia. This scale has high inter-rater reliability (Krawiecka, Goldberg & Vaughan, 1977; Manchanda, Saupe & Hirsch, 1986) and is sensitive to changes in clinical state (Barnes, 1994; Manchanda, Hirsch & Barnes, 1989). Jackson, Burgess, Minas, *et al.*, (1990) found that the negative factor scale was highly robust and correlated strongly with the SANS. Garety & Wessely, (1994) concluded that it is one of the best of the brief scales for measuring positive symptomatology. More recently the scale has been revised to provide a detailed interview to improve reliability and to assist non-clinically trained raters to elicit the necessary information needed to make a rating of the severity (Barnes, 1994; Lancashire, Haddock, Tarrier, *et al.*, 1996). The Manchester Scale provides less comprehensive coverage of neurotic symptoms, and in order to cover the complete range of psychopathology additional instruments are needed (Garety & Wessely, 1994).

The additional instrument used in this research was the FACE (Clifford, 1996). This is one of a new generation of empirically based multidimensional scales which has been specifically designed for use by Key Workers and Multi-Disciplinary Teams working with the long term mentally ill. The scale is divided into the following four major sections, Psychological, Activities of Daily Living, Interpersonal, Social Circumstances and Physical. The Psychological section is further subdivided into three parts, Mental health which covers a wide range of neurotic and psychotic symptoms, Behaviour which assesses risk behaviours and alcohol and substance abuse and Cognition, which provides a very brief rating of attention and orientation. The Cognition subscale is omitted in this research because this area is covered comprehensively by other detailed ratings of cognitive functioning. The Activities of Daily Living (ADL) scale comprises ratings of self-care and domestic and community living skills. The Interpersonal section assesses patient's interpersonal and communication skills and the range and quality of their relationships with family, friends and others. The Social Circumstances section assesses the appropriateness of the patient's housing and access to amenities and support. The Physical section

assesses physical ill health and disability including ratings of medication side effects.

Key Workers were also asked to make detailed ratings of the patient's everyday cognitive functioning using three instruments which have been proved promising in research on brain diseased patients. Everyday memory was assessed using the Memory Assessment Clinics Scale for independent raters which is referred to in this paper as the MAC-I for the sake of clarity. This is a modified version of the self-rating scale (MAC-S) (Crook & Larrabee, 1992; Larrabee, West & Crook, 1989; Larrabee, West & Crook, 1991) consisting of forty-nine items. This version is not as well researched as the self rating scale, but the total score has been found to be a reliable and valid measure of everyday memory in a study of Alzheimer's patients (Feher, Mahurin, Inbody, *et al.*, 1991). Everyday problems of executive function were rated using the Dysexecutive Questionnaire (Wilson, *et al.*, 1996) which is referred to here as the DEX-I. This instrument yields a single overall score, but recent factor analysis suggests that there may be three dissociable areas making up the dysexecutive syndrome in brain damaged patients (Wilson, *et al.*, 1996; Wilson, *et al.*, 1997). Everyday attentional problems were assessed

using the Rating Scale of Attentional Behaviour (referred to here as the RSAB-I)(Ponsford & Kinsella, 1991) which consists of frequency ratings of behaviours related to concentration.

The Key Worker administered five questionnaires to the patient, and offered unbiased guidance and support for patients who experienced difficulty completing them unaided. Three of the questionnaires were self-assessment versions of the cognitive rating scales referred to above. These were the MAC-S (Larrabee, West & Crook, 1989; Larrabee, West & Crook, 1991), and self-rating versions of the RSAB-I (Ponsford & Kinsella, 1991) and of the DEX-I (Wilson, *et al.*, 1996). These are referred to in this paper as the RSAB-S and the DEX-S respectively. Factor analysis of the MAC-S with normal subjects has identified ten separate factors (Crook & Larrabee, 1992), but there is no information about factor structure in pathological samples. The fourth questionnaire, the Test of Attentional Style (TAS) (Rombouts & Van den Bosch, unpubl) relies heavily on introspective reports and is therefore only available in self-report form. Factor analysis with normal samples suggests that the total score is dissociable into five factors (Van den Bosch & Rombouts, 1997; Van den Bosch, Rombouts & van Asma,

1993). A fifth questionnaire the Coping Response Inventory (CRI)(Billings & Moos, 1981) is an empirically derived measure of general coping style. Factor analytic studies suggest that it identifies the relative usage of three strategies for coping with stressful events, cognitive, behavioural and avoidant.

The objective cognitive tests were carefully selected with the following criteria in mind. Firstly they had to adequately cover the abilities that are most likely to be disproportionately impaired in schizophrenia. Secondly, preference was given to instruments that have been designed to be ecologically valid. Thirdly the tests were chosen on the basis of their difficulty level and preference was given to those requiring as little general intellectual ability as possible. It was important that the tests would be motivating and challenging for both the patients and the normal controls but without provoking undue anxiety, fatigue or helplessness. An effort was also made to select tests with a firm theoretical basis. Finally, in order to assess the evidence for disproportionate cognitive deficits it is important to obtain an estimate of both premorbid intelligence and of current general intellectual functioning. The National Adult Reading Test

(NART) (Nelson, 1982) was used to estimate premorbid IQ in the patient group, and the Quick Test (Ammons & Ammons, 1962) was included as a measure of current IQ. These instruments have been successfully used in previous research on schizophrenia (Frith, Leary, Cahill, *et al.*, 1991; Jones & Rodgers, 1993; Mockler, Riordan & Sharma, 1997)

The Rivermead Behavioural Memory test (RBMT)(Wilson, et al, 1985) was selected to assess overall memory ability. It was chosen mainly because it was constructed to be an ecologically valid test, and there is some evidence of this from research with brain diseased samples (Wilson, 1996; Wilson, *et al.*, 1989; Wilson, 1993). The RBMT yields two summary scores (RBMT Screening and RBMT Profile) which are very highly correlated. The Screening score can range from 0-12, and the Profile score from 0-24. Cut off points for level of memory function are given in the manual. The two RBMT summary scores (Screening and Profile) correlated significantly with patients' performances on a variety of traditional learning and memory tasks in the validation studies. Van Balen & Eling, (1989) found that the RBMT total screening scores for a mixed group of stroke patients correlated significantly with the a number of scores on the Rey

Auditory Verbal Learning Test a widely used multidimensional memory test. The highest correlation (r=0.70) was with the delayed recall score, but there were also moderately high correlations with immediate free recall and recognition memory. One disadvantage of the RBMT is that it is an atheoretical test which gives little information about the specific memory abilities which are spared or impaired. (Lezak, 1995). A second disadvantage is that with only a two to three point scoring range for each subtests it lacks sensitivity at both high and low ends of memory functioning (Legna & Parkin, 1990). Studies using schizophrenic samples indicate that the test is sensitive to their memory impairments in that a large proportion of them obtain scores in the moderately to severely impaired range (McKenna, *et al.*, 1990; Tamlyn, *et al.*, 1992). However the researchers report that the test is easily tolerated and often enjoyed even by very impaired patients.

The Test of Everyday Attention (TEA) was selected because it was constructed to be ecologically valid. The findings reported for the validation sample indicate that it is successful in this regard (Robertson, *et al.*, 1994). The test is also based on a promising theoretical framework (Posner & Petersen, 1990). The test is made up

of eight subtests designed to measure different aspects of attention. Raw scores are converted into age adjusted scaled scores which range from 1-19 with a mean of 10 and a standard deviation of 3. Factor analysis of the TEA and a number of traditional attentional tests from a large normal standardisation sample obtained four factors. These were labelled visual selective attention/speed, attentional switching, sustained attention and auditory verbal working memory. For the purposes of the present research the four subtests were selected in order to measure three of the four types of attention while keeping the size of the test battery to a manageable level. These were Map Search, Telephone Search, Visual Elevator and Telephone Search While Counting. Two separate scores can be calculated for Map Search and Visual Elevator, but only one score from each subtest was used in the factor analysis described above. These were the Map Search two minute tally and the Visual Elevator number correct total. These two measures were selected for the present research. The factor analysis found that Map Search and Telephone Search loaded on visual selective attention/speed as did Trails B (Reitan, 1958), the d2 visual search task (Brickenhamp, 1962), and the Stroop Test (Trennerry, Crosson, DeBoe, *et al.*, 1989). Visual Elevator loaded on attentional switching as did

the score for the number of categories obtained on the Wisconsin Card Sorting Test. Comparison of the subtests of Telephone Search and Telephone Search While Counting enable the calculation of a dual task decrement score which was expected to load on a separate factor of divided attention. In fact this score loaded highly on the sustained attention factor. Robertson, *et al.*, (1994) comment that the ability to do two tasks at once involves a strong sustained attention element. In the present research it was decided to measure the fourth attentional factor, auditory verbal working memory by using the backward digit span. In the factor analysis this test loaded more highly on this factor than the TEA subtest that was designed to do so. It is also well recognised as the simplest measure of auditory verbal working memory (Lezak, 1995). A decision was also made to include digit span forwards because it is a quick and easy measure that is widely used in neuropsychological research and clinical practice. It is generally held to measure the efficiency of attention and freedom from distractibility rather than what is commonly thought of as memory (Lezak, 1995).

The Hayling Test (Burgess & Shallice, 1997) was designed to measure two functions which are commonly

impaired in the dysexecutive syndrome, namely task initiation speed and the ability to suppress an habitual response. Initial validation studies are encouraging and indicate that the test is sensitive to these impairments for frontal patients (Burgess & Shallice, 1996)and for schizophrenics (Nathaniel-James & Frith, 1996). The test consists of two sections each containing fifteen sentences with the last word missing. Each sentence is read to the subject who is asked to complete it as quickly as possible with one word. In section 1 subjects are asked to make a sensible completion, but in section 2 they are asked to provide a word which is completely unconnected to the sentence in any way. The test yields three measures related to executive functions. The first (Hayling A) is the sum of response latencies in section 1 which provides a simple measure of response initiation. Section 2 yields two measures of the ability of subjects on a response suppression task. The first of these (Hayling B) is a count of the frequency with which subjects complete the sentences with words that are fully or partly semantically related to it. The second measure is time taken to respond which provides a further indication of the subject's efficiency on this task. Raw scores are converted into standard scale scores which are

not age adjusted. The scaled scores can range from 1-10 with a mean of 6.

The tests were administered to subjects in the order they were described above. Testing usually took place over two forty minute sessions approximately one week apart. All the data for a given subject was collected within a one month time period.

The same procedure was followed for the normal control group. They completed the self rating questionnaires followed by the objective tests. The only difference was that independent ratings were not completed for this group.

To aid interpretation of the results section, Table 1 presents an overview of the assessments used and the interpretation of the direction of scoring.

Table 1 Interpretation of Test and Rating Scores

INSTRUMENT	LOW SCORE
RBMT Profile	Impaired memory
Hayling A	Impaired response initiation (speed)
Hayling B	Impaired response suppression (speed)
Hayling C	Impaired response suppression (errors)

Table 1 (Cont'd)

INSTRUMENT	LOW SCORE
TEA Map Search	Impaired visual selective attention/speed
TEA Visual Elevator	Impaired attentional switching
TEA Telephone Search	Impaired visual selective attention/speed
Telephone Search While Counting	Poor sustained attention (possibly poor divided attention)
Digits Backwards	Impaired auditory verbal working memory
Digits Forwards	Impaired attentional capacity
MAC-S MAC-I	Poor memory (Self/Independent rating)
RSAB-S RSAB-I	Poor attention (Self/Independent rating)
DEX-S DEX-I	Good executive function (Self/Independent rating)
TAS	Poor attention (Self rating)
CRI (Active Cognitive, Active Behavioural, Avoidant)	Less use of the strategy
FACE Subscales (Behaviour, Mental Health, Physical, Activities of Daily Living Interpersonal)	Good health/functioning
KGV Factors (Negative, Disorganised, Psychotic, Dysphoric)	Good health

RESULTS

The data was analysed using SPSS 8.0. Very few of the scores were normally distributed either for the schizophrenic group or for the normal controls. Attempts to use a number of alternative methods to transform the data were successful for only a proportion of the scores.

After seeking statistical advice it was decided to analyse the data using parametric tests but to corroborate these wherever possible using non-parametric methods. For the sake of clarity it was decided to cite solely the parametric analyses in the Results section, except for any instances where the non-parametric analyses failed to confirm the findings.

Homogeneity of variances was tested routinely prior to applying parametric tests. If these differed then tests using the assumption of unequal variances were used, and this is noted in the text. In some cases this necessitated using independent samples T-Tests rather than Analysis of Variance, because the latter test assumes equal variances. Breaking this assumption can have serious consequences if the sample sizes are unequal as in this study.

There was very little missing data, and because of the relatively small sample sizes any missing values were excluded from the analyses pairwise rather than listwise. The controls completed all the objective tests and filled in all the self-rating questionnaires. All the Key Worker ratings were completed for the schizophrenic group. In the case of the objective tests the only missing data was

from three subtests of the Test of Everyday Attention (TEA). One patient failed to complete Map Search, Telephone Search and Telephone Search While Counting. The same patient and an additional two patients failed to complete Visual Elevator. Only three patients were unable to fill in any of their questionnaires. The other twenty-five patients completed them successfully. Patients and controls omitted a tiny proportion of self-rating items, and where possible subjects were contacted to rectify this. Means rather than totals were calculated for the self-ratings to ensure that missing items would not bias the overall scores.

HYPOTHESIS ONE

(a) The performance of schizophrenics on cognitive tests of attention, response initiation and suppression and memory will be significantly impaired compared to a normal control group matched for age and premorbid IQ.

(b) These impairments will still be apparent for a subsample of patients with minimal IQ deterioration compared to a subsample of controls matched for age and current IQ.

The mean age of the schizophrenic group was significantly higher than the controls and their premorbid IQ (estimated on the NART) was significantly lower (Tables 2 and 3).

Table 2
Patients and Controls
Mean Ages and NART Estimated IQs

	GROUP	N	MEAN	SD
Age	Control	26	33.85	8.88
	Patient	28	39.68	11.52
NART IQ	Control	26	114.27	4.64
	Patient	28	104.95	9.63

Table 3
Independent Samples T Test
Patients Versus Controls for Age and NART IQ

	T	Df	Sig (2-tailed)
Age	-2.09	50.35	.041
NART IQ	4.58	39.54	.000

(Equal Variances Not Assumed)

The normal and schizophrenic samples also differed in terms of the proportions of males and females. The controls consisted of equal numbers of each sex. The schizophrenic sample was made up of twenty-three males and five females which constitutes a significantly higher proportion of females (Chi-Square = 11.57; $p < 0.001$, 2-tailed test)(see Appendix 11). No sex differences were

predicted in this study. A series of T Tests comparing males and females on all of the variables for the schizophrenic and control sample respectively found only four significant differences (see Appendices 7-10). Females in the control group used active behavioural coping strategies significantly more than the males. In the schizophrenic sample females scored higher on the KGV dysphoria factor and lower on the KGV negative factor. They also showed a larger estimated IQ decline.

In order to test Hypothesis (1a) a sub-sample of schizophrenics and controls matched for age and estimated premorbid IQ was selected (Tables 4 and 5).

Table 4
Patients and Controls Matched for Age and NART IQ

	GROUP	N	MEAN	SD
Age	Control	14	33.86	7.22
	Patient	18	35.39	10.51
NART IQ	Control	14	110.79	3.42
	Patient	18	110.39	6.51

Table 5
Independent Samples T Test
Patients and Controls Matched for Age and NART IQ

	T	DF	SIG (2-TAILED)
Age	-.49	29.60	.629
NART IQ	.22	26.81	.826

(Equal variances not assumed)

Comparisons between the means of the objective tests for this sample are shown in Table 6 and the significance levels in Table 7.

Table 6
Patients and Controls Matched for Age and NART IQ, Mean Scores for Objective Tests

	GROUP	N	MEAN	SD
Quick Test IQ	Control	14	107.14	5.80
	Patient	18	100.56	11.07
Digits Forwards	Control	14	6.43	1.16
	Patient	18	6.33	1.33
Digits Backwards	Control	14	4.43	1.02
	Patient	18	4.83	1.43
RBMT Profile	Control	14	23.29	.73
	Patient	18	18.44	4.82
Hayling A	Control	14	5.86	.95
	Patient	18	4.89	1.02
Hayling B	Control	14	6.00	.79
	Patient	18	5.00	1.65
Hayling C	Control	14	6.57	1.45
	Patient	18	5.56	2.15
Map Search	Control	14	9.14	1.92
	Patient	18	5.19	4.23
Visual Elevator	Control	14	9.79	2.16
	Patient	17	8.06	3.15
Telephone Search	Control	14	9.43	3.20
	Patient	18	6.53	2.21
Telephone Search Counting	Control	14	9.93	2.73
	Patient	18	8.06	2.94

Table 7
Independent Samples T Test On Objective Test Means. Patients Versus Controls Matched on Age and NART IQ

	T	DF	SIG. (1-TAILED)
Quick Test IQ	2.17	26.76	.020
Digits Forwards	.22	29.56	.415
Digits Backwards	-.94	29.83	.178
RBMT Profile	4.20	17.99	.000
Hayling A	2.77	29.00	.005
Hayling B	2.27	25.54	.016
Hayling C	1.59	29.52	.061
Map Search	3.526	24.90	.001
Visual Elevator	1.80	28.15	.041
Telephone Search	2.89	22.11	.004
Telephone Search Counting	1.861	28.99	.036

(Equal variances not assumed)

Hypothesis (1a) receives considerable support. Even after matching the groups for age and estimated premorbid IQ the schizophrenics performed significantly worse on almost every objective test. The only three exceptions were Digits Forwards, which is often spared in schizophrenia, one of the two measures of response suppression ability (Hayling C) which just fails to achieve significance and Digits Backwards.

The degree of impairment on the objective tests varied widely among the patients. In the case of memory ability the mean RBMT Profile score was 18.44 which according to the cut-off points for level of memory function indicates 'poor memory' (Wilson, et al, 1985).

However the scores ranged from 6 which indicates 'severe impairment', to 23 which is in the normal range. The same heterogeneity of scores, ranging from severely impaired to normal was apparent for the TEA subtests and the Hayling Tests. A comparison with the percentile equivalents for the normal population in the published test validation samples (Burgess & Shallice, 1997; Robertson, *et al.*, 1994) gives an indication of the average performance of this schizophrenic subsample. They were in the bottom 6% for the Map Search subtest and the bottom 12% for the Telephone Search subtest. They performed somewhat better on Visual Elevator and Telephone Search While Counting, falling into the bottom 30% of the normal population on both of these subtests. The mean performance on the Hayling subtests also revealed a mild degree of impairment falling into the low average to moderate average range compared to the general population.

Tables 6 and 7 show that the current IQ of the schizophrenics which is estimated using the Quick Test, is significantly lower than that of the normal controls even though the groups were matched for premorbid IQ. Tables 8 and 9 show that there was a significantly greater discrepancy between the estimated premorbid IQ

and current IQ for the schizophrenics than for the controls. Thus as in previous studies there is a significant decline in IQ for schizophrenics even for samples whose estimated premorbid IQ is above average. Table 8 shows that there was considerable variation in the amount of IQ decline in the schizophrenic group.

Table 8
Mean IQ Declines for Patients and Controls

	GROUP	N	MEAN	SD
IQ Decline	Control	14	3.64	5.11
	Patient	18	9.83	8.09

Table 9
Independent Samples T Test
NART IQ and Quick Test IQ Discrepancy
For Patients and Controls

	T	DF	SIG (1-TAILED)
IQ Decline	2.64	28.95	.007

(Equal variances not assumed)

In order to test Hypothesis (1b) a further subsample of subjects were selected matched on age, premorbid IQ, current IQ and IQ decline as shown in Tables 10 and 11 below.

Table 10
Means for Groups Matched on Age, Premorbid IQ, Current IQ and IQ Decline

	GROUP	N	MEAN	SD
Age	Control	12	32.25	5.85
	Patient	15	35.47	10.94
NART IQ	Control	12	110.67	3.17
	Patient	15	110.87	6.47
Quick Test IQ	Control	12	105.67	4.81
	Patient	15	103.27	9.49
IQ Decline	Control	12	5.00	3.62
	Patient	15	7.60	6.27

Table 11
Independent Samples T Test
Patients and Controls Matched for Age, Premorbid IQ, Current IQ and IQ Decline

	T	DF	SIG.(2-TAILED)
Age	-.98	22.19	.339
NART IQ	-.11	21.24	.917
Quick Test IQ	.85	21.60	.404
IQ Decline	-1.35	23.01	.190

(Equal variances not assumed)

These subsamples are well matched on age, estimated premorbid IQ (NART) and current IQ. Satisfactory matching has also been achieved for estimated IQ decline.

Comparisons between the means of the objective tests for this sample are shown in Table 12 and the significance levels in Table 13.

Table 12
Matched Patients and Controls, Objective Tests Scores

	GROUP	N	MEAN	SD
Digits Forwards	Control	12	6.67	1.07
	Patient	15	6.47	1.19
Digits Backwards	Control	12	4.50	1.00
	Patient	15	4.80	1.52
RBMT Profile	Control	12	23.17	.72
	Patient	15	18.20	5.19
Hayling A	Control	12	6.08	.52
	Patient	15	5.07	.80
Hayling B	Control	12	6.00	.85
	Patient	15	5.20	1.42
Hayling C	Control	12	6.42	1.51
	Patient	15	5.33	2.26
Map Search	Control	12	9.17	1.90
	Patient	15	5.63	4.47
Visual Elevator	Control	12	10.08	2.15
	Patient	14	8.07	3.34
Telephone Search	Control	12	9.25	3.39
	Patient	15	6.60	2.41
Telephone Search Counting	Control	12	10.00	2.95
	Patient	15	8.40	2.87

Table 13
Independent Samples T Test On Objective Test Means. Patients Versus Controls Matched on Age, NART IQ, Quick Test IQ and IQ Decline

	T	DF	SIG.(1-TAILED)
Digits Forwards	.46	24.58	.325
Digits Backwards	-.62	24.22	.272
RBMT Profile	3.67	14.67	.001
Hayling A	4.00	24.06	.000
Hayling B	1.81	23.38	.042
Hayling C	1.49	24.32	.074
Map Search	2.76	19.74	.006
Visual Elevator	1.85	22.43	.038
Telephone Search	2.29	19.26	.017
Telephone Search Counting	1.42	23.41	.085

(Equal variances not assumed)

Hypothesis (1b) is substantially supported. Even after matching for current IQ and IQ decline, four out of five of the attentional tests remain significantly different, as does the response initiation measure (Hayling A) and one of the two response suppression measures (Hayling B). The significant differences between the schizophrenics and controls on both the memory scores also survive.

The next step in the analysis is an exploration for the whole schizophrenic sample of the correlations between the objective tests and a number of potential variables that may affect test performance. These are age, chronicity of illness and medication type and dosage. Age is unlikely to be a confounding variable for the subtests of the TEA and the Quick Test which use age scaled scores. It is likely to be related to objective tests such as Digits Forwards, Digits Backwards, the Hayling Tests and the RBMT Profile score that are sensitive to age and which do not use age scaled scores. The literature review indicated that chronicity may be significantly correlated with the objective tests in a cross sectional study such as this one. The review also concluded that as far as medication is concerned APM is unlikely to be a confounding variable, but that AEPSM might be related to impaired memory functioning.

Table 14
Correlations Between the Objective Tests and Potential Confounding Variables for the Total Schizophrenic Sample

	AGE	CHRONICITY	APM DOSE %	AEPSM DOSE %
NART IQ	.28	.02	.08	-.01
Quick Test IQ	-.12	.12	-.03	.24
Digits Forwards	-.13	-.10	-.30	.04
Digits Backwards	-.38*	-.10	-.00	.10
RBMT Profile	-.51**	-.52**	-.09	-.12
Hayling A	-.04	-.17	.04	.29
Hayling B	-.02	-.23	-.09	.09
Hayling C	-.32	-.38*	.06	.05
Map Search	.07	-.22	.07	-.05
Visual Elevator	-.27	-.45*	-.23	-.21
Telephone Search	-.06	-.22	-.04	.10
Telephone Search Counting	.02	-.27	-.19	.16

* p< 0.05 (1-tailed test)
** p< 0.01 (1-tailed test)

Twenty seven of the twenty eight patients were taking APM with dosages ranging from 1.25% to 117% of the recommended maximum. Seventeen of these patients were taking atypical antipsychotic medication either alone or in combination with traditional antipsychotics. However,

Table 14 shows that none of the correlations between the objective tests and APM dosage were significant. The correlations between AEPSM dosage and objective tests were also non-significant, which is an unexpected finding. This may be due to the fact that only four of the twenty eight patients were taking this type of medication and these patients were on low doses (40% or less of the recommended maximum).

As expected RBMT Profile and Digits Backwards are significantly correlated with age. The significant correlations of three of the tests with chronicity are difficult to interpret, but in the cases of RBMT Profile and Hayling C they may be partly explained by the joint association of chronicity and age, which are significantly correlated ($r = .580$; $p < 0.001$)

The next analysis explores the extent to which poor memory performance in the schizophrenic sample is linked to attentional dysfunction. Partial correlations were computed between the RBMT Profile score and the other objective tests. Estimated premorbid IQ (NART), current IQ (Quick Test) and age were partialed out because these variables are general factors which would otherwise

spuriously inflate the correlations between the different tests. The results are shown in Table 15

Table 15
Partial Correlations of RBMT Profile and Objective Tests Controlling for Age, Estimated Premorbid IQ and Current IQ

	RBMT PROFILE
DIGITS FORWARDS	.082
DIGITS BACKWARDS	.018
MAP SEARCH	.45*
VISUAL ELEVATOR	.19
TELEPHONE SEARCH	.26
TELEPHONE SEARCH COUNTING	.55**
HAYLING A	.29
HAYLING B	.17
HAYLING C	.18

* p<0.05 (2 tailed test)
**p<0.01 (2 tailed test)

Table 15 shows that RBMT performance shares significant variance with two of the attentional tests, Map Search and Telephone Search While Counting. It is unlikely that memory ability plays much of a role in the attentional tasks. Thus the results are consistent with the view that attentional functions play a significant role in memory performance in schizophrenia.

HYPOTHESIS 2

Cognitive test performance will be correlated with the disorganised and negative symptom factors, but not with the psychotic or dysphoric mood factors.

This prediction is tested in Table 16 below

Table 16
Correlations Between Objective Tests and KGV Symptom Factors

	NEGATIVE	DISORGANISED	PSYCHOSIS	DYSPHORIA
NART IQ	.20	.17	.04	-.07
Quick Test IQ	.16	.06	.01	-.07
Digits Forwards	.01	-.13	-.34	-.27
Digits Backwards	.09	.04	-.01	.15
RBMT Profile	.23	-.10	-.29	-.33
Hayling A	.11	.20	-.03	-.04
Hayling B	.11	.24	.02	-.27
Hayling C	.15	.05	-.00	-.22
Map Search	.12	-.16	-.15	-.36
Visual Elevator	-.12	-.10	-.22	-.18
Telephone Search	-.04	-.12	-.17	.01
Telephone Search Counting	-.12	.04	.01	-.11

There is no support for Hypothesis 2 in that none of the cognitive tests are significantly correlated with the negative or disorganised symptom factors as measured by the KGV (1 tailed tests). The lack of support for these hypotheses does not appear to be due to an insufficient range of scores on the relevant variables in this sample of patients (see Appendix 1).

As predicted, none of the objective tests are significantly correlated with the psychotic or dysphoric factors (2 tail tests).

The next step in the analysis is to assess the relationship between the objective tests and two general indices of psychopathology. These are the Mental Health and the Behaviour subscales of the FACE. It was concluded in the literature review that these measures are unlikely to be significantly correlated with the objective tests (see Table 17).

Table 17
Correlations Between the Objective Tests and the FACE Mental Health and Behaviour Scales

	MENTAL HEALTH	BEHAVIOUR
NART IQ	.13	.02
Quick Test IQ	.08	-.00
RBMT Profile	-.13	-.20
Digits Forward	-.01	.02
Map Search	-.36	-.34
Telephone Search	-.02	.09
Visual Elevator	-.23	-.05
Telephone Search Counting	.03	-.04
Digits Backward	.24	.21
Hayling A	.20	.12
Hayling B	.15	.11
Hayling C	-.03	.11

As predicted, none of the correlations reach significance (2 tailed tests).

HYPOTHESES 3

(a) Schizophrenics' level of social functioning will be correlated with their scores on the objective tests of attention, response initiation and suppression and memory.

(b) A range of other variables may be correlated with social functioning including symptoms, problem behaviours, age, chronicity, premorbid IQ, current IQ, medication, medication side effects, physical health

status and social circumstances. However it is predicted that the attentional deficits will be more powerful than the other variables in accounting for the variance in social functioning.

Social functioning was measured using the FACE. This yields two summary measures, one concerning the ability to perform activities of daily living (ADL) and secondly Interpersonal (Inter) which assesses the ability to function interpersonally. In order to test Hypothesis (3a) correlations between ADL, Inter and the objective tests were calculated as shown in Table 18

Table 18
Correlations Between the Objective Tests and Social Functioning

	ADL	INTER
NART IQ	-.13	.12
Quick Test IQ	-.13	-.05
RBMT Profile	-.31	-.06
Digits Forward	-.27	.11
Map Search	-.41*	-.53**
Telephone Search	-.42*	-.39*
Visual Elevator	-.57**	-.33
Telephone Search Counting	-.69***	-.32
Digits Backward	-.22	.18
Hayling A	-.35(*)	.05
Hayling B	-.27	.15
Hayling C	-.25	-.12

* p< 0.05 (1-tailed test).
** p< 0.01 level (1-tailed test).
*** p< 0.001 level (1-tailed test).

ADL is significantly correlated in the expected direction with four of the attentional measures and with the test of response initiation. The correlation with the RBMT, while in the right direction, is not significant. ADL is not significantly correlated with estimated premorbid IQ or current IQ.

Inter is significantly correlated in the expected direction with two of the attentional tests, but it is not correlated with RBMT. Inter is not significantly correlated with estimated premorbid IQ or current IQ.

The range of scores for ADL and Inter in this sample was fairly wide (see Appendix 1) and it reflects the range of disability in the population of people suffering from schizophrenia

In order to test Hypothesis (3b) correlations between social functioning and a range of other variables that might be related to it were calculated as shown in Table 19. On the basis of the literature review a firm prediction of a relationship can only be made for negative symptoms, and therefore 2 tailed tests were employed for all the other variables.

Table 19
Correlations Between Social Functioning and Age, Illness Variables and Medication

	ADL	INTER
Age	.01	-.12
Chronicity	.39*	.18
Behaviour	.35	.41*
Mental Health	.27	.49**
KGV Negative	.43#	.48#
KGV Psychosis	.17	.12
KGV Dysphoria	.25	.25
KGV Disorganised	.16	.26
Social Circs	.26	-.08
Physical	.23	.08
APM Dose	.35	.14
AEPS Dose	.05	-.08

# p< 0.05 (1-tailed test)
* p< 0.05 (2-tailed test).
** p< 0.01 (2-tailed test).

As predicted, negative symptoms were significantly correlated with both areas of social functioning. Chronicity was significantly related to poor ADL. General psychopathology (Mental Health) and behavioural problems (Behaviour) were both significantly related to Interpersonal functioning.

From looking at the number and sizes of the significant correlations in Tables 18 and 19 and it appears that the attentional tests are indeed more related to social functioning than the other variables are. The case for this appears to be more powerful for ADL than for Inter where general psychopathology,

behavioural problems and negative symptoms appear to play a more prominent role.

In order to test Hypothesis (3a) more stringently, two stepwise multiple regression procedures were employed. All of the variables that have been considered so far were entered into analysis in order to find the best predictor, or combination of predictors for ADL and Inter respectively. The predictor variables were age, chronicity, FACE Behaviour, FACE Mental Health, FACE Physical, FACE Social Circumstances, KGV negative factor, KGV disorganised factor, KGV psychotic factor, KGV dysphoric factor, NART IQ, Quick Test IQ, Digits Forwards, Digits Backwards, RBMT Profile, Hayling A, B, C, Map Search, Visual Elevator, Telephone Search, Telephone Search Counting, effective APM dose and effective AEPSM dose.

Table 20
Predictors of ADL Model Summary

MODEL	R	R SQUARE	ADJUSTED R SQUARE
1	.69(a)	.47	.45
2	.77(b)	.59	.55
3	.83(c)	.68	.64

a Predictors: (Constant), Telephone Search Counting
b Predictors: (Constant), Telephone Search Counting,KGV Negative
c Predictors: (Constant), Telephone Search Counting, KGV Negative, Chronicity

Table 21
Predictors of ADL ANOVA

MODEL		DF	F	SIG.
1	Regression	1	19.44	.000a
	Residual	22		
	Total	23		
2	Regression	2	15.00	.000b
	Residual	21		
	Total	23		
3	Regression	3	14.38	.000c
	Residual	20		
	Total	23		

a Predictors: (Constant), Telephone Search Counting
b Predictors: (Constant), Telephone Search Counting, KGV Negative
c Predictors: (Constant), Telephone Search Counting, KGV Negative, Chronicity

As expected, the most powerful predictor of ADL is an attentional measure (Telephone Search While Counting). The negative symptom factor of the KGV and chronicity of illness both add further predictive power.

Table 22
Predictors of Inter Model Summary

MODEL	R	R SQUARE	ADJUSTED R SQUARE
1	.53(a)	.28	.25
2	.77(b)	.59	- .55

a Predictors: (Constant), Map Search
b Predictors: (Constant), Map Search, KGV negative

Table 23
Predictors of Inter ANOVA

MODEL		DF	F	SIG.
1	Regression	1	8.56	.008a
	Residual	22		
	Total	23		
2	Regression	2	15.10	.000b
	Residual	21		
	Total	23		

a Predictors: (Constant), Map Search
b Predictors: (Constant), Map Search, KGV Negative

As expected, one of the attentional tests (Map Search) is the most powerful predictor of Interpersonal functioning. The KGV Negative symptom factor adds further predictive power.

HYPOTHESES 4

(a) Independent ratings of patients' everyday cognitive functioning will identify significant deficits. The scores will be comparable to those found for patients with moderate to severe brain damage.

(b) Independent ratings of schizophrenics' attention, executive functioning and memory will be correlated with

their scores on the objective tests of attention, response initiation and suppression and memory.

Table 24
Means of Independent Cognitive Ratings

	MEAN	SD
MAC-I Mean	3.30	.53
DEX-I Mean	1.36	.58
RSAB-I Mean	1.43	.67

To assess Hypothesis 4a the mean scores in Table 24 were compared with those in the published literature.
The mean score of 1.43 on the RSAB-I indicates somewhat less impairment than for patients with severe closed head injury (Ponsford & Kinsella, 1991). The mean ratings in that study varied between 1.77 and 1.97 depending on the profession of the rater and whether is was a first or repeat rating. The mean score of 1.36 on the DEX-I also indicates somewhat less impairment than in previous studies. It compares with a mean rating of 1.63 for patients with a mixed range of neurological disorders (Wilson, *et al.*, 1996), and 1.70 for a sample of brain injured patients (Evans, *et al.*, 1997). In the latter study schizophrenics were given a mean rating of 1.58. There is no published data with which to compare the means for the MAC-I, since the one study which used it

did not cite the relevant scores (Feher, Mahurin, Inbody, *et al.*, 1991).

The intercorrelations between the three independent cognitive ratings scales are shown in Table 25.

Table 25
Intercorrelations of the Independent Cognitive Rating Scales

	DEX-I	RSAB-I
MAC-I	-.20	-.42*
DEX-I		.42*

P< 0.05 (2-tailed test)

Table 25 shows that the correlations between the attentional scale (RSAB-I) and the other scales (MAC-I and DEX-I) are significant, but that the MAC-I and the DEX-I are not significantly related.

Table 26 shows that there is considerable support for hypothesis 4b which assesses the ecological validity of the objective tests. The attentional tests are all significantly correlated with the DEX-I, as is the memory test (RBMT Profile). The attentional rating scale (RSAB-I) is significantly correlated with two of the attentional tests. On the other hand, the prediction that the attentional and dysexecutive ratings would be related

to the tests of response initiation and suppression (Hayling A, B and C) was not supported. Finally, the prediction that the independent ratings of memory (MAC-I) would correlate with objective tests of memory, attention and response initiation and suppression was not supported either.

Table 26
Correlations of the Independent Cognitive Ratings and the Objective Tests

	DEX-I	RSAB-I	MAC-I
NART IQ	-.07	-.01	.07
Quick Test IQ	-.05	-.05	.13
RBMT Profile	-.34*	-.15	.26
Digits Forward	-.07	-.07	-.02
Map Search	-.55**	-.19	-.06
Telephone Search	-.43*	-.33*	.06
Visual Elevator	-.41*	-.42*	.09
Telephone Search Counting	-.38*	-.28	.12
Digits Backward	-.06	.01	.14
Hayling A	-.23	.11	-.04
Hayling B	-.13	.09	-.06
Hayling C	-.27	.03	.18

* p< 0.05 (1-tailed test).
** p< 0.01 (1-tailed test).

HYPOTHESIS 5

(a) Independent ratings of attention, memory and executive functioning will correlate significantly with social functioning.

Table 27
Correlations of Independent Cognitive Ratings and Social Functioning

	ADL	INTER
MAC-I Mean	-.23	-.11
DEX-I Mean	.64***	.56***
RSAB-I Mean	.29	.52**

** p< 0.01 (1-tailed test).
*** p< 0.001 (1-tailed test).

This prediction receives substantial support. Table 27 shows that DEX-I is significantly related to both measures of social functioning, and RSAB-I is significantly related to Interpersonal functioning. On the other hand RSAB-I is not significantly related to ADL, and the independent rating of memory (MAC-I) does not correlate significantly with either aspect of social functioning (although three of these correlations are in the expected direction).

Given the fact that negative symptoms are also correlated with ADL and Inter (see Tables 20-23), it was decided to analyse how the KGV symptom factors and the independent cognitive ratings relate to each other. This is shown in Table 28 below.

Table 28
Correlations Between the Independent Cognitive Ratings and the KGV Factors

	Negative	Psychosis	Dysphoria	Disorganised
MAC-I	-.35	-.34	-.18	-.02
DEX-I	.00	-.01	.34	.32
RSAB-I	.46*	.27	.32	.17

* p< 0.05 (2-tailed test).

The only clear conclusion that can be drawn is that RSAB-I is significantly correlated with the KGV negative factor. There is a non-significant trend for the DEX-I to be related to both the disorganised and the dysphoric factors, and for the MAC-I to be related to both the negative and psychotic factors.

HYPOTHESES 6

Hypothesis (6a): Schizophrenics' self-rated cognitive functioning will indicate that they experience significantly more problems than the normal controls. The most stringent test of this hypothesis entails comparing the schizophrenic and normal subsamples matched for age, premorbid IQ, current IQ and IQ decline. This controls for the possible biasing effects of these variables on cognitive self-ratings.

The results are shown in Tables 29 and 30 below.

Table 29
Means of the Cognitive Self Ratings for Matched Schizophrenics and Controls

	GROUP	N	MEAN	SD
MAC-S	Control	12	3.70	.45
	Patient	14	3.13	.68
TAS	Control	12	3.74	.25
	Patient	14	3.21	.50
DEX-S	Control	12	.85	.31
	Patient	14	1.32	.59
RSAB-S	Control	12	.65	.34
	Patient	14	1.77	.88

Table 30
Independent Samples T-Test on Cognitive Self Ratings Matched Schizophrenics versus Controls

	T	Df	Sig. (1-tailed)
MAC-S	2.56	22.65	.009
TAS	3.45	19.95	.002
DEX-S	-2.60	20.27	.008
RSAB-S	-4.40	17.31	.000

(Equal variances not assumed)

As predicted the schizophrenics rate themselves as significantly more cognitively impaired on all the questionnaires than the controls do.

Hypothesis (6b): Schizophrenics' self-reports of memory, attentional and executive functioning will not correlate with their performance on objective tests of these functions. They will correlate significantly with independently rated dysphoric symptoms.

These two predictions are tested in Tables 31 and 32 below.

Table 31
Correlations of Cognitive Self Ratings and Objective Tests

	MAC-S	DEX-S	RSAB-S	TAS
Age	-.37	.19	.14	-.39
Chronicity	-.34	.21	.24	-.49*
APM Dose	-.16	-.06	.09	-.26
AEPSM Dose	-.59**	.40*	.54**	-.54**
NART IQ	.19	-.39	-.38	.22
Quick Test IQ	.10	-.30	-.18	.11
RBMT Profile	.22	.01	-.01	.21
Digits Forward	.12	-.22	-.42*	.37
Map Search	-.10	.07	.09	-.18
Telephone Search	-.24	-.21	-.07	.11
Visual Elevator	-.11	-.15	-.27	.24
Telephone Search Counting	-.22	.05	.02	-.02
Digits Backward	.02	-.29	-.26	.27
Hayling A	-.11	.11	-.19	.08
Hayling B	.09	-.04	-.20	.19
Hayling C	.29	-.47*	-.22	.41*

* p< 0.05 (2-tailed test)
**p< 0.01 (2-tailed test)

As predicted, most of the correlations are non-significant. Only the correlation between Digits Forwards and self-rated attention (RSAB-S)is significant
The finding that AEPSM medication is associated with subjectively experienced cognitive failures of all types is the other finding of interest.

Table 32
Correlations Between Cognitive Self Ratings and Psychopathology

	DEX-S	RSAB-S	MAC-S	TAS
Behaviour	-.15	-.08	.04	.08
Mental Health	-.02	-.01	-.03	-.13
KGV Negative	-.24	-.11	.19	.07
KGV Psychosis	.03	.09	-.31	-.35
KGV Dysphoria	.15	.36*	-.31	-.36*
KGV Disorganised	-.16	-.13	.06	.05

* $p<0.05$ (1 -tailed test).

There is some support for the hypothesis that cognitive self-ratings will be affiliated with independently rated dysphoric symptoms. KGV dysphoria is significantly correlated with both the TAS and the RSAB-S.

Hypothesis (6c): Schizophrenics' self-ratings of cognitive functioning will not be correlated with independent ratings of cognitive functioning.

This prediction is supported in that none of the correlations between independent and self-ratings of cognitive functioning approach significance.(Table 33)

Table 33
Correlations Between Independent and Self Ratings of Cognitive Functioning

	DEX-I	RSAB-I	MAC-I
MAC-S	.03	.31	.29
TAS	-.10	.10	.12
DEX-S	.17	-.07	-.16
RSAB-S	-.01	.07	.08

Hypothesis(6d): Schizophrenics' cognitive self-ratings will not be significantly correlated with independent ratings of their social functioning.

Table 34 shows that as predicted cognitive self-ratings are not significantly related to either aspect of social functioning.

Table 34
Correlations Between Cognitive Self Ratings and Social Functioning

	ADL	INTER
MAC-S	.11	.29
TAS	-.19	.02
DEX-S	-.09	-.05
RSAB-S	-.08	-.12

Hypotheses 7

(a) Schizophrenics and controls will report using different types of strategies to cope with everyday problems. Controls will report using more active cognitive and behavioural coping methods, whereas schizophrenics will report using more avoidant strategies.

The most stringent test of this hypothesis compares the subsamples of schizophrenics and controls matched for age, premorbid IQ, current IQ and IQ decline (Tables 35 and 36).

Table 35
Means of Self Rated Coping Strategies (CRI) for Matched Schizophrenics and Controls

CRI	GROUP	N	MEAN	SD
Active Cognitive	Control	12	2.56	.66
	Patient	14	1.82	.87
Active Behavioural	Control	12	2.49	.56
	Patient	14	1.55	.75
Avoidance	Control	12	1.23	.76
	Patient	14	1.43	.86

Table 36
Independent Samples T-Test Comparing Self Rated Coping Strategies for Matched Schizophrenics and Controls

CRI	T	Df	Sig. (1-tailed)
Active Cognitive	2.46	23.69	.010
Active Behavioural	3.65	23.65	.000
Avoidance	-.62	23.96	.271

Equal variances not assumed

This hypothesis receives substantial support in that schizophrenics report using significantly less active coping strategies (both cognitive and behavioural) than the controls. On the other hand the prediction that they would report making more use of avoidant strategies was not supported. An alternative explanation for the finding that the schizophrenics use less active behavioural strategies than the controls may be that the schizophrenics in this sample were mostly male (12 males and 3 females) and the controls mostly female (8 females

and 4 males). Earlier it was shown that normal females report greater use of this coping strategy than males.

Hypothesis (7b) In the schizophrenic group, dysphoric symptoms will be associated with greater use of avoidant coping and less use of active cognitive and behavioural coping.

Table 37 shows that there is some support for this hypothesis in that dysphoria is associated with significantly less reported use of active cognitive coping. There is also a non-significant trend in the same direction for active behavioural coping.
On the other hand there was no support for the prediction that dysphoria would be associated with more use of avoidant coping strategies

Table 37
Correlations Between KGV Symptom Factors and Self Reported Coping Style

KGV FACTORS	ACTIVE COGNITIVE	ACTIVE BEHAVIOURAL	AVOIDANT
Negative	.08	-.22	-.09
Psychosis	-.05	-.27	.12
Dysphoria	-.46*	-.33	.14
Disorganised	.34	.03	-.15

* p< 0.05 (1 tailed test)

Hypothesis (7c): In the schizophrenic group severity of self-rated cognitive problems will be associated with greater use of an avoidant coping style and less use of active cognitive and behavioural coping.

Table 38 shows that there is some support for this hypothesis especially in the case of avoidant coping strategies. Avoidance is significantly correlated with self-reported cognitive difficulties as measured by all four instruments. The findings are much less convincing in the case of the active coping strategies. However, as predicted, self-reported attentional difficulties (RSAB-S) are significantly related to less use of active cognitive strategies. Six out of the seven other correlations are in the direction predicted, but fail to achieve significance.

Table 38
Correlations Between Self Rated Cognitive Functioning and Self Reported Coping Style

	ACTIVE COGNITIVE	ACTIVE BEHAVIOURAL	AVOIDANT
MAC-S Mean	.04	-.18	-.45*
TAS Mean	.26	.23	-.54**
RSAB-S Mean	-.34*	-.29	.44*
DEX-S Mean	-.24	.03	.66***

* $p<0.05$ (2 tailed test)

The pattern of results for Hypotheses 6 and 7 indicate that the various self rating scales of cognitive functioning tend to yield the same pattern of correlations with other variables. Table 39 below shows that consistent with this the scales are highly intercorrelated. Thus for all intents and purposes they appear to be tapping one dimension of subjective cognitive impairment. For these reasons it was decided not to carry out more detailed analyses using the subscales of the cognitive self rating instruments.

Table 39
Correlations Between the Cognitive Self Rating Scales

	TAS	DEX-S	RSAB-S
MAC-S Mean	.73**	-.62**	-.57**
TAS Mean		-.69**	-.66**
DEX-S Mean			.71**

** p< 0.01 (2-tailed test).

DISCUSSION

These results support the view that there are differential cognitive deficits in schizophrenia. A subsample of schizophrenics matched with controls for age and estimated premorbid IQ showed significant deficits on tests of attention, of memory and of response initiation and suppression. The only three exceptions were digits forwards which is often spared in schizophrenia (Lezak, 1995; McKenna, Clare & Baddeley, 1995), one of the two measures of response suppression ability (Hayling C) which just fails to achieve significance and Digits Backwards. Digits Backwards is generally held to be a measure of auditory verbal working memory (Lezak, 1995; Robertson, *et al.*, 1994). Fleming, Goldberg & Gold, (1994) argue that deficits of working memory underlie some of the core deficits of schizophrenia including general memory impairment. These results do not support that view. Others have argued that working memory impairments are episode markers and only become apparent during psychotic exacerbations (Nuechterlein, Dawson & Green, 1994; Rund, Landro & Orbeck, 1997). The present study provides no support for this viewpoint either. The scores on the KGV psychosis factor showed that a substantial number of patients were displaying moderate

to severe levels of psychotic symptoms (see Appendix 1), and yet reverse digit span performance was normal.

An almost identical pattern of deficits was found even after controlling for current IQ and IQ decline in addition to age and premorbid IQ. The only change was that the difference between the schizophrenics and controls on the Telephone Search While Counting subtest failed to reach significance. It is therefore unlikely that the impairments found on the tests of memory, attention and response initiation and suppression were due to a generalised deficit.

The degree of impairment on the objective tests varied widely among the patients. Comparisons with normals and brain damaged samples show that the scores ranged from normal through to severe impairment.

This study was not designed to address the issue of the mechanisms underlying poor memory performance. The RBMT is an atheoretical test which does not indicate whether memory impairments stem from attentional problems, encoding failures, loss from storage or retrieval deficits (Lezak, 1995). However in this study partial correlational data indicated that RBMT

performance shared significant variance with two of the attentional tests, namely Map Search and Telephone Search While Counting. Map Search is a measure of visual selective attention/speed, and Telephone Search While Counting a measure of sustained attention (Robertson, *et al.*, 1994). Since the attentional tasks were designed to require minimal demands on memory, the results support the view that attentional dysfunction play a significant role in memory impairment in schizophrenia (Duffy & O'Carroll, 1994; Frith, Leary, Cahill, *et al.*, 1991; Green, 1993; Hawkins, Sullivan & Choi, 1997; Perlick & et al., 1986; Tamlyn, *et al.*, 1992).

The relationship between objective test performance and possible confounding variables was considered next. The test scores were not correlated with APM dosage. This finding is consistent with the view put forward in the Introduction that illness variables rather than APM side-effects, account for most of the variance in cognitive functioning. There is emerging evidence that the atypical APMs may aid cognitive functioning (Mortimer, 1997). However it is salutary to note that the majority of patients in the present study were stabilised on atypical APMs, but a large proportion were nevertheless afflicted by serious cognitive deficits. The evidence for the role

of AEPSM in inducing cognitive impairments is more persuasive (Paulsen, Heaton, Sadek, *et al.*, 1995), but no significant correlations were found between dosage of this class of medication and test scores. This negative result may be due to the fact that so few patients were taking AEPSM in this study.

The expected correlations were found between age at testing and two tests, RBMT Profile and Digits Backwards, which yield scores uncorrected for age. The expected correlations with age were not found between the other uncorrected test scores (Digits Forwards, and Hayling A,B, and C).

Three of the tests, RBMT Profile, Hayling C and Visual Elevator were significantly associated with chronicity of illness. In the case of RBMT Profile and Hayling C this may be partly explained by the predictable joint association of chronicity and age. However, this explanation is unlikely to hold for Visual Elevator, where age corrected scaled scores were used. One interpretation of this finding is that the Visual Elevator subtest, which assesses attentional switching, is indeed sensitive to illness duration. However this appears unlikely given the evidence reviewed in the

Introduction which indicated that chronicity per se is not a cause of cognitive impairment. (From looking at the pattern of correlations of Visual Elevator with the other variables it is likely that the correlation between chronicity and Visual Elevator may be a function of their joint association with Activities of Daily Living. This is discussed below).

The predicted relationships between negative and disorganised symptom factors and the objective tests did not emerge. The most disappointing finding was that there was no support for the predictions based on the work of Frith, *et al.*, (1991) that there would be relationships between response initiation difficulties (Hayling A) and the negative factor, and between response suppression difficulties (Hayling B,C) and the disorganised factor. These negative findings do not appear to be due to a lack of range of scores on the relevant variables (see Appendix 1). It was clear from the Introduction that the findings in this area of research have been rather inconsistent. Andreasen, *et al.*, (1995) comment on the need for a substantial revision of symptom scales in schizophrenia research in order to clarify the links between the disorganised and negative factors and cognitive impairments. It may be that existing scales

including the KGV, are not sophisticated enough to allow consistent findings to emerge. For example, the KGV negative symptom factor does not incorporate any items assessing attentional functioning. Rating scales which include substantially enlarged sections covering cognitive functioning may be required (Andreasen, *et al.*, 1995). This issue is discussed further below.

As predicted there were no relationships between objective test scores and other aspects of psychopathology including the KGV psychotic and dysphoric factors, and the FACE Mental Health and Behaviour scales. These findings lend further support to the view that the cognitive impairments are an intrinsic part of the schizophrenic illness rather than being a consequence of the debilitating or distracting effects of symptoms or behavioural problems.

There was substantial support for the hypotheses that the objective tests of attention would be related to social functioning. ADL was significantly correlated with all four tests from the TEA battery (Map Search, Telephone Search, Visual Elevator and Telephone Search While Counting) and with the measure of response initiation (Hayling A). Interpersonal functioning was

significantly correlated with two tests from the TEA battery (Map Search and Telephone Search). Premorbid IQ, current IQ, memory functioning (RBMT Profile), working memory (Digits Backwards), attentional capacity (Digits Forward), and response suppression (Hayling B and C) were not significantly related to either measure of social functioning.

As predicted, the KGV negative factor was also significantly correlated with both aspects of social functioning. In addition, chronicity was significantly associated with ADL, and both scores from the Psychological section of the FACE (Mental Health and Behaviour) were significantly correlated with Interpersonal functioning. These findings were confirmed by the use of stepwise multiple regression procedures. A wide range of potential determinants of social functioning were entered in to the equations. ADL was best predicted by Telephone Search While Counting, the negative symptom factor and chronicity. Interpersonal functioning was best predicted by Map Search and the negative symptom factor. These results support the view that attentional deficits are the major determinants of poor social functioning in chronic schizophrenia.

The finding that attentional measures and negative symptoms added separate variance to the prediction of social functioning is of great interest. As mentioned earlier this suggests that the negative symptoms assessed by the KGV are not a direct consequence of the attentional disorders. One possible explanation is that the negative symptoms as presently conceptualised are so diverse in nature that they are an end product of a number of different mechanisms of which attentional disorders are only one (Fenton & McGlashan, 1992; Spalletta, *et al.*, 1997). This explanation is considered further below in the context of the relationships between social functioning, attentional deficits and independent ratings of cognitive functioning.

The above results indicate there may be some specificity in the type of attentional abiliities required for each area of social functioning. ADL may be more dependent on the ability to sustain attention (measured by Telephone Search While Counting), while Interpersonal functioning may be more dependent on selective attention and speed (measured by Map Search). The pattern of correlations also suggests that Interpersonal functioning is vulnerable to the disruptive effects of general psychopathology and behavioural

problems, whereas ADL is not. The relationship between poor ADL and chronicity is open to a number of possible interpretations. It may be the case that the more chronic patients tend to be both older and to live in more supported accommodation. Therefore they may have less incentive to use their abilities for self care, and as a result the may also have lost the skills they once had.

The everyday memory measure (RBMT Profile) was not related to either dimension of social functioning. This is somewhat surprising given that previous studies have shown substantial relationships between these two areas (Green, 1996). One possible explanation is that the memory measures used in previous studies are in fact measuring attentional functioning rather than memory per se. However this is unlikely since a number of studies have shown that both memory and attention make independent contributions to the prediction of social functioning (Corrigan & Penn, 1995; Corrigan, Wallace, Schade, *et al.*, 1994b; Perlick, Mattis, Stastny, *et al.*, 1992b). A second possible explanation is that impaired memory may be only related to poor social skills for female schizophrenics (Mueser, Blanchard & Bellack, 1995). This possibility cannot be tested in the present study since there were so few females in the sample. A

third explanation is that only deficits in certain kinds of memory result in impaired social functioning. For example Kolakowska, *et al.*, (1985) found that episodic verbal memory was related to functioning in chronic schizophrenia, but not visual memory. Sunderland, et al, (1996) commented that a number of studies have confirmed only a weak relationship between non-verbal memory test performance and everyday memory after stroke, head injury or in normal elderly people. They speculate that non verbal memory may not be so important for everyday function in our culture. This explanation is consistent with the fact that the studies cited by Green, (1996) used instruments which assessed episodic verbal memory. The RBMT Profile score is a global measure made up of visual, prospective and motor memory in addition to verbal memory. This would reduce the likelihood of a link with social functioning emerging. Unfortunately the individual subscales of the RBMT are not designed to be sensitive enough for separate analysis, and therefore this hypothesis cannot be tested here.

The scores on the independent ratings of cognitive functioning for the schizophrenics were similar to those obtained for brain damaged patients by Evans, *et al.*, (1997), Ponsford & Kinsella, (1991) and Wilson, *et al.*,

(1996) and for schizophrenic patients by Evans, *et al.*, (1997). There was also considerable support for the ecological validity of the objective tests. All the attentional tests from the TEA battery were significantly correlated with the DEX-I, as was the RBMT Profile. Two of the attentional tests (Telephone Search and Visual Elevator) were significantly correlated with the attentional rating scale (RSAB-I). As expected, none of the independent cognitive ratings were associated with indices of general intellectual functioning (NART or Quick Test). On the other hand, the prediction that the attentional and dysexecutive ratings would be related to the tests of response initiation and suppression (Hayling A, B and C) was not supported. In addition, no relationships were found between independent cognitive ratings and working memory (Digits Backwards) or with attentional capacity (Digits Forwards). Finally, the predictions that the independent ratings of memory (MAC-I) would correlate with objective tests of memory, attention and response initiation and suppression were not supported either. These negative findings were despite the fact that the MAC-I correlated significantly with the RSAB-I, although it did not correlate significantly with the DEX-I.

The above results add further support to view that attentional disorders are fundamental in schizophrenia, and that they are a major cause of problems in everyday functioning. They also support the evidence put forward in the Introduction (Evans, *et al.*, 1997; Frith *et al.*, 1991; Gold, *et al.*, 1994; Kenny & Meltzer, 1991) that dysexecutive problems in schizophrenia are a consequence of attentional disorders. The finding that the RSAB-I was significantly correlated with the DEX-I is also consistent with this argument.

The relationship between the RBMT Profile score and the DEX-I probably reflects the dependence of everyday memory performance in schizophrenia on intact attentional functioning.

The highly significant correlations between the objective tests of attention and the independent ratings of attention and dysexecutive function are in sharp contrast to the absence of any relationship between the objective tests and the negative and disorganised symptom factors described earlier. A possible interpretation of these results is that the RSAB-I and the DEX-I provide more accurate and comprehensive measures of the attentional problems picked up by negative and

disorganised symptom factors respectively. It was noted above that the KGV scale (unlike the SANS and the PANSS) does not contain any items assessing attentional or cognitive functioning. Furthermore, from looking at the content of the DEX-I and the RSAB-I it is apparent that they assess overlapping areas. On the whole the RSAB-I scale focuses on negative features of attention such as failures of initiation and problems with slowness, while the DEX-I covers both negative features plus problems with response suppression and disorganisation. Consistent with this account are the findings that the DEX-I and the RSAB-I are modestly correlated, that the RSAB-I is significantly correlated with the KGV negative factor, and that there is a trend for the DEX-I to be associated with the KGV disorganised factor. There is a need for factor analytic studies employing the DEX-I and the RSAB-I together with symptom scales with large schizophrenic samples in order to clarify these issues. This account might help to explain why no associations were found between the independent cognitive ratings (DEX-I and RSAB-I) and the Hayling Tests of response initiation and suppression. Since these rating scales do not provide a pure assessment of each type of disorder (i.e. negative versus disorganised) significant relationships with

objective measures of these deficits (i.e. initiation versus suppression) are unlikely to be found.

As predicted there were significant large correlations between the independent cognitive ratings and social functioning. Both DEX-I and RSAB-I were significantly associated with Interpersonal functioning and in addition DEX-I was significantly correlated with ADL. These results provide further support for the view that attentional deficits are a major determinant of social impairments in schizophrenia. One speculative interpretation of the pattern of results found is that Interpersonal functioning is adversely affected by negative features such as slowness (which is tapped by both the DEX-I and the RSAB-I), but not by disorganisation or disinhibition (which is tapped by the DEX-I alone). On the other hand ADL is disrupted by both slowness and disorganisation or disinhibition, and hence is correlated with both DEX-I and RSAB-I.

MAC-I was not associated with ADL or Interpersonal functioning. This result corroborates the finding reported earlier that RBMT Profile, an objective measure of everyday memory, is unrelated to social functioning. Like the RBMT, the MAC-I assesses many different memory

abilities. As mentioned earlier, future studies should use both objective tests and independent ratings to investigate which kinds of memory tasks are related to social functioning, and which are not.

The subjective experience of cognitive impairments was the next perspective to be examined. Schizophrenics' cognitive self ratings indicated that they reported significantly more problems of this kind than a normal sample matched for age, premorbid IQ, current IQ and IQ decline. This finding held equally for self ratings of memory (MAC-S), attention (RSAB-S and TAS) and executive functioning (DEX-S). The prediction that schizophrenics' self-reports of memory, attentional and executive functioning would not correlate with their performance on objective tests of these functions was also substantially supported. Only the correlation between Digits Forwards and self-rated attention (RSAB-S) was significant. If the latter finding is replicable it may indicate that it is possible to form accurate self judgements about simple abilities such as attentional capacity, but not about more complex cognitive functions.

The prediction that there would be no concordance between self and independent ratings of cognitive

functioning was also upheld. In addition there was substantial support for the prediction that subjective judgements of cognitive efficacy would be associated with KGV dysphoria but not with any other symptom dimensions. The only two significant relationships between symptoms and cognitive self ratings to emerge were between the KGV dysphoric mood factor and the two subjective attentional ratings (RSAB-S and TAS). These findings are in line with those of Van den Bosch & Rombouts, (1997) and Van den Bosch, et al, (1993).

The finding that AEPSM medication dosage is associated with subjectively experienced cognitive failures of all types was unexpected. Since only a small proportion of patients were taking this class of medication this result must be interpreted cautiously. If it can be replicated it may indicate that AEPSM leads to subjective experiences of cognitive failure even when there is no corroborative evidence of such deficiencies from objective tests or from independent cognitive ratings.

It was predicted that schizophrenics' cognitive self-ratings would not be related to social functioning. In line with this prediction none of the correlations

between the cognitive self rating scales and ADL or Interpersonal functioning were significant.

There were significant differences in the use of coping strategies between subsamples of schizophrenics and controls matched for age, estimated premorbid IQ, current IQ and IQ decline. As predicted schizophrenics reported less use of active cognitive and behavioural strategies than controls. The finding concerning active behavioural strategies needs to be treated with some caution. This is because in the normal sample females reported using active behavioural strategies more than normal males (see Appendix 9-10). No such difference was found in the schizophrenic sample however, but this may have been because the statistical test was unreliable due to the small numbers of females (see Appendices 7-8). Since the schizophrenic subsample was made up of a majority of males and the normal subsample consisted of a majority of females this imbalance might account for the group difference on this variable. There was no support for the prediction that schizophrenics would make more use of avoidant strategies than normals.

As predicted dysphoria was the only psychopathological variable to be associated with coping

style in the schizophrenic group. These findings support those of Van den Bosch, *et al.*, (1992). The KGV dysphoria factor was associated with significantly less reported use of active cognitive coping. There is also a non-significant trend in the same direction for active behavioural coping but there was no support for the prediction that dysphoria would be associated with more use of avoidant coping strategies.

Finally there was some support for the prediction that the severity of self-rated cognitive problems would be associated with coping styles in the schizophrenic group. Avoidance was significantly correlated with self-reported cognitive difficulties as measured by all four instruments (MAC-S, RSAB-S, DEX-S and TAS). In addition self-reported attentional difficulties (RSAB-S) were significantly related to less use of active cognitive coping strategies.

IMPLICATIONS

This research provides further support for the existence of differential cognitive impairments in schizophrenia (Bilder, 1996; Landro, 1994; McKenna,et al, 1995; McKenna, 1994; Paulsen, *et al.*, 1995; Rossell & David,

1997; Steffy & Oakman, 1997; Tamlyn, *et al.*, 1992; Tollefson, 1996) and especially for the presence of disproportionate attentional deficits (Gold, 1994; Kenny and Meltzer, 1991; Nuechterlein & Dawson, 1984; Oltmanns, 1978; Oltmanns & Neale, 1975; Steffy & Oakman, 1997).

The results add credibility to the view that attentional disorders are responsible for many of the problems of everyday living in schizophrenia (Green, 1996). Crucially these results are the first to demonstrate in a schizophrenic sample a clear relationship between attentional deficits measured by objective tests and those measured by independent ratings. This project is also the first to show that attentional deficits account for a substantial proportion of the variance in social and interpersonal functioning even after controlling for the potential contribution of a comprehensive range of other factors, including negative symptoms.

This study shows that schizophrenics are acutely aware of having cognitive difficulties. However the research confirms previous findings with a diverse range of samples showing that subjective judgements do not correspond to independent test results and independent

ratings (Cohen, 1996; Knight & Godfrey, 1995; Rabbitt, Maylor, McInnes, *et al.*, 1995). The finding that self ratings of cognitive efficacy are related to dysphoric mood, greater use of avoidant coping methods, and a failure to use active coping strategies suggests a possible vicious cycle of helplessness (Van den Bosch & Rombouts, 1997) which may be amenable to therapeutic interventions.

The present findings indicate the potential value of using comprehensive assessments of cognitive functioning as a part of the routine clinical assessment procedure for schizophrenic patients. Assessments based on existing symptom rating scales do not adequately describe the impairments faced by someone living with schizophrenia, nor how these deficits interfere so profoundly with the tasks of daily life.

Such detailed assessments of cognitive functioning may in the future help to guide cognitive and environmental interventions aimed at improving the well being, coping and functioning of those who have to endure this illness (Green, 1993; Spaulding, Reed, Storzback, *et al.*, 1998; Velligan, Mahurin, Diamond, *et al.*, 1997).

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Appendix 1
Total Schizophrenic Sample Descriptive Statistics

	N	MIN	MAX	MEAN	SD
Age	28	18.00	66.00	39.6786	11.5151
Chronicity	28	2.00	28.00	14.25	7.6479
NART IQ	28	86.00	124.0	104.95	9.6308
Quick Test IQ	28	73.00	120.0	95.1429	12.6746
IQ Decline	28	-7.00	28.00	9.7857	8.0937
Digits Forward	28	4.00	8.00	5.9286	1.3313
Digit Backward	28	1.00	7.00	4.3571	1.4960
RBMT Profile	28	6.00	23.00	16.5000	5.0589
Hayling A	28	1.00	6.00	4.6071	1.3427
Hayling B	28	1.00	6.00	4.6786	1.6567
Hayling C	28	1.00	8.00	4.8214	2.3735
Map Search	27	1.00	18.00	5.2778	3.7732
Visual Elevator	24	3.00	14.00	7.8750	3.1803
Telephone Search	27	3.00	11.00	6.5370	1.8960
Telephone Search Counting	27	2.00	12.00	7.5926	2.8320
APM Dose	28	.00	117.0	46.2946	29.4475
AEPS Dose	28	.00	40.00	3.5000	9.7582
Behaviour	28	.00	.66	.2079	.1892
Mental Health	28	.00	1.30	.5996	.3563
Physical	28	.00	.67	.1839	.2186
ADL	28	.00	2.83	1.1893	.6270
Interpersonal	28	.20	2.00	1.2375	.4804
Social Circumstances	28	.00	.83	.3586	.2861
KGV Negative	28	.00	1.67	.6054	.5298
KGV Psychosis	28	.00	4.00	1.2679	1.2944
KGV Dysphoria	28	.00	3.00	1.2500	.8108
KGV Disorganised	28	.00	2.50	.6189	.7464
MAC-I Mean	28	2.49	4.45	3.2971	.5265
DEX-I Mean	28	.35	2.75	1.3625	.5830
RSAB-I Mean	28	.07	2.85	1.4304	.6738
MAC-S Mean	25	1.71	4.45	2.9884	.6554
TAS Mean	25	2.09	3.89	3.0866	.5387
DEX-S Mean	25	.30	2.65	1.5168	.6431
RSAB-S Mean	25	.57	3.71	1.8936	.8092
Active Cognitive	25	.17	3.83	2.1060	.8448
Active Behavioural	25	.33	3.80	1.7776	.8917
Avoidance	25	.40	3.20	1.6924	.8773

Appendix 2

Total Normal Sample Descriptive Statistics

	N	MIN	MAX	MEAN	SD
Age	26	23.00	55.00	33.8462	8.8755
MAC-S	26	2.96	4.47	3.7400	.4126
TAS	26	3.15	4.27	3.7399	.3020
DEX-S	26	.20	1.45	.8154	.3373
RSAB-S	26	.21	1.93	.7804	.4237
Active Cognitive	26	1.00	3.33	2.5027	.5786
Active Behavioural	26	1.50	3.50	2.5250	.5565
Avoidance	26	.20	2.80	1.2231	.6913
NART IQ	26	106.0	120.0	114.269	4.6438
Quick Test IQ	26	100.0	120.0	109.769	6.4331
Digits Forward	26	5.00	8.00	6.8846	1.1774
Digits Backwards	26	3.00	7.00	5.0769	1.3542
RBMT Profile	26	21.00	24.00	23.3077	.9703
Hayling A	26	3.00	7.00	6.0000	.8000
Hayling B	26	4.00	8.00	6.1154	.7114
Hayling C	26	2.00	8.00	6.9231	1.1974
Map Search	26	5.00	19.00	9.5769	2.9688
Visual Elevator	26	5.00	14.00	10.3077	2.4943
Telephone Search	26	5.00	19.00	10.8077	3.3379
Telephone Search Counting	26	6.00	15.00	10.5000	2.3367

Appendix 3

Schizophrenic Sample Matched for age and NART
Descriptive Statistics

	N	MIN	MAX	MEAN	SD
Age	18	18.00	58.00	35.3889	10.5057
NART IQ	18	100.0	124.0	110.388	6.5092
Quick Test IQ	18	78.00	120.0	100.555	11.0731
IQ Decline	18	-7.00	28.00	9.8333	8.0896
Digits Forwards	18	4.00	8.00	6.3333	1.3284
Digits Backwards	18	3.00	7.00	4.8333	1.4246
RBMT Profile	18	6.00	23.00	18.4444	4.8169
RBMT Screening	18	2.00	11.00	8.4444	2.5023
Hayling A	18	2.00	6.00	4.8889	1.0226
Hayling B	18	1.00	6.00	5.0000	1.6450
Hayling C	18	2.00	8.00	5.5556	2.1481
Map Search	18	1.00	18.00	5.1944	4.2258
Visual Elevator	17	3.00	14.00	8.0588	3.1518
Telephone Search	18	3.00	11.00	6.5278	2.2127
Telephone Search Counting	18	4.00	12.00	8.0556	2.9400
MAC-S	17	1.71	4.45	3.1806	.6361
TAS	17	2.26	3.85	3.2331	.4537
Active Cognitive	17	.17	3.17	1.9606	.8559
Active Behavioural	17	.33	3.17	1.6071	.7913
Avoidance	17	.40	3.20	1.4824	.9248
DEX-S	17	.30	2.40	1.3529	.5591
RSAB-S	17	.57	3.71	1.7594	.8202
Valid N (listwise)	17				

Appendix 4
Normal Sample Matched for Age and NART
Descriptive Statistics

	N	MIN	MAX	MEAN	SD
Age	14	25.00	50.00	33.8571	7.2202
NART IQ	14	106.0	116.0	110.785	3.4234
Quick Test IQ	14	100.0	116.0	107.142	5.8026
IQ Decline	14	-9.00	10.00	3.6429	5.1082
Digits Forwards	14	5.00	8.00	6.4286	1.1579
Digits Backwards	14	3.00	6.00	4.4286	1.0163
RBMT Profile	14	22.00	24.00	23.2857	.7263
RBMT Screening	14	11.00	12.00	11.4286	.5136
Hayling A	14	3.00	7.00	5.8571	.9493
Hayling B	14	4.00	8.00	6.0000	.7845
Hayling C	14	2.00	8.00	6.5714	1.4525
Map Search	14	6.00	14.00	9.1429	1.9158
Visual Elevator	14	7.00	14.00	9.7857	2.1547
Telephone Search	14	5.00	16.00	9.4286	3.2037
Telephone Search Counting	14	6.00	15.00	9.9286	2.7306
MAC-S	14	2.96	4.43	3.6964	.4207
TAS	14	3.26	4.14	3.6771	.2807
Active Cognitive	14	1.00	3.33	2.5157	.6376
Active Behavioural	14	1.50	3.50	2.4393	.5909
Avoidance	14	.20	2.80	1.2571	.6991
DEX-S	14	.35	1.25	.8857	.3035
RSAB-S	14	.21	1.79	.7707	.4552

Appendix 5

Schizophrenic Sample Matched for age and NART Quick Test and IQ Decline Descriptive Statistics

	N	Min	Max	Mean	SD
Age	15	18.00	58.00	35.466	10.9405
NART IQ	15	101.0	124.0	110.86	6.4682
Quick Test IQ	15	87.00	120.0	103.26	9.4903
IQ Decline	15	-7.00	16.00	7.6000	6.2656
Digits Forwards	15	5.00	8.00	6.4667	1.1872
Digits Backwards	15	3.00	7.00	4.8000	1.5213
RBMT Profile	15	6.00	23.00	18.200	5.1851
RBMT Screening	15	2.00	11.00	8.4000	2.7203
Hayling A	15	3.00	6.00	5.0667	.7988
Hayling B	15	1.00	6.00	5.2000	1.4243
Hayling C	15	2.00	8.00	5.3333	2.2573
Map Search	15	1.00	18.00	5.6333	4.4740
Visual Elevator	14	3.00	14.00	8.0714	3.3389
Telephone Search	15	3.00	11.00	6.6000	2.4142
MAC-S	14	1.71	4.45	3.1286	.6793
TAS	14	2.26	3.85	3.2137	.4970
DEX-S	14	.30	2.40	1.3179	.5853
RSAB-S	14	.57	3.71	1.7743	.8832
Active Cognitive	14	.17	3.17	1.8207	.8691
Active Behavioural	14	.33	2.83	1.5464	.7471
Avoidance	14	.40	2.80	1.4286	.8552

Appendix 6

Normal Sample Matched for age and NART Quick Test and IQ Decline Descriptive Statistics

	N	Min	Max	Mean	SD
Age	12	25.00	42.00	32.250	5.848
NART IQ	12	106.0	116.00	110.666	3.171
Quick Test IQ	12	100.0	116.00	105.666	4.811
IQ Decline	12	.00	10.00	5.0000	3.6181
Digits Forwards	12	5.00	8.00	6.6667	1.0731
Digits Backwards	12	3.00	6.00	4.5000	1.0000
RBMT Profile	12	22.00	24.00	23.1667	.7177
RBMT Screening	12	11.00	12.00	11.3333	.4924
Hayling A	12	5.00	7.00	6.0833	.5149
Hayling B	12	4.00	8.00	6.0000	.8528
Hayling C	12	2.00	8.00	6.4167	1.5050
Map Search	12	6.00	14.00	9.1667	1.8990
Visual Elevator	12	8.00	14.00	10.0833	2.1515
Telephone Search	12	5.00	16.00	9.2500	3.3878
MAC-S	12	2.96	4.43	3.6983	.4480
TAS	12	3.31	4.14	3.7377	.2543
DEX-S	12	.35	1.25	.8500	.3082
RSAB-S	12	.21	1.14	.6492	.3417
Active Cognitive	12	1.00	3.33	2.5600	.6584
Active Behavioural	12	1.83	3.50	2.4850	.5623
Avoidance	12	.20	2.80	1.2333	.7572

Appendix 7
Total Schizophrenic Sample Sex Differences Descriptive Statistics

	GENDER	N	MEAN	SD
Age	male	23	39.7826	12.5189
	female	5	39.2000	5.7184
Chronicity	male	23	13.7826	7.8448
	female	5	16.4000	7.0214
APM Dose	male	23	44.7935	31.5912
	female	5	53.2000	17.0792
AEPS Dose	male	23	4.2609	10.6524
	female	5	.0000	.0000
NART IQ	male	23	104.9826	9.0688
	female	5	104.8000	13.1795
Quick Test IQ	male	23	95.9130	12.5115
	female	5	91.6000	14.2934
IQ Decline	male	23	9.0435	8.7619
	female	5	13.2000	1.4832
Digits Forward	male	23	6.0000	1.3143
	female	5	5.6000	1.5166
Digit Backward	male	23	4.3043	1.5793
	female	5	4.6000	1.1402
RBMT Profile	male	23	16.9565	5.2698
	female	5	14.4000	3.6469
Hayling A	male	23	4.6957	1.2223
	female	5	4.2000	1.9235
Hayling B	male	23	4.7826	1.5654
	female	5	4.2000	2.1679
Hayling C	male	23	5.0870	2.3532
	female	5	3.6000	2.3022
	GENDER	N	MEAN	SD
Map Search	male	22	5.7273	3.7945
	female	5	3.3000	3.3091
Visual Elevator	male	21	7.8095	2.9936
	female	3	8.3333	5.1316
Telephone Search	male	22	6.4773	1.5772
	female	5	6.8000	3.1937
Telephone Search Counting	male	22	7.7273	2.6758
	female	5	7.0000	3.7417
Behaviour	male	23	.2170	.1962
	female	5	.1660	.1650
Mental Health	male	23	.5726	.3541
	female	5	.7240	.3792
KGV Negative	male	23	.6939	.5409
	female	5	.1980	.1807
KGV Psychosis	male	23	1.1304	1.1986

Cont'd

Appendix 7 Cont'd

	GENDER	N	MEAN	SD
	female	5	1.9000	1.6733
KGV Dysphoria	male	23	1.0217	.6822
	female	5	2.3000	.4472
KGV Disorganised	male	23	.6230	.6856
	female	5	.6000	1.0840
Physical	male	23	.1952	.2050
	female	5	.1320	.2952
ADL	male	23	1.1800	.5514
	female	5	1.2320	.9895
Interpersonal	male	23	1.2543	.4983
	female	5	1.1600	.4278
Social Circumstances	male	23	.3500	.2805
	female	5	.3980	.3429
MAC-I	male	23	3.3304	.5518
	female	5	3.1440	.4014
DEX-I	male	23	1.3109	.4894
	female	5	1.6000	.9441
RSAB-I	male	23	1.4343	.6093
	female	5	1.4120	1.0110
MAC-S	male	22	3.0268	.6770
	female	3	2.7067	.4549
TAS	male	22	3.0944	.5676
	female	3	3.0293	.3065
DEX-S	male	22	1.5055	.6661
	Female	3	1.6000	.5408
RSAB-S	Male	22	1.9055	.8615
	Female	3	1.8067	.2307
Active Cognitive	Male	22	2.1736	.8742
	Female	3	1.6100	.3483
Active Behavioural	Male	22	1.7400	.9435
	Female	3	2.0533	.2542
Avoidance	Male	22	1.6777	.8584
	Female	3	1.8000	1.2166

Appendix 8

Total Schizophrenic Sample Sex Differences T Tests

	t	Df	Sig. (2-tailed)
Age	.159	13.928	.876
Chronicity	-.739	6.380	.486
APM Dose	-.833	11.051	.422
AEPS Dose	1.918	22.000	.068
NART IQ	.030	4.856	.978
Quick Test IQ	.625	5.416	.558
IQ Decline	-2.138	25.724	.042
Digits Forward	.547	5.387	.606
Digit Backward	-.487	7.786	.640
RBMT Profile	1.300	8.150	.229
Hayling A	.552	4.726	.606
Hayling B	.570	4.947	.594
Hayling C	1.304	5.967	.240
Map Search	1.439	6.635	.196
Visual Elevator	-.173	2.199	.878
Telephone Search	-.220	4.453	.836
Telephone Search Counting	.411	4.971	.698
Behaviour	.604	6.720	.566
Mental Health	-.818	5.623	.446
KGV Negative	3.574	20.564	.002
KGV Psychosis	-.975	4.931	.375
KGV Dysphoria	-5.208	8.667	.001
KGV Disorganised	.046	4.719	.965
Physical	.456	4.873	.668
ADL	-.114	4.554	.914
Interpersonal	.433	6.603	.679
Social Circumstances	-.292	5.228	.781
MAC-I	.874	7.724	.408
DEX-I	-.666	4.478	.538
RSAB-I	.048	4.651	.964
MAC-S	1.068	3.361	.356
TAS	.303	4.221	.776
DEX-S	-.276	2.901	.801
RSAB-S	.435	12.522	.671
Active Cognitive	2.056	6.459	.082
Active Behavioural	-1.258	12.401	.231
Avoidance	-.168	2.280	.880

Equal variances not assumed

Appendix 9
Total Normal Sample Sex Differences Descriptive Statistics

	GENDER	N	MEAN	SD
Age	Male	13	33.6923	7.2959
	Female	13	34.0000	10.5277
NART IQ	Male	13	115.2308	4.9523
	Female	13	113.3077	4.2892
Quick Test IQ	Male	13	110.9231	6.9097
	Female	13	108.6154	5.9657
Digits Forward	Male	13	6.8462	1.2142
	Female	13	6.9231	1.1875
Digits Backwards	Male	13	4.9231	1.7059
	Female	13	5.2308	.9268
RBMT Profile	Male	13	23.4615	.9674
	Female	13	23.1538	.9871
Hayling A	Male	13	5.9231	1.1152
	Female	13	6.0769	.2774
Hayling B	Male	13	5.9231	.6405
	Female	13	6.3077	.7511
Hayling C	Male	13	7.0769	.6405
	Female	13	6.7692	1.5892
Map Search	Male	13	8.9231	2.4987
	Female	13	10.2308	3.3455
Visual Elevator	Male	13	9.8462	2.8239
	Female	13	10.7692	2.1274
Telephone Search	Male	13	10.8846	4.0935
	Female	13	10.7308	2.5382
Telephone Search Counting	Male	13	10.7692	2.4547
	Female	13	10.2308	2.2787
MAC-S	Male	13	3.6923	.3906
	Female	13	3.7877	.4441
TAS	Male	13	3.6471	.3230
	Female	13	3.8328	.2589
DEX-S	Male	13	.9000	.3494
	Female	13	.7308	.3153
RSAB-S	Male	13	.8846	.5148
	Female	13	.6762	.2923
Active Cognitive	Male	13	2.4546	.5237
	Female	13	2.5508	.6466
Active Behavioural	Male	13	2.2815	.5322
	Female	13	2.7685	.4833
Avoidance	Male	13	1.0769	.6405
	Female	13	1.3692	.7341

Appendix 10 Total Normal Sample Sex Differences T Tests

	T	Df	Sig. (2-tailed)
Age	-.087	24	.932
NART IQ	1.058	24	.300
Quick Test IQ	.911	24	.371
Digits Forward	-.163	24	.872
Digits Backwards	-.571	24	.573
RBMT Profile	.803	24	.430
Hayling A	-.483	24	.634
Hayling B	-1.405	24	.173
Hayling C	.647	24	.523
Map Search	-1.129	24	.270
Visual Elevator	-.941	24	.356
Telephone Search	.115	24	.909
Telephone Search Counting	.580	24	.568
MAC-S	-.581	24	.566
TAS	-1.617	24	.119
DEX-S	1.297	24	.207
RSAB-S	1.270	24	.216
Active Cognitive	-.417	24	.681
Active Behavioural	-2.442	24	.022
Avoidance	-1.082	24	.290

Equal variances assumed

Appendix 11
Proportions of Males and Females in Schizophrenic and Normal Control Groups

GROUP	Gender	Observed N	Expected N	Residual
Controls	male	13	13.0	.0
	female	13	13.0	.0
	Total	26		
Schizophrenics	male	23	14.0	9.0
	female	5	14.0	-9.0
	Total	28		

GROUP		Gender
Controls	Chi-Square(a,b)	.000
	Df	1
	Asymp. Sig.	1.000
Schizophrenics	Chi-Square(a,b)	11.571
	Df	1
	Asymp. Sig.	.001