Neuropsychological Neurology
The Neurocognitive Impairments of Neurological Disorders
To Jo – because no one has dedicated a book to you before

Disorders of intellect . . . happen much more often than superficial observers will easily believe.

Samuel Johnson, *The History of Rasselas, Prince of Abyssinia* (1759)
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*Acknowledgements*  

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First and foremost I thank my wife Philippa, and children Thomas and Elizabeth, for their forbearance and moral support (perhaps involuntary) in allowing me to write another book.

I thank the many colleagues with whom I have worked and from whom I have learned much: Mark Doran, Eric Ghadiali, Daniel du Plessis, and Pavla Hancock in Liverpool; Alex Leff, Jonathan Schott, Nick Fox, Angus Kennedy, John Janssen, Lisa Cipolotti, Gail Robinson, Richard Wise, and Martin Rossor in London; and John Hodges in Cambridge.

I thank also the colleagues and friends who have offered advice on particular topics in this book: Rustam Al-Shahi, Alasdair Coles, Kalvinder Gahir, Desmond Kidd, Michael and Sally Mansfield, and Sivakumar Sathasivam.

All errors or misconceptions which remain are entirely my own work. I shall be pleased to hear from readers who detect errors or omissions.
The aim of this book is to review what is known about the neuropsychological or neurocognitive impairments which occur in neurological disorders, and in some general medical conditions which may be seen by neurologists. Such neuropsychological deficits are of course relatively well defined in those disorders which present with, or whose clinical features are largely restricted to, cognitive impairment, specifically the dementia syndromes, of both neurodegenerative and vascular aetiology, and these account for a fair proportion of this book. However, cognitive dysfunction may also occur in other neurological disorders, an observation which may have implications for both clinical diagnosis and case management. Few texts have, to my knowledge, specifically addressed this area (e.g. Grant & Adams, 1996; Green, 2000; Harrison & Owen, 2002), and some only in passing. To be sure, there are a number of excellent texts which tackle the classical neuropsychological syndromes such as amnesia, aphasia, alexia, agraphia, apraxia, agnosia, and executive dysfunction (e.g. Baddeley et al., 1995; Benson & Ardila, 1996; Kirshner, 2002; Heilman & Valenstein, 2003). The case-study approach to the neuropsychological features of neurological disorders (e.g. Kapur, 1996; Ogden, 2005) has even spilled over into populist texts, but though such in-depth case studies are informative, they may not immediately correspond to the case mix seen by clinical neurologists. Textbooks of neurology may mention dementia as a feature of certain neurological diseases, often in a rather diffuse way.

There is a perception in some quarters that neuropsychology is something rather separate from clinical neurology. The case may perhaps be persuasively made for academic cognitive neuropsychology, which aims to infer mental structure from neuropsychological test performance, often in single case studies of highly unusual but instructive patients (Shallice, 1988; Ellis & Young, 1996), and even ‘clinical’ neuropsychology texts (e.g. McCarthy & Warrington, 1990; Groth-Marnat, 2001; Halligan et al., 2003; Devinsky & D’Esposito, 2004) may contain more than a practising clinician would require, or possibly desire. Nonetheless, clinical neurologists neglect cognitive function at their peril. It should not be forgotten that cognitive neuroscience has neurological foundations (D’Esposito 2003; Panegyres, 2004).

It is well recognized that the standard neurological examination is focused predominantly on functions mediated by the parietal and occipital lobes, with frontal and temporal lobe functions being relatively untested. Since, in the context of the clinical history, neurological signs help to focus on the likely locale of pathology (Larner, 2006), it would seem desirable to be able to tap the functions of these areas of the brain as well.

A neuropsychological examination provides the opportunity to do this; such assessment permits a more fine-grained analysis of cognitive function, a refinement which may have localizing and diagnostic value. Just as one would not contemplate omitting the visual field examination or the plantar responses when examining a patient suspected of
Not only are neuropsychological tests essential in the diagnosis of dementia disorders, but they may also be helpful in differential diagnosis, for example of movement disorders (Pillon et al., 1996). Neuropsychological features may contribute to disease morbidity even where outcome is judged good or excellent on neurological grounds, e.g. in multiple sclerosis (Feinstein, 1999) or subarachnoid haemorrhage (Hütter, 2000). Neuropsychological parameters may therefore be as appropriate as motor, sensory, or functional scales as outcome measures in the conduct of clinical trials. Early identification and treatment of cognitive impairments would seem the most likely time point at which interventions might show therapeutic efficacy. Part of the desire here, of course, is to identify conditions with neuropsychological deficits that may reverse with appropriate treatment of the underlying condition. Much has been written on the subject of ‘reversible dementias’, no less than 65 such conditions being alluded to in one review (Cummings et al., 1980), although it seems that the overall frequency of such reversible conditions is low, and falling (Barry & Moskovitz, 1988; Waldemar, 2002; Clarfield, 2003).

Part of the problem, of course, is the sophistication of neuropsychological testing, the plethora of possible tests available to bewilder the uninitiated (Lezak et al., 2004; Mitrushina et al., 2005; Strauss et al., 2006), and the lack of time devoted in clinical training to this subject. For this reason, a brief overview of cognitive function and neuropsychological evaluation prefaces the chapters devoted to the neuropsychological profiles of specific disease entities. This modest excursion into applied neuropsychology will in all probability horrify those trained in the art and science of neuropsychology, but the aim has been entirely pragmatic, for the benefit of clinical practitioners. In the chapters which follow, the neuropsychological impairments of neurological and general medical disorders are considered. Detailed discussions of neurological features of the disorders covered are not included, although brief notes are given and, where possible, references to diagnostic criteria are cited. For more information on the clinical features of neurological disease, the reader is referred to other textbooks of neurology (for one of which the current author has a particular, and perhaps forgivable, predilection: Barker et al., 2005). A few comments on the treatment of cognitive impairments are given as a gentle rebuff to those who imagine neuropsychological neurology to be a purely descriptive undertaking.

This overview is no small undertaking (I have amongst my papers a draft plan of the book, not too dissimilar from the current contents, dated 27 August 1998), for which reason certain omissions have proved necessary. Perhaps the most important of these is the lack of coverage of neuropsychiatric features of neurological disease (mood disorders, delusions, hallucinations, depression, euphoria, etc.) which often coexist with, and may confound the examination of, neuropsychological deficits. (Pain is also a potential confounder of neuropsychological testing, as in mild traumatic brain injury or headache: Nicholson et al., 2001.) It seems to me that the domain of neuropsychiatry, or behavioural neurology, the overlap between neurological disorders and psychiatric features, has been relatively well addressed, both in general texts (e.g. Lishman, 1987; Trimble, 1996; Moore, 2001; Pincus & Tucker, 2002; Cummings & Mega, 2003; Feinberg & Farah, 2003) and in texts devoted to specific diseases (e.g. stroke: Robinson, 2006; multiple sclerosis: Feinstein, 1999; Parkinson’s disease: Starkstein & Merello, 2002; Alzheimer’s disease: Ballard et al., 2001). As a corollary to this, the grey area of depression-related dementia or depressive pseudodementia (Roose & Devanand, 1999; Kanner, 2005) has been referred to only briefly.

Given my personal clinical training and experience, the perspective is entirely that of adult neurological practice. For childhood disorders
causing cognitive decline, standard texts are available (e.g., Lyon et al., 1996; Brett, 1997; Clarke, 2002; Panteliadis & Korinthenberg, 2005). Learning disability (mental retardation), of which over 2000 different syndromes are described, is entirely eschewed. However, those ‘childhood’ neurodegenerative disorders that may on occasion present as dementia in adults (e.g., Coker, 1991; Doran, 1997; Panegyres, 2001; Sampson et al., 2004) have been included. Some specific topics have not been tackled, again for lack of personal training and experience, most notably head injury and drug-induced cognitive problems (for the latter see Farlow & Hake, 1998; Moore & O’Keefe, 1999), with the exception of antiepileptic drugs, radiotherapy and chemotherapy treatment of brain tumours, and a passing mention of solvent exposure (Berent & Albers, 2005). Neither the management of dementia (e.g., Qizilbash et al., 2002; Baldwin & Murray, 2003; Brown & Hillam, 2004; Curran & Watts, 2004; Rabins et al., 2006) nor neuropsychological rehabilitation (e.g., Wilson, 1999; Greenwood et al., 2003; Halligan & Wade, 2005; Selzer et al., 2006) is discussed. Since dementia syndromes have been relatively well covered, collectively (e.g. Parks et al., 1993; Hodges, 2001; Mendez & Cummings, 2003; Burns et al., 2005) and individually, the text is slightly weighted towards other neurological disorders. The arrangement of the chapters is somewhat arbitrary, with certain conditions potentially relevant to more than one, but hopefully those scanning rather than reading systematically will find what they are seeking without too much difficulty. Unavoidably, the author’s own interests may appear overemphasized.

This book is envisaged as a reference text relevant to all neurologists, not only those with a declared interest in cognitive disorders; to old age psychiatrists and geriatricians who have to assess patients with cognitive decline; and also as a resource for general physicians and specialists who deal with any endocrine, metabolic, vascular, or infective disorders that may compromise cognitive function. Practitioners of professions allied to medicine which involve contact with cognitively impaired patients (mental health nursing, physiotherapy, occupational therapy, speech and language therapy) may also find material of interest and use.

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Cognitive function, neuropsychological evaluation, and syndromes of cognitive impairment

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This chapter seeks to elucidate briefly the various domains of cognitive function, their neuropsychological evaluation, and syndromes of cognitive impairment. It is aimed at the practising neurologist rather than the academic neuropsychologist.

Without necessarily subscribing to an explicitly modular concept of cerebral function, it is nonetheless convenient to think in terms of cognitive domains or functional systems (‘a congeries of mental faculties’) in the brain, specifically attention, memory, language, perception, praxis, and executive function. These subdivisions, all (hopefully) working in concert, not in isolation, to produce in sum what we understand by consciousness, may direct a structured approach to the clinical assessment of cognitive function. Nowadays, a model of distributed neural networks with nodal points more specialized for certain functions has supplanted the idea of particular brain centres (Mesulam, 1990).
The neurocognitive domains may be described as either localized, implying lateralization to one hemisphere of part thereof, focal damage to which may impair that specific function; or distributed, implying a non-localized function often involving both hemispheres and/or subhemispheric structures (basal ganglia, brainstem), widespread damage being required to impair these functions (Hodges, 1994). Moreover, particular domains may be subdivided, or fractionated, into subsystems or specific functions which may be selectively impaired, suggesting the existence of functionally distinct neuropsychological substrates.

There are many tests available to the neuropsychologist for the evaluation of cognitive function, either global function or individual domains (Lezak et al., 2004; Mitrushina et al., 2005, Strauss et al., 2006). The variety of tests available may bewilder the non-specialist. Moreover, the choice of different test instruments in different studies may make direct comparisons difficult. Of course, it must be remembered that any neuropsychological test may have multiple sensory, motor, perceptual, and cognitive demands, and hence ‘pure’ tests of any single cognitive domain are the exception, rather than the rule.

Neuropsychologists insist, rightly, that special training is required in the administration and interpretation of neuropsychological tests. Clinical neurologists will therefore rely on their neuropsychologist colleagues for the performance and interpretation of these ‘formal’ tests, since they fall outwith neurologists’ expertise, and may take substantial time to administer, incompatible with clinical schedules. Nonetheless, some form of neuropsychological testing, often labelled as ‘bedside’ to distinguish it from ‘formal’ testing, is within the scope of neurologists and may be of diagnostic use (Griffiths & Welch, 2003). Numerous test batteries which may be applied within 10–30 minutes are available, encompassing not only cognitive function but also functional, behavioural, and global assessment (Burns et al., 1999, 2004). Because of the brevity which makes them clinically applicable, these instruments often have certain shortcomings that neurologists need to bear in mind: a raw score derived from a series of tests is not necessarily ‘diagnostic’, although it may increase the likelihood of a particular diagnosis. The potential for incongruous or anomalous performance of tests in a medicolegal setting has been noted (Trimble, 2004).

It is also important to note that when evaluating cognitive disorders, particularly those involving memory impairment, obtaining some collateral history from a relative, friend, or carer familiar with the subject is a vital part of the evaluation (Tierney et al., 1996; Jorm, 1997; Carr et al., 2000; Shulman & Feinstein, 2003), even for early stages of disease (Isella et al., 2006). Even the simple observation that a patient attends the clinic alone despite having been instructed to bring a relative or friend is of diagnostic relevance, arguing strongly against the presence of a cognitive disorder (Larner, 2005).

REFERENCES


1.1 Attention

It is perhaps redundant to point out that before any meaningful assessment of ‘higher cognitive function’ can be made, it should be ascertained that ‘lower cognitive function’ is intact, assuming that the workings of the nervous system are hierarchical in their operation. To indulge in reductio ad absurdum, it would not be reasonable to expect a comatose patient, or a sleeping subject, to perform well on tests of memory, although that memory function may be intact or impaired on recovery from coma or awakening from sleep. The nature of consciousness is an area of great interest to both neuroscientists and philosophers (e.g. Dennett, 1993; Penrose, 1995; Zeman, 2001, 2002; Libet, 2004), but other than to assume that it is an emergent property of brain function, nothing further about its possible neuroanatomical and neurophysiological basis will be considered here. Dissociation between apparent preservation of consciousness and absence of cognitive function may occur, for example in vegetative states (Jennett, 2002).

Disturbance of consciousness may encompass both a quantitative and a qualitative dimension. Hence one may speak of a ‘level’ of consciousness, perhaps in terms of arousal, alertness, or vigilance, forming a continuum from coma to the awake state; and an ‘intensity’ or quality of consciousness, in terms of clarity of awareness of the environment, and ability to focus, sustain, or shift attention. Coma obviously implies a state of unresponsiveness from which a patient cannot be roused by verbal or mechanical stimuli. Lesser degrees of impaired consciousness, sometimes labelled clinically as stupor, torpor, or obtundation (although these terms lack precision, their meaning often varying between different observers) may also interfere with cognitive assessment. There are many causes of coma (Plum & Posner, 1980; Young et al., 1998). These states may be obvious clinically, such as drowsiness, or difficultly rousing the patient, but may also be occult, perhaps manifesting as increased distractibility. Impairments in level of consciousness are a sine qua non for the diagnosis of delirium (see Section 1.10), as enshrined in the diagnostic criteria of DSM-IV and ICD10, although these deficits may be subtle and not immediately obvious at the bedside though yet sufficient to impair attentional mechanisms. These attentional deficits may be responsible for the impaired cognitive function that is also a diagnostic feature of delirium (Burns et al., 2004; Larner 2004; Inouye, 2006).

Attention, or concentration, is a non-uniform, distributed cognitive function. It may be defined as that component of consciousness which distributes awareness to particular sensory stimuli. Bombarded as the nervous system is with stimuli in multiple sensory domains, only some reach awareness or salience, whilst many percepts are not consciously taken notice of. Attentional resources, which are finite, are devoted to some channels but not others. Attention is thus effortful, selective, and closely linked to intention. Distinction may be made between different types of attentional mechanism: sustained attention implies devotion of most attentional resources to one particular stimulus;