Distinguishing Fluent Aphasia from Early Alzheimer's Disease Using Language and Memory Tests

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Abstract

This thesis compares the single word processing deficits found in fluent aphasia and the language of early Alzheimer's Disease (AD). The two disorders are said to mimic each other in terms of the severity of the level of communication breakdown. It is clinically important that the disorders are distinguished so that people with either diagnosis will be provided with the most appropriate care.

Four different studies were undertaken: the first compared picture naming ability in normal and demented older people and found that group differences were essentially quantitative. While the demented subjects produced lower picture naming scores, the groups produced similar patterns of errors. The second study presented a battery of single word processing and verbal episodic memory tests to small groups of normal, probable AD, Wernicke's and anomic aphasic subjects. The Wernicke's aphasic subjects displayed a more severe communication disorder than either of the other patient groups. Discriminant analysis, which employed test score data, easily distinguished Wernicke's subjects from the other three groups but misclassifications occurred among anomic and probable AD subjects.

The third study validated and extended pilot study findings using both accuracy and error measures. Larger groups of normal, probable AD and anomic aphasic subjects attempted a modified battery. The resultant data were analysed in two ways: through test scores as in the pilot study and through an in-depth examination of errors. Both types of data were included in discriminant analysis, which successfully distinguished the groups. The last study provided information about longitudinal score changes in the three groups used at validation stage. The question of whether people with early AD show semantic memory loss, while people with fluent aphasia have difficulty accessing the contents of semantic memory was examined using test-retest data. This distinction was not found to be useful in distinguishing the patient groups.

The thesis concludes that the two disorders are different in nature. The language disorder of early AD is associated with severe episodic memory loss. It resembles normal older language, but with more errors on tasks which require semantic processing. Fluent aphasia, on the other hand, is a specific and consistent disorder of language, with difficulty especially at the phonological level. It exists with more normal episodic memory.

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Declaration

I hereby declare that both the original work reported in this thesis and the thesis are my own.

Signed:

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Chapter 1
Introduction

1.1 Background - A Diagnostic Problem

One of the current clinical problems which faces speech and language therapists who work with elderly people is the differential diagnosis of two disorders of communication: fluent aphasia and the disorder associated with early Alzheimer's Disease (AD). The disorders are characterised by fluent language output (see section 2.2) and no obvious physical symptoms, but have different prognoses. To date, no adequate dedicated screening battery exists to provide the data required to give objective evidence for differential diagnosis. Accurate clinical diagnosis is essential for appropriate medical, paramedical and social management.

At present, clinicians rely on assessments designed for the evaluation of aphasia or on subjective measures and intuitions, despite the fact that the first report of this diagnostic dilemma was written over 60 years ago. Marie (1926) discusses the case of a person with Wernicke's aphasia who was treated as someone with senile dementia. Such reports continue, e.g. Butterworth (1985).

The problem is likely to become more acute as the population continues to age. Wells & Freer (1988) report that between 1985 and 2003 there will be significant growth in the numbers of people living to be aged 75 years and over (13%) and aged 80 years or over (30%). Since the incidences of both stroke (the most common cause of acquired aphasia) and AD increase with age, it is important that the underlying nature of their respective communication problems is explored so that an objective differential diagnostic measure can be developed.

The difficulty arises because the disorders mimic each other in severity of the communication breakdown, so that the naive listener can hear the same degree of expressive language disorder in the fluent aphasic person as in the person with mild-moderate AD (Bayles & Kaszniak, 1987). The two disorders are also of equal severity as tested by published formalised objective test batteries designed for the assessment of aphasia. The authors cited above report several such studies. The implication from the above evidence is that to provide an accurate differential diagnosis, scores alone are insufficient, i.e. success or not at tested language tasks will not distinguish disorders of similar severity.

1.2 <u>Questions</u>

The diagnostic problem forms the core of this thesis. It raises several main questions, working from the null hypothesis that fluent aphasia and the language disorder of early AD cannot be distinguished:

1. Can fluent aphasia be distinguished from the language of early AD?

2. If so, is the difference a reflection of different rates of error on a standard set of tasks or is it a reflection of different patterns of errors being produced by the two groups or of both?

3. Can the patterns of tested behaviour help to characterise the underlying deficits? For example, is the deficit found in AD more like that of normal ageing than of fluent aphasia?

Duffy & Myers (1989) summarise precisely the aims of the research by stating that group studies have three potential merits: (i) to improve our theoretical understanding of human communication and its disorders,

(ii) to improve differential diagnosis, and (iii) to help us to help people with communication disability.

1.3 Strategy

To answer these questions several studies were undertaken, with two aims:

(a) to develop a screening test battery which will distinguish fluent aphasia from the language of AD, and both from the language of normal elderly, using measures of verbal language expression and memory and

(b) to use the data derived from the analysis of error types produced by groups of normal elderly people, people with probable AD and people with anomic and Wernicke's aphasia to understand the linguistic and/or cognitive deficits underlying the disorders of communication found in fluent aphasia and the language of AD.

1.4 Outline

Two separate literature reviews follow. The first, in Chapter 2, considers the nature of fluent aphasia and the language of AD and concludes that the similarities between them are more apparent than real. The second, in Chapter 3, reviews previous attempts at distinguishing the groups and examines the particular language and memory skills selected for study. Reports from the four parts of the study are given in Chapters 4 - 7 and finally findings are discussed and their implications appraised (Chapter 8).

Of the four studies, a preliminary one (Chapter 4) compared picture naming performance in normal and demented elderly subjects. The pilot study, reported in Chapter 5, evaluated the differential diagnostic potential of a battery of verbal expressive and memory tests from test scores and their patterns. The validation study (Chapter

6) examined the effectiveness of a modified form of the pilot battery of tests, using both test scores and error analyses. Chapter 7 reports on a test-retest study which was undertaken to examine subjects' performance over time and the question of semantic memory loss in AD. The final chapter analyses findings from the studies, to create a better understanding of the nature of the disorders associated with fluent aphasia and early AD.

Chapter 2

The Nature of Fluent Aphasia and the Language Disorder of Alzheimer's Disease

2.1 Introduction

There exist as many definitions of aphasia/dysphasia (the terms are used interchangeably) as writers on the subject. Definitions vary according to the writer's philosophical position on the relationship between brain and language behaviour. Some, like Davis (1983), emphasise the specific nature of this language disorder, while others, such as Chapey (1986), do not so limit their definitions.

One generally acceptable definition of aphasia is given by Davis (1983), who states that aphasia is 'an acquired impairment of language processes underlying receptive and expressive modalities and caused by damage to areas of the brain which are primarily responsible for the language function'. Symptoms can manifest in both auditory and visual modalities, resulting in difficulty in auditory comprehension, verbal expression, reading comprehension and written expression. The severity and relative prominence of symptoms varies with the locus and extent of cerebral damage. Difficulties may also be encountered in higher language-mediated functions, such as problem-solving, e.g. calculation. However, intellectual functioning is said to remain at premorbid levels within the confines of a primary disorder of language.

Other writers do not require the inclusion of a localisationalist statement in their definitions. Chapey (1986) provides a psycholinguistic definition. She writes that aphasia is 'an acquired impairment in language and the cognitive processes which underlie language caused by organic damage to the brain'. Martin (1979) provides a similar definition of aphasia as the 'reduction, because of brain damage, of the efficiency of the action and interaction of the cognitive processes that support language'. Nevertheless, these three definitions share the assumption that language impairment can exist in the absence of other cognitive dysfunction (Au et al., 1988). The question of definition warrants a whole chapter in Rosenbek et al. (1989). They conclude that aphasia is a sudden onset condition which affects all language modalities and is caused by damage to the central nervous system. If cognitive impairment exist, it will be insufficient to produce the severity of language impairment.

Language processing is also affected by dementia. Bayles & Kaszniak (1987) define dementia as 'a condition of chronic progressive deterioration in intellect, personality, and communicative functioning'. Darley's definition of language impairment in dementia, as quoted by Wertz (1978), uses the term 'language of generalized intellectual impairment'. He lists among its symptoms that deficits are found on the most difficult language tasks. Problems exist in all communicative modes (as in aphasia), and the severity of language involvement is similar to that demonstrated in other areas of intellect, including judgment, ability to abstract, concentration, interpersonal skills, logic and reasoning (Cummings & Benson, 1992).

There are more than fifty types of dementia, some reversible and some not. For the irreversible types, one of the major causes is Alzheimer's Disease (AD), which was first described by Alzheimer in 1906 (Alzheimer, 1977). Cummings & Benson (1992) state that AD is probably the most common type of dementia (accounting from 35 - 60% of progressive dementias). This disease continues to be diagnosed with certainty only at post-mortem when the characteristic cerebral changes (neurofibrillary tangles and plaques) can be confirmed.

Attempts have been made (Eisdorfer & Cohen, 1980; Berg et al., 1982; Hughes et al., 1982; McKann et al., 1984; Roth et al., 1986; Morris et al., 1989) to develop batteries of assessment and clinical criteria to provide a 'possible' and 'probable' diagnosis of AD during life and to describe the disease's stages. McKann et al. (1984) list the major cognitive processes that are impaired in AD: time and place orientation (i.e. knowledge of current time and location), memory, language skills, praxis, attention, visual perception, problem-solving skills and social function. Their criteria for clinical diagnosis are based on medical history, clinical examination, neuro-psychological testing and laboratory assessments. The American Psychiatric Association, in its Diagnostic Statistical Manual III-R (1987), defines AD as a 'multifaceted loss of intellectual abilities, such as memory, judgment, abstract thought, and other higher cortical functions, and changes in personality and behavior.' The Medical Research Council (Wilcock et al., 1989) has produced a set of minimal data to be collected in research studies on AD, which include demographic and personal medical history information and cognitive, psychiatric and physical assessment.

Whilst aphasia has been well-documented this century, the communication problems caused by AD remain comparatively unreported, with picture naming and naming examples from a given category (i.e. active vocabulary search) notable exceptions. General descriptions such as that of Gravell (1988) have tended to take the view of staged deterioration and provide symptoms at mild, moderate and severe stages of the disease process. Such general accounts often appear alongside general comparisons with normal ageing effects on communication (Albert, 1980; Millar-Davis, 1984; Obler & Albert, 1984; Sandson, Obler & Albert, 1987; Light & Burke, 1988). Bayles et al. (1992) also provide such a description, but with a more scientific approach: seven stages of the disease are shown to be associated with different score profiles on a set of language tasks, which were administered over time to a number of normal and AD subjects.

Some researchers have concentrated on particular aspects of the communication process: reading aloud (Nelson & McKenna 1975), spelling (Rapcsak et al., 1989) and functional communication (Fromm & Holland 1989). Bayles and her co-workers have reported many studies which examined different aspects of language processing in AD: confrontation naming, generative naming, picture description and story recall are the most prominent (Bayles, 1982, 1984, 1985, 1986, 1991; Bayles & Boone 1982; Bayles & Tomoeda, 1983a, 1983b, 1990b, 1991: Bayles et al., 1982, 1985, 1989a, 1989b, 1990, 1991). She views the language impairment of AD as the result of an impairment in the person's ability to formulate ideas, in the face of intact mechanics (speech).

Several writers have been concerned with the relationship between the language associated with normal ageing and with dementia. Walker (1982) considered that the two exist on a continuum. She found similar patterns of deterioration among normal elderly and demented subjects, which were of a greater magnitude for the subjects with dementia. While she concluded that there may be a common process of deterioration, this does not imply that dementia is accelerated ageing. Cummings and Benson (1992) also emphasise that dementia is a pathological 'syndrome' and not just a reflection of normal biological ageing, but agree that the differentiation of normal ageing and AD is not straightforward. Indeed, the primary aim achieved by Bayles et al. (1989a) was to distinguish normal older people from subjects with mild AD on the basis of language and memory test scores. Sandson et al. (1987) compare the subtle normal ageing changes in language with the 'more dramatic' changes associated with AD. These writers agree that people with AD produce poorer scores on language and memory tests than normal older people. However, for the purpose of understanding the nature of fluent aphasia and the language of AD, it is also important to know whether the types of errors made by people with AD are more like those made by normal older peers than by people with aphasia.

2.2 Fluent Aphasia

Currently one of the main clinical distinctions made in aphasiology is based on the nature of verbal output, i.e. non-fluent v. fluent aphasia. This distinction was developed by Goodglass and co-workers in Boston in the 1960s and is of great pertinence here since the verbal output of people with AD has been likened to types of fluent aphasia (Appell et al., 1982). In fluent aphasia the rate and quantity of verbal output is said to be normal or increased, with little or no motor difficulties (Buckingham & Kertesz, 1974) whereas in non-fluent aphasia both speech rate and mean length of utterance are said to be reduced.

Fluent aphasia is usually associated with a dominant hemisphere lesion in the posterior regions of the language area of the cerebrum and with the following descriptive characteristics: use of a variety of word classes (including functors), frequent verbal paraphasias, completeness of grammar, few perseverations, phrase length of more than four words, minimal effort, normal or faster than normal rate of speech, absence of noticeable pausing, smooth articulation and varied, near-normal intonation (Kerschensteiner et al., 1972). Such vague descriptions are open to criticism (see Feyereisen et al. below). Fluent aphasia can be seen on a continuum from mild to severe, with expressive symptoms varying from circumlocution to all types of paraphasias and jargon.

This distinction is not without critics. Feyereisen et al. (1991) suggest that the meaning of 'fluency' remains ambiguous, is difficult to measure (norms are unavailable) and lacks relevance in current views of speech production. They however admit that rating fluency has clinical advantages in brevity of assessment and as an indicator of recovery.

2.2.1 Aphasia: Age and Type Relationships

It is generally agreed in the literature that a link exists between age (but not sex) and type of aphasia. Wernicke's aphasia (a fluent aphasia) is said to occur predominantly in older patients and Broca's aphasia (a non-fluent aphasia) in younger people (Obler et al., 1978; Harasymiw et al., 1981; Holland & Bartlett, 1985). Kertesz & Sheppard (1981), in a study extending over ten years, found a trend towards this pattern, without their data actually reaching statistical significance. Code & Rowley (1987) concur with these findings for people who are more than three months post-onset of aphasia.

Alternative explanations for this relationship between age and aphasia type include (i) pathophysiological factors relating to the cause and location of the brain damage, (ii) the continuing lateralisation hypothesis (Brown & Jaffe, 1975 as described in Code & Rowley, 1987) which proposes that lateralisation of function continues throughout the life-span, (iii) selection bias in subjects studied and (iv) cognitive changes associated with normal ageing. Coppens (1991) reviews each of these explanations and concludes that, although more data are required, the third and fourth alternatives above seem more likely and may interact to cause the relationship.

2.2.2 Aphasia Classification

Many disparate classification systems of aphasia have been developed and used throughout this century. Lesser (1978) provides a tabulated summary and discusses how classification of aphasia has developed. The one which is currently favoured and probably best substantiated is the neoclassical or Boston system in which the two main prototypical types of fluent aphasia are anomic and Wernicke's aphasia (Goodglass & Kaplan, 1972). 'Anomic aphasia is seen by some researchers as one end of a continuum of possible symptom patterns, with Wernicke's aphasia at the other end' (Davis, 1983). Transcortical sensory aphasia, although much rarer, has been cited in the literature as a pattern found in AD (Hier et al., 1985).

Cognitive neuropsychologists, however, reject the classification of aphasia by syndrome (Marshall, 1982; Ellis, 1987) arguing that each aphasic person should be described by individual symptoms. For present purposes, the limitations of classification are accepted but the terminology will be employed for methodological reasons: results from group studies can be inferred to general populations whereas single case study information cannot. However, a disadvantage of group studies is that they may mask individual performance variation.

2.2.3 Anomic Aphasia

Impairment in word-finding ability is the core characteristic of aphasia (Code, 1989). In anomic aphasia word finding difficulties are the dominant or only symptom. With (near) intact auditory comprehension and good self-monitoring of verbal output, the person with anomic aphasia has difficulty communicating because of 'empty speech' in which circumlocution and long pauses appear to mark attempts to access the required lexical items. Grammatical words remain intact while substantives may be unavailable. Often the empty quality of the verbal output is replete with non-specific words such as 'thing'. Anomic aphasia is the least accurately localised of the aphasic syndromes. Garman (1990) states that, as a mild symptom, anomia can be produced by lesions anywhere in the brain, even the non-dominant hemisphere.

Garman (1990) worries that anomic aphasia is a 'vague concept' and describes several clinical sub-types of anomic aphasia. The two main sub-types he describes as word-production anomia i.e. 'difficulty in activating the appropriate output-form component of the lexical item, when provided with an adequate content specification' and word-selection anomia, i.e. 'the patient knows the concept but cannot find the word. This is consistent with an inability to activate the lexical-form component'. In practice, the two problems often co-exist in the same person: tip-of-the-tongue and phonemic paraphasic or neologistic errors in picture naming are evidence for the two types of difficulty (see section 6.3.3.1). Goldfarb & Halpern (1989) offer several more types of anomia.

2.2.4 Wernicke's Aphasia

Wernicke first described this type of aphasia in a text published in 1874 (Wernicke, 1977, in translation). The person with Wernicke's aphasia has much greater communication difficulty but in most cases is anosognosic, that is, unaware of the inability to transfer the intended message. This difficulty is related to (often severe) loss of auditory comprehension (Albert et al., 1980). Verbal output is unrestrained but often unintelligible and characterised by phonemic paraphasias, in which phonemes are wrongly selected and ordered, and neologistic jargon, i.e. 'lengthy, fluently articulated utterance which makes little or no sense to the listener' (Davis, 1983). The unintelligible output does however retain normal intonation patterns. Rate of verbal output is often either normal or increased and logorrhoea is common, i.e. a tendency to maintain speaker turn even when inappropriate (Kirschner, 1982). Paragrammatism, i.e.

inappropriate use of affixes, describes the grammatical disorder manifested by this syndrome.

The abilities to repeat words and to read words aloud are compromised and reflect spontaneous verbal output. Writing ability is also affected so that the Wernicke's aphasic may be unable to produce any correctly spelled words. A less severely affected Wernicke's aphasic may have limited literacy ability, again reflecting spoken verbal output.

2.2.5 <u>Transcortical Sensory Aphasia</u>

This type of aphasia is similar to Wernicke's aphasia but with intact ability to repeat. It is also characterised by echolalia, where the person repeats what has just been said. This symptom is generally thought to reflect poor auditory comprehension (Goodglass & Kaplan, 1972).

2.3 <u>Communication in Alzheimer's Disease</u>

The staged description of language deterioration in AD is becoming recognised as an artificial method of defining the disease. It has been shown (Hart, 1985; Martin, Brouwers et al., 1986; Martin, 1987; Schwartz, 1987, Becker et al., 1988) that heterogeneity rather than homogeneity characterises the relative rate of degeneration of the various abilities known to be affected in this type of dementia. Furthermore individual variation within and between tasks and exceptional cases are the rule. Valdois et al. (1990) attribute this heterogeneity to the existence of 'cognitive subgroups' in the normally aged population. Nevertheless, there are communication symptoms which are universally accepted as part of the AD constellation.

Language symptoms include increasing difficulty in finding words and decreasing ability to benefit from external cueing in this task. Reading comprehension deteriorates while reading aloud remains normal. The ability to repeat words and sentences remains intact, but within the individual's short-term memory span. Phonology and syntax remain unaffected until late in the disease whereas semantic and pragmatic systems fail early, so the typical Alzheimer's patient produces phonologically and syntactically well-formed utterances which are semantically anomalous and break pragmatic rules (Schwartz et al., 1979; Bayles, 1982; Richardson & Marquardt, 1985). Written expression gradually deteriorates, with spelling and the semantics of the written utterance being affected. These symptoms are to be found alongside deteriorating memory, intellect, concentration and personality changes (Bayles & Kaszniak, 1987).

2.4 Symptoms Common to Fluent Aphasia and Language of AD

Bayles (1986) outlines several communication problems shared by fluent aphasics and people with AD. Anomia is present in both conditions, even when communication impairment is mild. Perseveration, which is associated with brain damage is also present in both conditions. Thirdly, 'verbal fluency generally characterizes patients with Alzheimer's Disease...causes them to be confused with posterior aphasia patients.' Jargon is reported to occur late in AD and also in fluent aphasia. Circumlocution also characterises both communication disorders. Despite these common symptoms, Bayles makes the point that there are 'subtle differences' between the symptoms as produced by the two conditions, which she suggests are the result of the intellectual deterioration in dementia.

2.5 Differences Between Fluent Aphasia and Language of AD

One difference has been described in section 2.1 above: the language disorder of AD is found among a constellation of other similarly affected intellectual functions while fluent aphasia is found within an otherwise reasonably intact intellect. Two further and related areas of difference are described below. Episodic memory (memory for events) is affected more than semantic memory (memory for words) in AD. Furthermore, a distinction has been drawn between problems of semantic memory storage and access. It has been suggested that storage deficits characterise the language of AD while access difficulties are found in aphasia.

2.5.1 Episodic and Semantic Memory

Tulving (1972, 1983, 1987) has distinguished two types of long-term memory, which are observed to be differentially affected in aphasia and the language disorder of AD. It is said that episodic memory 'receives and stores information about temporally dated episodes or events, and temporal-spatial relations among these events' (Tulving, 1972). 'The system is probably quite susceptible to transformation and loss of information'. Memory of the meal just eaten or of today's date are examples of this type of memory. Semantic memory is said to be 'the memory necessary for the use of language. It is a mental thesaurus, organized knowledge a person possesses about words and other verbal symbols, their meaning and referents, about relations among them, and about rules, formulas, and algorithms for the manipulation of these symbols, concepts and relations. Semantic memory does not register perceptible properties of inputs, but rather cognitive referents of input signals' (Tulving, 1972). In the simplest terms, a distinction is said to exist between an 'internal diary' and an 'internal dictionary' (Smith & Fullerton, 1981).

Difficulty in remembering events is one of the most common and early characteristics of AD. On the other hand, only recently has there been investigation and description of semantic memory deterioration in dementia. For example, it is now recognised that difficulty in word finding is also commonly reported by care-givers as an early indication of dementia (Bayles & Tomoeda, 1991), alongside episodic memory loss. On the other hand, in aphasia the prime difficulty is the comprehension and expression of language. Orientation and other temporal memories are said to remain intact.

The semantic system is said to be important for the storage and retrieval of verbal episodic memory information and semantic memory problems are implicated in the episodic memory loss of people with AD (Weingartner et al., 1981; Nebes, 1989). For example, for verbal recall of a narrative, semantic memory should contribute to both initial interpretation and subsequent retelling, so the aphasic person may fail a seemingly episodic memory-based test because of semantic memory difficulty - 'normal encoding and storage in episodic memory require fairly rapid interaction with the semantic memory system' (Clark, 1980).

2.5.2 Semantic Loss or Access Difficulty?

Very recently there has been interest in the nature of the effect of dementia on semantic memory. It has been suggested that one symptom of the deterioration which characterises AD is that material may be irretrievably lost from semantic memory (Huff et al., 1986). In contrast, it is said that the aphasic person who, for example, cannot label a picture is having difficulty in accessing the label or its phonological form, but has not lost either definitively (Buckingham, 1981a; Howard & Orchard-Lisle, 1984; Kay & Ellis, 1987).

If this distinction is a general one, that is, if fluent aphasics and people with AD show differences in test/retest performance on semantic memory tasks, such tests may be useful in the process of differential diagnosis. Is it really the case that fluent aphasics have difficulty in accessing semantic information and people with AD show semantic memory loss? If so, fluent aphasics should make errors on different stimuli as often as on the same ones when retested, while people with AD should show errors on the same stimuli on both occasions. Secondly, people with AD should not benefit from semantic or phonemic cueing in a picture naming task, whilst it is known that people with anomic aphasia can use cues to improve naming performance. Chapter 7 considers these questions.

As with any topic relating to language and memory in the two disorders, the literature is replete with studies offering contradictory results and using different methodologies which make direct comparisons difficult. Those studies examining semantic memory in AD are extensively reviewed in Nebes (1989). Nebes et al. (1984) suggest from their findings that their AD subjects have difficulty in accessing semantic memory, rather than suffering loss of its contents. Flicker et al. (1987) suggest from their findings that while general semantic information is retained in AD, specific semantic information becomes less accessible. Bayles et al. (1990) present contradictory evidence.

Huff et al. (1986), for example, used stimuli from four semantic categories to assess category fluency, naming, category recognition and name recognition in those Alzheimer's subjects with normal performance on a form discrimination task. Among other conclusions, they state that they found a consistency in errors between naming and name recognition tests (suggesting loss of semantic memory information) as did Chertkow et al. (1989). Hodges et al. (1992) similarly used the same items from 6 semantic categories in a series of tasks and found significant item-to-item error correspondence among the tasks.

In the most extensive work on semantic memory in AD to date, Bayles et al. (1991) report on a longitudinal study of 69 subjects who annually attempted 11 tasks, each with the same 13 stimuli. They found very few instances of a concept being lost in all tasks. Their conclusion was that task difficulty and word frequency have greater influence on performance consistency than does the presence/loss of a concept. Under this argument, when all the tasks become too difficult, a concept will 'disappear'.

Butterworth et al. (1984) provide an experiment similar to those of Huff et al. (1986) and Chertkow et al. (1989) but with aphasic subjects. While their subjects' performance on naming recognition and confrontation naming showed a positive correlation, there was no item specificity in errors.

Several papers have reported on test-retest performance. For example, Henderson et al. (1990) found 81% consistency in the correct/incorrect naming performance of 19 people with AD on the Boston Naming Test given twice six months apart. Shuttleworth & Huber (1989) tested their AD subjects repeatedly over a period of 18 - 42 months and report decline in naming performance but 60% error stability. Knotek et al. (1990) administered the Peabody Picture Vocabulary Test twice within seven days to 23 Alzheimer' subjects. This test assesses receptive vocabulary - which renders it less 'difficult' than most of the tests used in other studies. They found significant inconsistency of performance, which they conclude is the result of the experimental method, rather than an indication of semantic memory status. They suggest that attentional difficulties affected their (unexpected) results.

Huff et al. (1988) conclude, in a healthy compromise, that semantic impairments in both stroke patients and people with AD are due to both loss and access difficulty, with the former being more prominent in AD and latter in stroke.

Warrington & Shallice (1979) discuss four findings to support the argument that their dyslexic subject was experiencing semantic accessing difficulty. The findings related to (i) no word frequency effect, (ii) positive semantic priming effects, (iii) low performance consistency and (iv) the intactness of superordinate v subordinate information. A fifth criterion has been included since: accessing material from semantic memory may be improved if the person is given more time. Storage deficits will not be so helped (Warrington & McCarthy (1983) quoted in Rapp & Caramazza, 1993).

Rapp & Caramazza (1993) question the distinction between semantic storage and access deficits, arguing that the above phenomena have not proved robust and, using examples from the literature, do not pattern well. A further criticism is that few of the single cases reported were tested fully on all criteria. While they find the distinction potentially exciting and useful, they conclude that the single-case evidence to date has not been compelling.

2.6 A Shared Definition?

The distinction between these two disorders is made muddier by those authors who consider the language breakdown in AD as aphasia, e.g. Au et al. (1988). The simple basis for this label arises from the experimental method employed, i.e. the administration of aphasia test batteries to groups of people with AD.

2.6.1 Use of Aphasia Test Batteries

Appell et al. (1982) administered the Western Aphasia Battery and Whitworth & Larson (1989) gave the Boston Diagnostic Aphasia Examination to groups of demented subjects. Failure on test items has led such authors to classify people with dementia according to the neoclassical aphasia classification system outlined in sections 2.2.3 to 2.2.5. Cummings et al. (1985) discuss the evolution of aphasic syndromes at different stages of the deterioration process in dementia while Murdoch et al. (1987) report that the language disorder found in their AD subjects was like transcortical sensory aphasia. Bayles & Kaszniak (1987) give several more examples of such studies.

Hodkinson et al. (1984), on the other hand, used more sophisticated methods but a less sophisticated test to conclude that their factor analyses of individual subtest results showed marked differences between the patterns for the two groups. Wertz (1982) points out pertinently that 'poor performance on a language test does not necessarily make one aphasic'. Emery (1985) reminds the reader that the description of aphasic syndromes was developed from non-demented data.

A final point concerning the application of formal aphasia assessments to the evaluation of the language disorder of AD relates to the lack of comprehensive cognitive testing in the subject populations. The administration of a language assessment alone does not provide all the necessary information. It is known that dementia causes impairment of many cognitive processes. A differential profile of performance on a range of tests of cognitive abilities would lend power to the argument that the language symptoms of fluent aphasia and the language of AD are different in origin and nature, a point fully considered in the development of the present pilot battery.

2.6.2 Problems of a Shared Definition

One of the inherent dangers of considering the language disorder in AD as aphasia is the use of 'prescriptive terminology' (Murdoch, 1988). The term aphasia has historically validated connotations and predictions, which include improvements in language ability over time and the ability to learn compensatory strategies. Syndromes of aphasia have well-defined linguistic characteristics, some of which may be shared with some people who have a language disorder caused by AD. It would be a mistake to attempt to force the constellation of AD symptoms into language-defined categories.

Much of the evidence cited to admit the language disorder of AD into the category of aphasia is quantitative in nature, since most aphasia batteries do not provide in-depth information about error types. There is an increasing body of information (especially in the area of picture naming) which suggests that the analysis of error responses provides evidence that the two disorders are different in nature.

While Au et al. (1988) admit that 'different neurological pathophysiologies underlying aphasia and dementia account for qualitative differences in language performance', they still consider that aphasia is the appropriate term to describe the language disorder of AD. This position is considered to be counter-productive both in terms of the description and the understanding of differences between the two disorders. More importantly, if the language disorder of AD is considered as aphasia, the potential loss of new and different information to add to theories of language and language processing is immense.

2.7 Summary

The primary distinction between the two disorders concerns the assumption that in aphasia the communication disorder is primary, with other intellectual dysfunction absent or very mild in proportion to the level of communication breakdown. The language disorder of early AD is similar in degree to the other impairments which characterise this form of dementia (Wertz, 1982; Lebrun, 1988; Milberg 1989).

The two conditions have several fundamental differences. These include on a general level aetiology, onset, prognosis, management (on a medical and paramedical level) and also in the extent to which levels of linguistic organisation are similarly or differentially compromised.

The general nature of fluent aphasia and the language disorder of early AD have been explored and some important considerations can be taken forward for pilot battery development. The following review of the literature relating to particular language and memory skills and to previous attempts at distinguishing the two groups can further inform test development by summarising known information and directing attention at areas which have potential for distinguishing the two groups.

Chapter 3
Review of the Literature

3.1 Introduction

The general nature of fluent aphasia and the language disorder associated with AD has been described. This chapter looks more specifically at particular aspects of the relevant literature. Two main pertinent areas are reviewed here. The first (in section 3.2) includes previous attempts to distinguish fluent aphasia and the language of AD using batteries of tests, information from which informed the present attempt to develop a differential test battery. Since there have been several earlier attempts, a critical review served to prevent the present battery from suffering from similar methodological limitations and also positively informed test development, in terms of statistical techniques. The characteristics of a 'good' test are discussed.

The second domain of interest lies in current knowledge of, and speculation about, abilities on several language and verbal memory tasks which were used in the battery. Two distinct sets of tasks are included. First, single-word processing abilities were selected for inclusion in the battery on two grounds: they are easy to assess and the literature suggested possible differences in scores and error types produced on single-word tasks by the two patient groups. Single word tasks included in the pilot battery were picture naming, naming items from a category, reading aloud, repetition and writing. Second, several other tests involving memory were included in the pilot battery on the grounds that they had been discriminative in the study by Bayles et al. (1989a): story recall, verbal recognition memory and sentence disambiguation. The review briefly describes the state of knowledge relating to each of the tested tasks (section 3.3). Then, in section 3.4, aspects of theoretical interest relating to the three single word tasks (picture naming, reading aloud and writing) examined in depth at validation and retest stages are discussed. Error responses from these three tests were analysed to aid understanding of the nature of the deficits underlying fluent aphasia and the language disorder associated with AD.

Throughout the review, comment is made on aspects of language abilities in normal ageing which have implications either for test administration or for the understanding of the two disorders. Since both disorders are found in the older age-group, it is essential to use normal performance as a base-line from which to compare the disorders. General and specific communication changes associated with normal old age are documented in several texts, such as Edwards (1982), Ulatowska (1985) and Gravell (1988).

3.2 Previous Attempts at Distinguishing Fluent Aphasia and the Language of Early AD

The literature reveals that the group studies used in previous attempts at distinguishing the two disorders employed different materials (new tests, aphasia test(s) or a modified aphasia test) and different sets of subject groups (AD and other (unidentified) types of dementia, aphasia of various types, right hemisphere brain-damaged adults and normal controls, of varying ages). All types of study can inform the current attempt to develop a differentially diagnostic set of tests.

Four themes were selected for discussion here because of their relevance for test development: originality of materials, length of assessment, dedication to the particular purpose and method (including scoring, subject selection, use of a control group and selection of materials). Table 3.1 below gives a summary of the seven studies found in the literature which are used in the discussion which follows. (- indicates that the study was deficient in a particular aspect.)

Table 3.1 **Summary of Previous Studies which Attempted to Distinguishing (Fluent) Aphasia and the Language of AD**

Study	Originality	Length	Dedication	Method
Phillips (1984, 86)				-
Stevens (1992)				-
Bayles et al. (1989a)		-		-
Thompson (1986)	-	-		
Horner et al. (1992)	-	-	-	
Fromm & Holland (1989)	-	-	-	
Murray et al. (1984)	-	-	-	

3.2.1 Originality

Both Phillips (1984, 1986) and Stevens (1992) presented original materials. Bayles et al. (1989a) used an earlier version of the Arizona Battery for Communication Disorders of Dementia (ABCD) (Bayles & Tomoeda, 1990a), which was developed specifically to 'identify and quantify the linguistic communication deficits' associated with AD. It combines language and memory tests and consists of 4 screening measures and 14 sub-tests. These subtests include assessment of mental status, verbal learning and memory, linguistic expression, linguistic comprehension and visuo-spatial construction.

Thompson (1983, 1986, 1987) reported on the development of an assessment which was a modification of the Neurosensory Centre Comprehensive Examination for Aphasia (Spreen & Benton, 1969) and other published tests. It has not been published in its own right as an assessment of language in dementia for copyright reasons. The remaining studies employed already published tests.

3.2.2 Length

The two most original batteries were also the shortest. While brevity is attractive, some very brief tests (Kendrick et al., 1979; Weeks, 1988) have been criticised on the grounds that little information can be gained in five to ten minutes. Long tests often require assessments to be made over several sessions, a procedure which has inherent problems in terms of possible performance variability. While very long tests or a combination of test batteries can provide a large amount of information, a balance is required so that sufficient and correct information is gathered. In the set of studies reviewed here, length of test was not always associated with accuracy of discrimination.

3.2.3 Dedication

It has already been argued that tests designed to assess aphasia are not appropriate as assessments of other disorders (section 2.6.1). Phillips (1984) and Stevens (1992) presented batteries specifically designed for differential diagnosis, while Thompson (1986) and Bayles et al. (1989a) used batteries designed to assess communication function in dementia. The other three studies employed aphasia batteries.

3.2.4 Method

Each of the studies is considered separately as different methodologies were employed. Some are criticised, while others provide useful information for present test development.

Gravell et al. (1987) criticised Phillips' test on grounds of a lack of theoretical rationale and on a number of practical shortcomings which make it unusable. These are: no exclusion criteria, no normal elderly baseline was offered, very common vocabulary was used (which is insensitive in measuring dementia), no hypotheses relating to the choice of subtests, no test administration instructions or scoring information were given. The author responded (Phillips, 1987) that her test had a subjective basis and was intended to be a starting-point for further research, standardisation and validation. No published paper has described this test's further development or use.

Stevens (1992) aimed to distinguish only 9 elderly subjects with AD from 8 moderately dysphasic elderly subjects. Of particular note, is that her battery does not include any test of episodic memory, which is known to distinguish the groups. The dysphasic subjects were linguistically selected via their scores on responsive and confrontation naming sections of the Boston Diagnostic Aphasia Examination only (Goodglass & Kaplan, 1972). A mix of community-based and institutionalised people were tested. One difficulty with the results is that they appear to be based on groups with different degree of handicap. Another problem is the absence of a normal elderly control group.

A weighted and graded system of scoring was employed with + scores given to 'dysphasic' type errors and - scores to 'AD' type errors. An example from the gradings for naming errors will serve to illustrate: -6 was scored if the picture naming response was 'no attempted response/lack of recognition'. Conveniently, there are equal number of +/-

error responses for each of the three patterns of error which encompass the 8 sub-tests.

All but one of the full test and retest scores produced were correctly classified by this system: error totals were on the appropriate side of 0. All subjects, however, produced both positive (dysphasic-type) and negative (AD-type) errors: some 18.2% of errors were not as expected. Two tests (description of a drawn action and verbal description of object use) were found to be discriminative by regression analysis.

Bayles et al. (1989a) used large groups of healthy elderly, mild AD, moderate AD, nonfluent aphasic and fluent aphasic subjects (totalling 130). The test battery was developed and validated over many years using large numbers of subjects and is said to be culturally fair. The prime aim (to distinguish mild AD from normal ageing) was achieved. Of particular current interest was the finding that three tests proved effective in distinguishing normal elderly, fluent aphasic, mild and moderate AD subjects by their mean scores: story-retelling (immediate and delayed), delayed verbal recognition memory and sentence disambiguation. Several of the test performances (primarily on memory tests) showed significant differences between fluent aphasic and mild AD groups.

However, discriminant analyses were not undertaken to classify aphasic and demented subjects as some of the aphasic subjects did not complete all the tasks. This study provided very valuable differential information and three of their tests were included in the pilot test battery (in modified forms). The relevant literature on story recall, verbal recognition memory and sentence disambiguation is reviewed in section 3.3.

Thompson's (1986) battery consisted of 31 subtests and was able to distinguish different groups of psychiatric and neurological patients on the basis of test scores. Error analyses were not extensively used. Data presented was cross-sectional and longitudinal in nature, with emphasis on younger demented subjects. This long and unpublishable battery was 86.5% accurate in classifying aphasic and demented subjects. Despite the test's high level of success in classifying subjects, it remains only of academic interest.

Horner et al. (1992) attempted to classify AD, left hemisphere stroke, right hemisphere stroke and neurologically normal adults with the Western Aphasia Battery (WAB) (Kertesz, 1979). Discriminant analysis was used and produced correct classification for 29 of 40 (72.5%) subjects (19 of the 30 (63%) pathological subjects). Of the groups, AD was one of the two least well classified: all AD subjects demonstrated 'anomic aphasia' using WAB's taxonomy. These results were slightly better than those achieved in Horner's similar 1985 study, but one-third of the patients were misclassified.

Fromm & Holland (1989) gave the Communicative Abilities in Daily Living (CADL) (Holland, 1980) test to groups of normal elderly, mild and moderate AD, depressed and Wernicke's aphasic subjects. CADL is an American formal test of communicative performance in simulated situations from daily life, such as shopping and attending the G.P. Although moderate AD and Wernicke's subjects were not distinguished by mean score, error types showed group differences. The demented subjects' responses were irrelevant, vague or incomplete, while the aphasics produced perseverations, paraphasic substitutions, jargon and had auditory comprehension problems. This study serves to show that group differences can be masked when test scores only are considered, but can be seen when error distributions are considered.

Murray et al. (1984) used a combination of a formal and functional test scores to classify successfully their demented and aphasic subjects, by means of discriminant analysis. They employed the CADL and the Porch Index of Communicative Ability (PICA) (Porch, 1971). Their demented subjects suffered from arteriosclerotic senile dementia (a condition different from AD) and were mainly resident in nursing homes. Type or severity of aphasia are not documented as selection criteria.

PICA scores showed superiority of score by the demented group, while the aphasic group performed significantly better on CADL. This finding was said to reflect a basic difference between the groups, i.e. people with aphasia communicate better than they speak and vice versa for people with dementia. Additionally, it was reported that the demented group had difficulty with the simulated nature of CADL.

3.2.5 What Makes a Good Test?

The review above has considered several previous attempts at distinguishing aphasia and the language of dementia which used different tests and batteries of tests, some developed for the purpose and some already published for other purposes. When developing a new test (one of the current aims) it is imperative that several criteria are met: reliability, validity and practicality (Hatch & Farhady, 1982).

Tests should be constructed so that they produce consistent results. Such reliability can be measured in several ways, including 'test-retest' when the test is administered to the same subjects and the degree of correlation between the two performances calculated.

Inter-tester reliability is also important, to ensure that the test can be administered reliably by different people. Hatch & Farhady (1982) suggest several factors which influence reliability. These include the length of test, homogeneity of items, variation in group ability and test-taking time. They emphasise that test length is most important, but test length has to be tempered by other issues such as subjects' concentration span.

Validity is concerned with whether a test measures what it purports to measure. Validity can be measured at several levels. For example, does the test look as if it measures what it claims (face validity)? Does it have content validity - are the items representative of what is being measured? Can it predict behaviour on similar tests (predictive or criterion-related validity)? Factors which are said to influence validity include: unclear instructions, inappropriate difficulty levels, poorly constructed or inappropriate test items, too few items, improper order of items and identifiable patterns of answer (Hatch & Farhady, 1982).

Hatch & Farhady's final criterion (practicality) has already been discussed above, in terms of test length and methodological issues.

3.2.6 Summary

All the studies discussed above proved valuable in informing current test development: either positively or negatively. Important points taken forward for test development included: originality of materials, an appropriate length for a screening battery, dedication of materials to the particular purpose and a strong methodology (including a clear rationale for subject and group selection, reliability and validity issues and the use of discriminant analysis).

The next section describes the present state of knowledge concerning the tasks included in the pilot test battery.

3.3 Pilot Battery Tests

The tasks selected for inclusion in the pilot battery have attracted varying amounts of study. Picture naming (section 3.3.1) has received most attention and is the focus of interest in the preliminary study (Chapter 4). The current knowledge relating to the ability of people with fluent aphasia and the language disorder of AD to perform other single word processing tasks (reading aloud, naming items in a category, repetition and writing) is also described below (sections 3.3.2 to 3.3.5). In sections 3.3.6 to 3.3.8 the literature relating to the tasks which discriminated the groups in Bayles et al. (1989a) is described (story recall, verbal recognition memory and sentence disambiguation).

3.3.1 Picture Naming

In a picture naming task, a series of pictures (usually of concrete objects) is presented. The person being tested is asked to provide a one-word name for each object. Some naming tests allow for testees to be given cues: semantic (relating to the meaning of the target) or phonemic (the first sound(s) of the target).

3.3.1.1 Picture Naming - Normal Ageing

Word finding, as measured by picture naming is known to be affected by normal ageing (Goodglass, 1980; Nicholas et al., 1985b; LaBarge et al., 1986), while it is recognised that this deficit is not normally observed in daily life (Smith & Fullerton, 1981). In Walker (1982) 19% of her normal elderly subjects made naming errors, compared to 0% in the normative data presented with the test she used (Schuell, 1965). Older people also show longer naming latencies than younger people (Thomas et al., 1977; Davis, 1984). Clark (1980) suggests that word finding difficulties (WFD) encountered by normal elderly people may result from slowing down of semantic memory search (as part of the generalised slowing down associated with advancing age.

Elderly people may be discriminated against in some naming tests on the grounds of unfamiliarity of materials. Poon & Fozard (1978) found that their older subjects named 'dated unique objects' more familiar to them quicker than young adults and vice versa. Word frequency has also been implicated (Shuttleworth & Huber, 1988). Most of the normal elderly subjects' picture naming errors were semantic in Goodglass (1980), Walker (1982) and Nicholas et al. (1985b).

3.3.1.2 Picture Naming - Aphasia

WFD and picture naming deficits are well-documented in aphasia as the most common symptom (Pease & Goodglass, 1978). Williams (1983) reviews four major variables found in the literature to influence naming performance in aphasia: referent characteristics (operativity, category etc.), characteristics of the name (frequency, length), stimulus presentation variation (type of sensory input, time, method of eliciting the target etc.) and variation according to context and type of aphasia.

Extensive discussions of the level of breakdown in fluent aphasic naming are given in Lesser (1978), Buckingham (1981a) and Ellis & Young (1988). The typical literal paraphasic and neologistic, jargonistic expressive output may reflect word retrieval difficulties (Buckingham, 1979) or may indicate 'problems in retrieving the phonemic forms of words' (Ellis & Young, 1988). Three types of naming errors accounted for more then eighty percent of errors in Kohn & Goodglass (1985): semantic errors, multiword circumlocutions and phonemic errors.

3.3.1.3 <u>Picture Naming - AD</u>

There is a wealth of literature on naming deficits in dementia, consistently reporting that word retrieval deficit occurs at all stages of the dementing process and increases with the progression of the disease. Emery & Breslau (1988) dispute the claim that the main language problem in AD is anomia. As they rightly argue, this problem is the one which has been most studied. They used the Western Aphasia Battery and Emery's own Test for Syntactic Complexity and found that 'the Test for Syntactic Complexity, Word Fluency Test, and Sequential Commands test show most performance deficit relative to other measures'. Of the naming tasks, naming words in a category was more difficult than picture naming for their sample of subjects with AD. Thus one of the most accepted 'facts' in the description of language breakdown in dementia is put into a new perspective.

Kirshner et al. (1984) concluded that increased perceptual degradation (actual object --> masked line drawing) and word frequency affected naming performance in demented subjects, but word length did not. Sommers & Pierce (1990) and Shuttleworth & Huber (1988) confirm the effect of frequency. Barker & Lawson's (1968) data showed a significant difference in naming latency between normal and demented subjects which was a function of word frequency. Again the performance of the demented subjects showed a stronger effect of word frequency than the performance of the normal subjects.

Bayles and her colleagues have written extensively on the subject (Bayles & Kaszniak, 1987). Bayles & Boone (1982) included naming in their test battery aimed at identifying senile dementia in elderly people. The twelve-item naming test employed was not among the tests of most discriminative value. The authors now consider that the stimuli they used were not discriminative because they were of very common objects.

3.3.1.4 Picture Naming Errors

Obler & Albert (1981) observed that the person with early dementia may circumlocute normally but will need more time to find a word than a healthy old person. Bowles et al. (1987) distinguished their AD subjects from young and old normal subjects on their number of unrelated responses on an Action Naming Test.

In Walker (1982), phonemic errors were made by both mild and moderately affected demented subjects, but not by the normal controls. Conversely, in Cormier et al. (1991) both normal and AD subjects produced phonemic errors on their modified version of GNT. Contrary to other studies, their normal subjects produced more phonemic errors than the demented subjects. Interestingly, neither group produced phonemic errors on their degraded picture naming test. Blanken et al. (1987) suggest that phonemic paraphasias and neologisms are rare in dementia and are usually observed at a late stage.

3.3.1.5 Summary

It has been shown that picture naming ability is affected by normal ageing, aphasia and AD. The types of errors produced by the two patient groups appear to offer a possible way of discriminating the groups, if the appropriate picture naming test is offered. Two aspects of picture naming performance which are of theoretical interest (the effect of cueing and the possible origin of picture naming errors) are discussed in section 3.4.

3.3.2 Word Fluency

Word fluency tasks require 'the ability to retrieve members belonging to a specified category within a limited time period' (Diesfeldt, 1985). Such tasks are commonly used in studies of word finding ability, and can be based in either semantic categories or orthography. Rosen (1980), for example, used both types in her study of normal elderly people and elderly people with mild or moderate-to-severe AD. Martin & Fedio (1983) asked subjects to name items found in a supermarket. Similarly, in the Set Test (Isaacs & Ahktar, 1972) subjects are asked to name colours, animals, fruits and towns. Word fluency can also be approached through orthography as in the F.A.S. test, in which subjects are asked to produce as many words as possible which start with those letters (Miller, 1984).

Word fluency is one of the neuropsychological tests most sensitive to early dementia. Data reported by Martin & Fedio (1983), Diesfeldt (1985), Ober et al. (1986) and Bandera et al. (1991) concur in the finding that normal subjects generated significantly more words than the Alzheimer subjects on tests of word fluency. Bayles et al.'s (1989b) subjects with AD produced significantly different performances on semantic-category and letter-category generative-naming tasks. The authors suggest that this disparity results from the two tasks depending on different underlying memory subsystems. Davis (1984) proposes that normal older subjects' lower word fluency scores may be due to reduced speed of word retrieval.

Isaacs & Kennie (1973) administered the Set Test to 189 subjects. Results were interpreted so that a score of under 15 corresponded closely to a clinical diagnosis of dementia, 15-24 showed a lesser degree of association with dementia and no-one who scored over 25 was demented. Low scores were also associated with physical illness and to a limited extent with social class.

Hart et al. (1988) gave the F.A.S. Test and the Set Test to normal elderly and AD subjects. The control group scored better on both tests than the experimental group. Both groups scored more on the Set Test than on F.A.S. This finding indicates either that names are more likely to be stored according to their semantics, rather than orthographically or that semantic categories are more limited in size, affording the subjects more control and more cueing among responses. Demented subjects had most difficulty in naming towns, which Hart et al. (1988) suggest was because the task may have entailed a strong episodic memory component (whereas the other categories tap the semantic memory store). The cut-off points described by Isaacs & Kennie (1973) may not be stringent enough.

While the literature shows that normal ageing can be distinguished from dementia using word fluency tests, little has been written about the performance of aphasic subjects or about the potential of such tests for distinguishing fluent aphasia and the language disorder of AD. Bayles & Kaszniak (1987) describe a study which used the F.A.S. Test. The results showed very similar mean numbers of words produced by fluent aphasics and mild AD patients - demonstrating similarity rather than quantitative difference.

In summary, much has been written about word fluency deficits in dementia in comparison with those found in aphasia. The Set Test offers a word fluency test based on semantic categories, with age-appropriate norms and a potential distinguishing factor in the town category.

3.3.3 Reading Aloud

Theoretical issues relating to models of reading aloud are presented in section 3.4. The ability to read aloud remains relatively intact in early AD while aphasic people have some difficulty with this task. Gardner & Zurif (1975) conclude that operative nouns (manipulable) were easier to read than figurative nouns and that part of speech and picturability also contribute to word readability in aphasia. Schwartz et al.'s (1979) demented patient had poor word comprehension, but was able to read aloud words that she did not understand, a finding confirmed by Cummings et al.'s (1986) group study. Fromm et al. (1991) report a longitudinal study which used the National Adult Reading Test (Nelson, 1982). Scores for reading aloud irregular words correlated with dementia severity only at the later stages of the disease.

3.3.4 Repetition

Davis (1983) describes the inability of Wernicke's aphasics to repeat, while Goodglass & Kaplan (1972) state that repetition usually results in paraphasic distortion and the appearance of neologisms and irrelevant insertions. Li & Williams (1990) describe repetition deficits in three aphasic syndromes, including Wernicke's aphasia and find that the Wernicke's aphasics produced more unrelated words and jargon than the other groups.

Bayles & Kaszniak (1987) say that repetition deficits, if present, are mild in early AD and poorly differentiate dementia patients from normal subjects. However, Appell et al.'s (1982) results on repetition subtests of the Western Aphasia Battery showed a significant difference between normal control and Alzheimer subjects. They also present a comparison of repetition scores for Alzheimer's patients and stroke patients. For these groups differences in mean scores achieved by the groups are not significant. Unfortunately all syndromes of aphasia are represented in the aphasic group, thus diminishing the present usefulness of these comparative data. Repetition scores in that study represent data from sentence as well as single word repetition. Holland et al. (1986) undertook a longitudinal study of repetition in AD. Among other findings, they state that (as expected) sentence repetition deteriorates in time, but less so than many other skills.

3.3.5 Writing

Theoretical issues relating to writing words to dictation are presented in section 3.4. The following paragraphs describe studies which have explored or compared this ability in aphasia and the language disorder of AD.

3.3.5.1 Spelling in Aphasia

Goodglass & Kaplan (1972) and Davis (1983) suggest that written symptoms correspond to spoken symptoms (see section 2.2.4). Albert et al. (1980) report that the Wernicke's aphasic may refuse to write. Friederici et al. (1981) confirmed that there was no significant difference in oral and written performance in their Wernicke's aphasia subjects and emphasised the importance of word length in spelling success: responses ranged from 99.8% on monosyllables to 44.4% on trisyllables. In Bricker et al. (1964), both word length (in letters) and word frequency were significant in determining aphasic subjects' performance on a published test of spelling. Wapner & Gardner (1979) concluded that posterior aphasia was associated with spelling errors based on a word's sound structure.

3.3.5.2 Spelling in AD

Alzheimer (1977, in translation) wrote that the original Alzheimer's patient repeated single syllables, omitted others, and 'quickly became confused' while writing. Until recently very little had been written on this subject. In general terms writing has been said to deteriorate in dementia (Bayles & Kaszniak 1987). Horner et al. (1988) and Kumar & Giacobini (1990) found a significant correlation between agraphia and severity of cognitive impairment.

Code & Lodge (1987) screened recent referrals to a psychogeriatric unit for language difficulties. Of their measures, writing to dictation correlated best with score on their mental test questionnaire. Their demented subjects' writing errors were mostly omissions of consonants and vowels, with some substitutions, especially involving vowels. There were 'just one or two examples of additions of letters' and no examples of semantic errors.

Neils et al. (1989 provide a study of descriptive writing in AD with errors analysed on a qualitative as well as on a quantitative level. Errors affected content words more than function words or morphological endings.

3.3.5.3 Comparative Studies

Horner & Heyman (1981) compared writing errors in dementia and aphasia: in aphasia errors are characterised by letter substitutions and sequencing errors, and errors increase as words increase in length. Writing errors produced by demented subjects are often phonetically related to the target, and addition of letters is frequent. These comparisons suggest that the aphasic has difficulty with the word structure, while the demented person shows perseveration and seems not to have phonological problems. Copying is said to be better than spontaneous writing in aphasia but the reverse true in dementia, where attention is a problem.

Rapcsak et al. (1989) report a study which compared spelling in normal elderly people and AD subjects. While the AD subjects spelled regular words and non-words as well as the controls, they performed significantly worse on spelling irregular words. It may be inferred that the AD subjects retain the learned rules of grapheme-phoneme correspondence, but lose the entries in semantic memory for words with irregular spelling.

Glosser & Kaplan (1989) compared the performance of groups of AD patients and subjects with left-hemisphere stroke, who were matched for severity of naming and auditory comprehension deficits, on a number of writing tasks (written confrontation naming, word dictation, word copy, written sentence completion, written sentence description, sentence dictation and sentence copy). Significant qualitative differences were found in performances between tasks and in errors within tasks: fluent aphasics showed more impairment of syntactic, phonological and semantic aspects than AD subjects.

3.3.5.4 Summary and Implications

Spelling ability is the least well-described of the single word processes. Glosser & Kaplan's (1989) findings suggest that error types may distinguish the patient groups. The potential, therefore, of a writing words to dictation test as a discriminative task warranted exploration.

3.3.6 Story Recall

Story recall is used to measure several aspects of language and memory (discourse characteristics, auditory comprehension and immediate and delayed recall of prose). While the content of the present study does not include any measure of how the subjects involved cope in everyday life with language or memory tasks, it is interesting to note that of the battery of tests used by Baddeley et al. (1982), immediate and delayed prose recall best predicted memory in everyday life. Cohen (1979) showed that older people were less able than younger subjects on several tests of language comprehension, including story recall. Although several studies are reported below which compare story recall in normal ageing and dementia, apparently only Bayles et al. (1989a) compared performance by fluent aphasic and AD subjects. In this study, aphasic subjects recalled more than mild and moderate AD subjects, but less than the normal elderly subjects. The demented subjects showed loss of 98% of the immediately recalled information in the delayed condition.

Hertzog et al. (1992) present an extensive review of issues relating to story recall and its underlying processes. Their experiment explicitly examined the nature of intraindividual variation change over time in written story recall of normal older female subjects. Materials were designed to be age-appropriate. Recall was significantly better for texts with female protagonists and with gender-appropriate themes. This study provides useful indicators for the present study: the story required to be age-appropriate and its theme neutral for gender. Holland & Rabitt (1990) compared autobiographical and written text recall in elderly subjects. Subjects tended to recall main points better than details and tended to give generalised rather than specific accounts.

Obler (1980) reports two studies which employed immediate and delayed story recall. She used the logical memory passage from a published battery of memory tests with groups of normal subjects aged from 55 years. Recall was poorer for older subjects and in the delayed condition. In the second study subjects were people with dementia who recalled very little of the passage in comparison with the normal subjects.

Robinson-Whelen & Storandt (1992) review several studies which compared immediate and delayed story recall in normal and demented subjects and criticise their methods of evaluating change of performance between immediate and delayed recalls. Modest age-related effects were reported in their study for the normal subjects and the normal subjects recalled significantly more at both times than their very mildly demented subjects.

Bayles & Kaszniak (1987) outline variables which may affect discourse recall in normal ageing. These include education, culture, verbal ability, semantic encoding, decline in syntactic knowledge, semantic encoding deficit and a differential difficulty with implicit and explicit information. A summary of research into story comprehension and ageing shows that story retelling is adversely affected by age. Results are equivocal concerning the source of the age-effect: main and supplemental information, explicit and implicit linguistic information are variously argued. Cohen (1988) suggests that age-related decrement in memory for text results from loss of processing capacity with age rather than from a production deficit. Zelinski (1988) is not so sure.

In summary, while little is known about story recall by fluent aphasics, normal ageing adversely affects this ability and people with dementia have great difficulty with delayed story recall. Since successful story recall requires initial comprehension of spoken material, it could be predicted that the performance of fluent aphasics would be abnormal, but would reflect their ability to understand as well as remember the story.

3.3.7 Verbal Recognition Memory

Bayles & Kaszniak (1987) suggest that one advantage of the use of recognition memory tasks is to allow experimenters to observe variables such as response bias which cannot be measured in free recall tasks. They review several studies which employed recognition memory tasks, both verbal and non-verbal.

Abbenhuis et al. (1990) describe an experiment in which normal elderly and demented subjects performed a computer-mediated set of tasks. The nature of the distractors in their recognition memory task was not discussed. Some of the word stimuli were shown once, others twice and three times. The groups produced significantly different recognition performance, as expected.

3.3.8 Sentence Disambiguation

Understanding ambiguities in sentence constructions requires 'intact high-level nonverbal, pragmatic reasoning' according to Code & Lodge (1987) whose data showed that this skill is compromised early in dementia. It is possible, however, that failure on a disambiguation task does not reflect loss of pragmatic reasoning. Rather it reflects the relative complexity of the task in comparison with other routinely used tests of language such as reading aloud or picture naming (Emery & Breslau (1988) would argue for this stance).

Bayles et al. (1985) compared performance on sentence disambiguation in subjects aged between 20 and 79 years, grouped by decade. No significant age-related decrease in score was evident. Bayles & Boone (1982) report that sentence disambiguation was the most challenging test of their battery for both normal and demented subjects. No report (apart from Bayles et al., 1989a) has been found which used sentence disambiguation as a task in attempting to find differential indicators.

3.3.9 Conclusion

It is evident that picture naming has received most attention in the literature and more complex skills such as sentence disambiguation have received least. All the tasks which have been reviewed offer potential for discrimination among normal ageing, fluent aphasia and the language disorder of early AD. The next section discusses theoretical issues relating to picture naming, reading aloud and writing words to dictation. Error performance on these tasks was analysed (chapter 6) to investigate the nature of the deficits associated with fluent aphasia and the language disorder of AD.

3.4 Theoretical Issues

This section considers theoretical issues relating to the three tasks which were examined in detail, using data gathered at preliminary, pilot, validation and retest stages of this project, to understand more clearly the relationship between fluent aphasia and the language disorder associated with AD. Two aspects relating to picture naming are discussed: the origin of naming errors and cueing responsiveness, following a discussion of the cognitive neuropsychological (CNP) model of picture naming. Two models of reading aloud are discussed (dual and single route), while the single route to reading aloud is applied to writing words.

3.4.1 Picture Naming

3.4.1.1 A Model of Picture Naming

Most theories suggest that picture naming is a staged process consisting of a perceptual stage, in which an object is recognised, followed by a semantic or word-search stage, when the specific name is accessed. A third stage involves the encoding of the phonemes into a motor articulatory sequence (Davis, 1983: Kirschner et al., 1984). The CNP model of language processing postulated by Ellis & Young (1988) (see Appendix I) has modules for the stages described above and represents mutual influence among adjoining modules by its system of arrows. Morton (1985) added two preliminary processes: pictorial analysis and pictorial categorisation. Information from these is fed to the semantic system, speech output lexicon and thence via the phoneme level to the articulation of the picture's name. While many single aphasic cases have been described using this model (Miller, 1983; Howard & Orchard-Lisle, 1984; Kay & Ellis, 1987; Howard & Franklin, 1988) little similar attempt has been made to describe the problems associated with AD.

3.4.1.2 Naming Error Origin - AD and Aphasia

One of the main themes in the naming in dementia literature concerns whether the origin of picture naming errors in AD is perceptual or semantic. Rochford (1971) concluded that demented subjects' errors were largely a problem of visual recognition. He compared the performance of groups of aphasics and demented subjects on two naming tests (naming eight pictures and eight body parts). The demented subjects named body parts better than pictures. On the other hand, the dysphasics' performance was unaffected by subtest type. Rochford's analysis of naming error types showed contrasting distributions of recognition and misrecognition for the two groups: misrecognitions accounted for 55% of the demented group's errors, compared to 5% of the dysphasics' errors. Assignment to the different error types was made subjectively, but this difference is very marked.

This study has several flaws. Rochford's findings are based on only 16 responses by each subject. The ages of his groups are not well-matched. While the dysphasics were between 9½ and 70 years, with over half between 40 and 60 years, the demented group ranged in age from 58 to 89 with a mean of 75.6 years. His dysphasic group contained both acute and chronic patients and no analysis was made of the type of dysphasia each suffered. Nevertheless, this study has been seen as providing strong evidence for the idea that the failure of the visual perception system of demented people can explain their picture naming errors.

Bayles & Tomoeda (1983) disagree with Rochford's analysis. They argue that demented peoples' naming errors are semantic in origin since with increasing dementia severity, responses become increasingly unrelated to the target.

Stevens (1989) similarly compared naming performance by dysphasic and AD subjects on 24 coloured photographs and black and white line drawings of the same objects. AD subjects had more difficulty with line drawings than photographs, while the two modes produced the same performance from the dysphasics (see also Corlew & Nation, 1975). AD subjects tended to produce visual misperceptions while the dysphasic group's tendency was to the production of word finding errors.

Kay's (1989) concerns about this study lay in the high level of success achieved by both groups on both types of picture (indicating that their problems were incidental, rather than constitutional), the minimal difference in numbers of errors between the two conditions for the AD group and in Stevens' failure to use any objective measure of visual acuity.

Shuttleworth & Huber (1989) report variability in naming errors in dementia from longitudinal evidence. Although linguistic errors were most common, there was variation in types of linguistic errors made and some subjects produced errors mainly of perceptual origin.

Smith et al. (1989) assessed their AD subjects' confrontation naming ability and their ability to name to tactile cue, with both right and left hands. Subjects produced equal proportions of semantic and perceptual errors. On the other hand, Cormier et al.'s (1991) subjects made mostly perceptual errors and 'no response' errors from materials which must be considered perceptually 'difficult'. Shuttleworth & Huber (1988)'s 20 AD subjects and their age and education-matched controls made similar proportions of perceptual-recognition and aphasic errors. LaBarge et al. (1992), in another Boston Naming Test study, noted very few perceptual errors. Those they found, they argue were the result of lexical or semantic disturbance (a reflection of their analysis, where circumlocution was assumed to reflect misperception).

In summary, the evidence is contradictory and probably the result of the use of widely differing materials and subjects. It is useful to compare performance on word fluency and naming tests since the former does not rely on visual processing, but on retrieval of sets of words from semantic memory. This skill deteriorates early in dementia (see section 3.3.2). Margolin et al. (1990) compared performance of AD and aphasic subjects on a picture naming test and a letter category word fluency test: the demented group performed significantly worse than the aphasics on the picture naming test which has both visual and semantic components, but not on the word fluency test. While the aphasic subjects' results on the two tests were positively correlated, the relationship was not significant for the AD group. It seems, therefore, that the AD subjects had a specific problem in the perceptual stage of picture naming.

The literature thus suggests that two factors produce poor confrontation naming in AD: a deteriorating semantic system and, of greater influence, a deteriorating visual perceptual system. This possible distinction between aphasia and dementia was exploited at the validation stage of the present project by comparing the proportions of perceptual to linguistic errors produced by the patient groups.

3.4.1.3 Cueing Responsiveness - AD and Aphasia

If picture naming difficulty is primarily a linguistic difficulty in aphasia and largely a picture perception difficulty in dementia, then the two groups should be helped by different types of cueing. Goodglass' (1980) normal older people responded well to 'priming with the first sound', i.e. phonemic cueing. Pease & Goodglass (1978) found an inverse relationship between severity of naming disorder and cueing responsiveness (anomic aphasics benefited significantly more from cueing than did Wernicke's aphasics). Of their six cueing types, phonemic cueing was most effective, while no significant difference was observed among superordinate, function, location and rhyme cues. Of the cueing types, only phonemic cues benefited Wernicke's aphasics, while four of the six types benefited all other aphasic groups. Li and Canter (1987) controlled for naming severity, by using analysis of covariance. Only Broca's and Wernicke's aphasics had significantly different naming success following phonemic cue. Anomic subjects did not benefit as well as expected.

Stimley & Noll (1991) established that two types of cueing elicited different types of errors (when correct responses did not result). Semantic cueing, for example, was associated with an increased incidence of semantic paraphasia and decreased incidence of unrelated word responses. Li & Williams (1991) undertook a similar study, but included an action naming task as well as an object naming task. There were different effects of cueing in the two naming tasks: while subjects gained similar success following phonemic cue, semantic cues facilitated action more than picture naming.

In Neils et al. (1988) the ability to use phonemic cues showed a moderate negative correlation with dementia severity. Three language measures (confrontational naming ability, auditory comprehension and speech fluency) correlated positively with phonemic cueing effectiveness.

Cueing responsiveness, then, is another measure of picture naming performance which has potential in distinguishing the patient groups and in informing discussion of the nature of the deficits. While anomic aphasic subjects were expected to benefit more from phonemic cueing than Wernicke's aphasics, demented subjects were expected to benefit less, especially since some of their picture naming deficit can be explained by perceptual rather than linguistic difficulty.

3.4.2 Reading Aloud

3.4.2.1 Two Routes to Reading Aloud

It had been argued, and generally accepted until recently, that there are two routes available to the mature reader by which he/she is able to read a word aloud. By the top-down route, the reader is said to be able to retrieve familiar words from a hypothesised visual input lexicon. In CNP terms, this module holds representations for each word known to the reader. The word is activated through recognition by the visual analysis system (the input system for the visual input lexicon). In turn, the latter may feed information to the semantic system, so that the reader can understand the word that he has recognised (Ellis & Young, 1988).

Since not all words can be familiar, e.g. new words, uncommon words and non-word letter strings, a second route is also said to be available to the reader. This route is said to convert letter-strings to sounds, using a bottom-up approach. This process is invoked to translate unfamiliar letter strings into phoneme strings. These routes can been named 'lexical' and 'non-lexical' respectively - the former since representations are said to be retrieved from a lexicon and the latter since word pronunciations are derived by rules. The existence of two routes to reading can be demonstrated by a dissociation between the two routes in certain types of acquired dyslexia.

3.4.2.2 Or a Single Route to Reading?

Recently, this view has been challenged by proponents of a single route to reading aloud, for example by Seidenberg & McClelland (1989) and Glushko (1979). The single-route model excludes grapheme-phoneme conversion. Instead, in Glushko's model, the pronunciation of a letter string is 'based upon the stored pronunciations of all words that are 'orthographic neighbors' to the letter string in question' (Friedman et al., 1992). For known words, the letter string will activate the appropriate entry in the lexicon. At the same time all 'orthographic neighbors' will be partially activated. Here 'neighbours' are words which differ by a single letter from the target word (for example - 'ship' has nine neighbours, including 'chip', 'shin' and 'whip'). Coltheart et al. (in press) refer to neighbourhood size (Coltheart et al., 1977) as an influencing variable in the speed and accuracy of reading words aloud. If the word does not have a lexicon entry, its pronunciation will be a composite of its neighbours' pronunciations. Seidenberg & McClelland (1989), on the other hand, argue against a store for words. Pronunciations are said to be represented by 'patterns of weighted connections between orthographic and phonologic units' (Friedman et al., 1992).

Coltheart et al. (in press) show that any such single-route model will require much modification and development before it will be able to explain pathological reading phenomena. A single route model they tested failed to explain how skilled readers can read aloud non-word letter strings, how they can perform visual lexical decision tasks and how types of dyslexia (acquired and developmental) can arise, while a dual-route to reading model can be used to explain all these phenomena. Nevertheless Coltheart et al. report that the Seidenberg & McClelland (1989) model has two very positive features: it is computational and it can learn.

Jared et al. (1990) propose instead that whole word competition is apparent in experiments manipulating 'body neighbours'. A body neighbour is defined as a word with a different onset and the same word-body (nucleus and coda) as the target, e.g. 'whip' is a body neighbour of 'ship' while 'shin' (another neighbour) is not, as it does not share the same post-onset letters. Thus there is a relationship but not one-to-one correspondence between neighbours and body neighbours.

Among orthographically defined 'body neighbours', 'friends' rhyme with the target, e.g. 'whip' is a friend of 'ship'. 'Enemies' are body neighbours which do not share the same pronunciation as the target. Because 'ship' has no enemies it is classed as 'consistent' word. On the other hand, 'head' is an 'inconsistent' word, i.e. it has both friends ('bread', 'tread') and enemies ('bead', 'knead'). Words can also be 'unique', i.e. without any body neighbours ('debt') or 'exceptions', i.e. with enemies but without friends ('aunt' whose enemies include 'daunt', 'flaunt', 'gaunt','haunt', 'jaunt' and 'taunt').

This approach is not without problems, which include word length, word position, the reader's vocabulary and possible alternative pronunciations. These problems are discussed next.

Most of the reading aloud and writing test items used in battery development (see Appendix II) were one syllable in length. Of these many had body neighbours, as did some bi-syllable items. However, words with three syllables (and presumably those with more than three) generally lack body neighbours. Does this mean that longer words are all truly unique or does it mean that this approach is useful only in describing the reading of short words?

What constitutes a body neighbourhood? Do the body neighbours require to be only those words with a letter-length or syllable-length match to the target with different onset and same rhyme? If so, ' ology' would have very many body neighbours but the reader would surely still have difficulty with the word onsets ('psych' or 'soci '). 'Attitude' (one of the reading items) was categorised as 'consistent', with many body neighbours which had rhyming final syllables. Had the rhyme been taken from the second syllable onwards the body neighbour count would have fallen dramatically.

Another problem lies in the presumption that all adult readers will have knowledge of all a word's body neighbours. 'Promise' was an inconsistent word in the reading aloud test. It was found to have a small body neighbourhood: one lower frequency friend and three lower frequency enemies. The frequency totals for the enemies was higher than the frequency of the friend. It is possible that some readers will not know that 'chemise', 'demise' and 'surmise' do not rhyme with 'promise'. For them 'promise' would not be an exception word.

Finally, some words have more than one pronunciation. For example, 'read' is pronounced with a different vowel depending on whether it is representing the present or past tense of the verb. The pronunciation is not therefore dependent on the word's inconsistent nature, but on the context within which it appears. This is, of course, not a consideration in a single word reading aloud test but does reflect a more normal situation.

While the model is still being developed and refined, it has been employed in several studies which involved normal and pathological subjects. These are discussed below.

3.4.2.3 Using the Single Route Model

Jared et al. (1990) used a series of carefully controlled experiments to demonstrate that, for university undergraduates, inconsistent words took longer to read than consistent words and 'spelling-sound consistency affected the naming of lower frequency words'. Factors influencing the outcome included the relative strengths of rival pronunciations, with weak friend and strong enemy neighbourhoods producing the largest effect.

Friedman et al. (1992) tested the ability of normal elderly and AD subjects to read aloud pseudowords (non-word letter strings). All their demented subjects could read pseudowords but performed poorly on 'no analogy' stimuli, which had no neighbours and contained non-English letter combinations. The authors explain this discrepancy as the result of the loss of the ability of the subjects to use 'rules' with the retention of the ability to perform the automatic process of reading by analogy, i.e. reading as described by Glushko (1979).

Friedman & Kohn (1990) compare the two types of model using a single aphasic case. Their results are said to favour the single route model, which predicted the subject's specific reading problem, and place the problem of the aphasic at the phonological level. In an earlier comparison, Kay & Marcel (1981) also favoured a single-route explanation of their finding that normal young subjects were primed in their pronunciations of ambiguous non-word letter strings by immediately preceding real words with the same ambiguous segments.

Balota & Ferraro (submitted) studied the separate effects of word frequency and word regularity on reading aloud latency and accuracy in healthy young and aged subjects and in subjects with AD. Their results indicated that the frequency effect increases both with age and dementia severity. However, there was no parallel increase in either regularity effect or in the frequency by regularity interaction. Furthermore, there was an increased likelihood of regularisation errors (the vowel in 'pint' pronounced as the vowel in 'hint') as the subjects progressed from normal young to moderately demented. Balota and Ferraro suggest that the latter finding relates to breakdown in the inhibition of partially activated pronunciations, rather than because of a general slowing in processing or of reduced attention.

3.4.2.4 Summary

The single route model of reading aloud offers a new opportunity to compare this ability in the patient groups. While several group studies have used demented subjects, only single case studies have reported aphasic behaviour from this view-point to date. This approach provided a method of investigating whether aphasic and AD subjects reacted differently to words with different body neighbourhoods, reflecting different underlying pathologies.

3.4.3 Writing

3.4.3.1 Normal Spelling Ability

Little is written about spelling in normal adults who are literate in English. Sloboda (1980) describes the types of errors most commonly produced by such a population as 'phonologically plausible', e.g. confusing single and double consonants or confusion between unstressed vowels. He reports from his data that normal errors were explicable ('dearth' spelt as 'dirth' is said to have called on 'birth' rather than 'search'). This is reminiscent of the single route to reading approach.

Sloboda quotes earlier data from children's spelling, which suggests that they make phonologically plausible errors and also omissions, transpositions and substitutions which 'significantly alter the phonological representation'. He sums up adult spelling ability as the result of knowledge of certain spelling rules, certain orthographic constraints and grammatical context, the memory of exception words (words which do not follow the rules), spelling history and individual differences in tendency to certain types of error.

Ellis & Young (1988) describe a mirror image of reading aloud to account for possible routes to spelling words and non-word letter strings. Margolin (1984) similarly describes the spelling process but in greater detail using pathological single case studies. Frith's (1980) edited volume considers several aspects of spelling, (e.g. Sloboda above).

Campbell (1983), on the other hand, extended the concept of single-route reading to spelling. Priming occurred for normal subjects in the spelling of non-word letter strings when they were preceded by similar sounding real words. However, such priming did not occur for a man with surface dyslexia who was given the same set of materials and who failed to produce phonemically acceptable spelling of the non-word stimuli. His spelling ability mirrored his reading problems.

As a result of the Campbell (1983) paper, the extension of the single route to reading approach to writing seems to be a legitimate method of examining spelling problems in the patient groups. If writing ability were shown to parallel picture naming and oral reading abilities, then specific deficits can be predicted for the aphasics but not for the demented subjects.

3.4.4 <u>Summary</u>

This section has discussed various theoretical issues of three single word processes. All provide potential indicators for the distinction of fluent aphasia and the language disorder of AD, which implications for an understanding of the underlying deficits.

Before the pilot test battery was developed, a preliminary study was carried out which considered picture naming only. This study predated Bayles et al. (1989a) and compared those aspects of naming performance discussed above, in normal ageing and dementia.

Chapter 4

A Preliminary Study

4.1 Introduction

The three previous chapters have described the problem of distinguishing fluent aphasia and the language of AD, described the general nature of the two disorders and considered in more detail particular language and verbal memory abilities in the two groups. This chapter presents an evaluation of preliminary picture naming data from normal and demented elderly subjects, which formed the starting-point for the three main studies reported in later chapters. However, before the preliminary study is discussed, the methodology employed throughout the project is outlined below.

4.1.1 Introduction to Methodology

The central technique employed in the thesis is the use of a battery of language and verbal memory tests, including picture naming. The battery was administered in pilot and modified forms to groups of normal elderly, demented and fluent aphasic subjects. Several kinds of data gained from group performances were employed to explore the underlying deficits in the two disorders:

(i) test score profiles;

(ii) distributions of error types produced on picture naming (e.g. phonological, semantic, perceptual), reading aloud (e.g. phonological, suprasegmental, nonword letter strings realised as real words), writing (e.g. substitutions, omissions, two letter errors) and verbal recognition memory tests (i.e. types of distractors chosen) and the influence of various stimulus variables on performance (familiarity, frequency, stimulus length and word type);

(iii) effectiveness of semantic and phonemic cueing, i.e. degree of success in picture naming following a cue which gives more information about the picture, such as description, location or function or a cue which gives the word-onset of the target;

(iv) test-retest consistency, i.e. an examination of whether errors were made on the same items over time.

Four studies were undertaken. First, a preliminary study, which is described in this chapter, looked specifically at picture naming. Findings from it informed pilot test battery development and pilot study data analysis (chapter 5). The pilot battery was modified and administered to larger groups of subjects to validate pilot study results (chapter 6). Subsets of the subjects used in the validation study were retested to examine test-retest performance consistency (chapter 7). The resultant data are used to elucidate the nature of the deficits found in fluent aphasia and the language disorder of AD (chapter 8).

4.1.2 Introduction to Preliminary Study

Picture naming tasks are used to assess the degree and nature of the word finding difficulties known to occur in aphasia and the language of dementia. Picture naming is the area of expressive language which has received most attention in the literature (see sections 3.3.1 and 3.4.1). Despite the extensive literature on the subject, the question remains: are the picture naming deficits associated with fluent aphasia and the language of AD the same? This chapter aims to begin to answer this question, while the thesis aims to answer the wider question of the general relationship between the two disorders, by examining a range of language and memory abilities.

The question posed above subsumes several unresolved aspects of picture naming deficits in the two groups: (i) while the responsiveness of aphasic people to cues is well-documented, much less is known about phonemic cueing responsiveness in people with dementia (see section 3.4.1.3), (ii) are the naming errors made by people with dementia perceptual or semantic in origin? (see section 3.4.1.2) and (iii) do the naming disorders of the two groups differ in the same way from normal elderly naming? These sub-questions are examined in detail in the analysis of picture naming, and other language abilities (reading aloud and writing), in chapters 6 and 7, while they receive preliminary consideration in this chapter.

4.1.3 Aims of the Preliminary Study

The preliminary study described below had two purposes: (i) to establish a suitable level of picture naming test for the pilot test battery by comparison of normal and demented performance on the Boston Naming Test (BNT), Kaplan et al., (1983) and the Graded Naming Test (GNT), McKenna & Warrington, (1983) and (ii) to pilot methods of data analysis, particularly cueing responsiveness and error types, using normal elderly and demented subjects' picture naming responses.

The data for this study was collected during the College of Speech and Language Therapists' Advanced Studies Course in Care of the Elderly (1986). Some of the results are presented in Armstrong & Greig (1992).

4.1.4 Hypotheses

Three hypotheses were established for the preliminary study:

(1) If subjects with dementia have semantic memory loss (see section 2.5.2), they will be unable to benefit from phonemic cueing.

(2) If demented subjects have particular difficulty with visual perception (see section 3.4.1.2), they will make more errors associated with picture recognition than at the label retrieval stage of picture naming.

(3) If dementia is like normal ageing, subjects with dementia will make more picture naming errors than the normal older subjects, but will show similar types of error and distributions of error types.

4.2 Procedure

4.2.1 Subjects

Fourteen patients were selected from a psychogeriatric day unit. The charge nurse identified potential subjects. Selection criteria included the following: subjects should be aged over 65 years with a medical diagnosis of dementia (diagnosis by consultant psychiatrist). At this stage type of dementia was not stipulated. English should be the first language, and subjects should be without significant hearing or sight impairment. (Impairments corrected by hearing aid or spectacles were accepted). Subjects should have suffered no recent illness (to exclude an acute confusional episode confounding the dementia) and there should be no history of stroke-related disease (to exclude the possibility of an aphasia). A mental status score (Hodkinson, 1972) of less than 7 was also necessary. Medical criteria were obtained by inspection of medical notes. The subjects' attendance at the unit varied from two to five days per week, according to their needs and those of their carers.

Fourteen normal healthy elderly subjects were sought from various sources - a chiropody clinic, an orthopaedic ward and a sheltered housing complex. Criteria for their selection again included age over 65 years, absence of significant hearing or sight impairment (corrected as necessary) and English as first language. A particular criterion for this group was freedom from stroke-related disease or confusion.

Three of the subjects with dementia were excluded. Two were found to be too distractable for valid assessments to be made. One subject was excluded as her mental status score was 7 (above the acceptable cut-off for this group).

4.2.1.2 Subject Details

Both groups consisted of 11 subjects. Sex ratios in the two groups were similar: demented group - 3 men and 8 women and normal group - 4 men and 7 women. The mean ages of the groups were 79.3 and 77.5 years respectively. The difference in mean age was not significant - $t = 1.29$, (d.f. = 20), $p > 0.1$ using a one-tail t-test.

4.2.2 Place of Testing

All the demented subjects were withdrawn from the psychogeriatric day unit to a quiet consulting room nearby, where no interruptions were likely. The normal subjects were seen in a variety of locations: a health centre, a hospital ward and the subject's flat. Privacy and quiet were found in all the locations.

4.2.3 Materials

The subjects were assessed on three tests, which are described below. Changes made to test administration and scoring are outlined. Both the naming tests are fully reviewed in Beech et al. (1993).

4.2.3.1 An Adaption of Hodkinson's Abbreviated Mental Test Score (MTS) (Hodkinson, 1972)

This consists of a series of ten questions designed to evaluate memory and orientation in elderly people. It is reported by the author to have similar discriminatory value to the much longer (34 item) test on which it is based. A score of 7 - 10 is considered to represent a normal performance while a score of below 7 represents mental impairment.

Items include (1) Age, (2) Time to the nearest hour, (3) Address for delayed recall, (4) Year, (5) Name of hospital, (6) Recognition of two people (doctor, nurse etc), (7) Date of birth, (8) Date of first world war, (9) Name of present monarch and (10) Count from 20-1. Two minor alterations were made: a) Item 2 - correct choice between morning/ afternoon/evening scored the point, and b) Item 6 - since the tester did not know the day unit staff or subjects' relatives by name, this item was replaced by 'What is the name of the Prime Minister?'

4.2.3.2 Boston Naming Test (BNT) (Kaplan, Goodglass and Weintraub, 1983)

BNT was developed from an earlier 85 picture naming test designed so that the items could assess picture naming ability from pre-school age to the average adult, were easily picturable, corresponded to a single noun and were not biased for gender or special experience. The 85 pictures were arranged in order of difficulty after pilot testing with normal and aphasic subjects, rather than with reference to a word-frequency database. The test was revised in 1982 when 25 items were eliminated on grounds that they had multiple possible names, they were commonly misperceived or that they correlated poorly with overall test performance. The picture order was revised on the basis of the numbers of subjects who named each correctly and it was published in its current form (personal communication with the second author).

In this test, 60 black and white line drawings are presented to subjects for naming. If a subject fails to recognise or misperceives a picture, then a stimulus cue is given, which provides the subject with more semantic information about the target. If stimulus cueing does not result in correct naming, then a phonemic cue (the first sound(s) of the name) is given. Thus for Item 14 (mushroom) the stimulus cue is 'It's something to eat' and the phonemic cue is 'mu...'. Testing is discontinued after six consecutive failures to name (with cues). Norms are available for children from 5.5 to 10.5 years, for adults from 18 to 59 years and for aphasics. No norms are available with the test for elderly/elderly demented populations.

The test manual suggests that the testing should begin at item 30 if an adult is being assessed. For the purpose of this study, all items were included and the test always started at item 1. Dialectal synonyms were accepted as correct responses for a number of stimuli. Two of the stimulus cues were changed slightly to reflect British rather than American usage. (Item 7 'Used for fixing hair' became 'Used for tidying hair' and Item 15 'Found in a closet' became 'found in a wardrobe').

For the purpose of analysis, responses correct without cue or following stimulus cue were used as data, as the manual suggests. Responses correct following phonemic cue are analysed separately. The test manual recommends that 20 seconds are given for response before a cue is given. Testing here was untimed to maintain a parallel with the Graded Naming Test format (see below) and to allow a more accurate assessment of naming ability in this older population.

4.2.3.3 Graded Naming Test (GNT) (McKenna & Warrington, 1983)

GNT manual states that the test was designed to detect degrees of naming deficit before they become clinically evident and does so by sampling items on the boundary of an individual's naming vocabulary. It was developed from an earlier 61 item test, whose stimuli were derived from a variety of literary sources. Criteria for inclusion included that items were easily picturable, that they be unambiguous in name, that they should not require specialist knowledge and that they should not be in common usage. The last criterion marks the difference between BNT and GNT. 31 pictures were excluded during standardisation through being too easy, too difficult or ambiguous. The standardisation procedure involved 100 people: in-patients with extracerebral disorders and non-hospitalised volunteers.

In this test, 30 black and white drawings form the stimuli, graded in difficulty. Responses are untimed and three types of cue can be given as the tester feels necessary: a) Pointing to draw attention to salient features, b) Perceptual re-orientation (if misperception is suspected), in which the subject is told that the picture is 'something different altogether' and is given another opportunity to name and c) Semantic re-orientation (if the response is insufficient or imprecise), in which the subject is asked to provide another name or asked what else the picture could be.

One alteration was made to GNT. For item 15 'monocle', 'eye-glass' was accepted as a correct response (although it was described as a misnaming in the GNT manual). This decision was based on the degree of synonymy that exists between the two words in the subjects' variety of Scottish Standard English.

4.2.3.4 Test Battery Administration

The order of test presentation was randomised among the subjects to reduce the possible effects of fatigue. The tests were scored during their administration and were tape-recorded on a Tandberg System 500 with free-standing microphone to allow scoring and error analysis to be checked and elaborated later if necessary.

4.3 Results

The following sections describe the test scores achieved by the two groups (demented and normal elderly) and show how the scores relate to each other and to the factors of age, sex and cueing responsiveness.

4.3.1 Demented Group

Neither age nor sex was significantly associated with any of the following test results. Table 4.1 shows mean scores and score ranges for the three tests. The remaining 11 subjects scored below the cut-off on MTS suggested by the test's author. Only two attempted all the BNT stimuli as testing was discontinued after six consecutive failures for the others. Thus, 471 from a possible 660 stimuli were attempted. None of the demented subjects had more than 50% success on GNT.

Table 4.1 **Preliminary Study Demented Group - Means and Score Ranges for MTS, BNT and GNT**

Test	Mean Score	Range
MTS	2.7	2- 5
BNT	20.4	12-35
GNT	5.2	0-15

4.3.1.1 Naming Tests Comparison

Scores on BNT and GNT were calculated as percentages (means of 33.9% and 17.3% respectively) and compared using a one-tailed t-test - $t = 7.99$, (d.f. = 10), $p < 0.0005$. For the demented subjects, lower scores were achieved on GNT. Scores on BNT were significantly correlated with GNT scores - $r = 0.93$, d.f. = 9, $p < 0.0005$.

4.3.1.2 Relation Between Performance on MTS and Naming Tests

Non-significant correlations were found between scores on these tests: for the relationship between MTS and BNT, r = 0.18, d.f. = 9 and between MTS and GNT r = 0.37, d.f. = 9.

4.3.2 Normal Elderly Group

Again, neither age nor sex was significantly associated with any of the following test results. Table 4.2 below shows mean scores and score ranges for the three tests. None of this group failed to achieve the normal cut-off score of 7 on MTS. All the normal subjects were able to complete BNT by attempting to name all the pictures.

Table 4.2 **Preliminary Study Normal Group - Means and Score Ranges for MTS, BNT and GNT**

Test	Mean Score	Score Range
MTS	9.4	8-10
BNT	43	29-57
GNT	15.2	9-24

4.3.2.1 Naming Tests Comparison

Mean percentages achieved were 71.4 (BNT) and 50.7 (GNT). As for the demented group, the difference in means was significant: $t = 8.31$, (d.f. = 10), $p < 0.0005$ using a one-tailed t-test. Scores on the two tests were positively correlated - $r = 0.81$, d.f. = 9, $p = 0.001$.

4.3.3 Group Comparisons

4.3.3.1 MTS

This test adequately differentiated the two groups. Mutually exclusive score ranges were gained and mean scores were significantly different - $t = 16.23$, (d.f. = 20), $p < 0.001$.

4.3.3.2 BNT

The normal group scored significantly more than the demented group: $t = 6.2$, (d.f. = 20), $p < 0.001$, using a one-tail t-test. Scores at the low and high ends of the range were scored by the demented elderly and normal elderly respectively. However, individual scores in the middle of the range showed some overlap of groups.

4.3.3.3 GNT

Again the normal elderly subjects scored more than the demented subjects: $t = 5.04$, (d.f. = 20), $p < 0.001$. A similar but extended pattern of scoring overlap is evident for GNT.

4.3.3.4 Naming Test Comparisons

Group scores in intervals of five were plotted (see Table 4.3 below) to examine the pattern of error occurrence on the two naming tests. In both tests pictures are presented in a graded fashion, so that the most familiar pictures are presented earliest. Generally, numbers of correct responses fell from one interval to the next. Exceptions to this generalisation are marked (*).

Table 4.3 **Preliminary Study, Scores for Demented and Normal Groups on BNT and GNT**

	BNT		GNT	
Items	Demented	Normal	Demented	Normal
1-5	46	54	21	44
6-10	54*	55*	13	44*
11-15	27	49	10	36
16-20	22	42	10	28
21-25	16	38	2	10
26-30	20*	39*	2	5
31-35	15	40		
36-40	11	44		
41-45	5	36		
46-50	5	30		
51-55	1	28		
56-60	2	18		

The correlation between frequencies of correct responses in each interval achieved by the two groups was $r = 0.9$, d.f. = 4, $p < 0.05$ for GNT. For BNT, it was $r = 0.91$, d.f. = 10, $p < 0.01$. These figures indicate that a similar familiarity effect was evident for both groups.

4.3.4 Phonemic Cueing

A total of 247 phonemic cues were given to the demented group, of which 65 (25.4%) resulted in correct naming. The 187 phonemic cues given to the normal group resulted in 98 correct names (54% success). A one-tailed t-test comparing mean percentages of naming responses correct following phonemic cue gave $t = -4.04$, (d.f. = 20), $p < 0.0005$, indicating that the normal elderly subjects used phonemic cueing significantly more effectively than the demented subjects.

The relationship between phonemic cueing effectiveness and age, MTS, BNT and GNT scores was investigated in both groups. For the demented subjects, significant correlation was found only between phonemic cueing effectiveness and naming scores: $r = 0.87$, d.f. = 9, $p < 0.01$ for BNT and $r = 0.76$, d.f. = 9, $p < 0.01$ for GNT. This finding indicates that those demented subjects who scored well were able to benefit from being given word-onset cues. For the normal group, only one significant negative correlation was found: between phonemic cueing effectiveness and BNT score ($r = -0.88$, d.f. = 9, $p < 0.01$). Here lower scores were associated with more naming success following phonemic cueing.

4.4 Error Type Analysis

Analysis of subjects' errors suggested six categories, based on specific naming responses and accompanying verbal and non-verbal behaviour. The six categories are described below.

4.4.1 Perseveration

Perseveration is the inappropriate recurrence of a name given in response to an earlier stimulus, e.g. in BNT:

Item 22 - Snail
Item 24 - Seahorse --> response - Snail

4.4.2 Semantic Error

This is the name given to the wrong selection of a name from the correct semantic field, e.g. in BNT:

Item 2 - Tree --> Bush
Item 22 - Snail --> Lizard

Davis (1983), discussing symptoms of aphasia, defines such errors as 'semantic verbal paraphasia' or simply semantic paraphasia. These responses are real words related in meaning to the intended word.

4.4.3 Did Not Know

This error response was recorded if the subject either did not recognise the picture despite a semantic/stimulus cue or reported that he/she did not have the intended target in his/her vocabulary. Such errors were most easily recognised by accompanying verbal and non-verbal behaviour ('What the hell is this?', accompanied by a puzzled facial expression).

4.4.4 Visual Misperception

Visual misperception errors are responses outwith the semantic field of the target and related in appearance to the stimulus (as judged by the examiner). Such errors were recorded only if the examiner could see why the response had been given, e.g. in GNT:

Item 18 - Bellows --> Plates
Item 19 - Shuttlecock --> Leaves

4.4.5 Superordinate

This type of error gives the superordinate term of the semantic field in which the target is a member. For example, in BNT:

Item 29 - Beaver --> Animal
Item 32 - Acorn --> 'It's a kind of nut'

4.4.6 Tip-of-the-Tongue (ToT)

The subject indicates recognition of the stimulus but cannot retrieve its name. He/she can describe the target, gesture its use, give some relevant physical detail. Often the subject self-cues. Accompanying verbal and non-verbal behaviour include comments such as 'It's on the tip of my tongue'. Comments were often made with tutting and shakes of the head.

4.5 Distribution of Error Types

The following sections describe the distribution of error types produced by both groups in the two naming tests.

4.5.1 BNT

Table 4.4 below shows the distribution of error responses among the identified categories for the two groups on BNT.

Table 4.4 **Preliminary Study, Distribution of Errors on BNT, as Raw Numbers and Percentages of Total Error Responses**

Types of Error	Demented	Normal
Perseveration	3(1.6)	0(0)
Semantic Error	52(28.6)	23(25.8)
Did Not Know	60(33)	34(38.2)
Misperception	27(14.8)	7(7.9)
Superordinate	10(5.5)	0(0)
ToT	30(16.5)	25(28.1)
Total	182	89

Error responses represent 38.6% of total responses made by the demented group and 13.5% of normal group responses. While the degree of correlation between the types of errors produced by two groups was significant ($r = 0.92$, d.f. = 4, $p < 0.05$), chi-squared indicated that there was a significant difference in the proportions of error types made by the groups (chi-squared = 13.2, d.f. = 5, $p < 0.05$). Of note were the normal groups's lack of superordinate errors and the high proportion of ToT error compared to the demented group.

4.5.2 GNT

Table 4.5 below shows the distribution of error responses among the identified categories for two groups on GNT.

Table 4.5 **Preliminary Study, Distribution of Errors on GNT, as Raw Numbers and Percentages of Total Error Responses**

Types of Error	Demented	Normal
Perseveration	3(1.1)	4(2.5)
Semantic Error	89(32.6)	59(36.2)
Did Not Know	94(34.4)	55(33.7)
Misperception	54(19.8)	18(11)
Superordinate	12(4.4)	5(3.1)
ToT	21(7.7)	22(13.5)
Total	273	163

The demented group produced an error response rate of 82.7% (normal group 49.4%). Both groups scored errors of all types on GNT. The groups' error type distributions were found to be significantly correlated ($r = 0.91$, d.f. = 4, $p < 0.05$). Chi-squared was again significant - chi-squared = 10.2, d.f. = 5, $p < 0.025$ - with the normal elderly showing proportionately fewer misperceptions and more ToT responses than the demented group.

4.5.3 Comparing Error Distributions on BNT and GNT

Both groups showed similar patterns of error type distributions across naming tests despite the tests representing different degrees of difficulty: for the normal group, $r = 0.85$, d.f. $= 4$, $p < 0.05$, while for the demented group, $r = 0.94$, d.f. $= 4$, $p < 0.01$.

4.6 Discussion

The main part of this discussion centres on the hypotheses formulated in section 4.1.4. Comment is then made on the performance of the normal elderly subjects on the naming tests and on theoretical and practical implications for pilot test battery development.

4.6.1 Effectiveness of Phonemic Cueing in Dementia

Phonemic cueing was given during administration of BNT but not GNT. The authors of BNT suggest three positive outcomes from giving phonemic cues: (i) the subject is provided with a 'possibility of success' thereby relieving frustration in failure, (ii) response to cueing can differentiate aphasia types and (iii) whether the target is in the subject's potential vocabulary can be demonstrated. The present result has shown that demented elderly people can benefit from phonemic cueing, but less well than normal elderly subjects. Thus the first hypothesis is not supported.

Neils et al. (1988) studied the use of phonemic cueing in BNT in AD patients and examined the relationship between cueing responsiveness and severity of dementia, confrontation naming ability, auditory comprehension and speech fluency. Severity of dementia was the best predictor of cueing responsiveness. In the present data, naming ability but not level of dementia severity correlated significantly with phonemic cueing success. Reasons for different findings may include the larger sample size in Neils et al. (22 cf. 11), the more fine-grained selection criteria they used, different severity rating procedure (Clinical Dementia Rating Scale cf. the cruder estimation given by MTS) and the difference in mean age (69.6 cf. 79.3).

4.6.2 The Origin of Picture Naming Errors

Picture naming errors may be related to failure at any of the stages of the naming process, from visual recognition to phonetic realisation (see section 3.4.1.1). It was hypothesised that the demented group would make more perceptual than semantic errors. In fact, perceptual errors accounted for only 14.8% and 19.8% of errors on BNT and GNT respectively. In addition to semantic paraphasic errors, other linguistic errors were made: superordinate terms and tip-of-the-tongue errors. Taken together, these three error types accounted for 50.6% and 44.7% of errors on the naming tests. Therefore, the present data have demonstrated that the picture naming deficit in dementia is not primarily perceptual in origin.

The implications of the six error categories established from the preliminary study data for the understanding of the deficits underlying naming errors are discussed below. The absence of phonemic errors in the present data is noted. This discussion is preceded by a brief outline of subjects' perceived reasons for naming failure.

4.6.2.1 Subjects' Comments

Several factors were identified by subjects as causing difficulty. These include the size of the stimulus and their lack of colour as well as their own inexperience with some of the objects presented.

All the stimuli presented were of the same size, but represented objects of very different proportions (in GNT, Item 9, 'Tassle', and Item 21, 'Pagoda', are represented as the same in height). Some of the subjects found this confusing.

Some subjects suggested that the use of appropriate colour might have helped their naming, e.g. BNT Item 49 'Asparagus'. Yet Towne & Banick (1989) considered the effect of stimulus colour on naming performance in aphasic adults and found no difference in performance on identical black and white and coloured versions of a naming test. Therefore there is some evidence, if not from the present subject groups, to suggest that colour would not have helped naming performance.

Finally, previous life experience was used by one normal elderly subject as a reason for her poor naming ability. She reported that she had never travelled outwith her home town, had never worked outside her home and had spent her life looking after her brother.

4.6.2.2 Perseveration

Perseveration is associated with brain damage. Here verbal perseveration is the focus of interest, but motor responses and other behaviours may also be subject to perseveration. Verbal perseveration can be defined as 'inappropriate involuntary repetition of a verbal response' (Bayles et al., 1985). Buckingham (1985) describes two types of perseveration: (i) 'clonic', where 'a performance, once initiated, is repeated indefinitely without interruption' and (ii) 'intentional', where 'an intentional perseverate is produced when some new unit of performance is intended'. It is the latter that pertains to the type of perseverative responses made by the subject groups currently under study.

The cause remains under debate. Early writers on this topic believed that verbal perseveration occurred as a catastrophic response to a task that was outwith the ability of the person or as a reaction to fatigue. It may be due to neurones remaining in an excited state and resisting change of state. Inertia or lack of inhibition have been suggested as causes as have selective inattention and memory problems. The important word in the Bayles et al's definition is 'involuntary'. Some perseverators are aware of the repetition of their output and attempt to inhibit it, others are not and therefore are unable to do so.

Freeman & Gathercole (1966) recognised three types of perseveration in groups of schizophrenics and demented people. These were compulsive repetition, impairment of switching and ideational perseveration. The demented group most frequently had 'impairment of switching' (although they displayed all three types): this occurs when a response from a stimulus continues when on a second stimulus.

Bayles et al. (1985) studied the verbal perseveration behaviour of normal elderly people and in four types of dementia in verbal descriptive discourse. All groups (including normal elderly) perseverated. As the dementia became more severe, the frequency of perseveration increased. They suggest that the cause of perseveration in dementia may be multi-factorial: lack of inhibition of new memory and poor recent memory, persistent neuronal excitation and paucity of ideas.

Helmick & Berg (1976) report a study in which they gave a battery of visuomotor and language tests to brain-injured and normal adults over a wide age-range. They found that both groups perseverated to some degree, that of the experimental group, those who had suffered a C.V.A. perseverated more than non-vascular brain-injured subjects, that perseveration occurred more in recent (less than 6 months) brain-injury, but they found no relationship between degree of perseveration and age or educational level achieved. They found increased perseveration in those subjects with speech/language difficulties compared to those subjects with no communication disorder. Several studies describe verbal perseveration in aphasia (Yamadori, 1981; Albert & Sandson, 1986; Vilkki, 1989 etc)

Both of the present subject groups produced perseverative errors. Of the two tests presented, the normal subjects made perseverative responses (2.4% of total errors) only on the more difficult test (which endorses the suggestion that perseveration is increased by task difficulty). The demented group made perseverative errors on both tests. This finding is assumed to reflect the increased degree of difficulty represented by the tests to the demented group. Verbal perseveration, therefore, occurs in normal ageing, aphasia and in dementia. It appears not to be a good differential indicator.

4.6.2.3 Semantic Errors

This category encompasses errors which would have been classified as misperception by Rochford (1971) who identified only four error categories. For his demented subjects, the most common error was 'to give the name of an object which looks similar to the stimulus object'. Here, two types of such naming error were identified - one where the error response belonged to the same semantic field (e.g. anteater --> pig) and the other where the response belonged to a different semantic field (e.g. shuttlecock --> leaves). These were classified respectively as semantic and visual misperception errors. The sub-division is valid if compared to analysis of aphasics' naming errors - if an aphasic responded with 'pig' to a picture of an anteater, this would be seen as a semantic paraphasic error. The same mechanism operates in both normal and demented senescence - suggesting that rather more of demented subjects' naming problems may be linguistic than Rochford would suggest.

Semantic errors suggest that some but not all of the semantic information about the target has been accessed. Thus the name given is semantically related to the target.

4.6.2.4 Did Not Know

This error category unfortunately demonstrates one of the main problems inherent in using naming tests to assess WFD. Over 33% of errors made by subjects were caused by (reported) failure to recognise the stimulus or apparent ignorance of its name. Subjects' comments were the primary source of information for this error category, which may have been misleading as subjects may have obscured WFD by reporting that they had 'never' known the word.

4.6.2.5 Misperception

Errors of misperception were not made exclusively by the demented group. Normal elderly subjects also misperceived pictures (they scored half as many such errors as the demented people). Visual misperception has been said to be the primary cause of naming errors in dementia (Rochford, 1971). Results here seem to indicate that perceptual errors are at least partly caused by the normal ageing process and so are not totally a function of the cognitive decline associated with dementia.

4.6.2.6 Superordinate

This type of error indicates that the subject has begun to recognise the stimulus and is able to identify its semantic field. In many cases, stating the superordinate acted as a self-cueing strategy for the subject.

4.6.2.7 Tip-of-the-Tongue

This type of error is just one manifestation of WFD. The data presented here suggest that the normal group experienced more ToTs than did the demented group. This does not mean that the normal elderly subjects had more WFD than the demented subjects, just that they produced more overt instances. Errors classified in other categories had their underlying cause in WFD. Semantic errors, for example, represent a conscious or subconscious substitution of a closely related word to the target. Superordinate responses suggest that the full semantic representation of the target has not been accessed. Perseveration can also be indicative of WFD.

4.6.2.8 Phonemic Errors

In her analysis of naming errors, Walker (1982) found that phonemic errors differentiated the demented from the normal elderly subjects. Such errors were absent in the latter's performance but gradually increased in incidence with the level of dementia. Phonemic errors ('slips of the tongue') were made by current subjects but always self-corrected and so were not counted as errors. Therefore, the occurrence of phonemic errors was not a distinguishing feature for the current populations of normal and demented elderly subjects. Phonemic errors are absent at the earlier stages of the dementing process.

4.6.3 The Relationship between Normal Ageing and Dementia

The data support the hypothesis that dementia is like normal ageing. Although the demented subjects scored significantly less on all three tests, the distribution of their error types on both naming tests showed a strong positive correlation to that of the normal elderly group. A similar familiarity effect was also found.

4.6.4 Summary

The data presented here suggest: (1) demented subjects are able to benefit from phonemic cueing, but less efficiently than normal older subjects, (2) both semantic and visual processing difficulties are involved in misnaming in dementia, with linguistic difficulties more prominent, and (3) little difference is evident in the types of error made by the normal and demented elderly subjects, although significant difference was found by test scores. The differences between the two groups on naming tests can therefore best be described as one of degree rather than of kind, for this small sample of subjects.

4.6.5 Normal Elderly Naming Test Performance

Scores achieved by the present normal older people can be compared with normative data accumulated by the test authors. The two sets of data are not directly comparable as the oldest age-group used by BNT authors in standardisation was 50-59 years. It is useful to note whereas for that group the mean score was 55.82, the mean score achieved by the present normal group was substantially lower (43). The same pattern is observed with GNT. Its standardisation data included only two subjects over 71 years (exact ages were not given). For their sample, the mean score was 22.54 (compared to 15.2 for the present elderly subjects).

The figures presented above suggest that ageing can depress naming test scores (although the present data did not show a significant correlation between the two variables). Several authors have used BNT with older subjects and produced a similar finding (Borod et al., 1980; Nicholas et al., 1985b; Van Gorp et al., 1986; Albert et al., 1988; Nicholas et al., 1989 and Farmer, 1990). None has performed a similar function for GNT.

The implication of the foregoing information and previously presented information (section 3.3) on the effect of normal ageing on certain communication skills is that in developing a differential test battery, test performance by normal older people should be used as a base-line from which to examine the behaviour of fluent aphasic and AD subjects.

4.6.6 Implications

This study set the scene for the development of a pilot test battery designed to distinguish fluent aphasia and the language disorder of AD by establishing some normative data for both normal and demented subjects and by piloting some of the data analysis methods used in later studies.

4.6.6.1 Implications for Battery Development

The level of difficulty encountered by both groups of subjects on GNT indicated that a useful naming test should include more familiar objects, so that naming difficulties rather than vocabulary limitations can be assessed and numbers of 'Did Not Know' responses are reduced. Similar degrees of familiarity among stimuli on other tests of single word processing were required for findings to be valid and comparable. The performance of the normal older subjects has shown that the correct base-line for the description of language breakdown in aphasia and the language disorder of AD is the performance of their normally aged peers.

4.6.6.2 Implications for the Nature of the Deficits

This study has shown that the picture naming difficulty found in dementia is similar in type to that displayed in normal older people. While this is a important finding, its generality and replicability have still to be tested. Therefore other single word processing tasks were included in the test battery described and used in the following chapters (including reading aloud and writing). Secondly, while the study provided useful information about picture naming errors and cueing responsiveness in demented subjects, no direct comparison has yet been made with fluent aphasic subjects. In sum, the findings from this study can only be described as preparatory.

4.7 The Next Stage

The next chapter describes the development and initial application of a battery of language and verbal memory tests. The battery was designed to account for the factors outlined above and thereby to provide suitable information (test score profiles, types of error, effectiveness of cueing and consistency of response) to allow the two disorders to be distinguished and to offer insight into their underlying deficits. Thus the two aims of the project (section 1.3) could be fulfilled.

Chapter 5
Pilot Study

5.1 Introduction

The preliminary study provided information concerning the linguistic relationship between dementia and normal ageing through a comparison of the picture naming (error) performance and cueing responsiveness of groups of normal and demented subjects. The data indicated that the picture naming ability of demented subjects was distinguished from that of normal subjects by scores but not by error types. This finding may be valuable, but in itself is not conclusive: it requires to be replicated with different subjects and across other tests. The similarity may be an artefact of the picture naming test, rather than a general characteristic. Fluent aphasic performance has not yet been compared to normal. If aphasic subjects also produce inferior scores and a pattern of error performance similar to normal, then the preliminary study finding is worthless in the task of distinguishing fluent aphasia and the language disorder of AD.

A large number of tasks was identified through literature review (see section 3.3) which offered a history of or potential for distinguishing fluent aphasia and the language disorder of AD. These tasks formed the basis of a pilot test battery, which was developed following the preliminary study to attempt to distinguish the patient groups.

This chapter reports the development of the materials for the pilot battery of tests and the outcome of its use with small groups of normal elderly, AD and fluent aphasic subjects. This battery was considered very much as a first pass. The possibility of a reduction in the number of tests was attractive, because of the length of the pilot battery. For the elderly patient populations being studied, many problems of assessment exist (Armstrong, 1993) including fatigue. Sullivan (1991), for example, asks how often the Boston Diagnostic Aphasia Examination (Goodglass & Kaplan, 1972) is completed by elderly patients. So, tests should be kept as succinct as possible to produce representative performances.

5.1.1 Aims of the Pilot Study

The pilot study was therefore undertaken with two main aims, which reflect the general clinical and theoretical aims of the thesis (see section 1.3):

(i) To assess the effectiveness of the pilot battery in distinguishing fluent aphasia and the language disorder of early AD and to modify the battery accordingly,

(ii) To begin to develop analyses of errors on the various tests, which can supplement test scores and profiles as discriminators between the subjects groups.

5.1.2 Hypotheses

Two hypotheses were established for the pilot study:

(i) If the disorders are similar in severity (see section 1.1), then they will not be distinguished simply by mean scores on language tests.

(ii) If the disorders are different in underlying nature (section 2.7), then different test score profiles will be found.

5.2 Method

5.2.1 Subjects

Four subject groups were included: a normal elderly control group, a group with mild-moderate probable AD and two groups of aphasic subjects, who represented mild and moderate-severe fluent aphasia, Wernicke's and anomic types respectively. Since the language of AD has been likened to both anomic and Wernicke's aphasia (section 2.6.1), both groups were included. People with severe dementia are very unlikely to be misdiagnosed, because of their obvious behaviour problems, so only subjects with mild to moderate probable AD were included.

Potential subjects were identified through professional contacts, psychogeriatric day hospital services and speech and language therapy services in four Scottish health boards. Table 5.1 outlines subject details.

Table 5.1 **Pilot Study Subject Details**

Group	Male	Female	Total	Mean Age
Normal	4	6	10	73.4
Demented	3	6	9	77.7
Wernicke's	5	2	7	74.6
Anomic	6	1	6	69.9

Table 5.1 above shows that there is a different sex ratio in the dysphasic groups from the other two groups. This does not reflect the true general population ratios, but is likely to reflect clinical issues such as the number of female fluent aphasics identified to speech and language therapy services and the number of males with early AD who are maintained without health service resources. However, no gender effect was found in the preliminary study and many published studies of people with dysphasia offer similar sex ratios (Murray et al., 1984; Huff et al., 1988).

5.2.1.1 Criteria for Subject Selection

Criteria for subject selection were developed after lengthy discussion with other research workers using similar subject groups, with consultant psychiatrists, with the Medical Research Council and after consultation of Brookeshire (1983) and the papers referred to in section 2.1. Although the study required the identification of clearly and accurately defined groups, the diagnosis of AD can only be confirmed through autopsy and is a diagnosis by exclusion of other dementias in life. Also, a balance had to be struck between ensuring that subjects were appropriately selected and, on a practical level, that sufficient numbers of subjects could be identified.

General criteria which subjects in all four groups had to meet are listed in Table 5.2 below.

Table 5.2 **Pilot Study General Criteria for Subject Selection**

Aged over 65 years

English spoken as the subject's first language

No significant hearing or visual impairment (corrected if necessary)

No history of alcoholism, psychiatric illness, epilepsy or head injury

No current use of psychotropic drugs

Medical criteria validated by G.P. or consultant

Living in the community, with regular social contact

The age restriction represents the current age for receipt of the old-age pension by men in U.K. The language criterion excludes contamination by problems of English being used as a second language. Other medical problems known to affect cognition were included as exclusion criteria, to maintain 'purity' of diagnosis. Certain drugs and drug interactions are known to influence the performance of older people (Gawel, 1981; Eisenberg, 1985; Felstein 1985). All subjects were drawn from community rather than from institutional setting to maintain uniformity and to exclude possible influences of institutionalisation on performance.

In addition group-specific criteria were developed and are listed in Tables 5.3 to 5.5 below.

Table 5.3 **Pilot Study Additional Criteria for Normal Elderly Group**

Mini-Mental State Examination (MMSE) score 20 or more

No acute episode of confusion within three months prior to testing

No history of cerebro-vascular disease

Folstein et al. (1975) found in their original MMSE data that no normal subject scored less than 20 from a possible maximum score of 30. It is known that older people can become acutely confused by a variety of common infections which would affect normal test performance. The exclusion of people with a history of cerebro-vascular disease was designed to ensure that normal subjects had no known communication deficit.

Table 5.4 **Pilot Study Additional Criteria for Dysphasic Subjects**

Medical history of one reported cerebro-vascular accident (CVA) producing fluent language disability
Diagnosed as Wernicke's-type or anomic type aphasic using either the Boston Diagnostic Aphasia Examination (BDAE) or Western Aphasia Battery (WAB) or informal measures by a speech and language therapist
Onset of language problems sudden
No acute episode of confusion within six months prior to testing
Orientation and episodic memory intact, as assessed by a behavioural checklist with the help of a relative or carer

People who had suffered more than one CVA were excluded on the grounds of possible multi-infarct dementia. Both BDAE and WAB were developed by proponents of the neoclassical system of aphasia classification. Not all clinicians use these tests nor are they suitable for all aphasic people, so in the absence of such formal assessment, the professional opinion of the aphasic person's speech and language therapist was accepted. Although the variable of onset does not always distinguish stroke and dementia, it is much more common for onset to be sudden in stroke and gradual in dementia. Subjects were required to be at least six months post onset to exclude the possibility of acute confusion following CVA affecting performance. As it was deemed inappropriate to use mental status questionnaires (which measure orientation and episodic memory via language expression) in aphasic subjects, their orientation was measured instead with the Behavioural Rating Scale from the Clifton Assessment Procedures for the Elderly (Pattie and Gilleard, 1979) (see Appendix II for a list of its stimuli).

Table 5.5 **Pilot Study Additional Criteria for AD Subjects**

MMSE score less than 20

History of progressive cognitive and memory impairment of six months duration

Hachinski Ischaemic Score less than or equal to 4

Absence of other neurological disease

The Medical Research Council's AD Workshop (Wilcock et al., 1989) established minimum data to be collected in research involving AD subjects, so that such studies could be compared. It further suggested that the data should be collected also from control subjects. Thus both normal and AD subjects were given the cognitive assessment developed at the workshop, which included MMSE (see Appendix II for a list of stimuli). The preliminary study predated the MRC's workshop and therefore employed the mental status test commonly employed then (Hodkinson, 1972). MMSE is said to have good concurrent validity with more comprehensive neuropsychological assessments (Giordani et al., 1990). Hachinski et al. (1975) developed an Ischaemic Score to distinguish multi-infarct dementia (caused by cerebro-vascular problems) from AD. A score of less than 4 is associated with absence of cerebro-vascular problems. However, several studies have indicated the inadequacy of this measure (Kenny et al., 1984; Larson et al., 1989; Grasel et al., 1990) and, in fact, accurate scoring using this measure proved difficult in practice.

5.2.2 Materials

The development of the pilot study battery tests is described in detail below. First the tests of single word processing selected on the basis of potential score and error type discrimination among groups are described:

picture naming, oral reading, word fluency (Set Test), repetition and writing (see sections 3.3.1 to 3.3.5 for reviews). Then the modifications to the three tests found to be discriminative in the study by Bayles et al. (1989a) are discussed: story recall, verbal recognition memory and sentence disambiguation (see sections 3.3.6 to 3.3.8 for reviews). Hypotheses relating to subject group performance are given individually by test. A full list of test stimuli is given in Appendix II.

5.2.2.1 <u>Picture Naming</u>

50 pictures were selected and enlarged from the 260 member set standardised by Snodgrass & Vanderwart (1980). Norms were given for name agreement, image agreement, familiarity and visual complexity. Selection was based on several criteria -

(a) A high level of name agreement between subjects in their standardisation population (H less than or equal to 0.16, i.e. consensus among all or all but one of the subjects). This procedure reduced the set from 260 to 84,
(b) Exclusion of body part names. Rochford (1971) found that his demented subjects named body parts well,
(c) Exclusion of pictures correctly named by all the demented subjects in the preliminary study (bed, house),
(d) Exclusion of obviously culturally biased items, e.g. skunk, American football,
(e) Exclusion of some of the hyponyms from categories with very small numbers, e.g. in the 'Smoking' category, cigarette and pipe were retained, but ashtray and cigar were omitted, (b - e eliminated a further 14 pictures)
(f) Exclusion of very familiar pictures, which would be expected not to be discriminative (Bayles & Tomoeda, 1982). A group of twenty normal elderly Scottish people rated the pictures by familiarity. The 20 pictures with mean rating of 4.72 or more (from a possible maximum mean

of 5) were eliminated by this criterion to make the picture naming test stimuli total 50.

Word familiarity ratings were also obtained from twenty normal elderly people. They were asked to indicate for each of the 50 target words whether it was recognised, understood and said (often, sometimes or never). Scores from each of the three conditions were totalled to obtain each rating.

Pictures were presented individually and subjects asked to provide a one-word name for each. Most familiar pictures were presented first. If the subject failed to name a picture, the experimenter gave a 'semantic cue' usually the function of the object (see Appendix II for a list of cues). If the subject still failed to name correctly a 'phonemic cue' was given, which included the opening (C)(C)V of the target. This cueing procedure is analogous to the system employed in the Boston Naming Test (Kaplan et al., 1983). Testing was discontinued after failure to name five consecutive items, even with both cues.

While picture naming score was not anticipated to distinguish anomic and AD subjects, it was expected to distinguish AD from Wernicke's subjects on the grounds that the phonological difficulties which characterise Wernicke's aphasia (see section 2.2.4) would depress scores.

Cueing responsiveness was anticipated to distinguish the patient groups: phonemic cueing is known to help anomic aphasics but not to help Wernicke's aphasics (see section 3.4.1.3). On the basis of the preliminary study, the demented subjects were expected to benefit less from phonemic cueing than anomic subjects.

5.2.2.2 Set Test (Isaacs & Akhtar, 1972)

Subjects were required to name ten examples from four categories: colours, animals, fruits and towns. To validate the test, it was administered to 64 healthy elderly people. The authors found a decreasing score with increasing age. The results they obtained correlated closely with lengthier tests of mental function, such as Raven's Progressive Coloured Matrices (Raven, 1965). Although the authors state that the Set Test is unsuitable as a test of mental function with deaf or aphasic people, it can be used to measure word fluency.

According to the authors, this test is introduced with the words 'Let's see how good your memory is'. The examiner is allowed to repeat the instructions. If the subject cannot think of ten items in one of the categories or begins to repeat himself, then the next 'set' is introduced.

On the basis of the findings of Hart et al. (1988) (see section 3.3.2), demented subjects were expected to produce fewer town names than items from the other categories, while aphasic subjects were expected to produce parallel performances throughout the categories. Demented subjects were expected to score better on word fluency than on picture naming, while aphasic subjects were expected to produce similar performances (see section 3.4.1.2).

5.2.2.3 Reading Aloud

The 35 stimuli to be read aloud were taken from lists devised by Coltheart (1981, unpublished) to screen for and analyse the disorders of acquired dyslexia and dysgraphia and included non-word letter strings as well as 30 real word stimuli. Each stimulus was presented individually on a card, with the instruction that it should be read aloud.

A familiarity rating was obtained for each of the real word stimuli. Twenty normal elderly people were asked to indicate for each word whether it was recognised, understood and read (often, sometimes or never). Scores for each of the three conditions were totalled to obtain the rating.

Wernicke's aphasic subjects were predicted to perform significantly worse than the other groups, because of their known phonological problems (see section 5.2.2.1). Again, if the degree of communication difficulty is similar in anomic aphasia and AD, then no or little difference in performance should be expected.

5.2.2.4 Repetition

25 words were selected from Snodgrass & Vanderwart's (1980) data, which were of equal familiarity to the last 25 items of the present naming test as rated by their subjects. Subjects were asked to repeat the single word stimuli read by the examiner. The predictions for the reading aloud test hold for repetition, as neither task requires subjects to produce words with meaning and both are relatively intact in anomic aphasia (see section 2.2.3) and AD (see section 2.3).

5.2.2.5 Writing

Subjects were required first to write down their name and address, the numbers from 1-10 and their date of birth, to afford success to subjects unable to write words to dictation. Fifteen stimuli from Coltheart's reading list (1981) were then to dictated (13 words and 2 non-word letter strings). The potential score for this test was 15, with credit being given only for success on the dictation task. Stimuli were dictated both in isolation and with the provision of a semantic and grammatical context, e.g. 'book' -- 'You read a book'.

A familiarity rating was obtained for each of the real word stimuli. Twenty normal elderly people were asked to indicate for each word whether it was recognised, understood and written (often, sometimes or never). Scores for each of the three conditions were totalled to obtain the rating.

Wernicke's aphasics were expected to score very poorly on this test, as their written output is said to parallel their spoken output (see section 2.2.4). Again, anomic and demented subjects should score in similar ranges, as they are said to have similar degrees of communication problem.

5.2.2.6 Summary

The five single-word processing tests (picture naming, Set Test, reading aloud, repetition and writing) employed in the pilot test battery have been described above. Predictions formulated on the basis of literature review have been discussed. The next three sections consider the three tasks employed in the pilot test battery because of their discriminative power in Bayles et al. (1989a).

5.2.2.7 Story Recall

In Bayles et al. (1989a), the story used for the immediate and delayed story retelling tests had much intrinsic ordering: 'While a lady was shopping, her wallet fell out of her purse. But she did not see it fall. When she got to the check-out counter, she had no way to pay for her groceries. So she put the groceries away and went home. Just as she opened the door to her house, the phone rang and a small child told her that she had found her wallet. The lady was very relieved'.

In view of this difficulty, a new story was composed for the pilot battery, similar in length and complexity but with little intrinsic ordering: 'Mr. Smith went for a walk in the park one day. He saw boys sailing boats on the pond. His dog started barking at the swan that hissed back. He pulled the dog away and passed a family having a picnic under a tree. Next he came to the playground where children were playing on a roundabout and chute. As he made for the exit he gave some boys a row for running through leaves that had been raked into a neat heap'.

Subjects in the pilot study were asked to verbally recall the story immediately and after a short delay, as in Bayles et al. (1989a). Knopman & Ryberg (1989) report evidence from previous research which indicated that rate of forgetting in early AD may be very quick. From their own findings they suggest that there was little additional memory loss beyond ten minutes for subjects with AD. Therefore a lengthy delay was not required to demonstrate memory loss in people with AD.

In Bayles & Kaszniak (1987), the authors gave an alternative way for expressively impaired subjects to respond in story recall, that is by sequencing a set of nine cards that illustrated the story. Unfortunately, the subject need not have actually heard the story above to be able to sequence the pictures, but could have used general experience to do the task effectively. Pilot study subjects were similarly asked to select and sequence from a set of 12 pictures, those which told the story (five).

The following predictions were formulated: while normal older subjects will score imperfectly on immediate recall, they will score higher than the patient groups. All groups will recall less in the delayed condition, and the demented group will recall very little. Dysphasic subjects will demonstrate intact memory via the picture condition, if prevented from doing so in the verbal condition by verbal expressive difficulties. Accordingly, this test should allow a three-way distinction among the normals (best scores in both conditions of immediate and delayed recall), dysphasics (better picture choice than AD subjects) and AD subjects (very poor story recall immediately and after a short delay, picture condition no better than verbal condition).

5.2.2.8 Verbal Recognition Memory

In Bayles et al.'s (1989a) study, this task was a modified version of the delayed spatial recognition memory task. Subjects were asked to identify newly placed words on a matrix board. Previously placed words were rearranged each time another word was placed on the board. The maximum number of words involved was 14.

While this task is supposed to test memory, attentional difficulties might lower demented subjects' scores, as the examiner needed time after each response to select the next word and rearrange the other words. Instead, a task with similar aim was developed in which subjects were presented with a list of 20 words, including 6 which were reading aloud test stimuli and were asked to indicate which of the words had appeared in the immediately preceding reading aloud test. (It was intended to have 5 targets, but one target - hand - was mistakenly chosen as a distractor). The remaining 14 words consisted of semantic distractors: close hyponyms ('boat' for target 'ship'), phonetic distractors, i.e. words phonetically similar to a target ('chip' for the target 'ship') and unrelated distractors which bore no semantic or phonetic relationship to targets. Subjects were not fore-warned of this test before beginning the reading test.

It was hypothesized that while the dysphasic subjects might have difficulty reading aloud, they would score better on this test than the demented subjects since AD is known to affect short term memory (see section 3.3.6). A reflection of the underlying memory deficit would be the selection by demented subjects of more unrelated distractors than by aphasic subjects.

5.2.2.9 Sentence Disambiguation

Two forms of this task were administered in Bayles et al. (1989a) (verbal and picture). The forms are analogous to those used in the story retelling test. Three types of ambiguity were used: lexical ambiguity, structural and logical ambiguity. Subjects were asked to give two different interpretations for each of the five stimuli in the verbal version and to select from sets of four representations both of the meanings of the sentences in the picture condition.

Scores achieved by all their subject groups indicate that the picture condition of the test was easier. Of the two, the verbal version showed better group discrimination. This finding poses the question of whether the subjects who scored most were the ones with superior expressive skills and/or with superior disambiguation skills.

The possibility of offering pictures as a means of demonstrating sentence disambiguation ability was investigated but not pursued: this form was less discriminative in Bayles et al. (1989a) and it would have proved very difficult to produce adequate visual representations of the different interpretations, especially where more than two interpretations are possible.

A first attempt to replicate Bayles et al.'s findings was to present subjects with five sentences visually and verbally for disambiguation. They were asked to describe two different interpretations for each. The two papers used to develop the test materials (MacKay, 1966; MacKay & Bever, 1967) were those on which Bayles et al. (1989a) based their test.

For the five disambiguation stimuli, there were three sources of ambiguity (as defined by MacKay & Bever, 1967). Two were 'unsystematic lexical', i.e. where the ambiguity centred on one lexical item and the two meanings were unrelated ('We are confident that you can make it' and 'He wears a light suit in the summer'). One was of the 'derived constituent structure' type, i.e. a phrase-level surface structure ambiguity ('The stout mayor's wife stayed at home'). The remaining two stimuli employed were of the 'underlying constituent structure' type, i.e. ambiguous at deep structure level, where the ambiguity lies in the logical relations between words and phrases ('Italians like opera as much as Germans' and 'Those who play chess as well as Bill came'). The order of presentation was randomised among types.

On the basis of Bayles et al.'s (1989a) findings, fluent aphasics would be expected to score more than AD subjects. This prediction can be tempered however by the expectation that the Wernicke's group would score less than the anomic group because of their different levels of communicative deficit.

5.2.3 Procedure

Subjects were assessed individually and as privately as was practically possible. Sessions were audio-tape recorded so that more detailed analysis of responses could be made after the test session. The order of test presentation was altered as necessary for subjects who were unable to complete the battery at one test session (demented subjects only), so that delayed story recall could be administered at a constant delay from story presentation. Neuger et al. (1981) found order of test presentation not to be significant for verbal tests, while a much earlier study by Cassel et al. (1962) also found no order effect using intelligence testing. Testing was not time-limited as untimed testing is thought to give the most representative performance from subjects (Lezak, 1983).

5.2.4 Scoring

Principles of scoring were prepared before any subjects were assessed. Two normal elderly people were assessed in advance to allow the experimenter practice at test presentation, scoring and error analysis. For Set Test, oral reading and repetition, a correct response scored 1 and an incorrect response 0. In picture naming, only uncued correct responses scored 1. Pictures named correctly after semantic or semantic and phonemic cue were analysed separately, to establish the effectiveness of cueing among the groups. In the writing test, only dictated items were scored. Self-corrected responses were counted as correct. Procedures for scoring the MRC Cognitive Assessment and the modified Bayles et al. tests are described below.

5.2.4.1 MRC Cognitive Assessment

The Mini-Mental State Examination (MMSE) part of this assessment scores out of 30. It was scored according to the system laid down by the authors (Folstein et al., 1975) (see Appendix II for scoring). The rest of the assessment was unscored, but was used as an aid in the subjective judgment of how capable a potential subject would be of co-operation in the complete battery. It was always the first test to be administered.

5.2.4.2 Story Recall

A total possible score of 25 was established from the number of information-carrying units represented in the story. These units represent a variety of simple syntactic structures (noun phrase, verb phrase and preposition phrase) of varied expansions. Each is underlined in the text below:

Mr. Smith went for a walk in the park one day. He saw boys sailing boats on the pond. His dog started barking at the swan that hissed back. He pulled it away and passed a family having a picnic under a tree. Next he came to a playground where children were playing on a roundabout and chute. As he made for the exit he gave some boys a row for running through leaves that had been raked into a neat heap.

Scoring for picture selection and sequencing was designed to take account of correct and incorrect responses: 3 for presence of correct picture, 2 for correct order in relation to others, -3 for intrusion of an incorrect picture. As the picture condition was considered easier than the verbal condition, since it required no verbal expression, correct sequencing was credited. Both verbal and picture condition scores were recorded.

5.2.4.3 Verbal Recognition Memory

The maximum possible score was 6 (1 for each target), but -1 was scored for each incorrect selection. Patterns of error were analysed, according to the type of distractors selected.

5.2.4.4 Sentence Disambiguation

Subjects scored 2 for offering one of the possible explanations for each of the sentences to the extent that the experimenter was satisfied that an ambiguity has been understood and communicated effectively. The maximum score was 20. Should the subject have explained a sentence meaning following a prompt from the examiner, a score of 1 was awarded.

5.3 Results

Mean scores, standard deviations and score ranges for all tests and groups are given in Table 5.6 below. The means and score ranges are shown graphically in Appendix III. One-way analyses of variance (ANOVA) for groups are also shown for the tests which were attempted by all groups. Mini-Mental State Examination was attempted by the normal and demented subjects only, and a significant difference in mean score was found. All ANOVAs showed a significant result. The outcomes of post-hoc Scheffé tests, employed to establish which pairs of the group means differed significantly ($p < 0.05$), are reported below by individual tests as are other test results and analyses. Possible total scores are given in brackets after the test name.

Table 5.6 **Pilot Study Results**

Test	Mean(s.d.)	Range	One-way ANOVA
MMSE (30)			(d.f.= 3, 29)
Normal	28.8(1.3)	26-30	*
Demented	11.7(4.4)	6-19	
Story Recall:			
Immediate Verbal (25)			
Normal	10.7(4.8)	3-17	$F = 13.2$,
Demented	1.4(1.0)	0- 5	$p < 0.0001$
Wernicke's	1.1(1.3)	0- 2	
Anomic	4.4(5.0)	0-12	
Immediate Picture (25)			
Normal	15.7(6.1)	5-23	$F = 14.2$,
Demented	2 (2.7)	0- 7	$p < 0.0001$
Wernicke's	3.7(6.8)	-6-15	
Anomic	3.9(4.1)	-3-10	
Delayed Verbal (25)			
Normal	10.8(4.1)	4-16	$F = 14.2$,
Demented	0 (0)	0- 0	$p < 0.0001$
Wernicke's	0.4(0.8)	0- 2	
Anomic	3 (3)	0- 8	
Delayed Picture (25)			
Normal	15.4(6.7)	4-24	$F = 21.2$,
Demented	-1 (3)	-9- 0	$p < 0.0001$
Wernicke's	1.4(5.8)	-7-10	
Anomic	0.6(3.3)	-3- 7	

Table 5.6 **Pilot Study Results continued**

Test	Mean(s.d.)	Range	One-way ANOVA
Picture Naming (50)			
Normal	48.5(2)	45-50	F = 55.9,
Demented	28 (12.2)	3-46	p < 0.0001
Wernicke's	1.3(0.8)	0- 2	
Anomic	40.1(9.0)	29-47	
Set Test (40)			
Normal	40 (0)	40	F = 24.5,
Demented	18.8(12.4)	7-40	p < 0.0001
Wernicke's	5.4(6.7)	0-18	
Anomic	30.6(10.5)	14-40	
Oral Reading (35)			
Normal	34.9(0.3)	34-35	F = 203.9,
Demented	31.9(2.4)	28-35	p < 0.0001
Wernicke's	6.7(4.5)	2-12	
Anomic	33.1(1.8)	30-35	
Verbal Recognition Memory (6)			
Normal	2.8(1.5)	1- 6	F = 6.7,
Demented	-1.6(1.6)	-4- 0	p = 0.0016
Wernicke's	0.7(2.8)	-4- 4	
Anomic	1.3(2.[illegible])	-2- 5	
Repetition (25)			
Normal	24.6(0.7)	23-25	F = 203.2,
Demented	24.1(1.3)	21-25	p < 0.0001
Wernicke's	4.3(3.4)	0- 9	
Anomic	23.7(1.5)	21-25	
Writing (15)			
Normal	13.9(0.7)	12-15	F = 49.7,
Demented	7.4(3.4)	0-12	p < 0.0001
Wernicke's	0.6(2.6)	0- 3	
Anomic	10.9(2.8)	8-14	
Sentence Disambiguation (20)			
Normal	13.6(4.5)	7-20	F = 13.2,
Demented	6.8(2.8)	3-11	p < 0.0001
Wernicke's	3.3(2.6)	0- 6	
Anomic	8.3(3.1)	3-12	

* t = 11.17, d.f. = 17, p < 0.0001, one-tailed

5.3.1 MMSE and Behavioural Rating Scale (BRS)

MMSE adequately distinguished normal and demented subjects by mean score and by score range, as predicted by Folstein et al.'s (1975) data. The demented subjects' scores were further analysed by looking at the four subtests of MMSE. Table 5.7 below shows the distribution of performance by mean percentage score achieved (the subtests have different maximum potential scores). This group had particular difficulty with the attention/calculation subtest (Chi-squared = 35.76, d.f. = 3, $p < 0.001$). Also of note is that on registration/ recall all but 1 of the points were scored from the first part: all subjects were able to repeat the three words but there was very little recall of the words.

Table 5.7 **Pilot Study: MMSE Subtest Performance - Demented Group**

Subtest	Mean Percentage Score
Orientation	32%
Registration/Recall	52%
Language	54%
Attention/Calculation	9%

Analysis of those BRS returned (less than half) (see section 5.2.1.1) showed that despite communication problems, the behaviour of the aphasic subjects remained essentially normal (mean score was 25, from a maximum potential score of 32).

5.3.2 Story Recall

Inter-tester reliability was established at a high level for two scorers using a sample of nine transcripts (from both immediate and delayed conditions) from the four experimental groups ($r = 0.99$, d.f. = 7, $p < 0.001$). Normal subjects performed significantly better than the other three groups on all four conditions of story recall, as predicted. Scheffé tests showed that the patient groups did not differ among themselves.

A group of five normal subjects (four female and one male) aged 20-30 years attempted immediate story recall. They achieved a mean of 16.6 on the verbal condition, with a range of 13 - 19, which was significantly better than the normal elderly subjects ($t = 2.53$, d.f. = 13, $p < 0.005$, one-tailed). On the immediate picture recall condition, they scored a mean of 18.8, with a range of 7 - 25, which was not significantly different from the normal elderly group's mean score ($t = 0.87$, d.f. = 13, $p = 0.2$, one-tailed). Therefore, although the younger subjects were better at immediate verbal recall than the older subjects, the latter were able to demonstrate story recall via picture recall as well as the younger subjects.

While normal older and dysphasic subjects showed a decrease in verbal recall over time, of particular note is the performance of the demented group who showed absolute inability to recall the story after a delay, as predicted. Most reported that they had no memory of the story. Picture recall scores confirmed this: these subjects often began by describing the pictures. The dysphasic subjects did not show the predicted superior performance of picture recall over verbal recall in immediate story recall ($t = -0.65$, d.f. = 13, $p = 0.274$). Their verbal expressive abilities were adequate for demonstration of story recall.

5.3.3 Picture Naming

5.3.3.1 Naming Scores and Error Types

This test produced mutually exclusive score ranges for normal and Wernicke's subjects. Anomic and Wernicke's subjects also had no overlap of scores. Scheffé tests showed that all other groups scored significantly better than Wernicke's subjects (as predicted) and the normal group significantly better than the demented group. Thus, the picture naming tests makes a three-way distinction among normals, demented subjects and Wernicke's aphasics. Anomic and AD subjects were not distinguished by mean score, as was expected from their similar degrees of communicative deficit.

All of the normal subjects were able to name all the pictures. Any errors made were corrected following cue. Older subjects performed worse in this group ($r = -0.596$, $d.f. = 8$, $p = 0.035$). The demented subjects' range was large, because of D8's very poor performance - she scored 3 out of 50. The next lowest score to hers was 15. The Wernicke's group scored very poorly on this test, producing neologistic jargon and phonemic paraphasias and failing to understand the need for cues. For all Wernicke's subjects testing was stopped after five consecutive failures by the 10th picture.

The anomics scored well. Their difficulty was that of 'tip-of-the-tongue' experience, where they appeared to know the concept, could gesture information pertaining to it, could talk about it, but had difficulty producing the required word. They produced phonemic and semantic paraphasias and perseveratory responses. Phonemic errors were not made by either the normal or demented subjects tested in the preliminary study (see sections 4.5.1 and 4.5.2) or in the pilot study.

As the test was graded from most to least familiar using familiarity ratings as described in section 5.2.2.1, performance can be measured against an independent account of difficulty. This order of difficulty was reflected in performance: the number of errors increased as the test progressed. Table 5.8 below includes the numbers of errors made despite cues for pictures attempted by demented and anomic subjects. No normal elderly response fell into this category. Wernicke's aphasics' scores were excluded because so few pictures were attempted (their early failure indicating how poorly they responded to cues). Chi-squared was calculated from the patient groups' data and found not to be statistically significant: both demented and anomic subjects found less familiar pictures more difficult to name.

Table 5.8 **Pilot Study Picture Naming Errors Produced by AD and Anomic Subjects by 10-Picture Bandings**

	Group	
Picture	Demented	Anomic
1-10	14	0
11-20	15	2
21-30	22	3
31-40	21	4
41-50	25	7

5.3.3.2 Cueing Responsiveness

Table 5.9 below shows the semantic and phonemic cueing responsiveness of the normal, demented and anomic groups. The figures in brackets are percentages of total cues given. 15, 171 and 69 cues respectively were given. Again Wernicke's subjects have been excluded, as they did not find cueing helpful.

Table 5.9 **Pilot Study Correct and Error Responses to Semantic and Phonemic Cues in Picture Naming (as Raw Numbers and Percentages of Cued Responses)**

Group	Correct after Semantic Cue	Correct after Phonemic Cue	Error
Normal	8(53)	7(47)	0
Demented	34(19.9)	40(23.4)	97(56.7)
Anomic	25(36.2)	28(40.6)	16(23.2)

The normal group did not have any failures to name after cues. Their success was split equally between the types of cue. The demented group benefited much less from cueing, as predicted. Over half the cues offered were unsuccessful and level of naming success following phonemic cue was very similar to that demonstrated in the preliminary study (see section 4.3.4). The cueing responsiveness of the demented group was significantly different from that of the anomic group, again as expected (chi-squared = 22.48, d.f. 2, $p < 0.001$). The anomic group responded more positively to cueing overall, with marginally more naming success following phonemic cues than semantic cues.

5.3.4 Set Test

This test shows poor group discrimination by score range, only distinguishing clearly between normal and Wernicke's subjects. The Wernicke's group scored significantly lower than the normal and anomic subjects while the demented group were significantly worse than the normal group. Scores achieved by three of the demented subjects exceeded the Set Test's cut-off of 25 for people with dementia. Few unrelated responses or instances of perseveration were noted.

All the normal subjects scored a full 40, although they varied in their speed of response. The Wernicke's subjects had difficulty in understanding the task. Many had to have the test instructions repeated several times and some did not score because of lack of comprehension, despite these repetitions. Their responses were marked by neologistic jargon.

Table 5.10 below shows mean scores achieved by each of the groups in the four categories used. Within the groups mean scores by categories did not differ significantly. This finding contradicts that of Hart et al. (1988). Of note, however, is the superior recall of names of towns by normal and anomic groups.

Table 5.10 **Pilot Study Mean Scores by Category and Group (Set Test)**

Category	Normal	Group Demented	Wernicke's	Anomic
Colours	10	6.3	2	8.3
Animals	10	4.7	2.4	7.6
Fruit	10	3.8	1.4	6.3
Towns	10	4	0.6	8.4

Mean performance on Set Test and picture naming was compared for the three patient groups. T-tests showed that none of the groups produced significantly different mean percentage scores on the two tests (contrary to expectation for the demented group (Margolin et al, 1990)). This finding lends further weight to the argument (see section 4.6.2) that the picture naming deficit associated with dementia is not **primarily** perceptual. If picture naming errors were caused mostly by visual perceptual problems, a dissociation would have been anticipated between percentage scores on the two tasks since both require active vocabulary search, but only one requires visual processing.

Margolin et al. (1990) also measured the strength of association between scores produced on their picture naming and letter-category word fluency tests. While the present data are not directly comparable (the present word fluency test was based on semantic categories), degrees of correlation were calculated for all four subjects groups. A significant correlation was found only for the anomic group ($r = 0.83$, d.f. $= 5$, $p < 0.05$), which reflects Margolin et al.'s (1990) data. Therefore, the anomic group showed similar levels of impairment in 'naming' on tasks with different inputs.

5.3.5 Reading Aloud

As expected, the Wernicke's subjects scored significantly lower than the other groups. Anomic and demented subjects were not distinguished by Scheffé tests. The Wernicke's subjects scored outwith the range of any of the other groups. Again (as with picture naming), these subjects produced literal paraphasic errors, neologistic and perseverative responses in response to the stimuli. The other three groups had restricted score ranges at the high end of the scale. One normal subject made one error 'shup' --> 'shoop'. The demented and anomic subjects made most errors on the non-words. Both groups made real words from the non-words: on 16 and 6 occasions respectively.

5.3.6 Verbal Recognition Memory

The only significant group difference found by Scheffé test distinguished demented and normal groups. The dysphasic groups were not distinguished by mean score from the demented group, as had been predicted. Young subjects (see section 5.3.2 for young subject details) scored a mean of 4, with a range of 3 - 6, again better than the older subjects. Score ranges are interesting, in that none of the demented group produced a positive score, while dysphasic subjects produced positive and negative scores in similar ranges.

Chi-squared was calculated for the types of distractor chosen within each group, to establish whether the demented group had produced the expected significantly high number of unrelated distractors. Table 5.11 below shows the distributions of selected distractors. The only group with significant difference among distractor types was the Wernicke's group, where there was a preponderance of semantic errors. The other groups had a more even distribution. Chi-squared was also calculated for group, within each of the distractors. It was significant only for the unrelated category, which consisted of words which bore no phonetic or semantic similarity to any of the targets. The demented group scored almost double any of the other groups. Thus, the expected demonstration of memory deficit was made by the demented group. This outcome reinforces the idea (see section 2.7) that the language disorder of dementia is associated with other cognitive deficits, while aphasia affects language disproportionately to other cognitive abilities.

Table 5.11 **Pilot Study Distribution of Verbal Recognition Memory Error Responses by Type and Subject Group**

	Type of Error			
Group	Semantic	Phonetic	Unrelated	Total
Normal	7	2	3	12
Demented	11	5	12	28
Wernicke	15	4	7	26
Anomic	5	0	1	6

The groups produced different patterns of errors. The normal subjects did not make the smallest number of errors, but half of their total consisted of the same error (the inclusion of the semantic distractor 'boat'). The distribution of errors made by the demented group showed almost equal numbers of semantic and unrelated errors. It was observed (and some subjects reported) that they picked some of the listed words at random to satisfy the requirement of the tester. Others reported honestly that they did not remember any.

Although the Wernicke's subjects had very poor scores on reading aloud, they had superior scores to the demented group on this test. This implies that intact reading aloud ability is not required for verbal recognition memory. The anomics made the least number of errors of all four groups, with semantic errors being the type most frequently made.

5.3.7 Repetition

Scheffé tests demonstrated that the Wernicke's subjects performed significantly worse than all the other groups as expected (a common finding among the language tests) but there was no significant difference in performance between the anomic and demented subjects (also a common finding among the language tests). The Wernicke's subjects showed a more severe language problem overall in comparison with the other groups, while the anomic and demented groups consistently produced similar mean performances.

Any errors made by the normal group were attributable to hearing difficulty, e.g. 'thimble' --> 'cymbal'. The same kind of errors were made by the demented group, who had more errors than the normal subjects, but without any other evident error pattern. The Wernicke's subjects found this task difficult to understand - some subjects even tried to explain the words. They also required many repetitions of the stimuli, suggesting they had difficulty in processing them. Attempts resulted in literal paraphasic responses, neologistic jargon and perseveration. The anomics' errors could be mostly explained by hearing loss, with one exception. He had difficulty in selecting and sequencing phonemes.

5.3.8 Writing

Scheffé tests showed that the Wernicke's group scored significantly worse than the other groups and the normals better than the demented group. Again hearing loss was apparent and influenced scores, especially for 'shace/shase'. This item, with 'fallacy', gave rise to most of the normal group's errors (the latter perhaps because of its low frequency compared to most of the other words). The demented subjects made errors on all of the words, with poor attention appearing to contribute to their errors. Their error types included letter omission, letter addition, letter substitution and incomplete spelling. D3 was able to spell some of the stimuli orally (which was not required by the test), but was unable to convert phonemes to graphemes and scored 0 on writing words.

Five of the Wernicke's subjects were unable to produce any spontaneous written output, even being unable to write their own name or the numbers from 1-10. This failure proved to be an unpleasant experience for these subjects, who were aware of their difficulty. The anomics' errors were mostly only of one letter, e.g. 'discord' --> 'discort', 'blister' --> 'bluster'.

5.3.9 <u>Sentence Disambiguation</u>

Normal and Wernicke's subjects' scores showed no overlap in range of scores on this test. Scheffé tests showed the normals subjects' mean scores to be significantly better than Wernicke's and demented subjects. Wernicke's subjects scored very poorly while, contrary to Bayles et al.'s (1989) finding, anomic and demented subjects scored in very similar ranges. Both of these groups demonstrated good reading aloud of the sentences (a skill not required by the test). The demented group scored better than anticipated. Thus the finding which motivated the inclusion of this test has not been replicated.

This test's scoring was the most subjective in the battery. Significant inter-tester reliability was ascertained on an edited audio tape version of the performance of three subjects from each group. The independent listener who scored these gave ratings correlating with the experimenter's ($r = 0.91$, d.f. = 7, $p < 0.001$).

5.4 <u>Summary of Group Distinctions</u>

A summary of the group distinctions by test scores is given in Table 5.12 below, where N = normal group, D =

demented group, A = anomic group, W = Wernicke's group, n.a. = not applicable and + indicates the presence of a mean score difference.

Table 5.12 **Pilot Study Summary of Group Distinctions by Mean Test Scores**

Test	Group Distinctions N/D	N/A	N/W	D/A	D/W	A/W
MMSE	+	n.a.	n.a.	n.a.	n.a.	n.a
Story Recall:						
Immediate Verbal	+	+	+			
Immediate Picture	+	+	+			
Delayed Verbal	+	+	+			
Delayed Picture	+	+	+			
Picture Naming	+		+		+	+
Set Test	+		+			+
Reading Aloud			+		+	+
Verbal Recognition Memory	+					
Repetition			+		+	+
Writing	+		+		+	+
Sentence Disambiguation	+		+			

5.4.1 Differentiation of Normal from Demented Elderly

MMSE differentiated the two groups on score range, as did delayed story recall (verbal and picture), verbal recognition memory and naming. Reading and repetition were the only tests which did not produce significantly different means for these two groups.

5.4.2 Differentiation of Demented from Wernicke's Subjects

Verbal recognition memory was the single memory test which proved discriminatory on score range. Naming, reading, repetition and writing produced significant mean differences, showing the difference between these groups can be made on a linguistic basis.

5.4.3 Differentiation of Anomic from Demented Subjects

This proved the least discriminated pairing. There was much overlap in score ranges and no significant difference found in mean scores.

5.4.4 Analysis of Mean Scores

The first hypothesis for the pilot study (see section 5.1.2), which predicted that mean scores on the language tests would not distinguish the patient groups, can be accepted for anomic and AD groups but is rejected for Wernicke's aphasia and AD groups. Thus, for these groups, Wernicke's aphasic subjects presented the most severe language deficit. The second hypothesis, that different test score profiles would be found among the groups, is discussed in sections 5.5 and 5.6 below.

Two different methods were employed to test the second hypothesis. First, pair-wise test performance analysis was undertaken, with some success. Second, discriminant analysis was carried out which indicated which of the tests were most powerful in discriminating the groups and how the battery should be modified.

5.5 Pair-wise Analysis

Performance on single tests was not an adequate discriminant for anomic and demented groups. Could a combination of scores on pairs of tests produce group-distinct patterns? Each test score for each subject was paired separately with each other test score graphically (a total of 55 scattergrams). Scores on two pairs of tests, when plotted against each other, produced the most distinct patterns of performance for all four groups. These were delayed story recall (verbal condition) v. reading aloud and verbal recognition memory v. reading aloud. These graphs are shown in Figures 1 and 2 overleaf. Interestingly, each of these successful graphs included one memory and one language measure, which shows that the distinction between the patient groups implicates both systems.

Many of the paired test graphs produced distinct patterns for subsets of the four groups. A three way distinction (excluding anomic subjects) was achieved by 18 pairings, including repetition with delayed story recall (verbal and picture conditions), picture naming and verbal recognition memory. Of more importance, 4 of the graphs almost discriminated the anomic and demented groups: delayed story recall (verbal condition) with reading aloud, repetition and delayed story recall (picture condition). The fourth discriminating pair was verbal recognition memory and repetition.

5.6 Discriminant Analysis

The above pair-wise analysis can be viewed as a precursor to discriminant analysis. This type of analysis aims to maximise differences between groups to allow accurate classification of present data and of new cases. It weights and combines the smallest number of variables (in this case test scores) to make the groups as statistically distinct as possible. The discriminant function derived from the sums of the weightings of the variables can then be used to classify both the cases used in the discriminant analysis and new cases as well.

A discriminant analysis using Wilks' method was calculated via SPSS. All test scores were offered as possible variables. Wilks' method automatically uses the most discriminating variables. By this method, scores on four tests were found to be significant discriminators: reading aloud, delayed story recall (verbal condition), verbal recognition memory and delayed story recall (picture

Figure 1 Pilot Study Two-Test Graph: Plotting Score on Delayed Story Recall (Verbal Condition) Against Reading Aloud (All Groups)

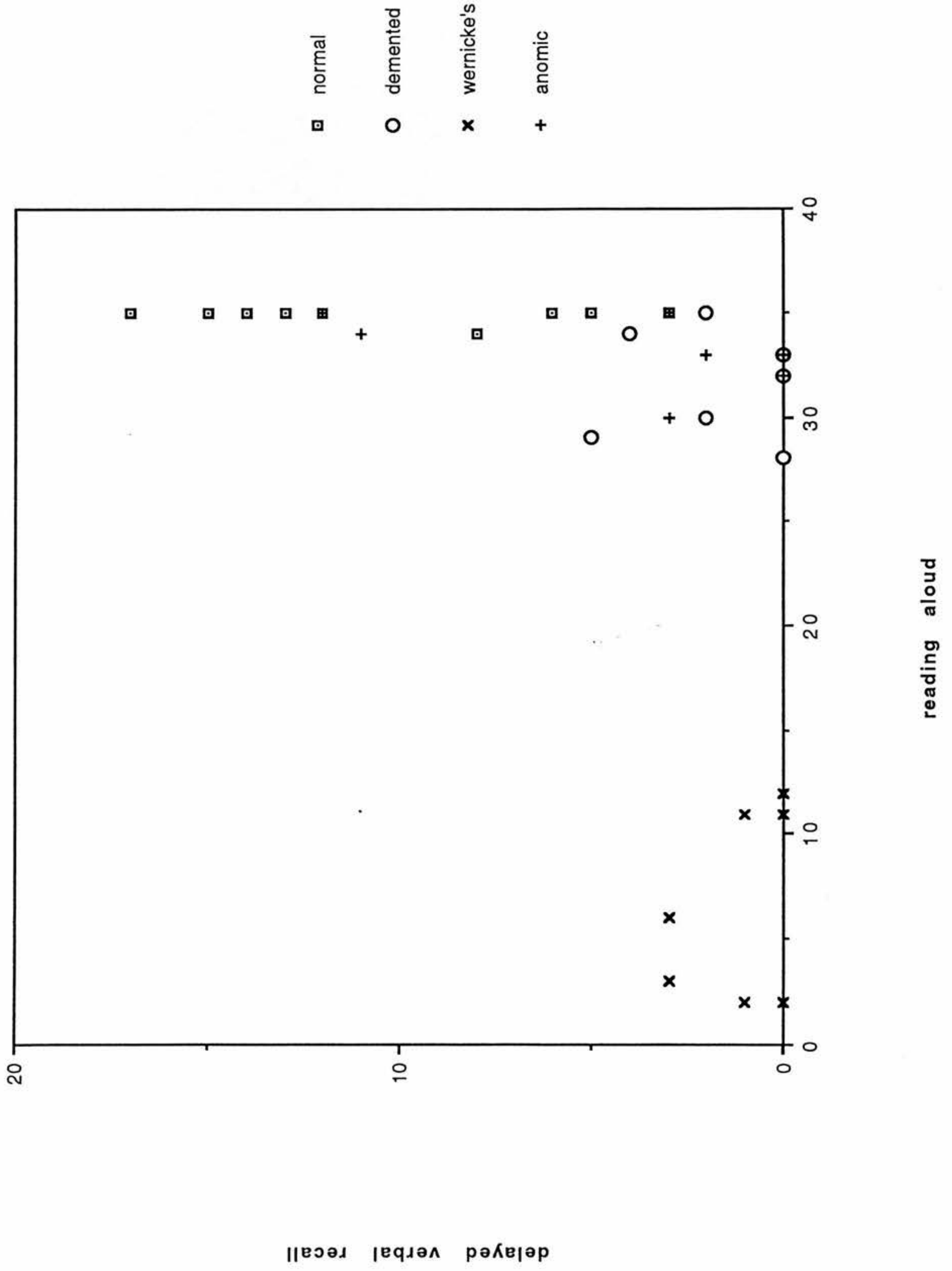
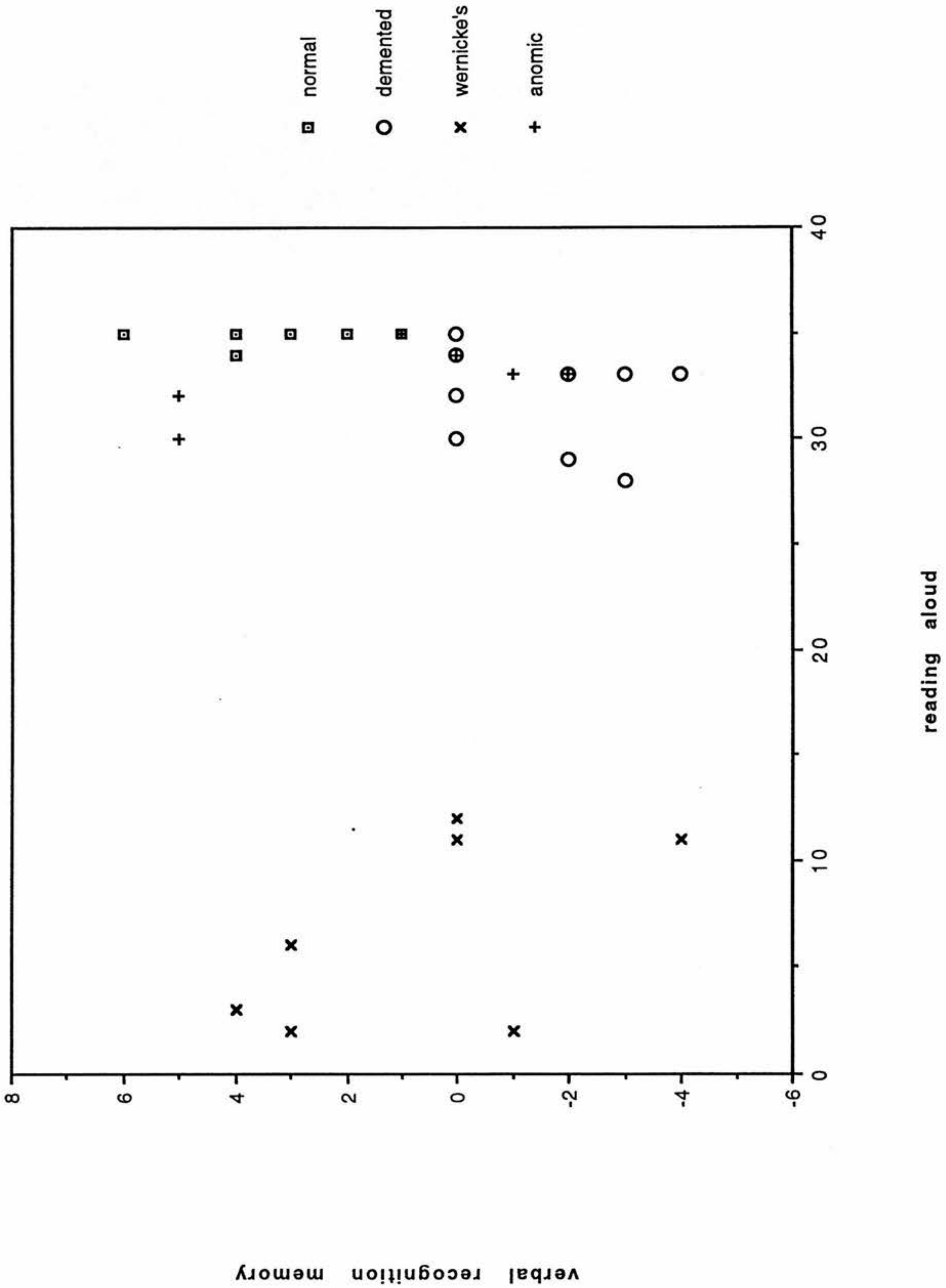


Figure 2 Pilot Study Two-Test Graph: Plotting Score on Verbal Recognition Memory Against Reading Aloud (All Groups)



condition) in that order. These variables reflect closely those found in pair-wise analysis to distinguish the groups (see section 5.5). The discriminant analysis result is shown in Table 5.13. This analysis correctly classified 87.88% of cases (where 25% success represents correct classification at chance level for four groups of subjects). In all four misclassified cases, the group assignment with second highest probability was the correct one.

Table 5.13 **Pilot Study Discriminant Analysis**

	Predicted Group			
Actual Group	Normal	Demented	Wernicke's	Anomic
Normal	9			1
Demented		8		1
Wernicke's			7	
Anomic		2		5

No Wernicke's subject was misclassified nor were any other subjects misclassified as Wernicke's. Three anomic and demented subjects were misclassified. Now the second hypothesis can be accepted: profiles of test scores did discriminate among the groups.

5.7 Implications for Battery Development

The pilot study battery was reduced in the light of current results (see chapter 6). Two of the four types of data outlined in section 4.1 were successfully employed: test score profiles and picture naming cueing effectiveness. Distributions of error types were described, but not statistically analysed, in this study. Analyses of errors supplement scoring profiles as discriminators in the validation study which follows. The fourth set of data (test-retest consistency) is reported in chapter 7.

5.8 Implications for Nature of the Deficits

The present data demonstrate that anomic aphasia and the language disorder associated with AD are indeed similar in severity of single word processing deficit. The two groups were not distinguished absolutely on the basis of discriminant analysis (the misclassification rate was 18.8%). Other aspects of performance require to be examined in detail to clarify the nature of the deficits: cueing responsiveness, error types and patterns and the influence of various stimulus variables, such as familiarity, length and word type, on task success (see section 3.4).

5.9 Summary

This study showed that the task of distinguishing normal older people and people with Wernicke's aphasia from people in the early stage of AD was relatively straightforward using the pilot test battery: raw individual mean test scores and score ranges, pairs of raw test scores and a quartet of weighted test scores distinguished these three groups. The problem of differentiating anomic aphasics from people with early AD remained. This was tackled in the following two studies (chapters 6 and 7).

Chapter 6

Validation Study

6.1 Introduction

The pilot study showed that a weighted profile of four scores from the battery of expressive language and verbal memory tests distinguished small groups of normal, fluent aphasic and demented elderly people, i.e. reading aloud, delayed story recall (verbal condition), verbal recognition memory and delayed story recall (picture condition). In addition, the pilot study replicated and extended preliminary study findings concerning cueing responsiveness in picture naming. Two further methods of data analysis (see section 4.1) are yet to be applied (error analyses and test-retest consistency) in the quest for an understanding of the deficits underlying the communication disorders associated with fluent aphasia and early AD. Error analyses are performed in this chapter, while test-retest consistency is examined in chapter 7.

To be useful as a clinical test, the subtests which survived the pilot study had to be shown to be reliable. They had to discriminate equally well on new and larger groups of subjects. Establishing the reliability of the modified battery was the first purpose of the validation study.

The second purpose was to return to the approach used in the preliminary study (chapter 4): the analysis of picture naming errors in normal and demented elderly subjects. It seemed likely that the additional information from error analysis would improve the objective classification of subjects (especially anomic aphasics) in discriminant analysis. Once more, error analysis should also provide a clearer picture of the pathological mechanisms underlying the abnormal performances of the patient groups. Alongside error type analysis, examination of the relationship between errors and specific characteristics of the stimuli (see section 4.1) should clarify the nature of the deficits. In particular, a close examination of subjects' errors could add further weight to the argument that dementia is like normal ageing, but qualitatively different from aphasia.

To facilitate error analyses, three single-word processing tasks were retained in the modified battery, including reading aloud, the only one which was a significant discriminator by test score (see section 5.6). Picture naming has already been found to provide useful differential information (chapters 4 and 5). The ability to write words to dictation offers theoretical interest (see section 3.4.3) through the extension of the single route to reading model to different input and output modes. Data from the writing test also offers an opportunity to strengthen arguments by replicating patterns of performance found in the other single word processing tasks.

6.1.1 Chapter Outline

After the hypotheses predicting the outcomes from this study are stated (section 6.1.2), the subjects are described and the modified battery is outlined (section 6.2). The results are discussed (section 6.3 onwards) according to the types of analyses described in section 4.1, i.e. test score profiles, error types and response to stimulus characteristics and cueing responsiveness. Outcomes from the three single word tests are employed severally and together to form a characterisation of the nature of the deficits which underpin the two disorders. An assessment of test-retest consistency, the fourth type of data, is made in the following chapter.

6.1.2 Hypotheses

The following two hypotheses were formulated on the basis of preliminary and pilot study findings and the above discussion:

(i) The patient groups will be fully discriminated through the use of both test score and error data in discriminant analysis. The pilot study demonstrated that a profile of test scores can contribute to the discrimination of anomic aphasia and the language disorder of AD. However, the similarity in level of single word processing ability militates against full discrimination by this method. The inclusion of error type data will allow full discrimination to be achieved. If the two disorders are different in nature, then analysis of the errors made by the patient groups will highlight the differences.

(ii) The pattern of single word processing deficits found in AD subjects will mirror those of the normal elderly subjects (i.e. general inefficiency), while the aphasic subjects will show a very specific and sustained pattern of errors (i.e. difficulty especially at the phonological level, with sensitivity to particular types of word).

6.2 Method

6.2.1 Subjects

Three subject groups were tested: normal elderly control subjects, people with probable AD and people with anomic aphasia. Each group was composed almost entirely of new subjects: 6 of the pilot study subjects were included among 65 validation study subjects (i.e 7% of validation subjects had attempted the pilot battery). At least eighteen months passed between pilot and validation study test sessions. The data gained through the retesting of several subjects were able to inform the issues of test-retest consistency and longitudinal change (see chapter 7).

Details of subjects' sex and age are given in Table 6.1 below. Again, as in the pilot study, the sex ratios are not uniform (see section 5.2.1). However, as in the preliminary study (see section 4.3.2), no gender effect on score was evident in the scores of normal subjects in the validation study: there was no sex-related subtest mean score difference. By inference to the patient groups, the different ratios of sexes among anomic and AD groups was felt not to contribute to any of the differences found in group performances. As in Bayles et al. (1989a), the aphasic subjects were younger than the AD group.

The selection criteria employed were those used in the pilot study (see section 5.2.1.1), except that the age criterion was reduced from 65 to 60 years and subjects with Wernicke's aphasia were not sought for two reasons justified by the pilot study results (i) this group produced significantly lower performances on most of the language tests compared to the other three groups (see 5.4), and (ii) this group was successfully classified by discriminant analysis (see section 5.6). The age criterion change was made to increase the number of potential subjects so that larger groups could be accessed. A target number of twenty subjects per group was sought.

All subjects lived in urban areas of the south of Scotland. A normal elderly group was included to provide appropriate normative data for test performance. It included patients from two G.P. practices, one in Fife and one in West Lothian. G.P.s were asked to provide a list of their patients who fulfilled the selection criteria. A letter of introduction was sent, asking for agreement to take part. Those who responded positively were tested in their own homes. In addition, normal elderly people in Fife and Edinburgh known to the tester personally or through previous experimental contact were recruited. Of the 25 normal older subjects, 3 lived in Edinburgh, 15 in Fife and 7 in Livingston, West Lothian.

The 20 demented group subjects attended psychogeriatric day hospitals in Edinburgh (4), Fife (8) and West Lothian (8). The 20 anomic aphasic subjects were initially identified through their speech and language therapists and lived in Fife (6), Lothian (8), Borders (1) and Greater Glasgow (5) health board areas.

Table 6.1 **Validation Study Subject Details**

Group	N	Male	Female	Mean Age
Normal	25	11	14	72.2
Demented	20	3	17	77.8
Anomic	20	12	8	69.6

6.2.2 Materials

Subjects were tested on a subset of the pilot test battery, with some minor improvements. The modified pilot test battery is briefly described below, with emphasis being given to modifications. Hypotheses are given which predicted group performances and differences.

6.2.2.1 Cognitive Assessment (including MMSE) and BRS

Both tests were given to all subjects at this stage (see section 5.3.1 for pilot study results). Golper et al. (1987) suggest that language clinicians might question the validity of using tests such as the MMSE with people who have aphasia as they appear to test language ability rather than 'cognitive status'. Their concern is extended to a prediction that mildly aphasic people (particularly if they are acutely ill and/or elderly) could be misdiagnosed as demented if evaluated only with tests like MMSE. These are precisely the reasons that MMSE was not given to the aphasic subjects at pilot stage.

Golper et al. (1987) appears, however, to be the only objective study offering this conclusion. Their normal subjects made very few errors, and these on the calculation sub-section. Their aphasic subjects made errors in all subsections, with particular difficulty also with calculation, and with overall performance dependent on degree of language impairment. Their scores placed them within the 'abnormal' category with the demented subjects. MMSE was included in the battery for all subjects at validation stage, so that the issue could receive further objective attention.

In addition, BRS was completed by a carer (relative, nurse or speech and language therapist) of each demented and anomic subject so that both MMSE and behavioural scales were available for both patient groups. Vigorous follow-up ensured 100% return of completed checklists.

From Golper et al.'s (1987) results and pilot study findings for the demented group, it was predicted that the normal group would be distinguished from the patient groups by mean score, although there might be some overlap in score range with the anomic group. A positive correlation was expected between MMSE and BRS score for the demented group but not for the anomic group, as the latter group's MMSE scores would be depressed because of communication difficulty.

6.2.2.2 <u>Picture Naming</u>

The pilot study procedure (see section 5.2.2.1) was employed but with improved semantic cues, the latter the result of comments by pilot study subjects about the unhelpfulness of some of the cues given. To devise the new cues, twenty speech and language therapy undergraduate students in first and third year of their degree studies provided written semantic cues for this test's stimuli in order to improve the quality of the cues which were used in the pilot study. Because this group of people will be potential users of the test battery when they work professionally with these patient groups, it seemed appropriate to use semantic cues selected by them. They were instructed to give the cue which came to mind immediately from the written name. The students did not have access to the pictures. Cues appropriate to other meanings of the stimuli were excluded. For example, 'chain' elicited 'worn round the neck' while the test picture was a chain that might be used for tying up a bicycle).

In many instances the students produced similar cues to those already used. Others which were discarded include phrases to complete ('arrow': 'bow and ___') which require the subject to close a learned phrase, cues not suitable for this age group ('rabbit': 'a bunny') and lengthy cues ('camel': 'animal that lives in the desert and has one or two humps'). 33 of the 50 semantic cues given in the pilot study were changed to reflect the consensus (see Appendix II). All new cues added detail. Cues give information either about function, location or attributes ('hammer': 'used for hitting nails', 'camel': 'lives in the desert', 'banana': 'it's long and yellow').

If this test is reliable, then the patient groups will once more be distinguished by cueing responsiveness and error types but not by mean score (see sections 5.3.3.1 and 5.3.3.2).

6.2.2.3 Reading Aloud

The pilot study procedure was repeated (see section 5.2.2.3). As with picture naming, error types were expected to distinguish the patient groups, while, in the light of pilot study findings (see section 5.3.5), mean score would not distinguish the groups. The pilot study findings also predicted that performance on non-word letter strings would not be discriminative, whereas the literature (see section 3.4.2.3) predicts that the patient groups would differ in their responses to different word types: the demented group would show no specific effect.

6.2.2.4 Verbal Recognition Memory

Again the same procedure was used (see section 5.2.2.8). A slight alteration was made so that the 20 word list contained five targets each with a semantic, phonetic and unrelated distractor. This had been the plan for the pilot study but was subverted by the erroneous choice of a target as a distractor.

Again, for a reliable performance, demented subjects were expected to perform very poorly on this task and to be distinguished from the anomic group by their distractor selection (see section 5.3.6).

6.2.2.5 Writing

This test was an extended version of that used in the pilot study (see section 5.2.2.5). Before being asked to write the 15 test stimuli, subjects were asked to copy shapes and words and to draw and write the same shapes and words. The new part of the test was included to afford all subjects some success in the test and to allow a comparison of copying and non-copied performances.

From pilot study findings, mean score was not expected to distinguish the patient groups. However, error analysis was expected to show group differences (as in reading aloud) as was the groups' spelling ability by word-type.

6.2.2.6 Delayed Story Recall

The pilot study procedure was repeated (see section 5.2.2.7). It was predicted that, as before, the demented group would not remember the story at all, while the aphasic group would show variable performance.

6.2.3 Procedure

Testing sessions were audio tape-recorded to allow later analysis. The tests were administered to all subjects by the writer and scored by her. Occasional re-ordering of test presentation was required so that the delay from story-telling to re-telling was held approximately constant.

The tape-recordings and scripts were also scored by two other people (a final year speech therapy honours undergraduate and a specialist speech and language therapist), who were blind to the subjects' medical diagnoses. The other scorers were trained in the scoring procedure through scoring the test performance of two normal elderly people on the modified battery. The scorers worked independently.

Once completed, scores were collated by all three. It is interesting to note that the few scoring discrepancies found were the result of clerical or arithmetic error. These were corrected at the time of the meeting between the scorers. Error types were established from discussion among the scorers, on the basis of preliminary and pilot study patterns. The independent scorers did not score MMSE because some of the responses required were visual. Inter-tester reliability is reported in section 6.3.1.9.

6.3 Results

Validation study results are discussed under three separate headings, which relate to types of data analyses (see section 4.1). First, raw scores and profiles of tests scores are considered (section 6.3.1), along with testing duration and inter-tester reliability. Second, error analyses are given attention in sections 6.3.2 to 6.3.7. These include error types and their distributions, the relationship between item characteristics and test performances, the analysis of reading aloud and writing data in the light of the analogy model (see section 3.4.2 and 3.4.3) and multiple regression. Then, the effectiveness of cueing in picture naming is discussed (section 6.3.8). These three types of data are drawn together in a discriminant analysis which successfully classified patient group subjects (section 6.3.9). Throughout this section (6.3), implications of results for the understanding of the nature of the deficits are discussed.

6.3.1 Test Scores and Their Profiles

The mean scores, standard deviations and score ranges for all tests for the three groups are given in Table 6.2 below. They are shown graphically in Appendix IV. One-way ANOVAs for groups were, as in the pilot study, significant for all tests. A wider range of performance within the anomic group than in the pilot study at this stage yielded some mean test scores which were significantly lower than those of the normal group, contrary to pilot study findings. Anomic and demented groups produced no significant differences on the language tests at either stage. The implications of significant outcomes of post-hoc Scheffé tests (at $p < 0.05$ unless stated otherwise) and of discriminant analysis are reported in this section.

Table 6.2 **Validation Study Results**

Test	Mean(s.d.)	Range	One-way ANOVA (d.f.= 2, 62)
MMSE			
Normal	27.6(1.5)	25-30	F = 73.6,
Demented	14.4(4.7)	8-22	p < 0.0001
Anomic	19.9(4.5)	13-27	
Picture Naming			
Normal	48.7 (2.0)	43-50	F = 17.6,
Demented	38 (8.8)	12-48	p < 0.0001
Anomic	34.4(12.3)	0-50	
Oral Reading			
Normal	34.6(1.0)	31-35	F = 8.8,
Demented	33.2(2.1)	28-35	p = 0.0004
Anomic	29 (7.8)	0-35	
Verbal Recognition Memory			
Normal	1.5(1.5)	-1- 5	F = 17.2,
Demented	-2.1(2.5)	-7- 1	p < 0.0001
Anomic	0.9(2.4)	-6- 4	
Writing			
Normal	13.7(1.1)	10-15	F = 14.9,
Demented	10.4(3.4)	2-15	p < 0.0001
Anomic	9.2(3.7)	1-14	
Story Recall: Delayed Verbal			
Normal	8.8(4.7)	1-18	F = 47.5,
Demented	0 (0)	0	p < 0.0001
Anomic	2.4(2.1)	0- 8	
Delayed Picture			
Normal	10.7(6.5)	-1-23	F = 24.7,
Demented	-0.1(0.3)	-1- 0	p < 0.0001
Anomic	4.8(5.7)	-4-15	

The results shown above are discussed by test below.

6.3.1.1 MMSE and BRS

Performance on MMSE again produced mutually exclusive ranges for normal and demented subjects. As expected, the anomic subjects' score range straddled those of the normal group. Scheffé tests showed significant differences between all pairs of group means at $p < 0.01$. Table 6.3 below shows the distribution of mean scores among the sub-tests of MMSE.

Table 6.3 **Validation Study: MMSE Subtest Performance for All Groups**

Subtest	Group: Normal	Group: Demented	Group: Anomic	F-Ratio*
Orientation	9.8	4.1	8	86.8
Language	8.1	5.9	5.7	18.6
Registration/ Recall	5.3	3.1	4	30.2
Attention/ Calculation	4.4	1.4	2.2	26.6

* One-way ANOVA for groups: d.f. = 2, 62, $p < 0.0001$

Scheffé test results below showed that normal elderly subjects scored significantly better on all four sub-tests ($p < 0.01$) than the other two groups. The anomic subjects scored significantly better on orientation ($p < 0.01$) and on registration/recall ($p < 0.05$) than the demented group. They were not distinguished on language and attention/calculation subtests. For different reasons, calculation was most difficult for both groups. While aphasic subjects were able to attempt the task and maintain their concentration, errors were made through difficulty with subtraction and expressing the numbers. AD subjects generally found it difficult to maintain the concentration required by the task.

Mean scores achieved on BRS were 18.6 and 26.9 for the demented and anomic groups respectively (a very similar mean was scored by the dysphasic subjects at pilot stage). The difference was significant ($t = -5.5$, d.f. = 38, $p < 0.001$, one-tailed). Neither group showed a significant relationship between MMSE and BRS scores ($r = 0.25$, d.f. =

18 for the demented group and $r = 0.17$, d.f. = 18 for the anomic group). While this had been predicted for the anomic group, it was not expected for the demented group. This finding is assumed to reflect the problems of using subjective measures. Carers are not detached observers and are often stressed. Their responses may or may not reflect the real situation for several reasons, including misperception of the problems, unwillingness to accept a medical diagnosis or to admit to certain symptoms, unrealistic view and so on.

Despite the adoption of a prudent attitude towards the use of MMSE in the assessment of 'cognitive state' in older people with aphasia (see section 6.2.2.1), it seems that this test has a place in the process of the differential diagnosis of people who present with mild communication disability of uncertain aetiology.

6.3.1.2 Picture Naming

Normal elderly subjects scored significantly better than the other two groups (Scheffé tests at $p < 0.05$). Other aspects of picture naming performance are considered in sections 6.3.3, 6.3.4, 6.3.5, 6.3.7 (with reading aloud and writing) and 6.3.8 (cueing responsiveness).

6.3.1.3 Reading Aloud

The anomic group had an 'outlier' in the subject who scored 0. Without her score their range was 22 - 35. Scheffé tests showed that normal subjects scored significantly more than the anomic group, but, as predicted, there was no significant mean score difference found for the patient groups. As in the pilot study, numbers of errors on the non-word letter string stimuli did not distinguish the patient groups.

6.3.1.4 Verbal Recognition Memory

Scheffé tests showed that the demented subjects scored significantly worse than the other two groups.

6.3.1.5 Writing

Again, the normal elderly group scored significantly better than the other two groups, but the patient groups were not distinguished by mean score.

6.3.1.6 Delayed Story Recall

The verbal condition produced mutually exclusive score ranges for normal and demented subjects. While the demented subjects as a group scored 0 on verbal recall, the anomic group ranged from 0-8, as predicted. Scheffé tests demonstrated that the normal subjects scored significantly better than the other two groups on both conditions (as in the pilot study). Thus pilot study findings have been replicated.

At pilot stage, younger subjects performed better on immediate verbal recall than older subjects (see section 5.3.2). At validation stage, a group of 16 adults, aged 25 - 55 years, produced a mean score of 15 on delayed verbal recall, which was significantly better than the validation study's normal elderly group's mean performance ($t = 4.04$, d.f. = 39, $p < 001$, one-tailed). (The young adults were told the story in a group and wrote down what they recalled after five minutes during a lecture whose subject was the test battery). Once again, the importance of using normal peers as a control group can be seen (see also section 4.6.5).

It is of interest that one of the younger subjects scored zero. She was the person with responsibility for the lecture organisation and for timing the delay. One of the normal elderly subjects also did not recall any information from the story. He reported that he had been still trying to remember the name of the prime minister from the MMSE. Thus, interference can severely affect verbal recall in any subject.

6.3.1.7 Summary of Group Distinctions

A summary of group distinctions by mean score is provided in Table 6.4 below, where nor = normal group, dem = demented group, ano = anomic group and + indicates the presence of a mean score difference.

Table 6.4 **Validation Study: Summary of Group Distinctions by Mean Test Scores**

Test	Group Distinction		
	Nor/Dem	Nor/Ano	Dem/Ano
MMSE:	+	+	+
Orientation	+	+	+
Registration/ Recall	+	+	+
Attention/ Calculation	+	+	
Story Recall:			
Delayed Verbal	+	+	
Delayed Picture	+	+	
Picture Naming	+	+	
Reading Aloud		+	
Verbal Recognition Memory	+		+
Writing	+	+	

The pattern of group distinctions found at validation stage can be contrasted with those found in the pilot study (see section 5.4), to assess the battery's reliability. MMSE scores cannot be directly compared because it was not attempted by aphasic subjects at the earlier stage, but consistent results were found for normal and demented groups. As before, story recall distinguished only the normal group from the others. Again, the intactness of the demented subject's reading aloud ability is shown (see section 2.3): at neither stage was the group's mean score significantly different from the normal group mean. On three 'memory' tests (orientation, registration/recall and verbal recognition memory) the demented subjects produced lower mean scores than the anomic group at validation stage. This highlights a disparity in ability: while their single word processing abilities are similar, verbal memory distinguishes the two groups. This pattern does not extend to the more difficult memory task of story recall, which requires a higher level of integration among language and memory abilities (see section 3.3.6) than the other verbal memory tasks.

Before the outcome of discriminant analysis (test scores only) is discussed (section 6.3.1.10), testing duration in the groups is compared and inter-tester reliability profiles are described.

6.3.1.8 Testing Duration

Table 6.5 shows the mean length of testing and duration ranges (in minutes) during the validation study.

Table 6.5 **Validation Study: Testing Duration in Minutes (All Groups)**

Group	Mean	Range
Normal	20.7	13-29
Demented	35.2	22-67
Anomic	40.3	22-82

Predictably, the normal group took significantly less time to complete the assessment than the other two groups, but there was no difference in mean duration of testing between the patient groups.

6.3.1.9 Inter-Rater Reliability

Inter-rater reliability was calculated from data from 82 subjects who completed the validation battery (this includes a small number of Wernicke's aphasics, persons with a questioned diagnosis and retest subjects as well as the 65 normal elderly, demented elderly and anomic aphasic subjects whose performances on the battery formed the validation study data). Three raters independently scored from audio-tape recordings (see section 6.2.3). Inter-rater reliability was calculated using Cronbach's alpha (McLaughlin & Marascuilo, 1990) which measures consistency of raters in terms of a co-efficient of correlation. Cronbach's alpha was calculated for each group separately and also for all 82 subjects together. The resulting co-efficients are presented in Table 6.6 below.

Table 6.6 **Validation Study: Inter-rater Reliability**

	Group			
Test	Normal (N=25)	Demented (N=20)	Anomic (N=20)	Combined (N=82)
Picture Naming	0.979	0.998	0.990	0.998
Reading Aloud	0.941	0.970	0.985	0.992
Verbal Recog. Memory	0.958	0.970	0.980	0.976
Writing	0.984	0.996	0.994	0.997
Story Recall: Verbal	0.990	**	0.916	0.993
Picture	0.996	0.919	0.979	0.993

[** unable to compute because of zero scoring]

Given that perfect inter-rater reliability would be represented by a Cronbach alpha value of 1, an alpha value of >0.95 is considered to show an adequate degree of inter-rater reliability (based on a significance level of 0.05) . None of the combined group values fell below this cut-off, although one rating from each group did.

6.3.1.10 Discriminant Analysis Using Test Scores Only

Two discriminant analyses using Wilks' method (step-wise selection) were carried out using test scores only as variables. The first used the tests involving memory: MMSE, verbal recognition memory, delayed verbal recall and delayed picture recall. The overall classification accuracy of this analysis was 77% (15 out of 65 subjects were misclassified).

In the second, all test scores for the patient groups were included as variables. This procedure successfully classified 95% of anomic and AD subjects. One subject in each group was erroneously classified (viz D7 and A14). Five of the test scores were included in this analysis (in order of inclusion): MMSE, naming, verbal recognition memory, writing and delayed story recall (verbal condition). Delayed story recall (picture condition) and reading aloud (significant in the pilot study discriminant analysis in section 5.6) were not included. The inclusion of MMSE scores in the analysis and wider ability ranges at validation stage can explain the different findings.

While this discriminant analysis was more successful than that of the pilot study at distinguishing the patient groups, two subjects were misclassified. Discriminant analysis findings were reinforced by some subjective judgments which are described below.

6.3.1.11 Subjective Judgments

Two sets of subjective judgments were made by (i) one of the independent scorers and (ii) five speech and language therapy honours students. The students listened to the recordings of D7 and A14 (misclassified by discriminant analysis), D13 and A5 (misclassified by the independent scorer) and D17 and A7 who were correctly classified by both. None of these judges had access to test hypotheses or to information relating to expected error types while making their classifications.

The independent scorer misclassified 6 of the 65 validation stage subjects: 4 normal and 1 from each of the patient groups (but not D7 or A14). All the misclassified normal subjects and the misclassified demented subject were thought to be dysphasic while the misclassified demented subject was thought to be anomic.

The students as a group misclassified D7 as dysphasic and A14 as demented (as did the discriminant analysis). D13 was correctly classified by the students, although A5 was alternatively classed as demented (1), not sure (2) and neither (2). D17 was categorised correctly by 4 (the fifth was 'not sure') and A7 was correctly classified by all.

These data show that misclassification still occurred when score data only was considered and when the potential of error types was not explored by judges. The following sections discuss in detail evidence from errors and picture naming cueing responsiveness. The resultant information is used to aid subject classification and to define the nature of the difficulties associated with fluent aphasia and the language disorder of AD.

6.3.2 Introduction to Error Analyses

This section of the interpretation of validation study results first considers the types and distributions of errors made in picture naming, reading aloud, writing and verbal recognition memory (section 6.3.3). The influence of word frequency and familiarity is then discussed (section 6.3.4). Thirdly, the influence of stimulus length (number of letters and /or syllables) is analysed (section 6.3.5). In section 6.3.6, reading aloud and writing error data are considered in the light of body neighbourhoods (see sections 3.4.2 and 3.4.3). To complete this section on error analyses, multiple regressions for picture naming, reading aloud and writing are reported, which describe the contributions of several variables to test scores (6.3.7). These data analyses show important group differences, which reflect the contrasting deficits underlying fluent aphasia and language in dementia.

6.3.3 Error Types and Distributions

The error types produced on the three single word processing tasks and on verbal recognition memory are presented here. Each test is presented separately but common findings are discussed to highlight consistent patient group differences, which can be explained by different pathological mechanisms.

6.3.3.1 Picture Naming

Table 6.7 presents the total number of picture naming errors by types which were defined in the preliminary and pilot studies (see sections 4.4 and 5.3.3.1). At validation stage, 'no response' and 'verbal paraphasia' categories were added. The latter is a real word which is not semantically related to the target (Ross, 1989). The total group number of errors is derived from different numbers of naming attempts and overall error rates differed among groups: 2.6% for normal elderly subjects, 23.9% for demented subjects and 27.5% for anomic subjects. Different total attempts are the result of (i) different group sizes and (ii) different numbers of unattempted stimuli (testing was discontinued following five consecutive errors).

Table 6.7 **Validation Study: Total Picture Naming Errors By Group and Type (as percentages of all errors in brackets)**

	Group		
Error Type	Normal	Demented	Anomic
Semantic paraphasia	18(54.5)	85(35.3)	64(24.5)
Superordinate		18(7.5)	7(2.9)
Circumlocution	2(6.1)	15(6.3)	31(11.9)
Perseveration		5(2.1)	8(3.1)
Tip-of-the-Tongue	3(9.1)	31(13)	64(24.5)
Phon. para./Jargon			65(24.9)
Verbal paraphasia		1(0.4)	7(2.7)
*Did Not Recognise	2(6.1)	38(15.9)	10(3.8)
*Visual Misperception	8(24.2)	36(15.1)	3(1.2)
No response		6(2.5)	2(0.7)
Other		4(1.7)	
Total Errors	33	239	261
Total Naming Attempts	1250	999	950

Of particular note from Table 6.7 is the occurrence of phonemic paraphasic errors/jargon responses by the anomic group exclusively and that group's relative lack of visual misperception errors in comparison to the demented group ($t = 3.47$, d.f. = 38, $p < 0.001$) (see sections 3.4.1.2 and 4.6.2). They also produced more tip-of-the-tongue errors than the demented group ($t = -2.03$, d.f. = 38, $p < 0.05$). Also of note is the 'did not recognise the picture' (DNR) category which also distinguished the groups ($t = 2.19$, d.f. = 38, $p = 0.034$).

The degree of correlation between the numbers of each error type was calculated pairwise by group. Only one significant relationship was found (between normal and demented groups): $r = 0.93$, d.f. = 9, $p < 0.01$. This correlation was significantly stronger than the two non-significant correlations, which did not differ significantly: $r = 0.44$, d.f. = 9, NS (normal and anomic groups) and $r = 0.42$, d.f. = 9, NS (demented and anomic groups).

The error types marked * in Table 6.7 above represent errors of visual origin, i.e. pictures which were misperceived or not recognised. The relative percentages of visually-based and linguistically-based errors were calculated: for the normal group, 30% of errors were visually-based and the remaining 70% were linguistically-based. Similarly, for the demented group, visually based errors constituted 31% of naming errors and linguistically-based errors (i.e. all the others apart from no response and other) 65%. For the anomic group, the figures were 4.98% and 94.25% respectively. These figures suggest a difference in the main source of naming errors for the patient groups but similarity between the normal and demented groups. While demented subjects show 'normal' levels of misperception, the anomics show that they have very particular difficulty in accessing the name of the pictures rather than in recognising the pictures.

Significant correlations were found between the number of errors made and the maximum number of error types produced for subjects in the patient groups, but not for normal subjects and no significant difference was found between the co-efficients: for the demented group, $r = 0.84$, d.f. = 9, $p < 0.01$ and for the anomic group, $r = 0.56$, d.f = 9, $p < 0.05$. The demented subjects showed a stronger tendency to make more types of errors as they made more errors, a finding which argues for the hypothesis (section 6.1.2) that dementia creates a general inefficiency in the language system.

Picture naming errors, therefore, have proved instructive in distinguishing the patient groups: demented subjects showed an error type distribution very like that of normal subjects, while anomic subjects produced a unique error type distribution. A difference in the main source of naming difficulty was observed. This finding has to be matched with similar conclusions from reading aloud and writing, before it can be accepted as a general one.

6.3.3.2 Reading Aloud

Reading aloud errors were analysed into seven categories established from observation of error responses in the validation study and are presented in Table 6.8 below. 'Non-word' errors were counted when a non-word letter string (NWS) was realised as a real word, 'visual' errors when a word was read as a semantically unrelated real word, 'phonemic' errors when any error in grapheme/phoneme conversion was heard, 'incorrect stress' when primary stress was given on an inappropriate syllable and 'semantic' when the target was realised by a semantically related word. 'No response' errors are self-explanatory. The data are presented in raw form in Table 6.8 and as percentages of total reading attempts by group, in brackets. Errors made on individual stimuli are shown in Appendix V.

The normal group made very few errors. Like the demented group, their errors were made mostly on non-word stimuli. However, 'non-word' errors did not distinguish the groups, as all had some instances of lexicalisation of non-word letter strings. While most common for the normal and demented groups, lexicalisation was the second most common error type for the anomic group. More than half of the anomic group's errors (52.94%) were either phonemic or suprasegmental, but only 8.57% of the demented group's errors were in these categories. The demented subjects made more no response and semantic errors than sound errors.

Table 6.8 **Validation Study: Reading Aloud Errors by Group and Type (as percentages of all errors in brackets)**

Error Type	Normal	Group Demented	Anomic
Non-word	6(0.7)	20(2.9)	17(2.6)
Visual	1(0.1)	2(0.3)	14(2.1)
Phonemic	1(0.1)	3(0.4)	39(5.9)
No response		6(0.9)	1(0.2)
Incorrect stress			6(0.9)
Perseveration			1(0.2)
Semantic	1(0.1)	4(0.6)	7(1.0)
Total Errors	9(1.0)	35(5.1)	85(12.9)
Total Attempts	875	700	665

As in picture naming, the only significant inter-group relationship of error type distribution was found between normal and demented groups: $r = 0.94$, d.f. = 5, $p < 0.01$. Again, significant differences between co-efficients were found between the significant result and the two non-significant correlations, but not between the non-significant correlations themselves: $r = 0.31$, d.f. = 5 (normal and anomic groups) and $r = 0.17$, d.f. = 5 (demented and anomic groups).

The relationship between number of errors made and the corresponding maximum number of error types was examined. There were insufficient data for a co-efficient to be found for the normal group. For the demented group, $r = 0.97$, d.f = 5, $p < 0.01$ and for the anomic group $r = 0.51$, d.f = 5, NS. Again, as in picture naming, the anomic group made more of the same types of errors as they got worse at reading aloud, while the demented group produced more variety as they got worse.

In summary, the demented group behaved like the normal group in reading aloud, on two measures: distributions of error types and relationship between number of errors and number of types of errors, while the anomic group produced mostly phonemic errors (as they had in picture naming). Very similar patterns of error have been found for picture naming and reading aloud. Error patterns from writing data are described next.

6.3.3.3 Writing

Nine mutually exclusive spelling types were identified among the errors. A 'nonword' error occurred when a real word was written in response to a non-word target. A word visually or semantically similar to target was called a 'visual' error. 'Omission' signified the omission of a letter, while 'NR/DNA' was recorded when no written response was given. For 'substitution' errors, another letter replaced the correct one. A few of the responses were 'illegible', i.e. the scorer was unable to decipher letters. For 'addition', an extra letter was added. The final two categories covered those responses with (i) either two of the previous error types observed in the same response or misordering of two letters ('2 of above') and (ii) more than two of the previous types ('>2 of above'). Table 6.9 below shows error data as raw numbers and as percentages of total writing attempts. Errors made on individual stimuli are shown in Appendix VI.

Normal and demented groups had similar distributions of error types ($r = 0.77$, d.f. = 7, $p < 0.05$), but no significant relationship was found with the anomic group: $r = 0.31$, d.f. = 7, NS (normal/anomic) and $r = 0.5$, d.f = 7, NS (demented/anomic). There was no other significant difference effects between any pair of co-efficients. Unlike in picture naming and reading aloud, both patient groups tended to make more types of error as their subjects produced more errors on the test: $r = 0.81$, d.f. = 5, $p < 0.05$ (demented group) and $r = 0.92$, d.f. = 5, $p < 0.01$ (anomic group). No significant difference between co-efficients was found.

Table 6.9 **Validation Study: Writing Errors by Group and Type (as percentages of all errors in brackets)**

Error Type	Normal	Group Demented	Anomic
Nonword	10(2.7)	15(5)	8(2.7)
Visual	1(0.3)	3(1)	4(1.3)
Omission	2(0.5)	10(3.3)	4(1.3)
NR/DNA		5(1.7)	27(9)
Substitution	6(1.6)	10(3.3)	18(6)
Illegible		3(1)	
Addition	1(0.3)	2(0.7)	9(3)
2 of above	5(1.3)	23(7.7)	20(6.7)
>2 of above	8(2.1)	20(6.6)	26(8.7)
Total Errors	33(8.8)	91(30.3)	116(38.7)
Total Attempts	375	300	300

The evidence presented immediately above confirmed the significant relationship between normal and demented groups' error type distributions. The anomic group produced distinct patterns of errors on all three single word processing tests. On both picture naming and reading aloud the anomic group produced more of the same types of errors as they got worse, while on writing, more types of error were made as more errors were made. Explanations for this discrepancy are explored in chapter 8.

6.3.3.4 Verbal Recognition Memory

Raw data for error types, produced through distractor selection is given in Table 6.10 below. Also shown is a breakdown by percentage of total distractors chosen. 'Semantic', 'phonetic' and 'unrelated' were the distractor types (see section 5.2.2.8). This table can be compared with findings from the same test in the pilot study (see section 5.3.6).

The ranking of distractor type selection was identical for normal and anomic groups. Unrelated and semantic errors had different orders for anomic and demented groups. This indicates, as in the pilot study, that the anomic group showed verbal recognition memory more similar to normal than did the demented group.

Table 6.10 **Validation Study: Verbal Recognition Memory - Error Types by Group (as percentages of all errors in brackets)**

Group	Type of Distractor			
	Semantic	Phonetic	Unrelated	Total
Normal	16(72.7)	2(9.1)	4(18.2)	22/375
Demented	26(32.5)	21(26.2)	33(41.3)	80/300
Anomic	16(47.1)	5(14.7)	13(38.2)	34/300

Chi-squared for the raw data was found to be significant: (d.f. 4) = 12.4, $p < 0.025$. Chi-squared was also calculated for each response type. Chi-squared = 3.45, (d.f. 2) was not significant for semantic distractor responses but was significant for phonemic distractor responses (chi-squared (d.f. 2) = 22.44, $p < 0.001$) and unrelated distractor responses (chi-squared (d.f. 2) = 28.63, $p < 0.001$). This indicates that the three groups made similar rates of semantic distractor responses but different rates of the other two types of distractor. The demented group showed its lack of memory for the targets by their selection of unrelated and phonetic distractors which account for twice as many as of their semantic distractor selection. They showed a more equal distribution among error types than the other two groups, who produced fewer errors in total and most were semantic distractor selection, indicating degraded memory of words just read. However, anomic subjects produced a similar percentage of unrelated errors (38.2) to that produced by the demented group (41.3).

6.3.3.5 Summary

The analyses presented in section 6.3.3 have highlighted several differences in the errors made by the subject groups which inform the understanding of the nature of the patient groups' deficits. While normal and demented groups produced similar patterns of errors on all three single word tasks, the anomic group produced unique patterns. While the anomic subjects tended to make more of the same kinds of error as they made more errors on picture naming and reading aloud, the demented subjects made more types of error as they made more errors. These findings suggests that the demented group were showing general inefficiency (see section 6.1.2), while the anomic group showed specific difficulty (at a phonological level). In verbal recognition memory, however, the anomic group behaved more like the normal group than did the demented group. This dissimilarity reflects the argument that aphasia is primarily a disorder of language processing, whereas the language of AD is associated with general cognitive decline (see sections 2.1 and 2.7), seen particularly in episodic memory.

To elucidate the group differences further, the influence of word frequency and word familiarity on the single word processing tasks in the two patient groups is evaluated next.

6.3.4 The Influence of Frequency and Familiarity

Word frequencies reported in Francis and Kucera's (1982) samples data were used as the basis for evaluating the influence of frequency of occurrence on single word processing performance in the validation study. Picture and word familiarity were calculated from the ratings made by normal older people (see sections 5.2.2.1, 5.2.2.3 and 5.2.2.5).

Normal older subjects showed no frequency and little familiarity effect, which may only reflect their good overall performance. For picture naming, number of errors increased as picture familiarity and word frequency fell for both patient groups (see Table 6.11 below, where d.f. = 48). None of the differences between co-efficients differed significantly.

Table 6.11 **Validation Study: Significant Correlations Between Familiarity and Frequency and Naming Performance for the Patient Groups**

Variable	Group	
	Demented	Anomic
Familiarity	0.43 ($p < 0.01$)	0.45 ($p < 0.001$)
Frequency	0.37 ($p < 0.01$)	0.31 ($p < 0.05$)

For oral reading, a frequency effect was again found for the anomic group ($r = 0.43$, d.f. = 33, $p < 0.05$). For the writing test, however, no group produced frequency-related or familiarity-related performance. So far, these data are not producing strong group distinctions. The influence of frequency and familiarity was further explored through regression (see section 6.3.7).

6.3.5 Effect of Stimulus Length

If the anomic group were showing a particular language deficit (at the phonological level - see sections 6.3.3.1 and 6.3.3.2), rather than a general inefficiency in the system, subjects' performance would be expected to be adversely affected by the longer stimuli. Data from picture naming, reading aloud and writing support this hypothesis. Table 6.12 below shows a breakdown (in percentage of possible responses) of errors made by the three groups on picture names with different numbers of syllables. Chi-squared, calculated using Yates Correction Factor (Hatch & Farhady, 1982), established that the anomic group's performance on three syllable targets (*) was significantly worse than their performance on two syllable targets and than the demented groups' performance on two and three syllable targets - chi-squared (d.f. 1) = 5, $p < 0.05$.

Table 6.12 **Validation Study: Naming Errors Produced on Words of Different Length - All Groups**

Group	Number of Syllables 1	2	3
Normal	2.5	3.1	2
Demented	19	28.6	28.1
Anomic	22	28.2	40.2*

In reading aloud, only the anomic group showed a significant length effect, with more errors on words with more syllables ($r = 0.39$, d.f. = 33, $p < 0.05$). In writing, number of syllables per stimulus was also not related to test score. However, word length (in letters) was positively correlated with number of errors for the thirteen real word stimuli for the anomic group ($r = 0.56$, d.f. = 11, $p < 0.05$). The inter-related effects of frequency and length are partialled out in section 6.3.7.

Again a distinction has been found between the tests which required written and spoken responses (see section 6.3.3.3). Overall, however, a sustained word length effect was found for the anomic group (but not for the demented group). This finding lends more weight to the argument that the two disorders are different in kind: the anomic group had more difficulty with longer items, which indicates a specific deficit.

So far, the patient groups have been distinguished by error type distributions on the single word processing tests and verbal recognition memory, and by the influence of stimulus length. The next section considers reading aloud and writing performances in the light of the analogy model, which reveals group differences in patterns of deficit.

6.3.6 Influence of Body Neighbourhoods on Reading Aloud and Spelling

Since the literature relating to the analysis of aphasic and demented reading aloud and writing behaviours using the analogy model is sparse (see sections 3.4.2 and 3.4.3) and since no direct comparison has yet been made, the validation study data were evaluated in the light of the distinctions made by such a model (body neighbourhoods). If anomic aphasia represents a specific linguistic deficit, while the language of dementia is characterised by general inefficiency (as the data so far indicate), then the anomic group should show particular difficulties while the demented group should show deteriorated but normal patterns of performance.

The basis of the model is the principle that words are read aloud (and spelled) by analogy to their neighbours or body neighbours (see section 3.4.2.2). Coltheart et al. (1977), as reported in section 3.4.2.2, predict that a word's neighbourhood (i.e. the number of words different by only one letter from the target) influence the accuracy of the reading aloud. No significant relationship was found for any of the groups between neighbourhood size and test scores in oral reading, nor any significant difference between the co-efficients, so that theme was not pursued. Performance on content and function words did not distinguish the patient groups: neither had any difficulty reading aloud or spelling function words. Data from the reading aloud and writing tests were analysed separately below.

6.3.6.1 Reading Aloud

The stimuli were categorised using the body neighbourhood method of Jared et al. (1990) (see section 3.4.2.2). The thirty five stimuli (30 words and 5 non-word letter strings) formed four categories inequal in size (14 consistent stimuli: with friends but no enemies, 11 inconsistent stimuli: with friends and enemies, 8 unique stimuli: with no body neighbours and 2 exception stimuli: with enemies but no friends). Table 6.13 below shows the total number of attempts per category by group and the error rates expressed as a percentage of total attempts per category per group.

Table 6.13 **Validation Study: Total Reading Attempts and Error Rates (as percentages of total attempts in brackets) for All Groups by Category**

	Group		
Category	Normal	Demented	Anomic
Consistent	350(1.7)	280 (7.5)	266(13.5)
Inconsistent	275(2)	220(11)	209(13)
Unique	200(0.5)	200 (1.2)	152(21.7)
Exception	50(0)	40 (2)	38 (7.9)

Table 6.13 shows little difference in performance across categories for the normal subjects, a peak for the demented subjects on inconsistent words and a peak for the anomic subjects on unique words. Anomic subjects were significantly worse than the other two groups on unique words (chi-squared = 37.1, d.f. = 2, $p < 0.001$). The two patient groups gave similar proportions of errors on inconsistent words and made more such errors than the normal subjects (chi-squared = 7.89, d.f. = 2, $p < 0.02$). Chi-squared for consistent words produced a similar significant effect, again reflecting the normal group's lack of errors (chi-squared = 9.16, d.f. = 2, $p < 0.01$). Chi-squared was not calculated for exception words.

These findings indicate a particular difficulty for the anomic group in reading aloud 'unique' words (with no body neighbours) and difficulty shared by the patient groups in reading 'inconsistent' words (both friends and enemies). Before a conclusion is drawn from this finding, two further analyses need to be reported: comparison of performance on real word and non-word letter string (NWS) items and of performance on low and high frequency items.

Table 6.14 below shows a breakdown of reading aloud performance by word and NWS, as percentages of total attempts per category. NWS items were of two categories only: consistent and inconsistent.

Table 6.14 **Validation Study: Reading Aloud Performance on Words and NWS for All Groups (Percentage Error Rate by Group)**

	Group		
Category	Normal	Demented	Anomic
Consistent:			
[Overall	1.7	7.5	13.5]
Words	0.7	4.1	10.5
NWS	5.3	20	24.6
Inconsistent:			
[Overall	2	11	13]
Words	0	0	1.75
NWS	4	27.5	26.3

All three groups had more difficulty with NWS than with real words. Particularly striking are the discrepancies between all groups' performances on inconsistent words and NWS. Chi-squared was not calculated for performance on inconsistent real words (as error rates were very low for all three groups) but was significant for inconsistent NWS - (d.f. 2) = 18.14, $p < 0.001$, indicating significantly worse than normal performance by the patient group subjects. This effect was less marked for consistent stimuli: chi-squared was calculated and found to be significant in both conditions - words (d.f. 2) = 9.71, $p < 0.01$ and NWS (d.f. 2) = 19.6, $p < 0.001$. Overall, however, performance on NWS did not distinguish the patient groups. To sum up so far: anomics had particular difficulty with unique words while both groups had difficulty with NWS.

The interaction of word type and frequency was also investigated for real word stimuli, to establish whether this would distinguish the groups. Table 6.15 shows the rate of error for high frequency (i.e. >100 in Francis and Kucera's (1982) samples database) and low frequency (i.e. <100) words.

Table 6.15 **Validation Study: Reading Aloud Errors by Word Type and Frequency for All Groups (as percentages of total attempts in brackets)**

		Group	
Category	Normal	Demented	Anomic
consistent<100	2/175 (1.1)	6/140 (4.3)	15/133 (11.3)
consistent>100	0/100	3/80 (3.8)	7/76 (9.2)
inconsistent<100	0/75	0/60	2/57 (3.5)
inconsistent>100	0/150	0/120	1/114 (0.9)
unique<100	1/175 (0.01)	2/140 (1.4)	31/133 (23.3)
unique>100	0/25	0/20	2/19 (10.5)
exception<100	0/25	0/20	3/19 (15.8)
exception>100	0/25	1/20 (5)	0/19

The normal subjects produced very low error rates on low frequency consistent and unique words and no other errors. The demented group showed a slight frequency effect for both consistent and unique words only. The anomic group showed a frequency effect for all four word types.

Overall, these analyses have shown two differences between the patient groups: anomic subjects had particular difficulty with 'unique' words and lower frequency words. Writing data are examined in the same way below, to compare performance in two different output modes.

6.3.6.2 Writing

The fifteen stimuli were sub-divided into three categories (see section 3.4.2.2) unequal in size - six consistent (including the two NWS stimuli), seven inconsistent and two unique words. There were no exception words. Performance by all three groups in these categories is shown in Table 6.16 (the figures are the total number of attempts by category followed by the number of error responses presented as percentage of total attempts).

Table 6.16 **Validation Study: Writing Error Performance by Category for All Groups**

Word Type	Normal	Group Demented	Anomic
Consistent:			
Word	100 (2)	80(17.5)	80(40)
NWS	50(34)	40(67.5)	40(65)
Overall	(14.4)	(37)	(47)
Inconsistent	175 (1.1)	140(23.6)	140(30.7)
Unique	50 (26)	40(52.5)	40(65)

The above data show a dissociation for all groups between the ability to write consistent words and NWS (as in reading aloud). Both patient groups show approximately twice the percentage of unique word to inconsistent word errors (unlike in reading aloud). Similar error levels are found between performances on consistent and inconsistent words for all three groups. Unique words are most difficult for all three groups. There was no significant difference found between the patient groups' performances by category using raw data (chi-squared = 2.8, (d.f. = 3), NS) (contrary to the finding from reading aloud). Thus the group differences found in the reading aloud data are not replicated for writing data. Findings must therefore be related to response mode.

The interaction of word type and frequency was also investigated. Table 6.17 shows the percentages of errors made by the three subject groups for high frequency (i.e. > 100) and low frequency (i.e. < 100) consistent, inconsistent and unique words).

Table 6.17 **Validation Study: Writing Errors by Word Type and Frequency for All Groups (as percentages in brackets)**

	Normal	Demented	Anomic
consistent<100	1/50 (2)	7/40 (17.5)	16/40 (40)
consistent>100	0/50 (0)	3/40 (5)	5/40 (12.5)
inconsistent<100	2/125 (1.6)	28/100 (28)	33/100 (33)
inconsistent>100	0/50 (0)	5/40 (12.5)	11/40 (27.5)
unique<100	13/50 (26)	21/40 (52.5)	26/40 (65)
unique>100	none tested		

There was no significant difference between the patient groups' percentage error rate on low frequency words of any type (chi-squared = 4.2 (d.f. = 2), NS) (unlike in reading aloud). For high frequency words, the anomic group scored more errors on both consistent and inconsistent words, but the proportions were maintained. Both patient groups showed a significant effect of unique word type at low frequency (chi-squared = 19.8, d.f. = 2, $p < 0.001$ for the demented group and for the anomic group chi-squared = 12.3, d.f. = 2, $p < 0.005$).

In summary, while data from reading aloud showed patient group differences, the writing data had not shown the same patterns. Once again (see section 6.3.3.3), discrepancy between spoken and written modes has been demonstrated. Despite the previous attempt by Campbell (1983) (see section 3.4.3.1), the extension of the single route to reading (analogy) model seems not to be valid. Results from reading aloud confirm findings from sections 6.3.3 and 6.3.5 which showed that the anomic group showed a unique pattern of deficits, while the demented group behaved like the normal group, but with less accuracy.

The next section aimed to discover which of the variables discussed above predicted test performance on the single word processing tasks using the statistical technique of multiple regression.

6.3.7 <u>Regression</u>

Regression was calculated by BMDP1r to evaluate which of the variables accounted independently for a significant proportion of the variance in group performances on picture naming, reading aloud and writing (real word stimuli only). Predictors of performance on non-word letter strings were not sought since the patient groups were not distinguished by their performance on this type of stimulus. Since the normal group made so few errors, only one significant Beta value was found (unique body neighbourhood in writing: -0.39, $p < 0.01$).

For each of the tests, result was the dependent variable (i.e. for picture naming: correct, correct following semantic cue, correct following phonemic cue or error, and for reading aloud and writing: correct/error). For picture naming, independent variables included frequency, picture and word familiarity and number of syllables (see sections 6.3.4 and 6.3.5). For reading aloud and writing, independent variables were word categories (see sections 6.3.6.1 and 6.3.6.2), frequency and frequency level (more or less than 100) (see sections as above), function/ content word (see section 6.3.6), abstract/concrete word (see section 3.3.3), number of syllables (see section 6.3.5) and familiarity rating (see section 6.3.4).

Each of the three calculations produced significant results for the patient groups and between the patient groups: the variables used (described above) significantly predicted performance differently for the patient groups. These results are shown in Tables 6.18 and 6.19.

Table 6.18 **Validation Study: Significant Regression Results (Patient Groups Only)** ($p < 0.0001$)

Test	Regression Values			
Naming:				
Group	Intercept	R^2	F	d.f.
Demented	1.14	0.08	28.45	3,995
Anomic	1.25	0.06	20.90	3,946
Reading:				
Anomic	0.54	0.08	5.783	9, 560
Writing:				
Demented	-0.41	0.18	7.75	7, 252
Anomic	0.94	0.13	5.36	7, 252

Table 6.19 **Validation Study: Analysis of Variance Comparisons of Regression Equations (Patient Groups Only)**

Test	F	d.f.	p
Picture Naming	4.12	5, 1939	= 0.001
Reading Aloud	10.18	10, 1150	< 0.00001
Writing	8.35	16, 821	< 0.00001

Significant individual Beta values are shown for each test and each group in Tables 6.20 and 6.21 below, where 'ns' indicates a non-significant value. For picture naming, picture familiarity was significant for both patient groups. Patient group differences lay in the influences of frequency (significant for the demented group but not for the anomic group) and of syllable length (vice versa). For reading aloud, significant regression co-efficients were found for three variables for the anomic data: unique neighbourhood, number of syllables and familiarity, but for none for the demented group. For writing, two independent variables were significant for the demented group: unique body neighbourhood and familiarity and one for the anomic group: number of syllables.

Table 6.20 **Validation Study Regression: Summary of Beta Values for the Demented Group (Language Tests Only)**

Predictor	Naming	Reading	Writing
Frequency	0.11(0.01)	ns	ns
Picture Fam.	0.23(0.01)		
Word Fam.	ns	ns	0.52(0.01)
Syllable	ns	ns	ns
Inconsistent		ns	not used
Consistent		ns	ns
Unique		ns	-0.41(0.01)
Exception		not used	
Level		ns	ns
Function		ns	ns
Concrete		ns	not used

Table 6.21 **Validation Study Regression: Summary of Beta Values for the Anomic Group (Language Tests Only)**

Predictor	Naming	Reading	Writing
Frequency	ns	ns	ns
Picture Fam.	0.14(0.01)		
Word Fam.	ns	0.12(0.05)	ns
Syllable	-0.15(0.01)	ns	-0.44(0.05)
Inconsistent		ns	not used
Consistent		not used	ns
Unique		-0.16(0.01)	ns
Exception		ns	
Level		ns	not used
Function		ns	ns
Concrete		ns	ns

In summary, different patterns of variables influenced test performance in the two groups. Length of stimulus was consistently found to be important for the anomic group, but not at all for the demented group. Like the normal group, words with unique body neighbourhoods were predictive of demented subjects' performance. A mixed pattern of frequency and familiarity effects were found (see also section 6.3.4).

Cueing effects have already been reported in the pilot study to distinguish the groups. Validation study results on cueing responsiveness are reported next.

6.3.8 Cueing Responsiveness

Table 6.22 below displays the success (or not) of semantic and phonemic cues for all three subject groups with these outcomes as percentages of total error responses in brackets. Patterns of group responses to individual stimuli are shown in Appendix VII.

Table 6.22 **Validation Study: Pictures Named Correctly after Semantic or Phonemic Cueing and Errors Uncorrected for All Groups**

Group	Correct Following Semantic Cue	Phonemic Cue	Incorrect	Total
Normal	16(48.5)	10(30.3)	7(21.2)	33
Demented	87(36.4)	74(31)	78(32.6)	104
Anomic	37(14.2)	119(45.6)	105(40.2)	261

These data show ostensibly that anomic subjects used semantic cues less successfully than the other two groups, but used phonemic cues more successfully. A significant effect was found within groups and across types of cue: while the normal and demented group showed no preference for cue, the anomic group showed a highly significant difference (chi-squared = 80.95, (d.f. 2), $p < 0.001$, which reflects their poor up-take of semantic cues. As a group, they tended not to require the additional information about the target which semantic cues give, but benefited more from being given a word onset cue. Success following such cues indicates that the subject had recognised the picture, but was experiencing word finding difficulties. They also had a higher number of cueing failures, which reflects the relative severity of their picture naming difficulties.

Patterns of cueing responsiveness among the patient groups in the preliminary, pilot and validation stages show some difference (see sections 4.3.4 and 5.3.3.2), which reflect the different degrees of group picture naming ability and inform rather than confuse. The pilot demented group had made more naming errors than the validation cohort, but maintained a similar level of semantic and phonemic cueing responsiveness throughout. On the other hand, the anomic group naming performance was worse at validation stage, when their cueing responsiveness showed a bias towards success following phonemic cue.

At both stages, a significant difference was found between patterns of cueing responsiveness in the patient groups. It can therefore be concluded that this type of data analysis is useful in discriminating the two groups. It shows that the groups differ in the stage at which their picture naming errors occur. While the demented group show the normal proportions of visual and linguistic errors (see section 6.3.3.1) and equal responsiveness to semantic and phonemic cueing, the anomic group had more difficulty in saying the name than recognising it, and therefore benefit more from phonemic cueing.

Discriminative information gathered from all the previous analyses in section 6.3 were included in the discriminant analyses which are discussed below.

6.3.9 <u>Discriminant Analyses</u>

Using test score data alone (section 6.3.1.10), all but two of the validation stage patient group subjects were correctly classified using discriminant analysis. Several more discriminant analyses were carried out, using different sets of data: error types, scores and cueing responses.

Three discriminant analyses using error data from picture naming, reading aloud and writing individually proved as unsuccessful as Horner et al.'s (1992) (see section 3.2.4) in classifying patient group subjects (see Tables 6.23 - 6.25). For picture naming, the variables offered in the discriminant analysis were: all error types (except 'other', i.e. unclassified, responses) (see section 6.3.3.1), number of responses correct following semantic cue or phonemic cue and responses incorrect despite cues. Data from both patient groups were used. Of the variables offered, only visual misperception errors, number of errors despite cues and number of responses correct following semantic cue were significant discriminators. Classification results are given in Table 6.23 below and reflect 85% overall accuracy.

Table 6.23 **Validation Study: Picture Naming Discriminant Analysis - Patient Groups Only**

Actual Group	N	Predicted Group Demented	Anomic
Demented	20	16	4
Anomic	20	2	18

For reading aloud, variables which contributed significantly were phonological errors, errors of stress placement and visual errors (see section 6.3.3.2). Other error types and number of correct responses did not. 77% of cases in the demented and anomic groups were correctly classified (see Table 6.24). More anomic than demented subjects were misclassified unlike picture naming).

Table 6.24 **Validation Study: Reading Aloud Discriminant Analysis - Patient Groups Only**

Actual Group	N	Predicted Group Demented	Anomic
Demented	20	19	1
Anomic	20	12	8

For writing, errors of letter addition, substitution, no response, combination of two types and combination of more than two were included with number of correct responses (see section 6.3.3.3 for a description of error types). Using data from demented and anomic subjects, 77.75% of subjects were correctly classified (very similar to correct classification using reading variables) (see Table 6.25). Five demented subjects and four anomic subjects were misclassified.

Table 6.25 **Validation Study: Writing Discriminant Analysis - Patient Groups Only**

Actual Group	N	Predicted Group Demented	Anomic
Demented	20	15	5
Anomic	20	16	4

Discriminant analysis correctly classified all validation stage anomic and AD subjects when test scores, cueing and error data (as described above for picture naming, reading aloud and writing) were used as variables. Distractor selection from verbal recognition memory were also included (see section 6.3.3.4). By step-wise selection, the variables which significantly contributed to discrimination included scores from the 'memory' tests and error information from the 'language' tests (see Table 6.26 below). The variables listed there are all those which significantly contributed to distinguishing the anomic and AD groups. The power and direction of the discrimination are shown in the size of the co-efficients and their signs respectively.

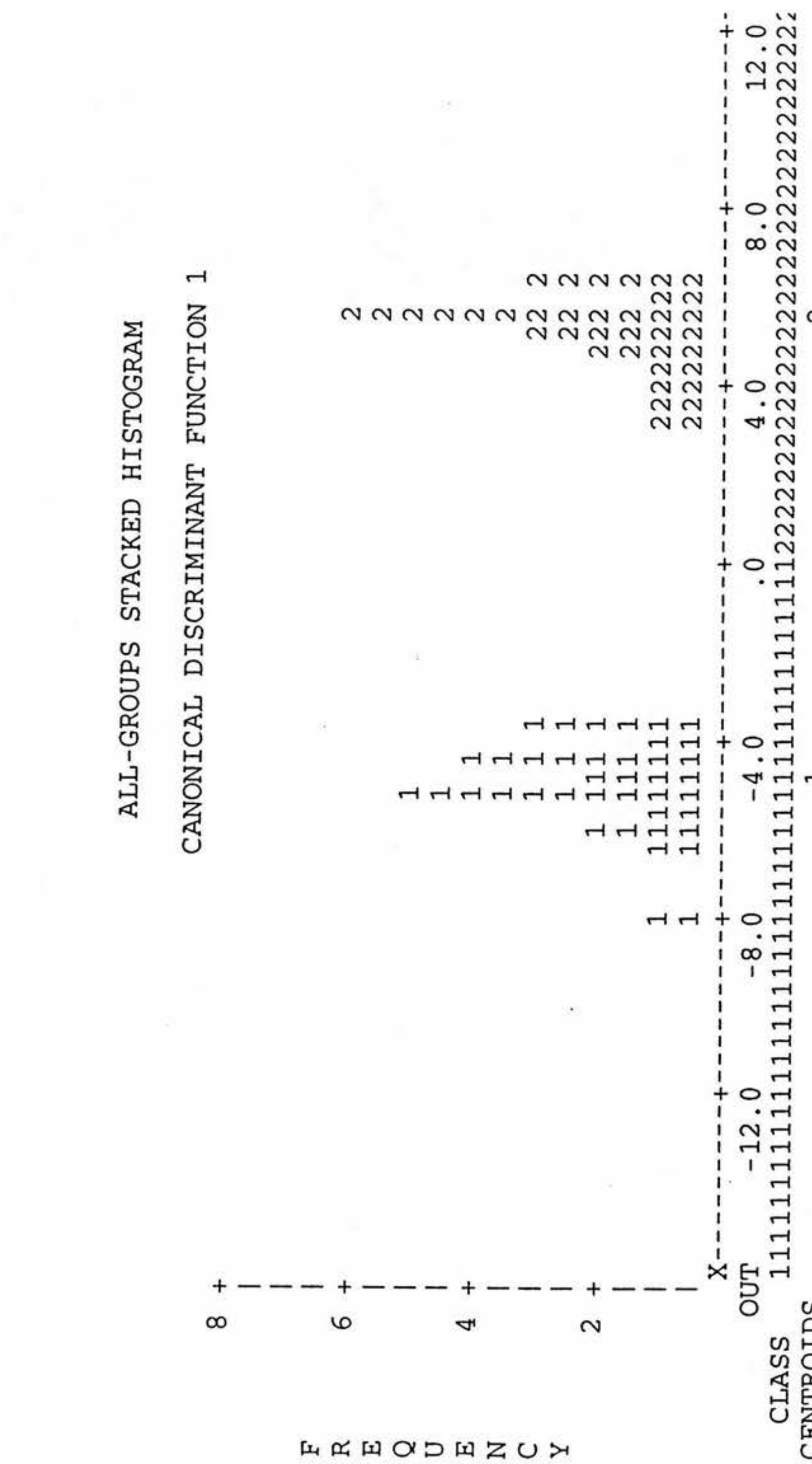
Table 6.26 **Validation Study: Discriminant Function Co-efficients**

Variable	Co-efficient
MMSE Score	0.52
Picture Naming:	
semantic paraphasia	0.39
circumlocution	0.31
perseveration	2.15
did not recognise	0.96
misperception	-3.02
correct following:	
semantic cue	0.43
phonemic cue	-0.25
Reading Aloud:	
visual errors	-1.59
no response	-2.65
incorrect stress	1.75
perseveration	2.68
semantic error	1.73
Verbal Recognition Memory:	
score	0.67
unrelated distractor	0.55
Writing:	
score	-0.20
no response	0.89
illegible	4.91
addition	2.46
>2 error types	0.61
Delayed Story Recall:	
verbal condition score	0.38
Constant	-10.60

6.3.9.1 Applying Discriminant Analysis to New Cases

On the basis of the weighted variables (discriminant co-efficients), a discriminant score was calculated for each case using the following procedure: (i) multiply the value of each co-efficient by that variable value, (ii) sum the resultant products and (iii) add the constant value. These scores were inserted into a histogram (see Figure 3)

Figure 3 Validation Study Discriminant Scores for Demented and Anomic Groups



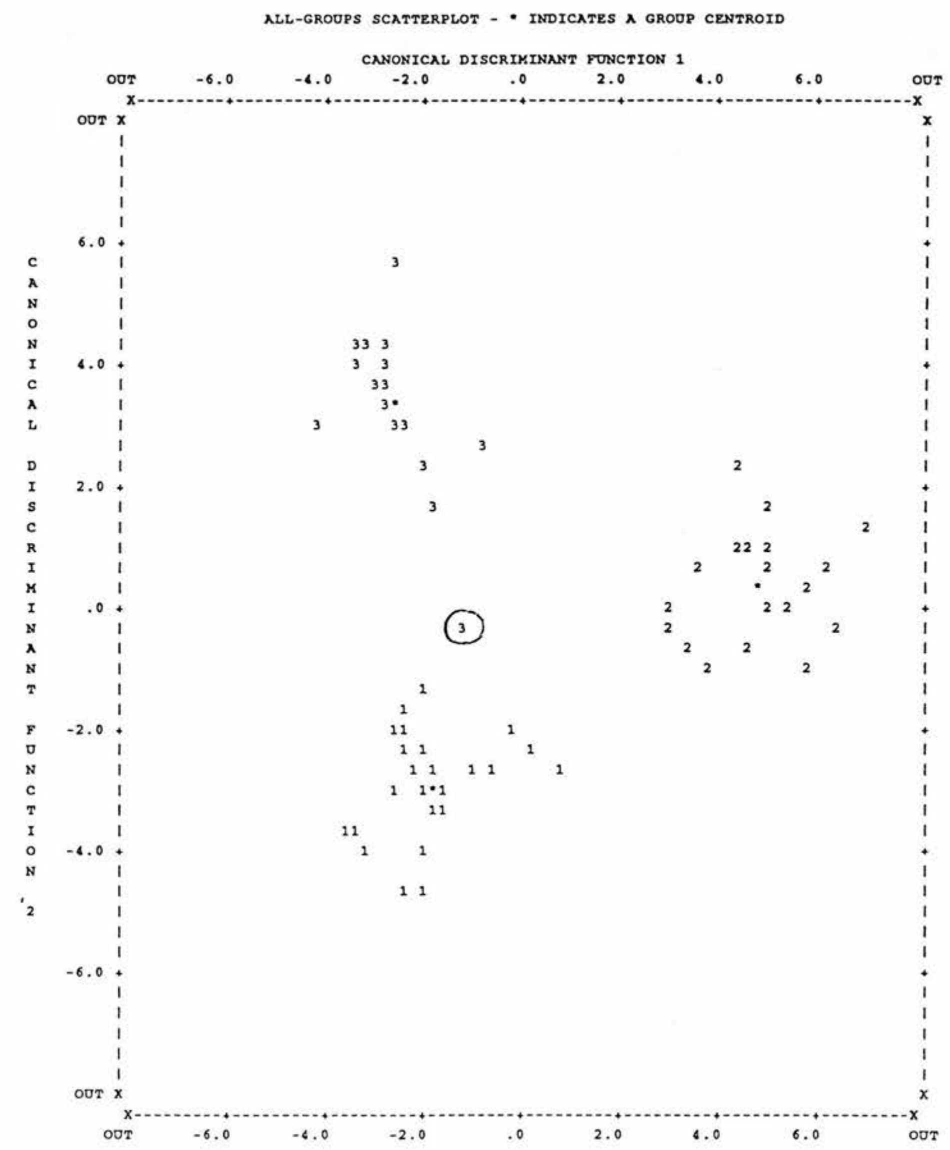
which shows the distribution of discriminant scores between the patient groups. The mean discriminant score for each group is marked by a 'group centroid': in this case, the group centroid for the demented group (1 in the figure) was -4.97, while the group centroid for the anomic group (2 in the figure) was 5.24. Table 6.26 above provides the values of each of the discriminant co-efficients.

For future patients who present to a speech and language therapist for differential diagnosis, the procedure would include the following steps. The test battery would be administered and the relevant data noted (i.e. the significant discriminant variables listed in Table 6.26). A discriminant score would be calculated as outlined above using the co-efficients in Table 6.26 and the resultant score placed on the histogram, to compare the new case with known cases. The new case can be compared also with the group centroid.

Should the new case not be clearly classified by this method, further investigation would be required. The battery could be administered after a short interval to establish error consistency and test-retest performance. The discriminant procedure would be repeated.

6.3.9.2 <u>More Discriminant Analysis Applications</u>
Normal older subjects' data were included with patient group data in a discriminant analysis (which included score and error data as described above). Figure 4 depicts the resultant scatterplot (* represents group centroids). The demented group are represented by the number 2 in the figure. The normal subjects (1 in Figure 4) were all correctly classified, though one anomic subject was misclassified as normal (circled in Figure 4). This misclassification has less severe management ramifications than an anomic-AD misclassification.

Figure 4 Validation Study Discriminant Analysis Outcome for Normal, Demented and Anomic Groups



For discriminant analyses involving three groups, two sets of discriminant scores may be calculated to maximally distinguish the groups. Thus two discriminant 'functions' are shown in Figure 4.

Discriminant analysis was also used to predict one half of the data from the other half using the most successful cluster of variables. The resultant best overall classification accuracy was 87.1% (normal - 100%, demented - 90% and anomic - 67%). Slightly different overall profiles were found, depending on which way the data was split, as some subjects were better examples of 'aphasia' and 'dementia' than others.

6.3.10 A Comment on Graded Scoring

Following the examples of most published studies which have made analyses of error data produced by fluent aphasic or AD subject populations (Glosser & Kaplan, 1989; LaBarge et al., 1992), the types of error produced by the current subjects were scored equally, i.e. each error was counted as one instance of a type. Stevens (1992) used a very different scoring system: graded and with positive (dysphasic) and negative (AD) values (see section 3.2.4). It is interesting to compare Stevens' system with the variables which were used in discriminant analysis to correctly classify the patient group subjects in the present study.

The two sets are not directly comparable because of task differences, error type differences, number and range of stimuli presented and different scoring principles (Stevens scored 0 for correct responses and then provided a range of +/- 1-7 according to error type produced). Taking these factors into account, picture naming comparison alone will be made here.

The variables selected in discriminant analysis of the present picture naming data (see Tables 6.23 and 6.26) coincide with five of Stevens' 14 categories. The same bias in +/- scoring is found for each of the variables in terms of the relative frequencies produced by the patient groups. The graded scoring system does capture some of the differences offered by the present data. However, an objective evaluation of the relative importance of the error types in distinguishing the patient groups is provided by discriminant analysis which involves weighting variables so that group distinctions can be amplified.

6.4 Summary and Conclusion

The patient groups have been fully discriminated and correctly classified by discriminant analysis as predicted (see section 6.1.2). Data analyses showed that the anomic group had a different pattern of single word processing deficits from the demented group, again as predicted. Group discrimination via test-retest patterns of consistency has yet to be investigated before a complete picture can be described.

6.4.1 Implications for Test Battery Development

The validation study results have replicated and extended the important findings from the pilot study: while the patient groups produced similar mean scores on the language tests, profiles of the scores from all tests produced good discrimination among the groups. The Behavioural Rating Scale can be omitted from the testing procedure as it did not relate to performance on MMSE (see section 6.3.1.1). The picture condition of the story recall test can also be omitted as it did not allow the aphasic group to demonstrate story recall more successfully than in the verbal condition (see section 5.2.3). It was not a significant variable in discriminant analysis in the validation study. Otherwise, all tests are required in order to distinguish the groups. Either the score and/or error types from each test are included in discriminant analysis.

6.4.2 Implications for Nature of the Deficits

This study has produced data from error analyses which suggest that the two disorders are of a different nature. The next step undertaken (chapter 7) aimed to provide longitudinal information, as Thompson (1986) had done and to examine test-retest performances as the other possible route to group discrimination (see section 4.1).

Chapter 7

A Longitudinal View

7.1 Introduction

The data analysed in chapters 4 - 6 were cross-sectional in nature, the result of one-off testing of groups of subjects on various batteries of tests. However, the fourth type of data analysis outlined in section 4.1, demands longitudinal group data in order to assess test-retest consistency. Such data were collected through the testing of a small number of people at various times: for the pilot study, the validation study and later to look at performance over time specifically. The nature of anomic aphasia and AD would dictate that positive and negative trends respectively would be expected in the test-retest performances of patients in these categories.

Parts of these test-retest data can be used also to examine the question of the status of semantic memory in the patient groups. Although it is preferable that a differential diagnosis is confirmed quickly, longitudinal examination of the status of a person's semantic memory can provide useful additional differential diagnostic information. The literature suggests that people with AD suffer semantic memory loss while people with fluent aphasia show difficulty in accessing its contents (see section 2.5.2). Test-retest data can be employed to compare responses to the same stimuli over time. If errors are consistently made on the same stimuli, we might diagnose memory loss. Alternatively, other factors could be held accountable.

The hypothesis, then, was that different group score trends would be demonstrated: AD subjects would score lower on retest by producing consistent as well as new errors while anomic aphasic subjects would show variable errors with stationary or improving scores on retests.

To test this hypothesis, two related sets of data were analysed. First, trends in test-retest scores were examined (section 7.2). Second, test-retest consistency of responses was investigated (section 7.3). The evidence is discussed in section 7.4.

It is acknowledged that inter-test interval varied greatly. This study was conducted as a response to work reported in the literature as the project progressed and therefore only some of the test-retest subjects were planned. The remaining data were gathered incidentally, through repeated use of subjects. Inter-test interval variation was not considered to affect results adversely as no idiosyncratic change was noted.

7.2 <u>Test-Retest Outcomes</u>

7.2.1 <u>Procedure</u>

6 normal elderly, 7 probable AD subjects and 5 anomic subjects were tested for the validation study battery and later for comparison of performance over time using the same battery. Extended data from these subjects (including pilot battery performance) are presented in the next section on test-retest consistency. The length of time between testing for this set of subjects varied from 2 to 48 weeks. Single case studies including subjects from normal, demented, anomic and Wernicke's groups are described in Appendix VIII, which provide in-depth analysis of scores and errors produced over time.

7.2.2 <u>Results</u>

Trends in mean scores for each group are described below in Tables 7.1 to 7.3. Significant ($p < 0.05$) changes are marked *. Overall the normal elderly data in Table 7.1 is stable. The demented group shows deterioration. In Table 7.2, all sections of MMSE have lower mean scores on retest, with a significant deterioration in the registration/recall subtest. Picture naming, reading aloud and writing show small deteriorations. The verbal condition of story recall is static at 0, and the picture condition shows some improvement. However, a memory improvement cannot be inferred from this because the change did not reach significance. Slight improvement for the anomic group (in Table 7.3) is evident in MMSE, picture naming, reading aloud, verbal recognition memory and story recall (verbal and picture conditions). A non-significant deterioration is seen in mean writing score.

Table 7.1 **Trends in Mean Scores (Normal Subjects)**

Test	Validation	Retest	Change
MMSE:	27.5	27.6	+0.1
Orientation	9.7	9.8	+0.1
Language	8.2	8.3	+0.1
Reg./Rec.	5.3	5	-0.3
Calculation	4.3	4.5	+0.2
Picture Naming	46.7	47	+0.3
Reading Aloud	34.7	35	+0.3
V. Rec. Mem.	1.3	2	+0.7
Writing	13.8	13.8	=
Story Recall:			
Verbal	9	9.5	+0.5
Picture	10.7	14.5	+3.8

Table 7.2 **Trends in Mean Scores (Demented Subjects)**

Test	Validation	Retest	Change
MMSE:	16	13.5	-2.5
Orientation	4.3	4	-0.3
Language	6.4	6	-0.2
Reg./Rec.	3.3	2.1	-1.2*
Calculation	2	1.4	-0.6
Picture Naming	42.6	40.7	-1.9
Reading Aloud	33.9	33.6	-0.3
V. Rec. Mem.	-1.1	-2	-0.8
Writing	13.1	12.4	-0.7
Story Recall:			
Verbal	0	0	=
Picture	-0.3	0.7	+1.0

Table 7.3 **Trends in Mean Scores (Anomic Subjects)**

Test	Validation	Retest	Change
MMSE:	20.6	21	+0.4
Orientation	8.4	8.2	-0.2
Language	6.6	6.8	+0.2
Reg./Rec.	2.8	3.8	+1.0
Calculation	2.8	2.2	-0.6
Picture Naming	32.6	34	+1.4
Reading Aloud	29.8	32	+2.2
V. Rec. Mem.	0	1	+1.0
Writing	10.4	10.2	-0.2
Story Recall:			
Verbal	3	5.4	+2.4
Picture	8.8	9.4	+0.6

7.3 Test-Retest Consistency

7.3.1 Subjects

Subjects from the normal elderly, demented and anomic aphasic groups who were employed at the pilot, validation and retest stages of the differential diagnostic test battery were included in this study. The re-tested subjects were all those who were still accessible and who continued to fulfil the selection criteria. The sampling was therefore unsystematic in terms of previous test performance, as subjects were not selected nor matched across groups on the basis of previous performance.

Table 7.4 outlines group details. Demented subjects ranged in age from 69 - 81 years and anomic aphasics from 61 - 75. The figures below represent mean ages at the time of the first administration of the test battery and mean times between testing in weeks. The time between test and re-test here varied from 2 - 108 weeks: the inter-test interval between pilot and validation study was at least eighteen months. Three subjects from the patient groups were tested three times (two aphasics and one subject with dementia) as were two normal elderly subjects. The remaining subjects were tested twice, thus eight comparisons were possible in all groups.

Table 7.4 **Test-retest Consistency: Group Details**

Group	N	Age	Time Difference
Normal	8	79	28
Demented	8	76	32
Anomic	8	67	49

7.3.2 Procedure

The subjects were tested on the pilot version of the battery and the validation study test battery under comparable experimental conditions. The aim of this particular part of the study was not discussed with subjects.

For the purposes of this study, test-retest performance on a subset of the battery, i.e. the fifty-item picture naming test, reading aloud words (the 30 real word stimuli of the test's 35 stimuli) and writing words to dictation (the 13 real word stimuli of the test's 15 stimuli), was analysed in three ways. (Only real word stimuli were included, as non-word letter strings cannot have representation in semantic memory.) First, test performance consistency over time was evaluated for the three tests (section 7.3.3.1). Second, a detailed test-retest response analysis was undertaken for picture naming (section 7.3.3.2) and third the effect of cueing in picture naming was examined (section 7.3.3.3).

7.3.3 Results

All subjects included in this part of the study were able to complete the test battery at least a second time.

7.3.3.1 Test Performance Consistency

Results from each of the three tests are considered separately below. First, Table 7.5 shows the pattern of test-retest performance consistency on the picture naming test. The first column, 'consistent' indicates the number of times the same response type was produced on both occasions (from a maximum potential consistency score of 50). The next three columns break down these numbers of consistent responses: 'correct' is the number of consistently correctly named pictures, 'prompted' is the number of naming responses consistently correct following semantic or phonemic cue and 'incorrect' is the number of consistent failures to name despite cues.

Table 7.5 **Consistency of Naming Performance Over Time (Patient groups)**

Group	Consistent	Correct	Prompted	Incorrect
Demented				
D14	37	25	6	6
D9	45	45	0	0
D17	39	34	5	0
D17	45	40	5	0
D19	47	43	4	0
D5	39	38	0	1
D4	38	36	2	0
D10	45	42	3	0
Mean	41.875			
s.d.	4.01			
Anomic				
A1	37	29	7	1
A1	39	35	3	1
A3	32	7	7	18
A2	38	33	5	0
A7	37	31	2	4
A7	33	29	2	2
A10	38	37	1	0
A5	47	47	0	0
Mean	37.625			
s.d.	4.53			

Several subjects appear twice in the table above: these are the subjects who were tested on three occasions. Each pair of two consecutive test performances has been compared. Statistics reported below are calculated using triple testees. There was no difference in test results when only subjects who had been tested twice were included.

Mean number of consistent responses did not differ between the patient groups ($t = 1.99$, d.f. = 14, $p = 0.066$, one-tailed). Therefore, rates of consistent naming errors did not distinguish the patient groups contrary to prediction. Of the demented group's 7 consistent errors, 6 were made by the same subject (who also scored lowest in the naming test in her group on both occasions). Similarly, 18 of the anomic group's 26 consistent errors were made by one subject, whose errors were related to word length and often recognisable as the target, e.g. [gre'tar] for 'guitar'. Such behaviour suggests that the subject was able to retrieve the name from semantic memory, but had difficulty in producing the correct phonological forms. Therefore, neither group showed much evidence of loss of lexical entry on picture naming. Error consistency in reading aloud and writing were also examined.

None of the normal elderly or demented subjects made any consistent reading aloud errors on test-retest. The anomic group's six instances of reading error consistency from a possible total of 240 responses (2.5%) are described in Table 7.6 below. The anomic group produced consistent errors on low frequency stimuli (all less than 100) and 4 of the 6 consistent errors were made on words with unique body neighbourhoods which were seen in the validation study (see section 6.3.6.1) to be most difficult for that group to read aloud.

Table 7.6 **Consistent Reading Errors (Anomic Group)**

Word	Frequency	Type of Word
debt x2	13	Unique
cigar	9	Unique
sign	43	Unique
county	35	Consistent(two friends/lower freq.)
cult	7	Consistent(one friend/lower frequency)

[Frequency = frequency of occurrence, Type of Word = word described by body neighbourhood]

In the writing test, the demented subjects had difficulty with 'fallacy', producing six consistent mis-spellings. No other stimulus was consistently mis-spelled. This performance is consistent with normal elderly test-retest performance as 'fallacy' was the stimulus which the control group found most difficult to spell and was consistently mis-spelled on three occasions. The anomic group produced seventeen instances of consistently mis-spelled words (i.e. 14% of possible responses) They are described below in Table 7.7.

Table 7.7 **Consistent Spelling Errors (Anomic Group)**

Word	F.	Type of Word	Total Errors
an	498	Inconsistent	1
fallacy	1	Unique	7
discord	1	Inconsistent	1
spear	3	Inconsistent	2
biscuit	2	Unique	3
sword	6	Inconsistent	1
mermaid	1	Consistent	2

Again fallacy, as the most difficult word, is the stimulus most often consistently mis-spelled. The remaining consistently mis-spelled words were (apart from 'an') of low frequency. Again a frequency effect is apparent for the anomic group as is their particular difficulty in writing words with unique or inconsistent body neighbourhoods.

Overall, data presented in this section reveal that the anomic group produced more consistent errors: not because they had lost the words from semantic memory, but because they had particular linguistic difficulty with those words. Very few consistent errors responses were observed in the demented group. These were found only in the picture naming performance of the subjects with the lowest naming score and in the spelling of the word which all groups found most difficult to spell. So far, no compelling evidence has been presented to suggest that the hypothesis (see section 7.1) should be accepted. The next analysis looked more closely at picture naming test-retest performance.

7.3.3.2 Test-retest Response Analysis (Picture Naming)

Unlike the other two tests, picture naming had four potential response types (correct, correct following semantic cue, correct following phonemic cue and incorrect despite cues). Therefore, a more in-depth analysis was possible, which could provide more detailed information about test-retest picture naming performance. Table 7.8 below shows the distribution of both consistent and inconsistent naming responses, where + = correct, pr. + = correct following cue, x = not named correctly despite cues. Figures represent group totals (from a maximum of 400), with group means in brackets.

Table 7.8 **Distribution of Test-retest Naming Patterns - All Groups**

Response Type	Normal	Group Demented	Anomic
Consistent Response			
+ --> +	362	303(37.9)	248(31)
pr.+ --> pr.+	8	25(3.1)	27(3.4)
x --> x	1	7(0.9)	26(3.2)
Total	371	335	301
Improvement			
pr.+ --> +	11	21(2.6)	31(3.9)
x --> pr. +	1	3(0.4)	11(1.4)
x -->+	3	3(0.4)	17(2.1)
Total	15	27	59
Deterioration			
+ --> x	3	6(0.8)	8(1)
+ --> pr. +	9	25(3.1)	16(2)
pr.+ --> x	2	7(0.9)	16(2)
Total	14	38	40

The table above shows that the patient groups made very similar total 'deterioration' responses, i.e. responses showing less successful second attempt naming. The anomic group showed twice as many 'improvement' responses, i.e. responses showing more successful second attempt naming. A significant chi-squared was calculated using the total numbers of consistent, improved and deteriorated responses produced by each group (chi-squared = 13.776, d.f. 2, $p < 0.01$) which indicates that the groups produced different profiles, as predicted.

Mean scores produced by the patient groups from each test-retest performance were compared. The only significant difference was found when an incorrect item on first testing was correctly named on the second test administration ($t = -3.67$, d.f. = 14, $p < 0.003$). This finding indicates that the anomic group showed significantly more ultimate improvement than the demented group.

Picture naming data was also examined in terms of the order of picture presentation. The data presented in Table 7.8 was divided by 10-item banding (see Appendix IX): the test was originally ordered by picture familiarity, which correlated significantly with word frequency ($r = 0.38$, d.f. = 48, $p < 0.01$). Both patient groups produced progressively fewer consistently correct responses in higher bands (chi-squared was non-significant). Items consistently prompted correct were steady throughout the bandings for the anomic group and varied from 0 - 10 for the demented group, with no simple progression through the bandings. Consistently incorrect naming responses increased steadily over the bandings for both groups (chi-squared was not significant). None of the improved or deteriorated categories showed a familiarity effect, but two warrant interest. For items improving from incorrect to prompted correct between tests, the anomic group produced 8 of their 11 such responses in the final, least familiar band. Of items deteriorating from correct to incorrect, the demented group produced 4 of their 6 such responses in this same band. The above figures provide some evidence that 'frequency' had some effect for both patient groups. It has been argued (see section 2.5.2) that this finding is evidence for semantic memory loss in both conditions.

7.3.3.3 Effect of Cueing Over Time

Third, the effect of cueing was evaluated by examining more closely items for which the first test response was prompted correct (a total of 53 for demented subjects and 74 for anomic subjects). Eight patterns of response were possible and are listed below in Table 7.9: for this analysis prompted correct responses are divided into correct following semantic cue (S/C) and following both semantic and phonemic cues (P/C). Again responses are categorised as consistent, improved or deteriorated.

Table 7.9 **Effect of Cueing: Test-retest Comparison (Patient Groups)**

Response Type	Demented	Anomic
Consistent		
S/C --> S/C	9 (17)	1 (1.4)
P/C --> P/C	13 (24.5)	23 (31.1)
Total	22	24
Improvement		
S/C --> +	17 (32.1)	6 (8.1)
P/C --> +	4 (7.5)	25 (33.8)
P/C --> S/C	1 (1.9)	0
Total	22	31
Deterioration		
S/C --> x	7 (13.2)	4 (5.4)
S/C --> P/C	2 (3.8)	3 (4)
P/C --> x	0	12 (16.2)
Total	9	19
Total	53	74

No significant difference was found between the patient groups when data from both types of cue were considered together. The more interesting type of cue here is the phonemic type. Semantic cues can aid naming when the subject has not recognised the picture correctly. Phonemic cues provide initial sound information which helps the subject who has recognised the picture but cannot retrieve its name. Did the patient groups show different cueing responsiveness patterns over time? Tables 7.10 and 7.11 below show a further breakdown of the data presented in Table 7.9, by separating test-retest semantic and phonemic cued behaviour.

Table 7.10 **Test-retest Effect of Semantic Cueing (Patient Groups)**

Response Type	Demented	Anomic
Consistent	9	1
Improvement	17	6
Deterioration	9	7
Total	35	14

Table 7.11 **Test-retest Effect of Phonemic Cueing (Patient Groups)**

Response Type	Demented	Anomic
Consistent	13	23
Improvement	5	25
Deterioration	0	12
Total	18	60

Chi-squared was calculated from both Tables 7.10 and 7.11 and found not to be significant for semantic cueing: the groups' reaction to semantic cueing was similar over time. The pattern of response over time to phonemic cues was different between the groups (chi-squared = 7.73, d.f. = 2, $p < 0.025$). The anomic group made as many improved as consistent responses to phonemic cueing and half as many deteriorated responses. That is, they showed a varied pattern of behaviour over time, a finding which suggests accessing difficulty. Although the demented group's errors were largely consistent, they showed no evidence of semantic memory loss in the form of a transition from responses corrected by following phonemic cue to uncorrectable responses.

6.3.3.4 Summary

Test-retest data have been examined in the three of the five ways suggested in section 2.5.2: test-retest consistency, word frequency effect and priming effects (phonemic as well as semantic). Implications from the analyses are made in the following section.

7.4 Discussion

Different trends in group performance over time were found as predicted. Since very few of the changes reached significance, test-retest comparison using the modified battery does not seem to be a practical tool in differential diagnosis. Data from the three single word processing tests were analysed to examine whether responses met the criteria suggested in section 2.5.2 for either semantic memory loss or access difficulty.

The data did not lend themselves to examination of superordinate v subordinate information intactness. The 'time' criterion (accessing semantic memory may be improved if the subject is given more time to respond, but a storage problem will not be so helped) also cannot be explored as subjects were not given a specific time to respond. Instead, they dictated the pace and cues were only given in picture naming on the tester's recognition that the correct name was not going to be given (when an incorrect or inaccurate name was given or no name was given and the subject indicated failure to find the target). This criterion fails to take account of the possibility that accessing difficulty may be so severe that unprompted naming is simply not viable whatever time is given. Therefore the data were examined for frequency effect, cueing effect and performance consistency. Results are discussed under these three headings below.

7.4.1 Effect of Frequency

By the frequency criterion, both groups showed a degree of semantic memory storage deficit in picture naming: four of the seven consistent error responses given by the demented group (i.e. 57%) were made in the last ten pictures as were eleven of the anomic group's twenty six (42%). In addition, there was a steady increase in numbers of consistent errors for both groups as the test progressed and a steady decrease in the number of consistently correct responses. In reading aloud and writing, frequency affected the anomic group's performance only.

7.4.2 Benefit from Cueing

It was suggested that access difficulties will benefit from cues, but loss will not. Both groups were able to benefit from semantic and phonemic cues but they were distinguished by the effect of phonemic cueing over time.

7.4.3 Performance Consistency

The patient groups produced similar rates of consistent naming performance. The AD group produced 22 instances of naming 'improvement' and only nine of 'deterioration'. Of the latter, seven may be considered as evidence of loss. However, the anomic group, with 16 consistent errors, could arguably be said to have shown more evidence of loss. Alternative reasons have been given for the anomic group's number of consistent errors (see section 7.3.3.1). Further testing over time would be required to ascertain whether the responses incorrect on second test are consistently lost. Such behaviour would be evidence for deterioration towards loss.

Of more interest is the analysis of the type of consistency observed in the subjects. For both groups, consistently correct responses were most common but both groups produced responses of all three types, i.e. consistent, improvement and deterioration. The only significant difference lay in the number of correct responses on re-test which had been incorrect (despite cueing) on the first test. The anomic group thereby showed a contraindication of storage deficit. Of the demented group, only subject D14 (who produced 6 consistent errors on naming) showed any strong evidence of semantic memory loss.

7.4.4 Preliminary Conclusion

By the criteria established by Warrington and colleagues (1979 and 1983), both groups showed a frequency effect, had consistent naming errors, failed to name different pictures on retest and responded positively to some extent to cues (but not consistently). The anomic group additionally had several consistent reading aloud and writing errors. Under the current interpretation, both groups showed both semantic memory loss and access difficulty.

7.4.5 An Alternative Interpretation

However, in the demented group, demonstrated semantic memory loss was restricted to the subject who had most difficulty in naming the pictures. In the anomic group, many of the consistent error responses in naming showed evidence of retrieval of the semantic concept and partial retrieval of the necessary phonological information for accurate articulation (targets were often recognisable as phonemic paraphasias). Evidence from the other two tests showed that the anomic group showed most error consistency on 'difficult' stimuli. These findings concur with those of Bayles et al. (1991), in that task difficulty and word frequency influenced performance.

The balance for both groups by these arguments, then, was in the direction of access difficulty, with little evidence for loss. The arguments for accessing difficulties in anomic aphasia are strong while this view can be held for the demented group by default: little evidence for semantic loss was produced by the data. The different rates of improvement and deterioration are the result of the natural process of recovery and deterioration in the patient groups but also lend further weight to the argument for accessing difficulty in both groups.

7.4.6 Conclusion

In conclusion, the evidence presented here gleaned from test-retest data on naming, reading and writing tests, fails to support the hypothesis that people with AD show semantic memory loss. At the stage when confusion with fluent aphasia is possible semantic memory loss is not a symptom which can be used to distinguish the two groups.

Chapter 8
Discussion

8.1 Introduction

Four studies have now been presented, whose results were examined by test scores and partly by error analyses. Both aspects of performance proved instructive and discriminative. This chapter will discuss and interpret the findings with a view to answering the questions posed in chapter 1 (see section 1.2).

The null hypothesis, that there is no difference between fluent aphasia and the language disorder of AD, can be rejected. Fluent aphasia can be distinguished from the language of early AD. Differences were observed via both patterns of scores on the test battery and error behaviour. A combination of test scores and error behaviour best distinguishes anomic aphasia and early AD, while mean language test scores alone distinguish Wernicke's aphasia from AD. No specific language processing deficit was found in the AD group. The test performance for early AD subjects is qualitatively similar to that of normal ageing, but with more errors. People with early AD remember significantly less than normal older people of the same age. However, the aphasic groups had particular difficulty with phonological processing across tasks and across time. This difficulty was associated with certain word characteristics.

The first question has been answered: fluent aphasia can be distinguished from the language of early AD. The second question, which asked how the groups differ (section 1.2), is answered in section 8.2. The third question, which asked whether patterns of tested behaviour could help in characterising the disorders, is answered in the following two sections. First, in section 8.3, the language of early AD is considered as a less efficient version of normal aged language combined with poor episodic memory. Then, in section 8.4, fluent aphasia is characterised as a specific language processing deficit. To complete the chapter, conclusions and implications are made (section 8.5).

8.2 Distinguishing Fluent Aphasia and AD

Fluent aphasia and the language disorder of AD were distinguished in the current studies. The question posed in chapter 1 asked whether the differences between the groups were a reflection of different rates of error, of different patterns of errors or of a combination of both. This section answers that question in detail and considers also other aspects of error performance which distinguished the groups.

8.2.1 Different Scores?

On a simple level, and as expected, anomic aphasia and the language disorder of AD were not easily distinguished by the present mean test scores. This finding is consistent with that of many previous studies. Mean scores on most of the language and memory tests did not produce significant differences between these groups at either pilot or validation stage. Wernicke's aphasic subjects, on the other hand, were easily distinguished from demented and anomic subjects by mean test scores at pilot stage (see section 5.4). An examination of their error types was therefore considered unnecessary.

A more complex examination of test score profiles used the statistical technique of discriminant analysis. At pilot stage, this method was successful in classifying Wernicke's aphasic subjects (thus reinforcing the differences observed in test scores) but not so successful in classifying anomic and demented subjects. At validation stage, discriminant analysis was relatively successful in distinguishing anomic and AD groups using patterns and weightings of test scores (much more so than when individual test scores alone were compared). However, a misclassification occurred in each patient group. Therefore test score data alone did not produce 100% accuracy but a combination of weighted language and memory test scores produced better discrimination than the level achieved by language test scores alone (Horner et al., 1992). In the validation study, error analyses provided further differential information. These are discussed next.

8.2.2 <u>Different Error Patterns?</u>

Categories of error for the language tests were established first for picture naming (from the preliminary study data). They were modified and extended at pilot and validation stages to account for errors made on the other single word language tests and for those made by the aphasic subjects. Relevant data from picture naming, reading aloud and writing are considered separately below. Distractor selection in the verbal recognition memory test also warrants discussion since a complementary pattern of patient group differences was observed there.

For validation stage error data, no significant relationship was found between the distributions of error types produced by the two patient groups: although the demented and anomic groups shared mainly the same types of errors, they were produced with different frequencies. On none of the tests did the anomic group's distribution of error types resemble the normal's (see section 6.3.3). This finding suggests that the anomic group had language problems of a different origin from those of the other two groups.

8.2.2.1 <u>Picture Naming</u>

The distinction between the patient groups was very clear in the numbers of phonemic paraphasic errors or neologisms produced. Phonemic paraphasias are responses which are recognisable as the target, but produced with some phonological distortion, either addition, omission or substitution of sounds. In neologisms, the target is not recognisable. Responses consist of a string of phonemes that do not constitute a real word in the target language. It is said that in fluent aphasia, neologisms may result from difficulty in word retrieval (a string of phonemes is inserted to maintain the flow of an utterance), from phonological difficulty (neologism is an exaggerated form of phonemic paraphasia) or through perseveration. They may mask word selection blocks, by filling the space that would be left if no word was accessed (Buckingham, 1981b).

Only aphasic subjects produced such sound errors. The theoretical implication of this finding is discussed in section 8.4. Although phonemic errors are said to occur in AD (Bayles & Kaszniak, 1987), these occur later in the disease process, when the present differential diagnostic question would not be raised (i.e. when general behaviour would distinguish the groups). Huff (1988), for example, found phonemic errors comprised only 1% of total errors on the Boston Naming Test (Kaplan et al., 1983) for AD subjects, who represented all stages of the disease.

A positive error type discriminator for the demented group was the picture recognition stage of picture naming. As far as the data allows us to see, demented subjects did not recognise the stimulus and made errors of visual perception significantly more often than anomic subjects but in the same proportion as the normal group.

8.2.2.2 Reading Aloud

Similar patterns of error behaviour were found on reading aloud. Error types were not investigated at the pilot stage, except to comment that most errors made by the demented and anomic subjects were on non-word letter strings and that the Wernicke's group's errors were literal paraphasias, neologisms and perseverative responses. At validation stage, the distributions of types of error provided some insight into the mechanisms which caused the errors. More than half the errors made by the anomic group were phonological/ suprasegmental. This compares with less than 10% for the demented group and suggests that for the anomic group retrieval of the phonological form proved difficult: although the target was correctly identified and its name recognisable, it was distorted, e.g. stress being placed on the first syllable of 'cigar' rather than the second. Difficulty with word production in reading aloud therefore spans both Wernicke's and anomic aphasia and is noticeably rare in AD. For the anomic group, there was no corresponding increase in the number of error types as the number of reading errors increased. This lends further credence to the idea that the anomic aphasics had a particular difficulty in reading aloud, which has been associated with production.

On the other hand, for the demented group there was a significant relationship found so that the demented subject who made more errors also produced more error types. This finding suggests that in AD reading aloud errors are less systematic than in anomic aphasia and possibly the result of a general inefficiency in the language processor. The demented subjects consistently showed that their difficulty with the reading aloud task lay in reading aloud non-word letter strings (novel stimuli). For this group, however, reading real words aloud remains almost intact.

8.2.2.3 Writing

Categories of error were established at validation stage. The largest discrepancy in frequency of error types made by the patient groups lay in the 'no response' category, which reflects the anomic subjects' awareness of spelling problems and their unwillingness to attempt to spell words which they recognised as very difficult. The demented group rarely displayed this behaviour.

The error type differences between AD and anomic subjects on the writing test were less conspicuous than on picture naming and reading aloud. Similarly, while analysis which used the analogy model for reading aloud data was useful in the identification of group differences for that task, different behaviour patterns were observed when the model was extended to writing (see section 6.3.6). Two possible reasons are suggested below to account for this disparity: processes involved and acquisition.

In picture naming and reading aloud a visual representation is presented to be named or read. Response is spoken in both naming and reading aloud tasks so that, unlike writing, both will be adversely affected by deficits in phonological and articulatory output systems. Different input and output channels are employed in the writing task from those used in picture naming and reading aloud, which may explain the disparate patterns of performance. The data showed that the aphasic subjects had specific difficulty with spoken forms, while the demented subjects did not. This issue is considered next through a discussion of acquisition of speech and writing.

The ability to speak is normally developed by children without obvious effort and, by school-entry age, most children will have adequate speech competence to be understood in the classroom. The development of the abilities of writing and spelling is however conscious and effortful. Once the mechanics of writing are in place, the long process of spelling development begins. Rules and patterns have to be learned. Irregular and infrequent words may be remembered in later life because of their unusual character and because they are learned as exceptions to rules (Friederici et al., 1981). In comparison to speech, spelling development is a life-span activity as new words are encountered. Both patient groups showed similar rates of errors on rare words and words with unusual spelling. While demented subjects retain early learned and unconscious skills in spoken forms, aphasic subjects show a specific deficit in this area. More recently acquired skill in spelling shows deterioration for the demented group and thus a dissociation from the spoken form of language, while a similar degree of deficit in the two forms are observed in aphasic subjects.

8.2.2.4 Summary

In summary, the patient groups were distinguished through language test error types and their distributions. Furthermore, particular error types tended to be associated with the different patient groups. The writing test results showed fewer patient group differences than results from picture naming and reading aloud tests. Possible explanations for the disparity between spoken and written responses were outlined above.

8.2.2.5 Verbal Recognition Memory

Error analysis was also possible for the verbal recognition memory test. Overall the demented subjects selected most distractors, i.e. they showed most evidence of inaccurate recall of words just read. Some admitted to having selected from among the words to carry out the task since they could not remember any of the words they had just read. Others simply admitted they could not remember any of the previous stimuli. The remainder appeared to attempt the task and selected a combination of correct and incorrect words.

Apart from general behaviour, the choice of distractor responses also provides insightful information. Demented subjects consistently selected most phonetic and unrelated distractors and fewer semantic distractors than the anomic group. They selected a more equal distribution of distractor types than did the other groups (see section 6.3.3.4). These facts, along with their score means and ranges, are indicative of the known short-term memory deficit associated with AD.

Of their errors, the anomic group (like the normal group) selected primarily semantic distractors, as did the Wernicke's group at the pilot stage. Despite the Wernicke's subjects' poor reading aloud ability, the aphasic subjects generally demonstrated more intact verbal recognition memory, with the selection of semantic distractor indicating degraded representations of target responses. On this memory test, aphasic subjects behaved more like the normal group than on the language tests, while the converse was true for the AD subjects, who demonstrated clearly a memory deficit, but had produced 'normal' patterns of error types on the language tests.

8.2.2.6 <u>Other Distinguishing Features</u>

Certain of the error categories and their distributions proved informative in distinguishing the patient groups as presented above. Other aspects of performance also add to the power of the group distinctions: cueing in picture naming, word type effects, stimulus length effect and error consistency. These are discussed below.

First, a distinction was apparent between the patient groups in their responsiveness to cueing. Early indications from the pilot study data were that demented subjects benefit equally from semantic and phonemic cues, while anomic subjects benefit more from phonemic cues. This pattern was replicated with larger numbers of subjects at validation stage, when the difference between the patient groups was even clearer.

The evidence from cueing responsiveness presented above has implications for the question of the origin of picture naming difficulty in the two groups. The anomic pattern allows the interpretation that anomics recognise the pictures and access the required semantic information. Their poor success rate following semantic cue, together with the accompanying behaviour, can be taken to indicate that the recognition function of the cue was already complete. Their difficulty lies in accessing the word form itself. The provision of the first sound(s) of the word aids their naming success. Failure to name correctly following cues cannot be assumed to indicate loss of that name from semantic memory, as often incorrect responses were recognisable as the target (chapter 7). Whereas, the equal success of the two cueing strategies for the demented group could indicate a more general difficulty: sometimes the problem lies in identifying the particular picture and sometimes in finding its name.

Second, the groups were also distinguished by their reaction to different word types in the reading aloud test. Words with unique body neighbourhoods proved most difficult for the anomic group to read aloud, but this group also found consistent words and exception words more difficult than did the other two groups. Anomic subjects' errors were found more in the low frequency than high frequency bands. The implication of this positive finding for the anomic group is considered in section 8.4. On the other hand, the AD group showed no specific difficulty with word type: their difficulty lay solely in reading aloud non-word letter strings.

Third, the length of words as measured by number of syllables influenced performance for the anomic group at validation stage for picture naming and writing, but not at all for the demented group. Although number of syllables per stimulus was not a significant predictor for the reading test, a significant correlation was found for this test between number of syllables and number of errors for the anomic group only (Friedman & Kohn (1990) also found this relationship). Thus for all three tests, length of word affected performance in the anomic group, but not in the demented group. This disparity can be explained by the anomic group's difficulty with phonological processing (see section 8.4).

Fourth, on all three tests, anomic subjects showed some error consistency over time. The demented group produced similar, very low, degrees of error consistency to the normal group. Many of the anomic group's consistent errors were made on longer stimuli. In reading aloud and writing, the anomic group showed consistency of error on the stimuli they found most difficult (low frequency and unique words) (see above).

8.2.2.6 Summary

The main areas of difference between the patient groups lie in distribution of error types, cueing responsiveness, awareness of difficulty and in consistent sensitivity to word length and word type. The most successful discriminant analysis included both test scores and error data (see section 6.3.9). Thus, a combination of the two types of information, scores and error analysis, produced most distinction between the groups (although separately both types of information yielded very accurate classifications).

The implications from the differential information discussed above are used in the next two sections to elucidate the nature of the deficits underlying fluent aphasia and the language of early AD.

8.3 Characterising the Language of AD

The argument to be presented here has already been summarised in section 8.1: the present data demonstrate that the subjects with AD show no evidence of a specific language processing deficit, although there is ample evidence from test performance of an episodic memory deficit. Indeed, the language of the early AD subjects was like that of the normal older subjects, but with more errors. This section discusses the nature of the deficits underlying the behaviour exhibited by groups of AD subjects through cross-sectional and longitudinal data analysis. Before the AD group is characterised (section 8.3.2), some preliminary comment is made immediately below on the performance of normal older subjects on the battery to direct the discussion.

8.3.1 Normal Ageing: Baseline Measure

Because there are age-related decrements on published tests of language (see chapter 4, Walker (1982) and others), an appropriate base-line for diagnosing elderly people with suspected fluent aphasia or probable AD must be normal elderly individuals. The battery of language tests was developed so that normal elderly people would be able to complete it almost without error.

The normal elderly groups tested provided the appropriate and necessary baseline. The overall numbers of errors made on the language tests were few: mean performances of no less than 91% of maximum possible scores were achieved on the language tests used at both pilot and validation stages. Error types can inform a discussion of the nature of the normal subjects' imperfect performance on the language tests, with the proviso that very few errors were made overall. In picture naming, most of the errors originated in difficulty in retrieving the target name, although a third of the errors can be attributed to an earlier stage of picture recognition. In reading aloud and writing, most of the errors were made on non-word letter strings.

Noted first at preliminary stage, overlap in the mid range of picture naming scores was found among normal and demented subjects. Score ranges also overlapped at pilot and validation stage for all three language tests. Repetition and the Set Test, used at the pilot stage only, produced the same picture. This overlap shows that some normal elderly subjects can produce performances on off-line language tests which are 'pathological' and probably reflect individual differences.

8.3.2 The Language of AD is like that of Normal Ageing

The profile presented on the three language tests at validation stage by the probable AD subjects greatly resembled an normal ageing pattern but with more errors, termed a common process of deterioration by Walker (1982) (see section 2.1). This statement is justified by both test scores and error patterns.

8.3.2.1 Test Scores Evidence

Subjects with AD scored consistently lower than normal older subjects on many of the language tests. Significant differences were found in the mean scores achieved by the two groups at both pilot and validation stage on picture naming and writing (and at pilot stage on the Set Test). No significant difference was found at either stage between their mean performances on reading aloud (or on repetition at pilot stage). The latter finding supports those of Schwartz et al. (1979) and Cummings et al. (1986) who reported intact reading aloud ability (in the face of poor reading comprehension). While several studies have reported deterioration in sentence repetition, Bayles & Kaszniak (1987) state that the repetition deficit is mild at the early stage of AD.

Reading aloud and repeating words represent tasks which Margolin et al. (1990) say do not require access to meaning. Similarly, reading words aloud is known to take less time than naming pictures (Potter & Faulconer, 1975; Glaser, 1992) since no knowledge of the named object is required in the former task. This statement is reflected in how cognitive neuropsychological models conceive of these processes. Both have a route which bypasses both input lexica and the semantic system. Tasks which required the AD subjects to look for items in the mental lexicon (such as Set Test and picture naming) caused them significantly more difficulty than for the normal older subjects.

In terms of general characterisation, people with AD retain normal performance on language tasks which do not require access to meaning, but they have difficulty with tasks which require such processing. On such tasks they produce error type distributions like those produced by normal older people.

8.3.2.2 Evidence from Errors

At validation stage, although the normal and AD groups made different numbers of errors, they made the same patterns of errors (see section 6.3.3) on the single word tests. The picture naming deficit is documented in the literature as one of the first language symptoms in AD. Chapters 4-7 show that the AD subjects' picture naming errors were the result both of difficulty in accessing semantic material, rather than definitive loss of semantic material, and of problems at the first, visual, stage of the naming process. Very similar proportions of visual to lexical errors were found for normal and demented subjects. Similar patterns of cueing responsiveness were also found for normal and demented subjects. Neither group showed a syllable-length effect. Overall, qualitatively the picture naming deficits are similar for both groups.

The reading aloud of non-word letter strings (NWS) proved relatively difficult for demented subjects (in comparison with real word items) as they represent novel stimuli, which cannot be processed automatically. Friedman et al. (1992) hypothesised that their subjects with AD would be unable to make 'deliberate use of a complex cognitive strategy' to decode the unfamiliar material presented. In other words, the well-worn path of known words remains intact, but people with AD have difficulty with novel stimuli. However, the significance of errors on NWS should not be over-emphasised, as (i) data from pilot, validation and retest studies showed that people with AD were, to some extent, able to read NWS and (ii) similar proportions of errors were made on this type of stimulus by normal and demented subjects. Neither normal elderly nor demented subjects made many errors on stimuli with body neighbourhoods which included friends and/or enemies (see section 3.4.2.2).

Overall, both test scores and error analyses can be implicated in the argument that the single word processing skills of people with AD are like those of normal older people with more errors especially on tasks which require semantic memory access. A second characterisation of the language of AD is that a general inefficiency is evident in the language processor, rather than a specific deficit.

8.3.2.3 <u>A General Inefficiency</u>

The data suggest that the deficits shown by the demented subjects reflect a general inefficiency in the language processing system. Several types of evidence support this idea. First, demented subjects produced inconsistent errors on real word stimuli, i.e. generally errors were not made on the same stimuli when a sample of subjects were retested. Therefore, errors did not reflect difficulty with any particular word characteristic: on neither the reading aloud nor the writing test did the demented group show particular difficulty with any of the word types or word length. A third finding further fuels the inefficiency argument: for both picture naming and reading aloud at validation stage, more types of errors were made as more errors were made. Had the AD group showed a specific processing deficit, more of the same type of error would have been expected as subjects made more errors.

In summary, the data indicate that the AD subjects showed no specific difficulty of a linguistic nature, but rather shown a general inefficiency in their single word processing abilities. As discussed in chapter 2, the language difficulties associated with dementia are found among a constellation of other intellectual deficits, including episodic memory especially. To complete the characterisation of the language of the AD subjects, comment is made below on their performance on the memory tests.

8.3.2.4 Evidence from the Memory Tests

AD subjects were consistently unable to recall any detail from a short story following a short delay. This quick decay of episodic memory is well-documented and is one of the core symptoms of AD. Unlike the language tests, verbal recognition memory distinguished AD subjects from the normal group consistently. Again performance for the demented group reflected very poor recall, even with a very brief delay. Thus AD subjects demonstrated language abilities which reached normal levels (reading aloud and repetition), as well as a severe degree of episodic memory loss. Overall, performance on tests of recall showed AD subjects to be severely affected by poor episodic memory, even when the delay was very brief.

8.3.2.5 Summary

The present data have demonstrated that the language processing abilities of people with AD are less efficient than those of normal elderly people when lexical search is required (at least for single word processing). Similar types of error are produced by the two groups. Normal ageing and AD, then, were repeatedly distinguished by their extent of difficulty with the language and, more especially, memory tests, but not by the character of their error performance.

The current data portray the language deficit of early AD as selective. Tasks which require little cognitive effort were spared while those requiring active lexical search, the implementation of rules or a complex set of cognitive actions were affected. This interpretation reflects Emery & Breslau's (1988) contention that the 'structural complexity of linguistic demand' affects performance of people with AD on language tests, which was based on Emery's (1988) finding of an inverse relation between performance and complexity of language task.

A general inefficiency characterises the deficit, which is not well-explained using the modular system offered by cognitive neuropsychology. No particular 'modules' were found to be affected in AD. Instead, the language processor seemed to be operating with less efficiency than normal.

In summary, the present evidence indicates that the single word processing deficit associated with AD is like deteriorated normal older language output, in the face of very poor episodic memory for new information.

8.4 Fluent Aphasia

A very different set of characteristics define fluent aphasia. Two different types of fluent aphasia were studied here. At the pilot stage both Wernicke's and anomic aphasic subjects attempted the test battery, while at the later stages only anomic aphasic subjects were tested. One main aphasic symptom, phonological errors, is discussed below. Then Wernicke's and anomic aphasia are considered separately. The characterisation of Wernicke's aphasia warrants less attention: since the anomic aphasic subjects were more difficult to distinguish from demented subjects, they underwent more testing and produced more data for detailed analysis.

The present data have nothing to add to current cognitive neuropsychological descriptions (see section 3.4.1.1): aphasic single word production is already well-described (Ellis & Young, 1988). The present aphasic subjects did not produce any novel error performance but further confirm the reported levels of breakdown.

8.4.1 <u>A Main Symptom</u>

One error type in particular characterised the aphasic groups in the spoken single word processing tests. They alone produced phonemic paraphasic errors/neologisms: at validation stage the anomic group produced as many phonological errors as semantic paraphasias and tip-of-the-tongue errors. This evidence implies that errors of phonological output is a significant symptom for people with fluent aphasia throughout the severity range. This particular difficulty was alleviated for anomic aphasics by phonemic cueing in picture naming (whereas the more severe form of word production difficulty evinced by the Wernicke's aphasic group was not).

Friedman & Kohn (1990) use an information-processing model to discuss the single route to reading model, but also describe in detail the performance of H.R. (an aphasic man) to show that 'disrupted access to information within the phonological lexicon should have a similar effect upon performance on all tests of single-word oral production, and in ways that can be characterised in terms of phonological properties of the target words.' They found that syllable length was associated with performance for picture naming, reading aloud and repetition and propose that H.R. had a general phonological deficit. This proposition is attractive as an explanation of the types of errors produced by the fluent aphasic subjects over the present spoken language tests, whether or not a modular organisation of language is supported.

8.4.2 Wernicke's Aphasia

In the pilot study, people with Wernicke's aphasia had significantly more difficulty on tests of single-word processing than any of the other three groups: on picture naming, reading aloud and repetition their mean scores were significantly lower than all the other groups. The verbal output of Wernicke's aphasia was characterised by severe phonological distortion (neologisms), which permeated all spoken language tests. Spelling was all but impossible for this group. Performance on story recall (verbal condition) was affected by their difficulty with spoken language. However, on verbal recognition memory, a similar pattern of errors to normal was found. Furthermore, despite severe communication problems, Wernicke's aphasics were observed via the Behavioural Rating Scale to behave normally.

In summary, despite the severe communication deficit associated with Wernicke's aphasia, relatively normal patterns of episodic memory and behaviour are observed. The second, milder type of fluent aphasia studied, anomic aphasia, is characterised below.

8.4.1.3 Anomic Aphasia

As a group, the anomic subjects at pilot stage had less difficulty with the tests than the larger number employed at validation stage, when mean scores on all three single word processing tests were significantly lower for the anomic group than for the normal elderly group. All but one of the anomic aphasics (A5) at validation stage were correctly classified by discriminant analysis on test scores. A5 had very little difficulty at single word level. His anomic difficulties were more obvious, and interfered with communication, at sentence and discourse level.

Anomic aphasia can be characterised as a language disorder which has specific and consistent or sustained symptoms (c.f. the language disorder associated with AD). Word production difficulties at the phonological level have already been described for picture naming and reading aloud (see section 8.4.1.1 above). Several other findings support the argument that anomic aphasia is associated with particular deficits of a linguistic nature: difficulty with particular word types, specificity of error types, effect of word length separate from word frequency effects and error consistency. These have already been discussed as variables which distinguished the patient groups and are discussed below in a characterisation of anomic aphasia.

Although not an absolute finding, the anomic group tended more than the other groups to make more of the same kinds of error as they made more errors. They produced a different distribution of error types for the three language tests at validation stage from the other groups. The frequent error types can be seen as indicating extreme difficulty (see Table 6.9). For example, frequent errors of 'more than two types' indicated severe spelling difficulty. Frequent 'no response' errors indicate the anomics often could not respond or were aware of their spelling difficulty. Similarly, numbers of phonological errors on reading aloud and picture naming underline that particular difficulty.

A significant correlation was found between unique body neighbourhood and reading aloud test performance (see Table 6.23). This specificity was not found in writing, which suggests that the anomic aphasic subjects did not rely on the phonological organisation of a word to be able to spell it. Difficulty in reading aloud was especially common for 'unique' words, but general for lower frequency words (see Table 6.15). Longitudinal data confirmed this pattern of disability. Thus, it appears that anomic aphasics have problems reading aloud words to which they receive infrequent exposure. Words which cannot be read using patterns of pronunciations provide extra difficulty to the language processor.

Another linguistic factor which influenced anomic group performance repeatedly was stimulus length. This was significant in both spoken and written tasks (see section 6.3.5). Data from the writing test show the same pattern of findings as Blicker et al. (1964) (see section 3.3.5.1). The significant correlation between word length in syllables and probability of spelling errors (see Table 6.23) hints at a system in which the more material it processes, the more errors it makes.

The related variables of frequency and length were considered separately in multiple regression calculations. Number of syllables significantly correlated with performance on the two more difficult language tests, while frequency was not significant for either. On the other hand, familiarity (a measure related to frequency) alone predicted performance on reading aloud. Therefore, differential and separate effects of frequency, familiarity and length were found on the language tests for the anomic group.

Finally, error consistency across all three language tests used in the test-retest situation (chapter 7) emphasises that the errors made by the anomic aphasic subjects were due to specific difficulties in language processing. These difficulties were associated with word length, word type and frequency. Overall, better performance was available for shorter, more common, more regular words.

Evaluation of performance by anomic subjects on the memory tests can provide further information to add to the characterisation of the communication disorder associated with anomic aphasia. First, superior scores produced on certain subsections of MMSE in comparison with the demented group (see section 6.3.1.1) reflect the underlying nature of the disorder: episodic memory remains relatively intact, while people with anomic aphasia have difficulty accessing semantic memory (see section 2.5.1).

However, the story recall task did not distinguish the anomic group from the demented group at either pilot or validation stage, when a quarter of the anomic subjects scored 0 on delayed story recall (verbal condition). Bayles & Tomoeda (1990b) produced a similar finding in a comparative study, but report that overall the memory profiles of their aphasic subjects with poor story recall were unlike those of demented subjects. Poor story recall may reflect difficulties in language comprehension and expression at sentence and discourse level, which were not evident during single word processing tasks.

Verbal recognition memory produced a picture in which anomic subjects behaved like normal subjects. They were able to demonstrate degraded memory of words by selecting semantic over phonetic or unrelated distractors.

8.4.1.4 Fluent Aphasia - Summary

While subjects with fluent aphasia showed linguistic deficits on the single word processing tests which were specific and consistent in nature, their memory test performances were similar in type but less efficient than those produced by the normal subjects.

8.5 Conclusions and Implications

The final two sections describe: (i) the extent to which the two aims stated in chapter 1 have been achieved and (ii) implications from the current findings for future study.

8.5.1 Screening Test Battery

A screening test battery was developed on literary and clinical grounds. A pilot study was carried out to evaluate its quantitative potential to distinguish fluent aphasia and the language disorder of early AD. At this stage, subjects with Wernicke's aphasia were clearly different in the abilities tapped by the tests, compared to the other three groups (normal elderly, probable AD and anomic subjects). Their communication disorder was clearly manifested in single-word expression and was characterised by phonological distortions.

A modified battery was administered to larger groups of normal elderly people, people with probable AD and anomic aphasic subjects. The near ceiling performance of the normal elderly people (especially on the language tests) indicates that an appropriate base-line has been established. Discriminant analysis, using both test scores and error profiles, successfully distinguished the groups.

The battery can now be offered to a small number of clinicians working with older people who have communication problems and who are referred for differential diagnosis, so that its effectiveness can be assessed. Modification is likely to be required in the future and some modifications can be suggested from the current findings. For example, modification of story length or delay length might improve the scores achieved by people with anomic aphasia. While demented subjects were absolutely unable to recall the story in the delayed condition, there was a range of scores for the aphasic subjects. Generally the amount of information for recall generated by the verbal recognition memory test allowed aphasic subjects to perform like normals. Therefore, alteration of story recall variables should do likewise and increase the differentiation of the groups by test score.

8.5.2 <u>Fluent Aphasia v. Language in Early AD</u>

Within two limitations (small numbers of subjects and a particular set of tasks) the deficits underlying pathological performances have been explored. No specifically linguistic difficulty was found in the demented group: the profile was similar to that of the normal older subjects (see section 6.3 especially). Their performance pattern reflects a generalised inefficiency in cognitive abilities. On the other hand, aphasic subjects demonstrated a specific deficit in linguistic processing in the face of relatively intact episodic memory (see sections 6.3.2 and 7.4.3 especially).

This study has only considered a small number of off-line language and memory processing tasks. Some future work can be implied from the current data, to develop themes and to explore new possibilities in both the descriptions of fluent aphasia and the language disorder associated with early AD and in their differentiation, e.g. how well can people with fluent aphasia and early AD spell exception words? Are there group differences? This ability was not examined during the present studies.

Several studies have developed from the current data. One examined the possibility of gender differences affecting the performance of older people on a variety of language tests with a range of difficulty (and found none). Another is exploiting data which were collected but not analysed here. It is comparing discourse characteristics (lexical cohesion in particular) of the patient groups under several conditions (picture description, immediate and delayed story recall). While this is not a unique approach (Nicholas et al., 1985a; Maxim, 1991), it was not adopted in this series of studies but may hold useful differential information. A third proposes to examine a potential therapeutic application to anomic aphasia of the single route to reading model. The finding that anomic aphasic subjects had most difficulty reading aloud words with unique body neighbourhoods can be taken forward into the examination of whether this difficulty is associated also with reading comprehension problems. If so, then the ability to understand written text could be effectively remediated through more appropriately targeted treatment of a specific type of word.

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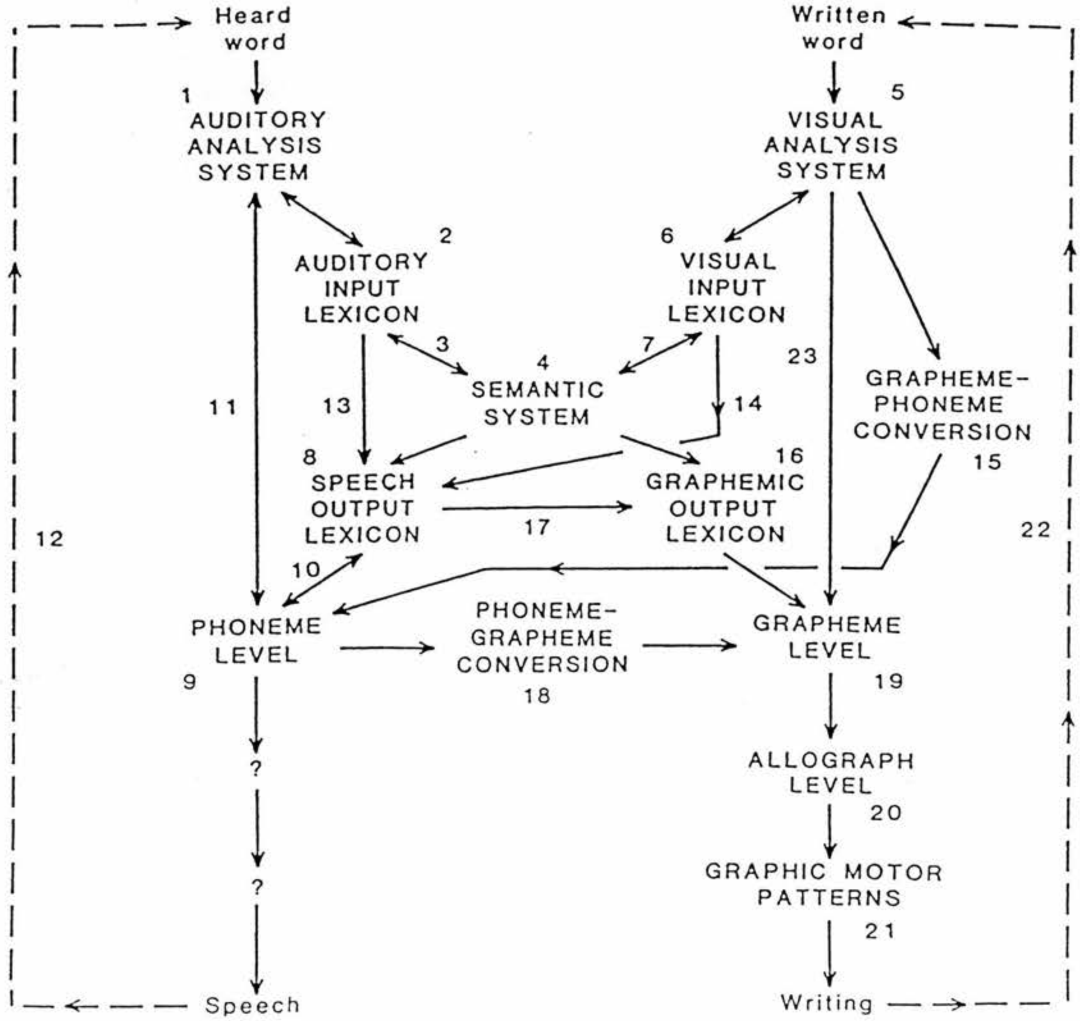
Appendix I Cognitive Neuropsychological Model of Single-Word Processing (Ellis & Young, 1988)



Appendix II Test Stimuli and Instructions

MRC Cognitive Assessment
Items from MMSE are marked *.

(a) Orientation:
What is the time of day (morning, afternoon, evening)?
What day of the week is it?*
What is the date today? (Day, month, year)***
What is the season?*
What county are we in?*
What is the name of this town?*
What are two streets nearby/near your home?*
What floor of the building are we on?*
What is the name of this place/your address?*

(b) Language:
Please nod your head.
Point to the window and then to the door.
I'm going to give you a piece of paper. When I do, take it in your right hand. Fold it in half with both hands. Then set it in your lap.***
Repeat: No ifs, ands or buts.*
Name - pencil and watch.**
Name - elbow and shoulder.
Read and do: Close your eyes*, Cough hard.
Write a complete sentence.*
Copy a complex shape.*

(c) Registration/Recall (new learning):
Give names of three objects - to be repeated*** and recalled later***. (apple, table, penny)

(d) Attention/Calculation:
Subtract 7 from 100, 7 from that number (five times)*****

Memory:
Repeat and recall an address.
Who was - Neville Chamberlain, Guy Burgess?

Praxis:
Show me how you wave goodbye.
Pretend to brush your teeth.

Abstract Thinking:
In what way are an apple and a banana alike?
In what way are a boat and a car alike?

Perception:
Name three objects photographed from unusual angles.

Behaviour Rating Scale

1. When bathing or dressing, ___ requires -
No assistance
Some assistance
Maximum assistance

2. With regard to walking, ___
Shows no sign of weakness
Walks slowly without aid, or uses a stick
Is unable to walk, or if able to walk, needs frame, crutches or someone at side

3. ___ is incontinent of urine/faeces (day or night)
Never
Sometimes (once or twice a week)
Frequently (three times or more per week)

4. ___ is in bed during the day (not on couch)
Never
Sometimes
Almost always

5. ___ is confused (unable to find way around, loses possessions etc.)
Almost never confused
Sometimes confused
Almost always confused

6. When left to his own devices, ___ 's appearance is
Almost never disorderly
Sometimes disorderly
Almost always disorderly

7. If allowed outside, ___ would
Never need supervision
Sometimes need supervision
Always need supervision

8. ___ helps out at home
Often
Sometimes
Never

9. ___ keeps himself occupied in a constructive/useful way
Almost always
Sometimes
Almost never

10. ___ socialises with others
Establishes a good relationship with others
Has some difficulty establishing good relationships
Has a great deal of difficulty

11. ___ is willing to do things suggested
Often
Sometimes
Almost never

12. ___ is objectionable to others during the day (e.g. pilfering, interfering)
Rarely or never
Sometimes
Frequently

13. ___ is objectionable at night (shouting, wandering etc.)
Rarely or never
Sometimes
Frequently

14. ___ accuses others of doing him harm or stealing
Never
Sometimes
Frequently

15. ___ hoards meaningless items (e.g. food, paper)
Never
Sometimes
Frequently

16. Sleep pattern at night
Almost never awake
Sometimes awake
Often awake

Picture Naming

Phonemic cues are underlined. Semantic cues given at pilot and validation stages are listed.

1. Pencil
Pilot: You write with it
Validation: Something you write with

2. Glass
Pilot: You drink from it
Validation: ditto

3. Shirt
Pilot: Men wear this
Validation: ditto

4. Apple
Pilot: It's a fruit
Validation: ditto

5. Hat
Pilot: For your head
Validation: You wear it on your head

6. Ring
Pilot: For your finger
Validation: ditto

7. Sock
Pilot: They come in pairs
Validation: You put it on your foot

8. Sandwich
Pilot: It's a snack
Validation: You might eat it for your lunch

9. Envelope
Pilot: For a letter
Validation: For putting a letter in

10. Banana
Pilot: For eating
Validation: It's long and yellow

11. Star
Pilot: In the sky
Validation: It shines in the sky

12. Dog
Pilot: It barks
Validation: ditto

13. Skirt
Pilot: Women wear this
Validation: ditto

14. Onion
Pilot: It makes you cry
Validation: ditto

15. Waistcoat
Pilot: It goes with a suit
Validation: Worn under a jacket

16. Cat
Pilot: It purrs
Validation: ditto

17. Pipe
Pilot: For smoking
Validation: You put tobacco in it

18. Stool
Pilot: For sitting on
Validation: Something to sit on

19. Fish
Pilot: Lives in water
Validation: Swims in the sea

20. Lemon
Pilot: It's sour
Validation: ditto

21. Hammer
Pilot: For using with nails
Validation: Used for hitting nails

22. Cigarette
Pilot: it comes in a packet
Validation: You smoke it

23. Pear
Pilot: You eat it
Validation: It's juicy

24. Chain
Pilot: Made of metal
Validation: Made of metal links

25. Ladder
Pilot: You go up it
Validation: You climb up it

26. Arrow
Pilot: It shows the direction
Validation: ditto

27. Nail
Pilot: For hammering
Validation: Hit it with a hammer

28. Bell
Pilot: It rings
Validation: ditto

29. Butterfly
Pilot: Eats cabbage
Validation: Pretty flying insect

30. Ruler
Pilot: For measuring
Validation: ditto

31. Horse
Pilot: You ride it
Validation: You can ride it

32. Snowman
Pilot: Children build it
Validation: Children build it in winter

33. Screwdriver
Pilot: Joiners use it
Validation: ditto

34. Barrel
Pilot: For storing herring
Validation: For storing beer

35. Rabbit
Pilot: It hops
Validation: Lives in a burrow

36. Candle
Pilot: It gives light
Validation: Made of wax

37. Toaster
Pilot: It's like a grill
Validation: You put bread in it

38. Guitar
Pilot: A musical instrument
Validation: An instrument with strings

39. Drum
Pilot: Gives the beat
Validation: You bang it with sticks

40. Pineapple
Pilot: An exotic fruit
Validation: A tropical fruit

41. Mushroom
Pilot: You eat it
Validation: A fungus you can eat

42. Owl
Pilot: It's awake at night
Validation: A night bird

43. Crown
Pilot: The Queen wears it
Validation: ditto

44. Elephant
Pilot: A big animal
Validation: It has a trunk

45. Camel
Pilot: Lives in the desert
Validation: ditto

46. Kangaroo
Pilot: Has a pouch
Validation: ditto

47. Sledge
Pilot: It's used in the snow
Validation: It's for sliding in the snow

48. Frog
Pilot: It croaks
Validation: ditto

48. Kite
Pilot: It flies
Validation: It flies in the wind

50. Snake
Pilot: It slithers
Validation: It hisses

Oral Reading

band	grin	ship	foom	chead
and	are	behind	base	county
aunt	debt	castle	street	cigar
fact	promise	attitude	room	head
gand	brin	shup	but	they
gang	cult	sherry	sign	answer
hand	journal	hospital	idea	topic

Verbal Recognition Memory
Pilot Study Targets: cigar, castle, idea, hand, ship, and.

cigarette	boat
thought	also
plant	skiier
castle	palace
chip	lamp
ship	sicker
run	and
cheese	dance
hand	hassle
cigar	idea

Validation Study Targets: cigar, castle, idea, ship, and

Semantic Distractors: cigarette, palace, thought, boat, also.

Phonetic Distractors: sicker, hassle, skiier, chip, land.

Unrelated Distractors: plant, lamp, run, cheese, dance

Repetition

Pliers	Motorcycle	Basket	Peach	Bird
Ashtray	Cap	Broom	Gorilla	Pepper
Pumpkin	Dustbin	Football	Clown	Doll
Box	Wheel	Cannon	Barn	Peacock
Goat	Necklace	Chisel	Thimble	Beetle

Writing

Validation Study only: copy and draw a square, circle and cross. Copy and write pencil, toaster, guitar.

Pilot and Validation Studies: write the numbers 1 to 10, name and address, date of birth and the following -

book	an	mermaid	flood	face
pook	spear	blister	biscuit	you
shace	fallacy	sword	discord	tooth

Sentence Disambiguation

Two practice sentences were given: 'They can fish' and 'The old men and women got into the lifeboat first'. The test sentences were:

1. We are confident that you can make it.
   i.e. physically make or achieve

2. The stout mayor's wife stayed at home.
   i.e. stout mayor or stout wife

3. Italians like opera as much as Germans.
   i.e. Italians and Germans like opera to the same degree
   Italians like opera as much as they like Germans

4. Those who play chess as well as Bill came.
   i.e. 'as good as' or Bill came aswell

5. He wears a light suit in summer.
   i.e. light in colour or weight

There may be other interpretations.

A standard set of test instructions was developed and used throughout the project. The instructions are listed below for the final battery.

MMSE: 'I'm going to ask you some questions and get you to do some things. Some things will be easy and some might be hard, but I'd like you to try them all'.

Picture Naming: 'Here's a set of pictures of common things. I want you to give me a one-word name for each of the. If you get stuck, I'll give you a clue'.

Delayed Story Recall: 'Now I'm going to tell you a short story. Listen carefully because I'm going to ask you to tell me it later on. Do you understand?' Possible second explanation here.

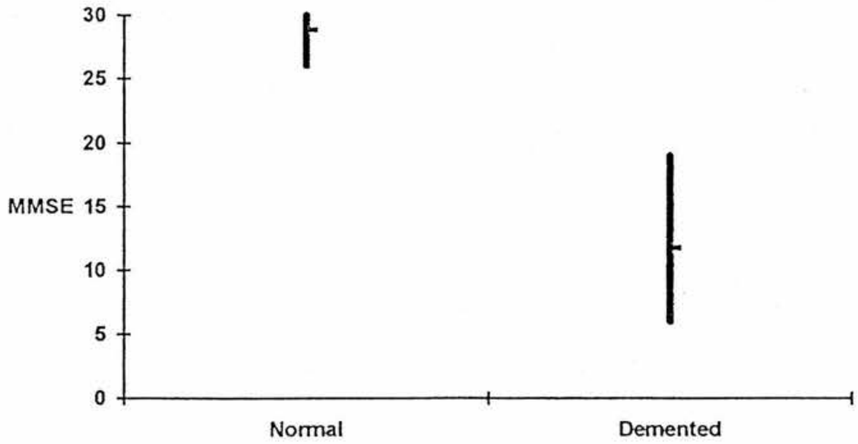
Reading Aloud: 'Now I'm going to show you some cards with things written on them. I want you to read them out aloud. Some will be words and some won't be real words, but try to read them all.'

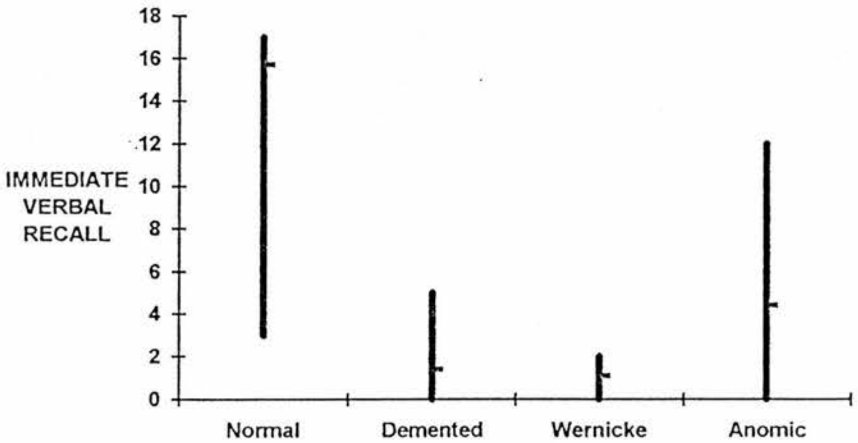
Verbal Recognition Memory: 'Here's a list of words - some of which you've just read on the cards. (Demonstrate cards) Show me the ones you remember from the cards you've just read.'

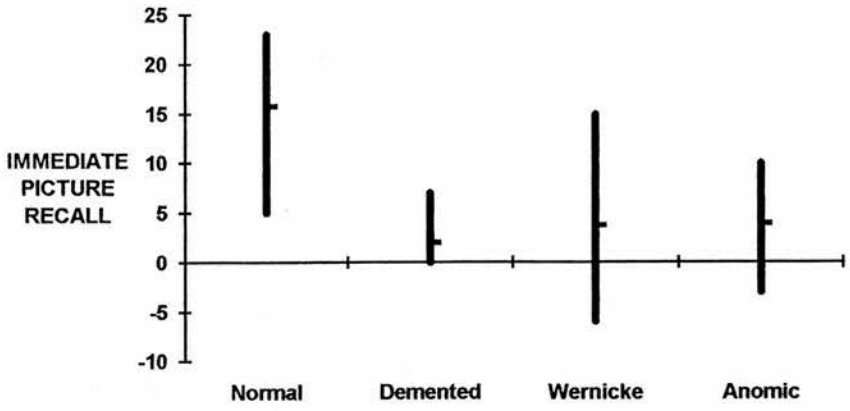
Writing: 'Now I want you to put some things on paper. We'll start off with these shapes. Copy each one .... the same with these words. Now write the numbers 1 -10, ...your name and address .... and your date of birth. Now can you draw a square,....... a circle .... and a cross and write down pencil,....... toaster .... and guitar. I've got a few more things for you to write. Most of them are real words, but some of them aren't. Try to write them all'.

Delayed Story Recall: 'Can you tell me the story you heard earlier on?' Picture condition - 'Now look at these pictures and find the ones that go with the story I told you.... now put them in the right order.'

Appendix III Pilot Study Results



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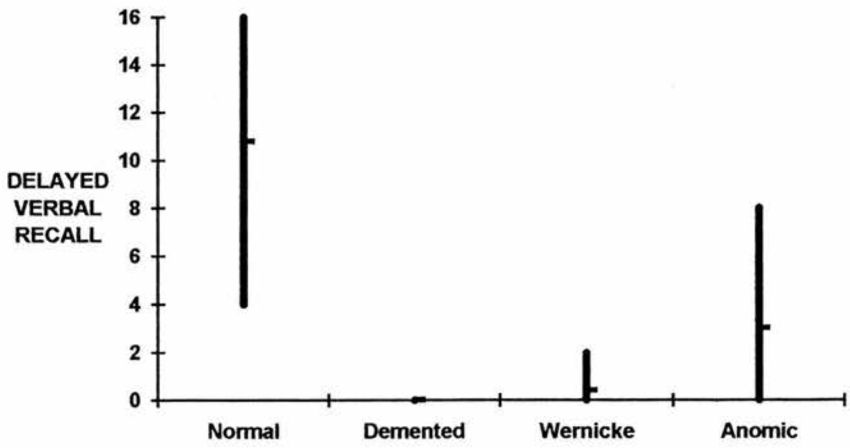
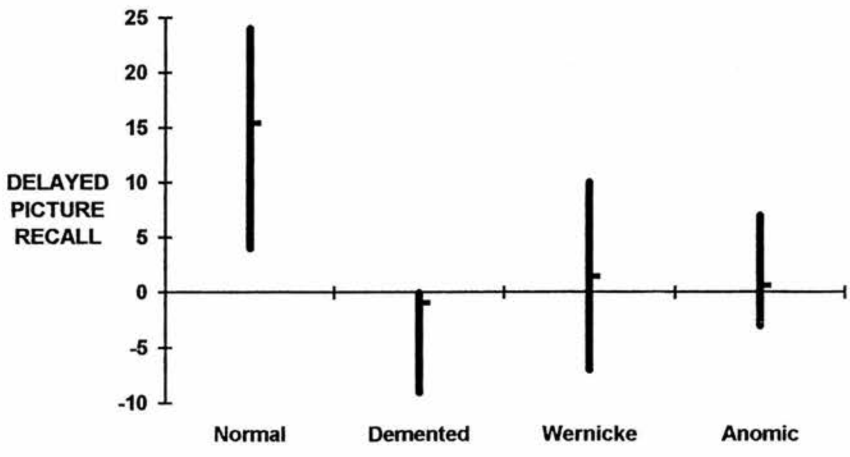
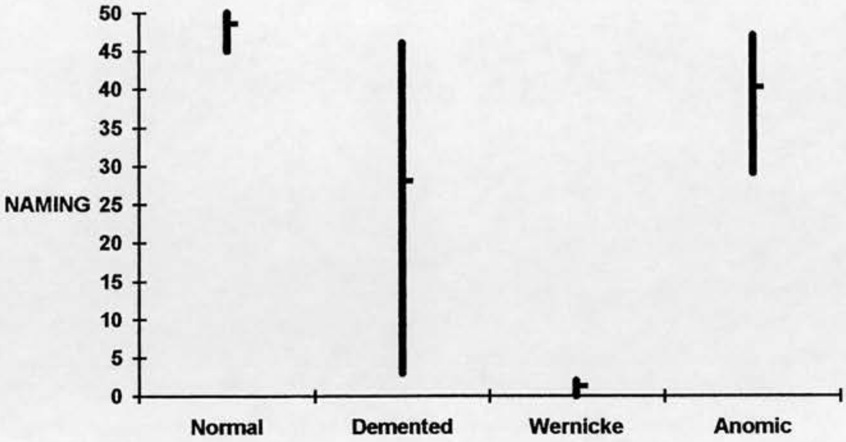
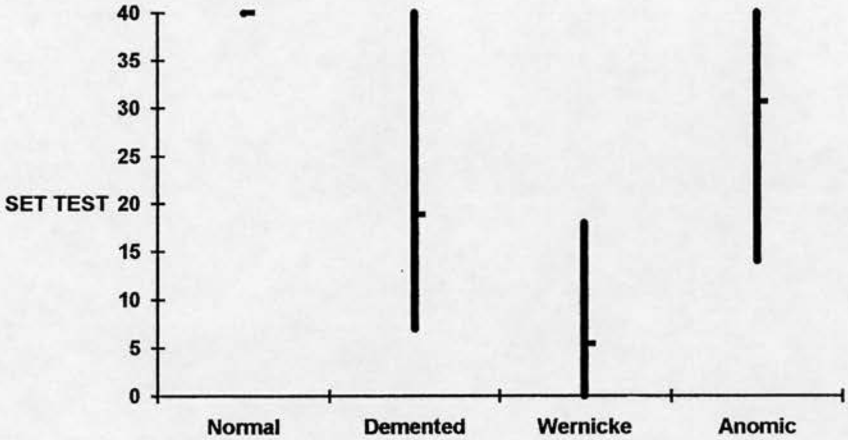
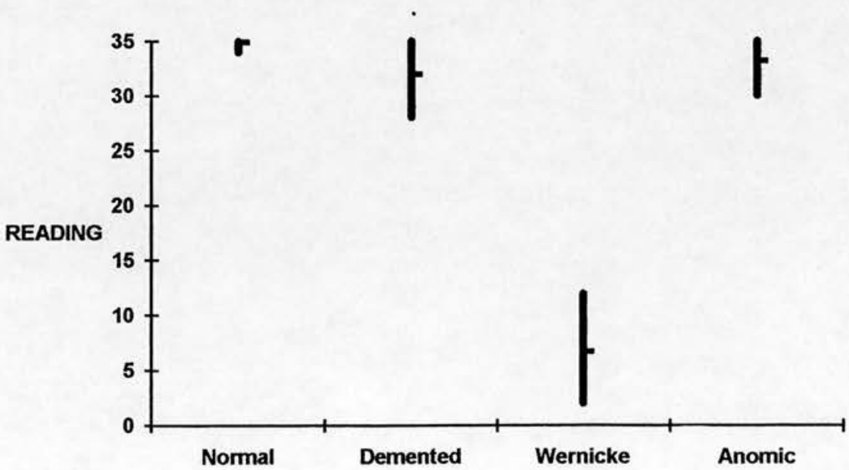
20
15
IMMEDIATE PICTURE RECALL
10
5
0
-5
-10
Normal
Demented
Wernicke
Anomic

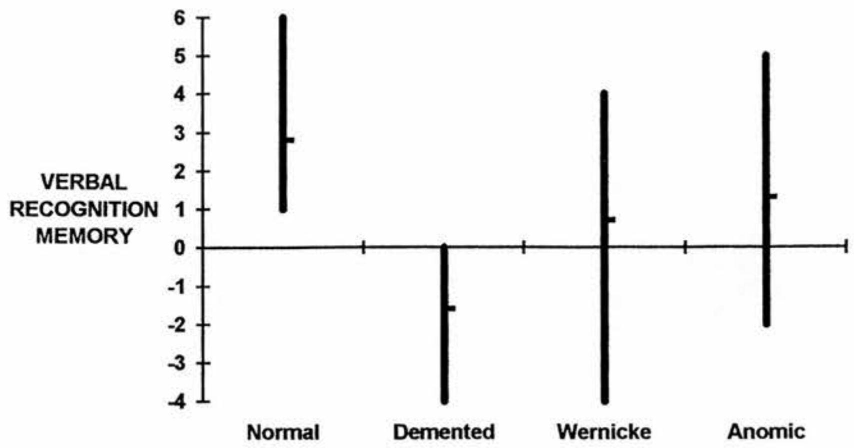

16
14
12
10
DELAYED VERBAL RECALL
8
6
4
2
0
Normal
Demented
Wernicke
Anomic

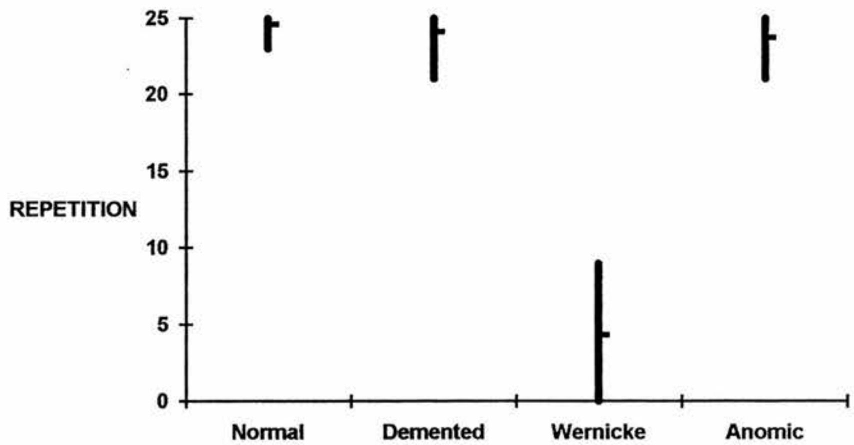

25
20
15
DELAYED PICTURE RECALL
10
5
0
-5
-10
Normal
Demented
Wernicke
Anomic

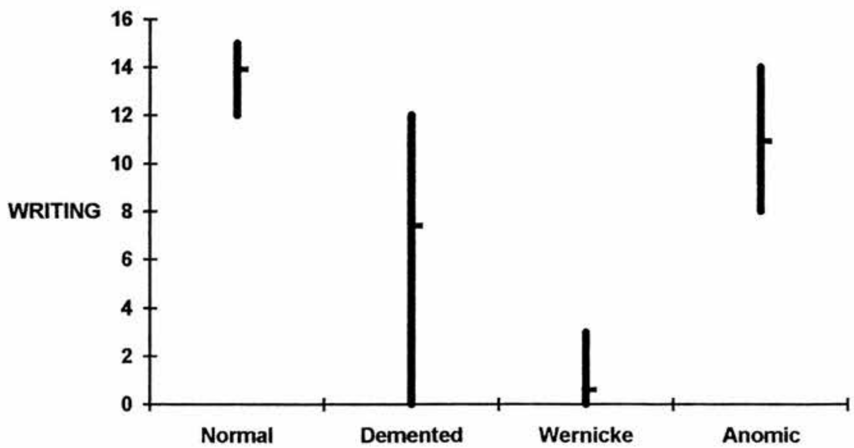

NAMING
50
45
40
35
30
25
20
15
10
5
0
Normal
Demented
Wernicke
Anomic

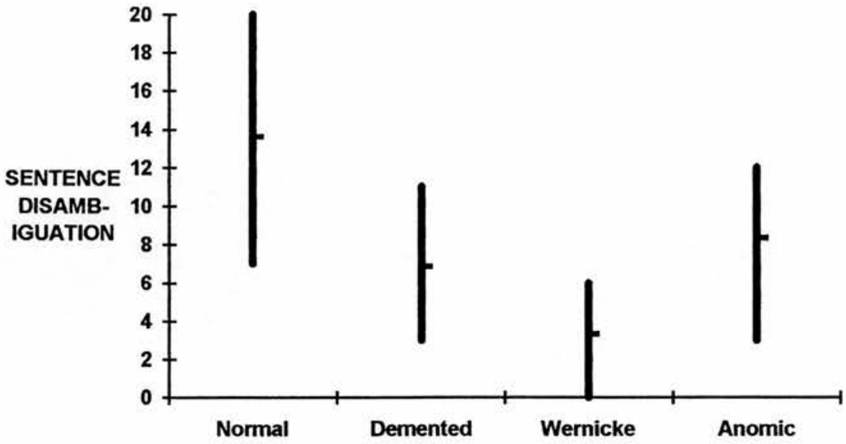

SET TEST
40
35
30
25
20
15
10
5
0
Normal
Demented
Wernicke
Anomic


READING
35
30
25
20
15
10
5
0
Normal
Demented
Wernicke
Anomic

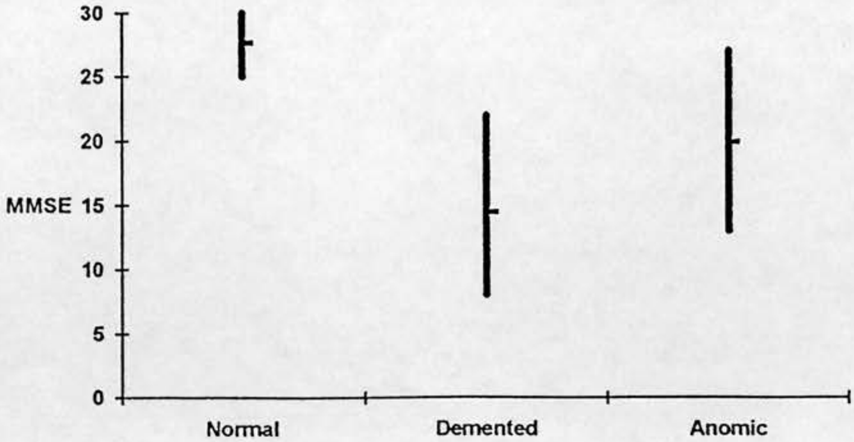

6
5
4
3
2
1
0
-1
-2
-3
-4
VERBAL RECOGNITION MEMORY
Normal
Demented
Wernicke
Anomic

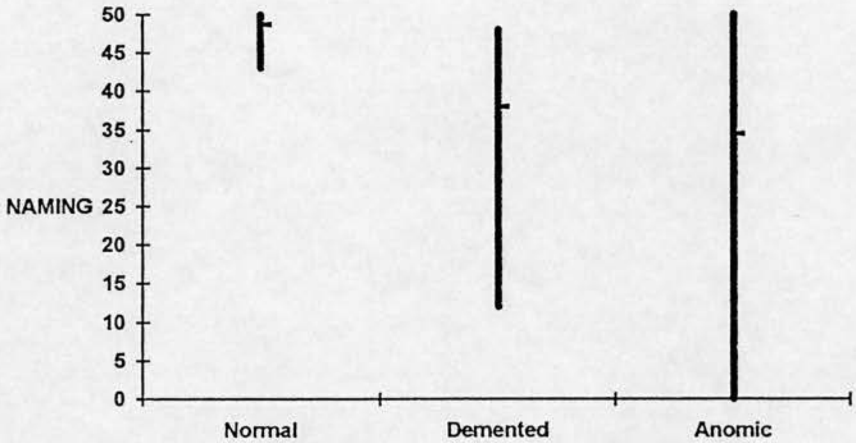

25
20
15
10
5
0
REPETITION
Normal
Demented
Wernicke
Anomic

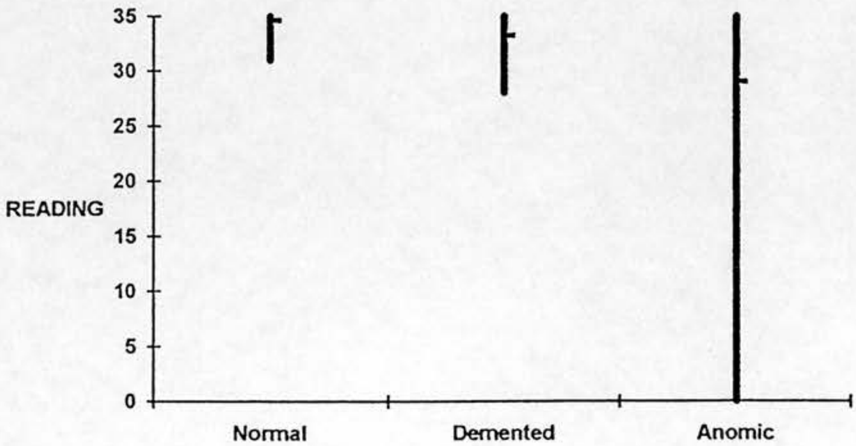

16
14
12
10
8
6
4
2
0
WRITING
Normal
Demented
Wernicke
Anomic

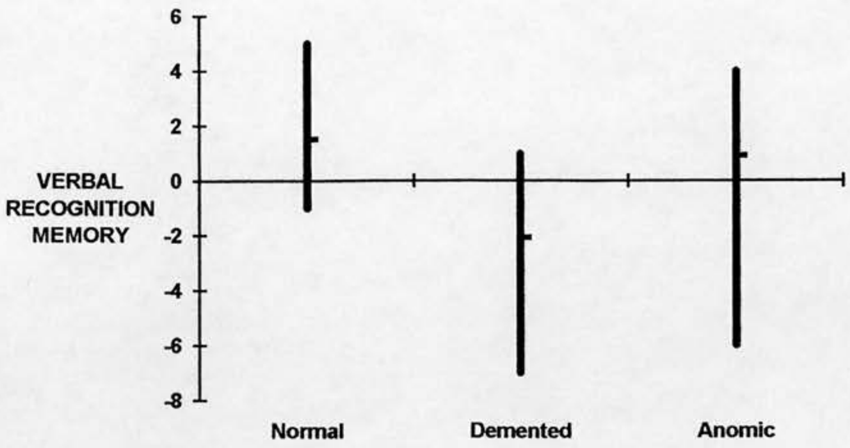

SENTENCE
DISAMB-
IGUATION
20
18
16
14
12
10
8
6
4
2
0
Normal
Demented
Wernicke
Anomic

Appendix IV Validation Study Results

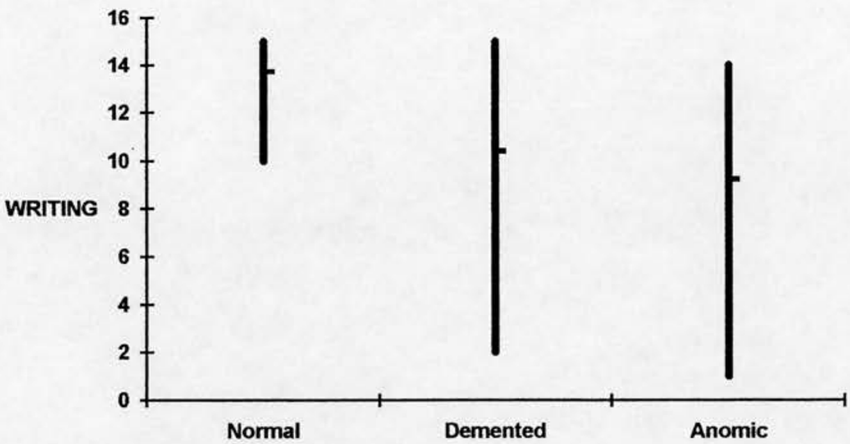




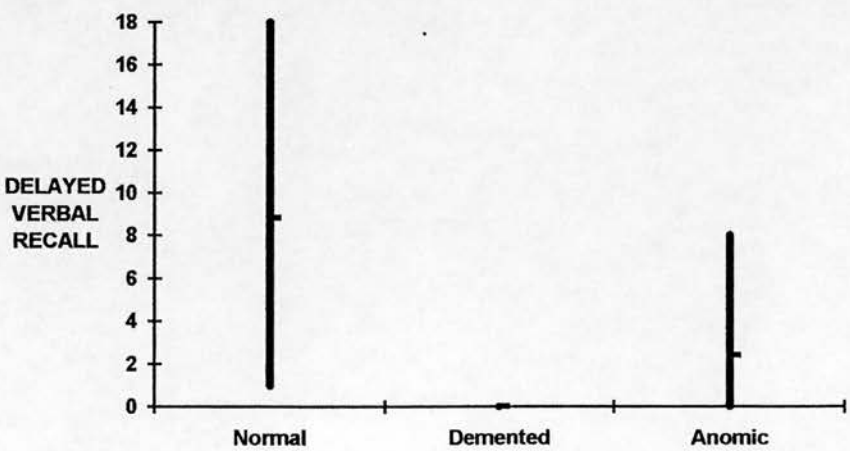




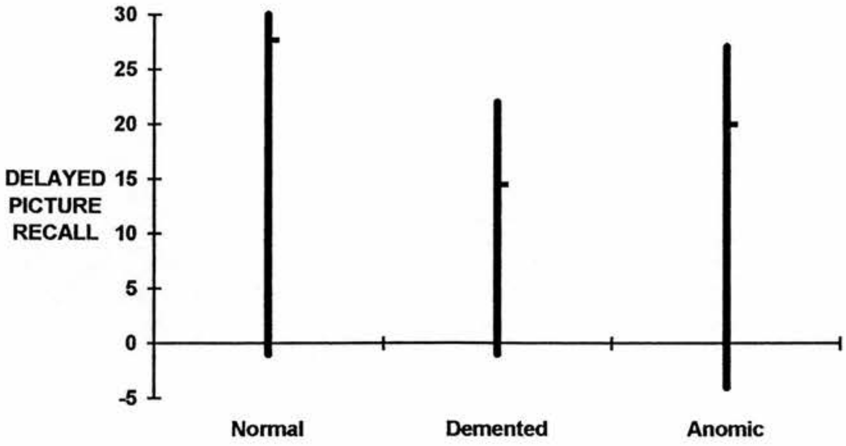
6
4
2
0
-2
-4
-6
-8
VERBAL
RECOGNITION
MEMORY
Normal
Demented
Anomic



16
14
12
10
8
6
4
2
0
WRITING
Normal
Demented
Anomic



18
16
14
12
10
8
6
4
2
0
DELAYED
VERBAL
RECALL
Normal
Demented
Anomic


30
25
20
DELAYED PICTURE RECALL
15
10
5
0
-5
Normal
Demented
Anomic

Appendix V Validation Study Reading Errors

<u>Normal Group</u>

band	grin girn	ship	foom [fom] x2	chead ahead
and	are	behind	base	county country
aunt	debt dept	castle	street	cigar
fact	promise	attitude	room	head
gand grand	brin	shup shrub ship	but	they
gang	cult	sherry	sign	answer
hand	journal	hospital	idea	topic

<u>Demented Group</u>

band	grin grim	ship	foom foam x5	chead shed ahead x4 no resp head cheat
and	are no resp.	behind	base	county country x3
aunt	debt debit	castle	street [slis]	cigar
fact	promise	attitude	room	head
gand grand x3	brin grin brine brim x3 no resp.	shup no.resp.	but	they
gang no resp.	cult cut	sherry	sign no.resp.	answer
hand	journal	hospital	idea [aɪdi] [aɪdid]	topic

Anomic Group

band	grin [gran]	ship	foom [fom]x3 [fun]	chead 'sheed' cheese chit cheatx2 shed head no.resp.
and	are	behind	base [ber]	county country x4 [gaunti]
aunt and auntiex2	debt [dɛpt]x3 debit [dɛp]x2 net [dɛbrɛ]	castle [kastɫ]x2 [karlaɪl] [kadɫ] [asgɪl]	street	cigar [s ger] ['sɪgɪr] x4 cigarette ['sɪkɪr]
fact [faks]	promise [prɔ'maɪs]	attitude 'atshood' stress [astjut] [atidʒud] [atidʒus]	room	head
gand grand band	brin 'drin' [braɪ] brim grin	shup [shup] shut upx2 shrub shut chub	but	they
gang gan gand	cult [kʌtrɪl] guilt	sherry	sign sinx2 [saɪ]	answer andrew [answɪr]
hand 'shan'	journal 'gunnel' joiner journey [dʒarlɪn] [dʒʌrnɛr]	hospital	idea [aɪdi]x2 [aɪia] idol [adi] ideal	topic [tupɪk] [tɔpt] [dʔpɪde]

+35 unclasssified errors made by subject 70, who demonstrated visual comprehension by gestures etc, but was unable to read aloud and recognised this inability.

Appendix VI Validation Study Spelling Errors

Normal Group

BOOK	AN	MERMAID
		mermade
FLOOD	FACE	POOK
		puck
		puke x2
SPEAR	BLISTER	BISCUIT
		buiscut
		buiscit
		buscuit
YOU	SHACE	FALLACY
	chase x4	fallesy
	chaise x2	fallicy
	shaith x2	falishay
	shade	falacy x2
	shayth	fal
	shafhe	falasy
	chaisse	falisacy
	shaze	facility
	chafe	falisy
SWORD	DISCORD	TOOTH
	dischord	thooth

Demented Group

BOOK	AN	MERMAID
	ann	mermade x3
	I	mert?aid
	and	mersaid
		illegible
		mermad
FLOOD	FACE	POOK
flod x2	space	puke x2
fled	fase	cook x3
blood	yace	No response
illegible		puick x2
ylood		phuck
		poke
SPEAR	BLISTER	BISCUIT
beer		bisciut
spier x2		bisccuit
speir		biscut
speer x2		bisccut
ser		bicler
illegible		bisker
spere		

YOU	SHACE	FALLACY
iyu	chase x7	fallucy
nou	shevesh	fallasy
	chace	fall
	No response x3	falasie
	shaith	falasay
	shathe	falacy x5
	shake	tali
	sake	falousy
	stath	falis
		falus
		faliser

SWORD	DISCORD	TOOTH
sond	no response	toottt
sord	disorg	teeth
sowerd	discard	tood
tord	s	
soard		
soarr		

Anomic Group

BOOK	AN	MERMAID
	and x5	mairmid
	annd	mermade
	am	merbaid
		buiacht
		magenan
		medmaid
		meremaid
		mi....din
		mime

FLOOD	FACE	POOK
floudx2	faste	puck
food	feas	cook
a look	faick	pucuk
fold	fact	poopeka
foot	te	put
		bouk
		pueck
		p
		unable to start

SPEAR	BLISTER	BISCUIT
speer x3	bleast	biscutt
spier	DNAx2	buiscet
spere	spe	NR
DNAx2	plister	buiscuit
NR	bilster	DNAx2
spead	blosi	bicuit
sleer		buicuit
		bisurt
		buicsit

YOU
my
DNAx2
yus

SHACE
shath x3
chase x2
shaves
yeath
chaste
shate
DNAx2
sp
NR
shade
skece
shaces
si

FALLACY
falac
valacie
falasity
NR x3
falasay
fiihday
DNAx2
value
falasue
falacex2
phalice
fallcy

SWORD
shord
DNAx2

DISCORD
discourt
DNAx2
biscourt
NR
dicord
dascord
dic

TOOTH
tooch
touth
DNAx2
toothe

Appendix VII Group Responses by Individual Naming Stimulus

N.B. Sem. = number of subjects by group (nor/dem/ano) who named the stimulus correctly following semantic cue. The second and third rows are numbers of responses correct following phonemic cue and incorrect despite cues. (N.B. These figures are based on different total attempts.)

1. Pencil	2. Glass	3. Shirt
Sem. 1/1/2	Sem. 0/0/1	Sem. 2/5/2
Phon.0/0/0	Phon.0/0/2	Phon.0/4/2
x 0/0/2	x 0/0/1	x 1/2/2
4. Apple	5. Hat	6. Ring
Sem. 0/1/0	Sem. 0/0/0	Sem. 2/9/4
Phon.0/2/0	Phon.0/0/1	Phon.0/1/0
x 0/0/1	x 0/0/1	x 0/0/0
7. Sock	8. Sandwich	9. Envelope
Sem. 0/0/0	Sem. 0/3/1	Sem. 0/2/3
Phon.0/0/2	Phon.0/0/2	Phon.0/0/1
x 0/1/1	x 1/2/0	x 0/0/4
10. Banana	11. Star	12. Dog
Sem. 0/0/0	Sem. 0/1/2	Sem. 0/0/0
Phon.0/0/0	Phon.0/0/0	Phon.0/0/0
x 0/0/1	x 0/2/0	x 0/0/0
13. Skirt	14. Onion	15. Waistcoat
Sem. 0/2/2	Sem. 1/4/1	Sem. 0/1/0
Phon.0/0/2	Phon.0/2/2	Phon.0/0/4
x 0/0/0	x 0/1/1	x 0/1/4
16. Cat	17. Pipe	18. Stool
Sem. 0/0/0	Sem. 0/0/0	Sem. 0/1/1
Phon.0/0/0	Phon.0/0/0	Phon.0/1/5
x 0/0/1	x 0/0/1	x 0/0/2
19. Fish	20. Lemon	21. Hammer
Sem. 0/0/0	Sem. 0/2/1	Sem. 0/0/0
Phon.0/0/0	Phon.0/2/5	Phon.0/0/1
x 0/0/0	x 0/2/0	x 0/0/0
22. Cigarette	23. Pear	24. Chain
Sem. 0/4/0	Sem. 0/3/0	Sem. 1/0/0
Phon.0/0/2	Phon.0/0/1	Phon.1/4/6
x 0/0/4	x 0/1/0	x 0/0/4
25. Ladder	26. Arrow	27. Nail
Sem. 0/1/0	Sem. 0/0/0	Sem. 0/3/0
Phon.0/0/4	Phon.1/1/3	Phon.0/0/2
x 0/1/0	x 2/6/ 7	x 0/1/1

28. Bell
Sem. 0/1/1
Phon.0/0/2
x 0/0/0

29. Butterfly
Sem. 0/1/2
Phon.0/0/2
x 0/2/5

30. Ruler
Sem. 1/1/1
Phon.0/3/4
x 0/6/4

31. Horse
Sem. 0/3/1
Phon.0/0/2
x 0/0/0

32. Snowman
Sem. 0/3/1
Phon.0/2/2
x 0/2/4

33.Screwdriver
Sem. 0/2/0
Phon.0/6/5
x 1/3/6

34. Barrel
Sem. 0/0/1
Phon.0/1/3
x 0/0/2

35. Rabbit
Sem. 0/1/0
Phon.0/0/2
x 0/1/0

36. Candle
Sem. 0/1/0
Phon.0/1/1
x 0/0/2

37. Toaster
Sem. 2/11/1
Phon.1/1/2
x 1/6/5

38. Guitar
Sem. 2/3/0
Phon.1/6/4
x 0/7/3

39. Drum
Sem. 0/1/3
Phon.0/0/1
x 0/1/2

40. Pineapple
Sem. 0/1/0
Phon.0/6/11
x 0/3/3

41. Mushroom
Sem. 0/0/1
Phon.0/1/4
x 0/5/2

42. Owl
Sem. 0/3/0
Phon.1/5/3
x 0/1/1

43. Crown
Sem. 0/3/3
Phon.0/0/3
x 0/3/4

44. Elephant
Sem. 0/0/0
Phon.0/0/0
x 0/1/3

45. Camel
Sem. 0/2/0
Phon.0/3/2
x 0/3/5

46. Kangaroo
Sem. 0/0/0
Phon.3/11/10
x 0/3/2

47. Sledge
Sem. 3/5/1
Phon.0/2/0
x 1/4/6

48. Frog
Sem. 1/1/0
Phon.0/3/2
x 0/4/5

49. Kite
Sem. 0/0/1
Phon.2/5/3
x 0/1/1

50. Snake
Sem. 0/1/0
Phon.0/1/4
x 0/2/2

Two of the items produced no errors: both between items 11 -20. Four more produced only one error among all three groups: each made by an anomic subject. Many of the stimuli produced similar performances for the patient groups, e.g. items 30, 33. Several produced very different error performance profiles, e.g. item 37 produced 18 errors by demented subjects and item 38 produced twice as many errors by demented subjects than anomic subjects.

Appendix VIII Single Case Studies

There follow short descriptions of two normal elderly, two demented and two anomic subjects who were, in all but one case, tested three times. One demented subject was tested only twice. One Wernicke's aphasic was also tested twice. His results are also presented.

N12

This gentleman was born on 27.7.09 and lives alone, is independent in daily care and helps neighbours. He believes his healthy old age is the result of his religious faith.

	11.7.89	25.11.91	14.2.92
MMSE	28	27	27
Naming	50	48	49
Reading	35	35	35
Repetition	24		
Set Test	40		
V.Recog.Mem.	1	-1	1
Writing	14	14	14
Disambiguation	10		
Imm. V. Recall	15		
Imm. P. Recall	15		
Del. V. Recall	15	11	9
Del. P. Recall	20	4	11

Comments: Errors made on MMSE were not consistent (see below) -

	11.7.89	25.11.91	14.2.92
Orientation	9	10	10
Language	9	8	8
Reg/Rec	6	6	5
Att/Calc	4	3	4

He produced very few naming errors, which included one semantic paraphasia and two visual misperception errors. He was not able to name one picture despite cues on 25.11.91 and named correctly following semantic cue on 14.2.92. On verbal recognition memory mis-selections were made at each stage. In writing, 'shace' was incorrectly spelled at each stage. Non-assessed writing tasks were correctly completed at each stage. Delayed verbal recall shows progressive deterioration but fluctuation is evident in delayed picture recall. Two pictures were wrongly included on 25.11.91 and three on 14.2.92. In summary, his test results show little variation in language scores but some fluctuation in memory scores.

N2

This lady, born on 8.11.08, lives with her daughter's family. She wears a hearing aid and uses a walking frame. She attempts the Scotsman crossword daily and maintains an interest in current affairs.

	12.7.89	1.10.91	28.2.92
MMSE	30	29	27
Naming	45	46	48
Reading	35	33	35
Repetition	23		
Set Test	40		
V.Recog.Mem.	3	5	2
Writing	14	14	13
Disambiguation	12		
Imm. V. Recall	14		
Imm. P. Recall	20		
Del. V. Recall	10	14	12
Del. P. Recall	18	20	20

Comments: Some fluctuation is evident in test results, although all scores vary by three or less over time. Most MMSE errors can be attributed to hearing loss, e.g. omitting all /s/ in the repetition task (see below for profile) -

	12.7.89	1.10.91	28.2.92
Orientation	10	10	10
Language	9	9	8
Reg/Rec	6	5	4
Att/Calc	5	5	5

Naming errors consisted mainly of WFD and visual misperception errors. Only on one stimulus was the picture name not produced despite cues. On one occasion, she read two non-words as words, but this is not a loss of reading skill as when next tested she read all stimuli accurately. She only once selected a distractor in the verbal recognition test. Scores in the writing test reflect errors on non-words, which were realised as real words. She completed non-assessed writing tasks without difficulty. In summary, this lady is another octogenarian who has maintained language and memory skills.

D17

This lady is a widow who stays alone, but with support from her son and his family who lives locally. She was born on 8.12.12 and attends a psychogeriatric day hospital three times weekly.

	3.11.89	18.12.91	11.3.92
MMSE	19	19	16
Naming	36	43	42
Reading	35	31	35
Repetition	25		
Set Test	35		
V.Recog.Mem.	0	1	0
Writing	12	13	14
Disambiguation	6		
Imm. V. Recall	2		
Imm. P. Recall	7		
Del. V. Recall	0	0	0
Del. P. Recall	0	0	0

Comments: performance over time is very stable and indeed there are some instances of improvement in language scores. MMSE score on third testing was reduced from previous occasions by her inability to subtract 7s from 100 (see profile below) -

	3.11.89	18.12.91	11.3.92
Orientation	6	7	7
Language	7	6	6
Reg/Rec	3	3	3
Att/Calc	3	3	0

Naming errors included visual misperceptions, semantic paraphasias, did not recognise errors, WFD and circumlocutions. Errors over time are tabulated below -

	Dem5	49	L
Vis. Mis.	4	1	2
Sem. Para.	6	2	3
Did not recog.	2	1	1
WFD		3	1
Circumlocution	2		1

On first testing, only one picture was not named despite cues. On the second and third occasions all pictures were named correctly with cueing. On the only occasion she made reading errors, two were non-words realised as real words, and one visual and one semantic error were made. Repetition was completely intact and she was one of the subjects who scored above the authors' suggested cut-off for dementia on Set Test. Writing performance was within normal limits - errors were almost entirely on non-word stimuli. Non-assessed writing tasks were completed on each occasion apart from the year of her birth which she was unable to recall. On one occasion she correctly identified one of the targets in verbal recognition memory. At no stage did she select any pictures to demonstrate delayed recall, although she showed some ability in immediate story recall. In summary, this lady is showing stability over time, with deterioration on memory tests but relatively intact language skills.

D4

This lady was a widow, born on 7.3.11. She stayed alone but received much support from a daughter who lived very close, on whom she was very dependent. She attended a psychogeriatric day hospital three days weekly and died shortly after the second test session.

	8.7.91	8.6.92
MMSE	13	7
Naming	44	39
Reading	35	30
Repetition		
Set Test		
V.Recog.Mem.	0	0
Writing	13	9
Disambiguation		
Imm. V. Recall		
Imm. P. Recall		
Del. V. Recall	0	0
Del. P. Recall	0	0

Comments: This lady's test performance showed much deterioration over one year (c.f. Dem5/49/L). She scored

0 both times on the calculation section of MMSE and showed deterioration on the remaining three sections (see profile below) -

	8.7.91	8.6.92
Orientation	4	1
Language	5	4
Reg/Rec	4	2
Att/Calc	0	0

Naming errors are tabulated below -

	8.7.91	8.6.92
Sem. para.	3	5
Did not recognise	1	2
Visual mispercep.	2	3
Circumlocution		1

Two pictures were not named despite cueing on the second test occasion. There is a trend for more of the same type of errors to occur and on the second occasion she also made one circumlocution error. On the second reading test she made three non-word errors and two errors on real word stimuli. In the writing test, she mis-spelled both non-words on both occasions, but also made errors on four real words on the second occasion. Non-assessed writing tasks on the first occasion showed one spelling error and inability to recall the name of her home town. One year later, she was unable to copy a cross (she perseverated on the previous shape) or to copy any of the three words. When drawing the shapes, she again perseverated which prevented her from drawing the cross. She also perseverated on the second word written to dictation, but was able to write two of the three words correctly (although unable to copy them). She correctly wrote the figures from 1-10 and gave her initial and maiden name. She was unable to recall her address, but was sure it was somewhere near Liverpool. She was unable to recall her date of birth. On neither occasion could she verbally or by pictures recall any detail from the story. In summary, deterioration of approximately 15% was evident in one year. Deterioration was evident in both memory and language tests. In addition, attention control and concentration deteriorated over time and perseveration was an intrusive difficulty at the time of the second test session.

A1

This gentleman, born on 20.12.27, suffered a C.V.A. in 1987. He was advised not to return to work as a foreman in a paper mill and lives in retirement with his wife. He is very uncertain in communication (naturally a nervous and quiet man), but continues to be motivated to improve communication skills.

	1.12.89	9.7.91	5.2.92
MMSE		19	16
Naming	29	38	39
Reading	32	30	31
Repetition	23		
Set Test	18		
V.Recog.Mem.	5	3	1
Writing	9	9	10
Disambiguation	8		
Imm. V. Recall	0		
Imm. P. Recall	2		
Del. V. Recall	0	5	4
Del. P. Recall	0	15	5

Comments: MMSE shows an apparent deterioration over time (see profile below) -

	9.7.91	5.2.92
Orientation	8	7
Language	7	6
Reg/Rec	2	2
Att/Calc	2	1

Naming errors are tabulated below -

	1.12.89	9.7.91	5.2.92
Sem. paras	2	2	6
Superordinate	2	0	3
WFD	6	5	3
Circumlocution	9	2	0
Phonological err.	2	2	0

A degree of consistency in misnamed stimuli is evident. Nine of the stimuli were spontaneously named incorrectly in all three test sessions and a further seven were misnamed in two of the three sessions. A reduction in the number of WFD, circumlocutions and phonological errors can be seen in conjunction with an increase in the numbers of semantic paraphasias and superordinate errors. Three pictures were not named despite cueing on the first occasion, four on the second and on the third. A degree of consistency was also evident in the reading test - 'debt' was misread three times. Most reading errors were phonological or in stress placement. Writing error performance is profiled below -

Stimulus	1.12.89	9.7.91	5.2.92
mermaid	mear	mairmid	mermad
pook	pock		
biscuit	biscusts	bisciut	
fallacy	falace	falac	falace
discord	discort		
sword	sward		
spear		speer	speer
you		my	
shace		shath	shas
an			and

He mis-spelled guitar on the second and third occasions (copying/drawing/writing was not included on the first occasion). He offered distractors in the verbal recognition test only on its third administration. There is some fluctuation in delayed recall - from no verbal or pictorial score on first testing, to a reduction from second testing on third testing. At no stage did he select incorrect pictures. In summary, objectively there would appear to be some deterioration in memory over time, with fluctuation in language test performance.

<u>A7</u>

This gentleman, born on 20.12.27, suffered a C.V.A. on 12.9.88. He lives with his wife and was identified through his speech and language therapist. He finds his aphasia difficult to accept and can be verbally aggressive in the home. He was very co-operative on testing.

	21.11.89	13.11.91	17.2.92
MMSE		21	21
Naming	32	36	36
Reading	33	33	33
Repetition	21		
Set Test	32		
V.Recog.Mem.	-1	2	1
Writing	8	12	10
Disambiguation	8		
Imm. V. Recall	2		
Imm. P. Recall	7		
Del. V. Recall	2	5	6
Del. P. Recall	1	15	15

Comments: MMSE subtest scores are given below -

	13.11.91	17.2.92
Orientation	9	9
Language	5	7
Reg/Rec	5	5
Att/Calc	2	0

Naming errors are shown below -

	21.11.89	13.11.91	17.2.92
Sem para	2	4	1
Circum	0	1	0
Persever.	3	1	1
WFD	0	3	3
Phon.para.	11	2	7
Verb. para.	2	3	2

Seven pictures were misnamed at all sessions. A further seven were misnamed on two occasions. Ten pictures were not named on 21.11.89, eight on 13.11.91 and five on 17.2.92. Reading performance produced one consistent error: 'county' was always read as 'country'. Non-assessed writing tasks were completely accurately. Writing error performance is described below -

Stimulus	21.11.89	13.11.91	17.2.92
flood	floud		flud
biscuit	buiscet	buiscet	buiscet
you	oo		yew
shace	chase		
fallacy	falicity	falasity	falacity
discord	disord		discort
tooth	touth		
spear		speer	

In verbal recognition memory, he produced one semantic distractor on first and third testing, and one phonetic distractor on the second test occasion. In summary, this man shows improving memory scores over time, improvement in language scores from first to second testing and stability from second to third testing (with a reduction in writing score).

W3

This man was born on 30.7.10 and lives at home with his wife. He is a retired sales co-ordinator and his main hobby is growing orchids. He is unaware of how his communication abilities are improving over time.

	9.8.89	2.8.91
MMSE		12
Naming	2	15
Reading	12	15
Repetition	9	
Set Test	18	
V.Recog.Mem.	0	2
Writing	1	3
Disambiguation	6	
Imm. V. Recall	0	
Imm. P. Recall	0	
Del. V. Recall	1	0
Del. P. Recall	-1	-9

Comments: Some improvement is evident in all the scores for tests that were undertaken twice. Picture naming was very poor on first test. Naming, repetition and oral reading attempts mainly resulted in phonemic paraphasias and neologisms. He performed better on the Set Test than scores on other language tests would have predicted and it is likely that correct responses were masked by phonological errors. Cueing was not helpful.

On verbal recognition memory, he correctly indicated 4 of the targets on first test (but also pointed out 4 distractors, of which 3 were semantic distractors). On second test he correctly identified 2 of the targets and did not select any distractors. On neither occasion was the writing test completed as he was aware of his difficulty in spelling. Notably on the second occasion, he occasionally used the written form when he was unable to say a picture's name. He was able to write his name and address and the numbers from 1-10 on both occasions and was able to write his date of birth on the second. Finally, he scored 29 on the behaviour rating scale on both occasions.

<u>Summary</u>

The case studies presented above show two people who have fully functional language and memory skills although aged over eighty. Two very different profiles of people with AD can be seen - one deteriorating little over time and the other deteriorating quickly. Three aphasic men were also described, both producing consistent error responses in naming, reading and writing, one apparently with some memory deterioration, the others showing gradual improvement.

Appendix IX Distribution of Naming Performance Over Time (Patient Groups)

N.B. x = error despite cues, pr.+ = prompted correct, + = correct without cues

Demented Group

	Band 1	2	3	4	5	Total
Consistent Response:						
+ --> +	63	76	63	54	47	303
pr.+ --> pr.+	7	0	1	10	7	25
x --> x	0	0	1	2	4	7
Improvement:						
pr.+ --> +	2	1	8	3	7	21
x --> pr.+	0	0	1	2	0	3
x --> +	0	0	1	1	1	3
Deterioration:						
+ --> x	1	0	0	1	4	6
+ --> pr.+	5	2	5	4	9	25
pr.+ --> x	2	1	0	3	1	7

Anomic Group

	Band 1	2	3	4	5	Total
Consistent Response:						
+ --> +	57	57	49	48	37	248
pr.+ --> pr.+	4	5	7	6	5	27
x --> x	2	3	5	5	11	26
Improvement:						
pr.+ --> +	5	5	6	9	6	31
x --> pr.+	1	1	0	1	8	11
x --> +	3	2	4	3	5	17
Deterioration:						
+ --> x	1	1	4	1	1	8
+ --> pr.+	6	1	1	5	3	16
pr.+ --> x	1	5	4	2	4	16