Patterns of Adaptive Functioning in Cortical and Subcortical Diagnostic Groups of Dementia.

Paul Matthew Dammers
Louisiana State University and Agricultural & Mechanical College

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Patterns of adaptive functioning in cortical and subcortical diagnostic groups of dementia

Dammers, Paul Matthew, Ph.D.
The Louisiana State University and Agricultural and Mechanical Col., 1994
PATTERNS OF ADAPTIVE FUNCTIONING IN CORTICAL AND SUBCORTICAL DIAGNOSTIC GROUPS OF DEMENTIA

A Dissertation
Submitted to the Graduate Faculty of the Louisiana State University and Agricultural and Mechanical College in partial fulfillment of the requirements for the degree of Doctor of Philosophy in
The Department of Psychology

by
Paul Matthew Dammers
B.A., Auburn University, 1987
M.A., Wake Forest University, 1989
May 1994
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ABSTRACT

Much debate exists as to the independence of subcortical dementia as a recognizable clinical entity. Researchers in the dementia area seem to accept that cortical dementias are relatively more incapacitating than subcortical dementias. However, there are no empirical studies to support this claim. Impairment in adaptive functioning is one criterion to be met in the diagnosis of dementia according to DSM-III-R (APA, 1987) and NINCDS-ADRDA criteria (McKhann, Drachman, Folstein et al., 1984). However, a comparison of the degree of impairment in adaptive functioning between subcortical and cortical diagnostic groups of dementia has never been systematically and empirically investigated. This study examined the degree to which adaptive functioning can be used to differentiate groups of prototypical subcortical and cortical pathology groups, as well as normal age control subjects. Results of Discriminant Function Analysis covarying effects due to gender differences yielded a significant discriminant function, suggesting that adaptive functioning separates the groups. The PD subjects were correctly classified by DFA at a much lesser rate than either AD or NORM subjects. Thus, despite marked differences in neuropsychological functioning, the PD subjects overlap considerably with the other subject groups.
with regard to adaptive functioning. Follow-up regression analysis suggests that the discriminating variance attributable to adaptive functioning is shared by cognitive status. Indeed, the adaptive variables contributing most to group separation all shared an element of cognition. It is suggested that separating cognitive status from adaptive functioning is perhaps not as important as measuring both facets of behavior in concert. Measuring both areas will allow the clinician to gain a complete understanding of the individual patient.
INTRODUCTION

Subcortical dementia is a clinical syndrome resulting from dysfunction of subcortical nuclei. As a result of this dysfunction, white matter tracts connecting frontal and subcortical nuclei are disrupted. Also, frontal lobe regions projecting to subcortical regions are disrupted. Subcortical dementia has been most extensively researched in the extrapyramidal syndromes (see Appendix I for a complete listing of etiologies). Briefly, the dementia syndrome is characterized by slowed mentation, memory impairment, diminished executive function, and mood and personality changes. Cummings (1990) recently surveyed the subcortical dementia literature and readers may refer to that text for a thorough discussion of the historical foundations of this syndrome. Appendix II contrasts the clinical characteristics of subcortical and cortical dementia syndromes.

While the concept of subcortical dementia (SD) is not new, this syndrome has only been systematically investigated since its reemergence into the scientific literature in 1974 by Albert and colleagues' study of progressive supranuclear palsy. Controversy has surrounded the exploration of this topic. Despite a growing literature, many researchers remain skeptical about whether SD exists as a distinct phenomenon. For example, Mayeux, Stern, Rosen, & Benson (1983) reported a failure to
Stern, Rosen, & Benson (1983) reported a failure to differentiate prototypical subcortical and cortical dementia syndromes using a mental status questionnaire. However, this conclusion was critiqued by Cummings (1990) on the grounds that differences were masked by a failure to analyze language components separately. Also, memory testing was limited to spontaneous recall. Recent studies have demonstrated differences in frontal lobe functions and memory between Alzheimer's dementia (AD) and SDs (Brandt et al., 1988; Cummings, Darkins, Mendez, Hill, & Benson, 1988; Freedman & Oscar-Berman, 1986; Pillon et al., 1986). These studies suggest that when test methodology is sensitive to frontal lobe functions and recognition memory, contrasting profiles of neuropsychological performance may be revealed.

While there has been a considerable growth of information regarding the concept of SD, many questions still remain unanswered. As discussed by Cummings (1990), distinguishing a dementia as subcortical has both theoretical and clinical importance, but clinically, most patients with subcortical syndromes present with treatable dementias. This is in contrast to cortical dementias (e.g., Alzheimer's, Pick's) which are irreversible. Thus a clearer distinction between the two clinical presentations may lead to earlier treatment for those who possess treatable dementias. Theoretically, the role of frontal-subcortical systems in mediating mood/emotion, motivation,
and cognition will be advanced greatly by future SD research. Dementia severity is typically described as more marked in Alzheimer's dementia (AD) than in Parkinson's Disease (PD), suggesting that subcortical dysfunction produces less cognitive impairment than cortical dysfunction. As a result, AD patients are described as relatively more severely disabled, although no systematic behavioral research has been offered to support this claim.

Methodological limitations temper the generalizations that can be made from the current literature regarding subcortical dementia. There is a lack of research using patient groups adequately matched for severity of cognitive impairment (Huber & Shuttleworth, 1990). However, the question should be raised: Is it reasonable to assume that cortical and subcortical groups of dementia can be matched for severity of dementia and if so, how is severity to be defined and which dimensions of severity are most critical? For example, Loring, Meador, Mahurin, and Largon (1986) matched subcortical and cortical dementia groups on age, education, and a dementia rating scale (severity), but subsequent testing still revealed a marked group difference in IQ. Is this IQ difference a result of group membership or another factor to be controlled? Researchers may well be masking the very phenomenon they seek to investigate by attempting to equate on the basis of essentially arbitrarily defined "severity."
Few studies use instruments sensitive enough to document dissociable neuropsychological differences among diagnostic groups of dementia (Mayeux & Stern, 1987). Brief screening exams have been favored in the literature over broad and more comprehensive batteries. Huber and Shuttleworth (1990) reported preliminary data using a comprehensive battery of neuropsychological measures. These results suggested an identifiable pattern of cognitive disturbance. The subcortical syndrome of PD was associated with slowed information processing, intact recognition memory, poor visuospatial skills, disturbance of executive functioning, and depression.

Before presenting the proposed study, it will be necessary to briefly review five relevant areas: (1) the diagnosis of dementia, (2) Parkinson's Disease and its neuropsychological sequelae, (3) the general issue of the assessment of adaptive functioning among dementia patients, (4) the relation between neuropsychological and adaptive functioning, and finally, (5) the relation between affective status and adaptive functioning.
Determination of Dementia. Not all patients with subcortical syndromes develop dementia. In addition to this uncertainty, there is also considerable inconsistency in the criteria used to define dementia and the assessment tools employed in rendering this diagnosis. As suggested by Huber and Shuttleworth (1990) and Cummings (1990), two sets of criteria are employed to diagnose dementia: (1) DSM-III-R (APA, 1987), and (2) Cummings and Benson (1983). Additionally, the NINCDS-ADRDA criteria are used to diagnose probable Alzheimer's Disease (McKhann et al., 1984).

The DSM-III-R criteria are well known in clinical practice, and the NINCDS-ADRDA criteria are frequently used research standards. Both of these criteria include impairment in adaptive functioning as one criterion to be met in the diagnosis of dementia. In contrast, the Cummings and Benson (1983) set of criteria uses objective neuropsychological measures (language, memory, visuospatial function, cognition, and personality/emotion) to detect subtle neuropsychological impairment. This set of criteria is rarely used in clinical practice, and downplays the importance of the loss of adaptive functioning. The NINCDS-ADRDA criteria are also objective and rarely used for clinical diagnostic purposes. The DSM-III-R set of criteria remains the least objective, although most
frequently used criteria. A recent survey found that over seventy percent of clinicians used DSM-III-R criteria, while fewer than ten percent use either Cummings and Benson (1983) or NINCDS-ADRDA criteria (Dammers, Bolter, Batiansila, Todd, Gouvier, & Adams (1993). When used to assess SD patients, DSM-III-R criteria are confounded by the fact that physical disabilities inherent in subcortical syndromes may inappropriately increase the likelihood that patients will be classified as demented. Additionally, these criteria are by definition more subjective in the assignment of the diagnosis of dementia.

The importance of the preceding discussion is to highlight the uncertainty in the literature regarding the assessment and diagnosis of dementia. Additionally, the assessment of adaptive functioning is often neglected, despite the general perception that this factor should be critical in the diagnosis of dementia. Dammers et al. (1993) reported that only approximately forty-three percent of clinicians assess adaptive functioning. The issue of diagnosis is further muddled by the recognition of SD as a clinical entity, and the resultant need for research to discriminate among the dementia subtypes. Huber and Shuttleworth (1990) in compiling preliminary neuropsychological data, utilized all patients diagnosed with PD, rather than limit their sample to demented PD patients. For initial subcortical studies, this approach
seems prudent in an effort to allow comparison among not only different diagnostic schemes, but also levels of cognitive impairment.

**Parkinson's Disease.** First described by James Parkinson in 1817, idiopathic PD is a degenerative brain disease of unknown etiology. In 1861 Charcot and Vulpian (cited by Boller, 1980) reported a dementia syndrome was present in idiopathic PD. Freedman (1990) has recently described the clinical and pathologic characteristics of PD. Readers may refer to that text for a thorough discussion.

The dementia syndrome of PD has proven to be heterogenous in its presentation. Examinations of prevalence rates of dementia among PD patients have revealed rates ranging from 4 to 93 percent (Cummings and Benson, 1983). Marder, Leung, Tang, et al. (1991) reported incidence to be a much better measure of dementia in PD than prevalence, as discordant duration of disease makes it less likely to detect demented PD patients. These authors claimed that as disease duration is shortened by the presence of dementia, than dementia among PD patients may be more common than reflected in the multitude of varying prevalence studies.

It is unclear whether the dementia syndrome of PD is limited to subcortical pathology (Cummings & Benson, 1983). The pathophysiologic basis of the dementia syndrome has
not been explicitly elucidated. However, a role for dopamine is suggested by the covariation of dementia and akinesia and the ability to partially reverse the dementia syndrome with dopamine replacement therapy (Meier & Martin, 1970; Mortimer, Pirozzolo, Hansch, & Webster, 1982). Other neurotransmitters including norepinephrine and acetylcholine have been implicated as well (Stern, Mayeux, & Rosen, 1984; Whitehouse, Price, Struble, Clarke, Coyle, & Delong, 1983). Clearly, the pathogenesis of the intellectual deterioration in PD is not putative nor is it uniform. The consistent finding of a dopamine deficiency and ventral-tegmental-frontal pathology parsimoniously accounts for the subcortical-frontal dementia most commonly observed among these patients. Patients displaying more severe dementias most likely harbor more extensive pathological and neurochemical changes.

As discussed in a recent review by Freedman (1990), studies outlining the neuropsychological impairment of PD patients typically focus on four broad areas: (1) language deficits, (2) memory and learning, (3) visuospatial function, and (4) conceptual ability and mental set. These reports can be summarized briefly.

Language deficits are not typically present among SD patients relative to cortical dementia patients. Even when equated for severity of dementia, it is not surprising that PD patients exhibit greater impairment on motoric speech
functions (e.g., dysarthria, phrase length, speech melody, and writing mechanics) relative to cortical dementia patients (Cummings, Darkins, Mendez, Hill, & Benson, 1988). Two groups of investigators have reported impairment in naming ability in PD patients with intellectual decline (Freedman et al., 1984; Globus et al., 1985).

Reports of deficits in short-term memory are prevalent in the literature (Della Sala, Di Lorenzo, Giordana, & Spinnler, 1986; Halgin, Riklan, & Mistak, 1977; Hamel and Riklan, 1975; Tweedy, Langer, & McDowell, 1982; Pirozollo, Hansch, Mortimer, Webster, & Kuskowski, 1982; Reitan & Boll, 1971). Additional studies have reported impairment in long-term memory (Brown & Marsden, 1988), procedural learning (Cohen & Squire, 1980; Saint-Cyr, Taylor, & Lang, 1988), and retrograde amnesia (Sagar, Cohen, Sullivan, Corkin, & Growdon, 1988). Bondi and Kaszniak (1991) have recently reported selective impairment among PD patients on a skill learning component of the fragmented pictures test. This impairment was revealed despite relatively superior performance on explicit tests of memory relative to AD patients. PD patients have been reported to have a memory deficit for recognition of unfamiliar as well as familiar faces, despite intact measured recognition memory for words (Dewick, Hanley, Davies, Playfer, & Turnbull, 1991).

Specific visuospatial deficits have been well documented in PD patients (Boller, Passafiume, Keefe,
Disturbances in conceptual ability and mental set (executive function) have been well described in PD (Bowen, Hoehn, & Yahr, 1975; Cools, Van Der Bercken, Horstink, Van Spaendonck, & Berger, 1984; Flowers, 1982; Flowers & Robertson, 1985; Lees & Smith, 1983; Nelson, 1986; Taylor et al., 1986). Performance on a simplified version of the Wisconsin Card Sorting Task distinguished AD and PD patients matched globally for severity of dementia.

Additional distinguishing characteristics can be drawn between PD and cortical dementias. Depressive symptoms are less severe in patients with DAT. Depression in PD antedates the onset of movement disorder (Mindham, 1970), is generally not related to the severity of disease (Robbins, 1976; Huber et al., 1988) and is apparently related to a reduction of brain serotonin rather than to dopamine metabolism (Mayeux et al., 1984). In addition,
general neurological abnormalities clearly distinguish cortical and subcortical dementias.

Assessment of Adaptive Functioning. The determination of level of adaptive functioning is frequently ignored in the assessment of dementia. This occurs despite the fact that impairment in functional status is one criterion for the diagnosis of dementia by the DSM-III-R (APA, 1987) and the NINCDS-ADRDA criteria (McKhann et al., 1984). Perhaps more importantly, there is a dearth of evidence to suggest that psychological tests adequately give insight into the functional capabilities of older adults. Existing scales of adaptive functioning will be reviewed followed by a discussion of the correlation between neuropsychological measures and functional status.

A number of scales have been developed to measure demented patients' abilities to engage in activities of daily living; these scales can be generally classified as either self-report or behaviorally based (performance evaluation). Early investigators have relied heavily on the report of caregivers. A discussion of each of these approaches will follow.

Scales to be completed by caretakers, significant others or the patient include the Cognitive Behavior Rating Scale (CBRS; Williams, Davis, Little, & Haban, 1987), the Katz Index of Activities of Daily Living (Katz, Ford, Moskowitz, Jackson, & Jaffe, 1963), the Instrumental
Activities of Daily Living Scale (IADL) (Lawton & Brody, 1969) the Blessed Dementia Rating Scale (Blessed, Tomlinson, & Roth, 1968), the Global Deterioration Scale (Reisberg, Ferris, de Leon, et al., 1982), the Functional Assessment Stages (Reisberg, Ferris, & Franssen, 1985), the GBS scale (Gottfries, Brane, Gullberg, & Steen, 1982), and the OARS: Instrumental Activities of Daily Living Scale (Duke University, 1978; Fillenbaum & Smyer, 1984). The Community Competence Scale (CCS; Anderten, 1981) is a combination of performance evaluation and structured interview. These measures are limited by the fact that they rely upon self-report and thus introduce reporter biases. Additionally, caregiver ratings may also be biased in that they reflect what caregivers allow patients to do, rather than the actual capacities of these individuals (Lowenstein, Amigo, Duara, et al., 1989; Skurla, Rogers, & Sunderland, 1988).

A few behaviorally based instruments have been developed to assess adaptive functioning among the elderly. These measures include the PPG Instrumental Activities of Daily Living (Lawton, 1972), the Activities of Daily Living (ADL) Situational Test (Skurla, Rogers, & Sunderland, 1988), the Echelle Comportement et Adaptation (ECA; Ritchie & Ledesert, 1991), and the Performance Test of Activities of Daily Living Scale (Kuriansky & Gurland, 1976). The latter measure concentrates on basic motoric function
rather than cognitive impairment. Lowenstein, Amigo, Duara et al. (1989) summarized the limitations of these behaviorally based measures of functional status citing their failure to provide a detailed analysis of higher order functional abilities and insensitivity to changes in subskills that occur in incipient phases of AD and other dementias. This group developed a behaviorally-based rating scale, the Direct Assessment of Functional Status (DAFS). This measure was designed to provide a standardized and directly assessed measure of the functional capacities often impaired in dementing illnesses. This measure has high interrater and test-retest reliabilities, as well as good convergent validity with established measures. The DAFS has also been used successfully among a Spanish-speaking population (Lowenstein, Ardila, & Rosselli, et al., in press).

Only one measure has been developed specifically for use with a subcortical dementia patient group. Bylsma and Brandt (1991) developed the Huntington's Disease Activities of Daily Living (HD-ADL) scale, a 17-item self-report instrument. This measure is reliable, has high internal consistency and a stable factor structure. The development of scales such as this for use with specific subcortical syndromes is one way to address the purportedly different clinical sequelae of the various subcortical dementias.
Adaptive and Neuropsychological Functioning. Given a review of the existing measures of adaptive functioning among suspected dementia patients, what is the relationship between these measures and more traditional, more widely used neuropsychological measures? A relationship between dementia severity and functional status has been demonstrated, although correlations are typically modest (Chelune & Moehle, 1986; Eastwood, Lautenschalaeger, & Corbin, 1983; Ferm, 1974; Hart & Hayden, 1986; Heaton & Pendelton, 1981; Lawton & Brody, 1969; Reed, Jagust, & Seab, 1989; Smyer, Hofland, & Jones, 1979; Vitaliano, Breen, Albert, et al., 1984; Wilson, Grant, Witney, et al., 1973; Williams, 1986; Winograd, 1984). Haut, Franzen, Keefover, & Rankin (1991) reported correlations ranging from .02 to .64 between specific neuropsychological measures and the DAFS. Lowenstein, Rubert, & Berkowitz et al. (in press) reported that neuropsychological measures accounted for less than 50 percent of the variance in performance on various functional tasks covered by the DAFS. Eisdorfer, Cohen, Paveza et al. (1992) theorized that functional status is not related to indirect neuropsychological measures. These authors suggested the use of separate instruments to insure an accurate portrayal of the heterogeneous cognitive, psychiatric, and functional impairments found among AD patients.
The above reports highlight the notion that cognitive functioning is sufficiently independent of functional status to warrant separate evaluations when making patient care decisions and perhaps even research inclusion decisions. As stated by Williams (1988, pg. 129), "Although the clinician may know that a patient's IQ is reliably near 85, this knowledge may not reduce the uncertainty in predicting whether this patient can work at a certain occupation, or function independently at work." Additionally, these suggestions of unique variance between functional status and neuropsychological measures are very much similar to those offered in the head injury literature (Butler, Anderson, Furst, Namerow, & Satz, 1989). However, clinicians continue to rely on the results of neuropsychological measures to assist them in making judgments of adaptive capabilities.

A number of researchers have commented on the vast discrepancy between dementia severity and functional status noted in some patients (Skurla, Rogers, Sunderland, 1988; Weintraub, Baratz, Marsel-Mesulam, 1982; Wilson, Grant, Witney, et al., 1973). When using global measures of cognitive/functional performance, specific patterns of neuropsychological deficits are typically not predictive of distinct patterns of functional decline (Breen, Larson, Reifler, et al., 1984; Spinnler & Della Sala, 1988; Teri, Larson, & Reifler, 1988). In contrast, Vitaliano et al.
(1984) did report that certain adaptive skills could be predicted by attentional/memory deficits. Also, Teri, Larson, & Reifler (1988) as well as Nadler, Richardson, Malloy, Marran, & Hostetler (October, 1991) reported that the adaptive functioning of AD patients was correlated with the initiation/perseveration and memory subtests of the Mattis Dementia Rating Scale.

In sum, a variety of studies have reported moderate relations between measures of adaptive functioning and neuropsychological measures. Findings have differed across studies due to varying neuropsychological measures (e.g., global versus specific measures) and varying measures of adaptive functioning (e.g., self-report versus behavioral). Notably, what some researchers refer to as "high correlations," others dismiss as "moderate" or as "accounting for less than 50% of the variance." Global cognitive measures are typically inferior to specific neuropsychological tests in their correlation with adaptive functioning. Neuropsychological measures that tap into executive functioning appear to be necessary for the planning, organizing, and initiation of functional activities. The role of mood disorders in the performance of activities of daily living is muddled, although apparently contributory.

Representative diagnostic groups of subcortical and cortical dementia have never been systematically examined
for differences in patterns of functional status. This is a potentially distinguishing factor that warrants investigation. Research to date supports the notion that the area of adaptive functioning warrants study beyond that assessed indirectly by neuropsychological testing. Additionally, the research literature suggests a greater prevalence of depression among SD patients, which may differentially effect their functional abilities.

**Adaptive Functioning and Mood Status.** It is clear that both dementia and depression independently compromise cognitive functioning. However, it is less clear whether their coexistence leads to increased cognitive and functional disability. This coexistence of dementia and depression has been called "double disability" by Pearson, Teri, Reifler, and Raskind (1989).

Early studies have suggested that dementia/depression patients tend to be less cognitively impaired than their dementia only counterparts (Pearson, Teri, Reifler, & Raskind, 1989; Rabins, Merchant, & Nestadt, 1984; Reifler, Larson, & Hanley, 1982). Breen, Larson, Reifler, Vitaliano, & Lawrence (1984) reported differing patterns of relation between measures of cognitive and functional status among dementia and dementia/depression patients. Whereas dementia only patients' intellect significantly correlated with functional status, dementia/depression patients' memory functioning was significantly related to
self-reported functional status. This same research group later reported that tricyclic antidepressants improved functional status and mood ratings in a number of dementia/depressed patients (Reifler, Larson, Teri, et al., 1986). Pearson, Teri, Reifler, and Raskind (1989) reported that dementia/depression patients showed greater impairment of adaptive functioning than dementia only patients. Thus, cognitive impairment appears to be greater among singularly demented patients, although functional impairment is greater among dementia/depression patients.

Haut et al. (1991) have presented the only study of directly assessed functional status and mood status among dementia patients. Although patients presenting with formal diagnoses of depression were not studied, no relationship was observed between functional status and degree of depressive symptomatology.

The purpose of this study was to examine adaptive functioning among representative groups of subcortical and cortical dementia patients. Age-matched control subjects served as an additional comparison group to evaluate the clinical alterations in functioning associated with apparently benign senescent impairment. Subjects were selected to control for major confounding factors such as additional major medical or psychiatric illnesses which may influence test performance. The measure of adaptive functioning is one of proven validity and reliability.
Multiple additional measures were gathered in an effort to comprehensively describe the cognitive status of the subjects, rather than rely upon basic examinations of mental status.

The primary hypothesis to be examined by this study was whether directly assessed adaptive functioning differs between PD and AD diagnostic groups of dementia. Self-reported mood symptoms and neuropsychological variables were also assessed to adequately characterize the status of the samples.
MATERIALS AND METHODS

Sample Characteristics. Subjects diagnosed with probable Alzheimer's Disease and Parkinson's Disease were recruited in cooperation with neurologists practicing in Baton Rouge, Louisiana. The spouses of the subjects described below, if available, were also included in the study as control subjects. Additionally, elderly control subjects were recruited by offering Louisiana State University undergraduate students extra credit.

The neurologists were mailed a description of the study and were asked to refer appropriate subjects. When possible, lists of potential subjects were generated and these individuals were then contacted for possible participation. As an incentive, all participants, should they desire, were provided with a report of their performance suitable for inclusion into their medical chart. Trained examiners administered all tests.

Patient diagnoses were assigned by the referring neurologists' and were supported by at least one objective neurodiagnostic test to rule out the presence of an alternative neurologic condition. Subjects with a diagnosis of Alzheimer's Disease were excluded if focal neurologic signs suggestive of multi-infarct dementia were present on either neurologic exam or neurodiagnostic workup (e.g., CAT or MRI scanning studies). Due to controversy surrounding the assignment of the diagnosis of dementia to
PD patients, all PD patients were entered into the subject pool. This subject sample was chosen to resemble the population typically encountered by practicing clinicians. All subjects were excluded from the study if they had a history of a co-existing neurological disease, head injury with significant loss of consciousness, ongoing substance abuse, acute medical illness, hearing or visual impairment, lack of mastery of the English language, or a premorbid diagnosis of anxiety, depression, or psychosis. All subjects were selected only if they lived independently in either a group or individual setting.

Overall, the sample consisted of predominantly white subjects, with sixty-eight whites and two blacks. It is not possible to determine then, whether the race of subjects might have exerted a systematic influence upon the data. No significant differences between racial groups have been reported in the neuropsychological literature (Lezak, 1983). However, generalizations from the study should be appropriately limited. Subject characteristics were as follows:

1. AD: The sample of AD patients consisted of twenty subjects with a mean age of 72.4 years (s.d. = 8.1). The sample consisted of four males and sixteen females. Mean level of educational advancement was 11.6 years (s.d. = 2.9). All patients met NINCDS-ADRDA criteria for the diagnosis of probable Alzheimer's disease.
2. PD: The sample of PD patients consisted of twenty subjects with a mean age of 67.4 years (s.d. = 9.4). The sample consisted of fourteen males and six females. Mean level of educational advancement was 12.8 years (s.d. = 2.2). Thirteen of the twenty subjects met Cummings and Benson (1983) diagnostic criteria for dementia.

3. NORM: The sample of normal controls consisted of thirty subjects with a mean age of 69.2 years (s.d. = 8.4). The sample consisted of fourteen males and sixteen females. Mean level of educational advancement was 12.2 years (s.d. = 2.8). All subjects were free of neurologic disease.

Materials.

1. Information Questionnaire. This measure included questions about demographic variables, major medical illnesses, neuropsychological risk factors, family history of neurological/psychiatric disorder, current medications, and prior experience with neuropsychological tests (see Appendix III). Information from this measure was used to characterize the subject sample, and to make exclusionary decisions.

2. Mood Status. The subjects were administered the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1977). This is a widely-used, highly reliable, and valid measure of anxiety. As a measure of depression, the subjects were administered the Beck Depression Inventory (BDI; Beck, Ward, Mendelson,
Mock, & Erbaugh, 1961). Test-retest reliability has been reported above .90 (Beck, 1970). A concurrent validity coefficient of .79 was reported in psychiatric patients (Kerner & Jacobs, 1983).

3. Neuropsychological Evaluation. A brief, broad-based and reliable neuropsychological evaluation, the Consortium to Establish a Registry for Alzheimer's Disease (CERAD) neuropsychological battery was administered (Morris et al., 1989). This battery included: (1) Verbal Fluency (FLU): "animal category" (Isaacs & Kenney, 1973), a measure of verbal word production, (2) modified Boston Naming Test (BOST; Kaplan, Goodglass, & Weintraub, 1978), a measure of object naming, (3) Mini-Mental State Exam (MMSE; Folstein, Folstein, & McHugh, 1975), a general cognitive battery that measures orientation, immediate and delayed memory, concentration, language and praxis, (4) Word List Memory free recall (FR) and delayed recall (DR; Atkinson & Shiffrin, 1971), and word list recognition (RECOG; Mohs, Kim, & Johns, 1986), all measures of verbal memory. Morris et al. (1989) reported substantial test-retest correlations for this battery. These measures were administered to replicate earlier findings, and to comprehensively describe the cognitive status of the subjects.

Fine-motor functioning was assessed by the Grooved Pegboard Test (PEG; Matthews & Klove, 1964). This test is often used in conjunction with the Halstead-Reitan
Neuropsychological Battery and is a sensitive measure of fine-motor movement, visuomotor coordination, and psychomotor speed. Test-retest reliabilities ranging to .82 have been reported (Reddon, Gill, Gauk, & Maerz, 1988). The test was discontinued on seven subjects after five minutes elapsed.

4. Intellectual Functioning. The Peabody Picture Vocabulary Test (PPVT Form L; Dunn & Dunn, 1981) was administered to obtain a comprehensive measure of verbal functioning among the subject groups. This measure was selected as its multiple choice nonverbal format minimizes the subjects' response requirement. A split-half reliability coefficient of .82 for Form L was reported using an adult sample (Stoner, 1981).

5. Adaptive Functioning. Subjects were administered the Direct Assessment of Functional Status (DAFS) (Lowenstein et al., 1989). This behaviorally based rating scale measures a broad spectrum of functions including time orientation, communication, transportation, finances, shopping, grooming, and eating, all of which are used in the patient's everyday activities. Excellent interrater and test-retest reliabilities, as well as convergent validity for the DAFS, has been reported (Loewenstein et al., 1989).

In addition to the DAFS, the Blessed Dementia Rating Scale (BDRS) was administered to caregivers (Blessed,
Tomlinson, & Roth, 1968). In the case of normal control subjects, spouse or significant others were asked to complete the BDRS. This is an established self-report measure which has been shown to have good convergent validity (-.588) with the DAFS among Alzheimer’s patients (Loewenstein et al., 1989). This measure was administered for replication purposes.

**Procedure.** Subjects who did not meet the exclusion criteria were given an informed consent form to read and sign (see Appendix IV). Caregivers or significant others were asked to complete the BDRS. Subjects were then administered the neuropsychological battery and adaptive functioning assessment described previously.

Following completion of the testing, subjects were debriefed with regard to the study and their performance. They were then offered the choice of having their performance summarized in a brief report suitable for inclusion into their medical chart.

**Data Analysis.** A power analysis was performed to determine the number of subjects needed with a set power level of .80, and an alpha level of .05. This analysis was based on detecting a difference of .8 standard deviation between samples of SD and AD subjects on the DAFS (Loewenstein et al., 1989). The effect size was based on the research of Loewenstein, the developer of the DAFS (D.A. Loewenstein, personal communication, July 18, 1992).
In accordance with the preceding specifications, approximately twenty subjects per group was determined necessary. Also, when performing a discriminant function analysis, adequate robustness is assumed with twenty cases in the smallest group (Tabachnick & Fidell, 1983). Alternatively, for adequate power the sample size of the smallest group should exceed the number of predictor variables (Tabacknick & Fidell, 1983).

The first step in the data analyses was to determine if the patient groups differed with respect to background demographic variables. As discussed previously, a test of statistical independence (Chi-Square) was not appropriate to assess the distribution of subjects by race. A Chi-Square statistic was computed for sex distribution, while one-way ANOVAs were used to evaluate subjects scores between groups to insure that the three groups did not differ with respect to age and education level.

A significant difference was found between the three subject groups for the background variable gender. In order to further examine the possible influence of the gender difference between the subject groups, an exploratory MANOVA was conducted collapsing across subject groups with gender serving as an independent variable.

Following the suggestion of Huberty and Morris (1989), a MANCOVA covarying the influence of gender was used to determine the extent to which the adaptive functioning
variables separated the three groups. Discriminant Function Analysis (DFA) was then used to determine outcome variable subsets that accounted for group separation.

In addition to a gender effect, a significant difference existed between the three groups for performance on the Mini-Mental Status Exam (MMSE), a measure of global cognitive status. Although attempting to control for cognitive status is fraught with difficulty, a regression analysis was performed to examine the contribution of diagnosis to adaptive functioning, with the influence of gender and cognitive status removed. This analysis forced in both the gender variable and MMSE total score variable, and then stepped in dummy-coded diagnostic group classification to predict adaptive functioning.

Pearson correlations were performed between self-reported mood symptoms, adaptive functioning, and neuropsychological functioning variables for each group. These analyses were performed largely to replicate earlier findings, and to comprehensively describe the subject sample. Due to the large number of correlations, the Bonferroni correction procedure was used, resulting in an alpha level of .004 (.05/13). Notably, this conservative alpha level may result in increased risk of Type II error. However, given that the analyses were conducted to replicate earlier findings, this risk was assumed.
RESULTS AND DISCUSSION

Background Information. No significant differences were found among the three patient groups with regard to age $F(2,67)=1.66$, $p=.20$, nor education level $F(2,67)=1.00$, $p=.37$. Computation of a Chi-Square statistic revealed a significant difference between groups with regard to gender distribution ($X^2=10.09$, $p=.00$). To further evaluate the gender difference influence upon the dependent variables, a MANOVA was performed collapsing across groups which showed that performance on the dependent variables did separate males and females (Wilks' Lambda = .500, $F(22,45) = 2.048$, $p=.02$). As a result, subsequent analyses covaried the effects of gender.

Neuropsychological Functioning. Table 1 presents the means and standard deviations for the neuropsychological measures that were assessed for all subject groups. Table 2 presents the $F$ and $p$ values for each variable by subject group. ANCOVAs controlling for gender revealed significant main effects of subject group on every measure except performance on the Pegboard Test.

Tukey's HSD statistic revealed that both NORM subjects' and PD patients earned significantly higher scores on the PPVT, verbal fluency, Boston Naming, verbal free recall, recognition recall, construction, and delay recall of construction task, than AD patients. Each of the three groups significantly differed with respect to performance
Table 1

Means and standard deviations for neuropsychological measures by group

<table>
<thead>
<tr>
<th></th>
<th>NORM</th>
<th>AD</th>
<th>PD</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEG</td>
<td>117.8 (104.6)</td>
<td>218.7 (219.8)</td>
<td>227.2 (250.1)</td>
</tr>
<tr>
<td>PPVT</td>
<td>101.7 (21.0)</td>
<td>72.0 (28.9)</td>
<td>94.1 (17.6)</td>
</tr>
<tr>
<td>FLU</td>
<td>18.7 (4.9)</td>
<td>9.7 (5.6)</td>
<td>16.6 (5.2)</td>
</tr>
<tr>
<td>BOST</td>
<td>15.0 (0.0)</td>
<td>12.4 (2.9)</td>
<td>14.8 (0.4)</td>
</tr>
<tr>
<td>MMSE</td>
<td>29.4 (0.8)</td>
<td>20.0 (4.9)</td>
<td>27.3 (2.3)</td>
</tr>
<tr>
<td>FR</td>
<td>20.1 (4.3)</td>
<td>11.4 (5.7)</td>
<td>20.1 (4.2)</td>
</tr>
<tr>
<td>DR</td>
<td>7.8 (2.2)</td>
<td>1.8 (2.3)</td>
<td>6.3 (1.8)</td>
</tr>
<tr>
<td>RECOG</td>
<td>19.4 (1.1)</td>
<td>13.8 (3.8)</td>
<td>18.6 (2.4)</td>
</tr>
<tr>
<td>CON</td>
<td>10.2 (0.8)</td>
<td>7.0 (3.1)</td>
<td>9.5 (2.2)</td>
</tr>
<tr>
<td>DCON</td>
<td>10.8 (2.6)</td>
<td>2.8 (4.2)</td>
<td>9.2 (3.6)</td>
</tr>
</tbody>
</table>

Note. PEG performance is presented in total seconds for the dominant hand. PPVT performance is presented as a standardized score. The remaining measures are raw scores.

Key. Pegboard Test (PEG), Peabody Picture Vocabulary Test (PPVT), verbal fluency (FLU), Boston Naming Test (BOST), Mini-Mental State Exam (MMSE), verbal free-recall (FR), verbal delayed recall (DR), verbal recognition (RECOG), construction (CON), and delayed construction (DCON).
Table 2

**F and p values for ANCOVA covarying gender on neuropsychological variables by group**

<table>
<thead>
<tr>
<th>Test</th>
<th>F(2,60)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pegboard</td>
<td>2.49</td>
<td>.09</td>
</tr>
<tr>
<td>PPVT</td>
<td>10.53</td>
<td>&lt;.01*</td>
</tr>
<tr>
<td>Verbal Fluency</td>
<td>18.76</td>
<td>&lt;.01*</td>
</tr>
<tr>
<td>Boston Naming</td>
<td>19.87</td>
<td>&lt;.01*</td>
</tr>
<tr>
<td>MMSE</td>
<td>65.45</td>
<td>&lt;.01*</td>
</tr>
<tr>
<td>Verbal Free Recall</td>
<td>-24.12</td>
<td>&lt;.01*</td>
</tr>
<tr>
<td>Delay</td>
<td>49.04</td>
<td>&lt;.01*</td>
</tr>
<tr>
<td>Recognition</td>
<td>33.14</td>
<td>&lt;.01*</td>
</tr>
<tr>
<td>Construction</td>
<td>14.70</td>
<td>&lt;.01*</td>
</tr>
<tr>
<td>Delay</td>
<td>33.70</td>
<td>&lt;.01*</td>
</tr>
</tbody>
</table>

**Key.** Peabody Picture Vocabulary Test (PPVT) and Mini-Mental State Exam (MMSE).
upon the MMSE and delayed verbal recall. The observed pattern in both cases was NORM, followed by PD, with AD subjects offering the worst performance.

**Adaptive Functioning.** Table 3 presents the means and standard deviations for the adaptive functioning measures assessed for the subject groups.

The correlation between the DAFS and the BDRS for the NORM group was .15, for the AD group -.82, and for the PD group -.64. The significant correlation with the AD group is in keeping with previous reports (Loewenstein et al., 1989).

Following the suggestion of Huberty and Morris (1989), MANCOVA covarying gender was used to determine the extent to which the dependent variables separated the groups. This MANCOVA showed that the variables differentiated the groups (Wilks' Lambda = .308, $F(16,118) = 5.919, p = 0.00$). Discriminant function analysis covarying the gender effect found one significant function (sequential chi square(16) = 74.827, $p = 0.000$). The canonical correlation for this function was .786, indicating that adaptive functioning variables accounted for 62% of the function's variance. Table 4 shows the canonical loadings of the three subject groups for the adaptive measures. The canonical loadings of each measure on the significant discriminant function indicate the relative contribution of the measures to group separation (generally a canonical loading greater than .4.
Table 3

Means and standard deviations for adaptive functioning measures by group

<table>
<thead>
<tr>
<th></th>
<th>NORM</th>
<th>AD</th>
<th>PD</th>
</tr>
</thead>
<tbody>
<tr>
<td>BDRS</td>
<td>0.3 (1.2)</td>
<td>8.4 (6.1)</td>
<td>5.5 (5.6)</td>
</tr>
<tr>
<td>Time</td>
<td>16.0 (0.0)</td>
<td>10.0 (4.5)</td>
<td>14.9 (2.0)</td>
</tr>
<tr>
<td>Communication</td>
<td>14.0 (0.0)</td>
<td>10.3 (4.0)</td>
<td>12.2 (2.6)</td>
</tr>
<tr>
<td>Finance</td>
<td>21.3 (0.9)</td>
<td>14.0 (4.7)</td>
<td>18.9 (4.3)</td>
</tr>
<tr>
<td>Shopping</td>
<td>19.9 (0.4)</td>
<td>11.6 (6.0)</td>
<td>17.0 (4.9)</td>
</tr>
<tr>
<td>Dressing</td>
<td>13.0 (0.2)</td>
<td>9.7 (4.6)</td>
<td>10.4 (2.9)</td>
</tr>
<tr>
<td>Eating</td>
<td>9.9 (0.4)</td>
<td>7.6 (3.5)</td>
<td>8.9 (3.1)</td>
</tr>
<tr>
<td>DAFS</td>
<td>94.1 (0.9)</td>
<td>63.0 (21.1)</td>
<td>82.4 (15.4)</td>
</tr>
</tbody>
</table>

**Note.** Raw scores are presented.

**Key.** Blessed Dementia Rating Scale (BDRS) and Direct Assessment of Functional Status (DAFS).
### Table 4

**Canonical loadings of adaptive functioning measures on significant discriminant function**

<table>
<thead>
<tr>
<th>Measure</th>
<th>Canonical Loading</th>
</tr>
</thead>
<tbody>
<tr>
<td>BDRS</td>
<td>-.650</td>
</tr>
<tr>
<td>Time</td>
<td>.788</td>
</tr>
<tr>
<td>Communication</td>
<td>.523</td>
</tr>
<tr>
<td>Finance</td>
<td>.720</td>
</tr>
<tr>
<td>Shopping</td>
<td>.710</td>
</tr>
<tr>
<td>Dressing</td>
<td>.384</td>
</tr>
<tr>
<td>Eating</td>
<td>.341</td>
</tr>
<tr>
<td>DAFS TOTAL</td>
<td>.783</td>
</tr>
</tbody>
</table>
is considered significant). As can be seen, the BDRS and each scale (except for the dressing and eating scales), as well as the total score of the DAFS loaded most heavily on the function. An inspection of the means in Table 3 strengthens the impression that the dressing and eating scales accounted for little differences among the groups.

The distinctiveness of the AD group can be clearly seen by examining actual and predicted group membership based on the discriminant function of the groups. The function correctly classified 28 of 30 (93.3%) of the NORM group, 17 of 20 (85.0%) of the AD group, but only 9 of 20 (45.0%) of the PD group. Patients in the PD group were just as likely to be incorrectly classified as belonging in the NORM group (5) as they were the AD group (4). Cohen's kappa was .641, indicating that the function correctly classified subjects at a rate greater than predicted by chance.

In order to examine the contribution of cognitive status to group separation, a forward stepwise multiple regression analysis was performed in which the gender and MMSE (a broad measure of cognitive status) variables were forced in, and dummy-coded diagnostic codes (NORM, AD, and PD) were allowed to step in to the analysis. Total score on the DAFS was the dependent variable. The regression analysis entered only the two forced variables (gender and MMSE) into a significant model predicting total score on
the DAFS (Adjusted R-Square = .746, $F = 102.19$, df = 2, $p = .000$). A significant change in R-square was provided by gender ($F = 4.96$, df = 2, $p = .03$), and MMSE score ($F = 204.38$, df = 2, $p = .000$). The best predictor by far of DAFS score was the MMSE score.

Adaptive Functioning and Mood Status. Table 5 presents the means and standard deviations of the mood variables for each group. One-way ANCOVAs covarying gender revealed significant main effects for subject group on the BDI, $F(2,67)=4.29$, $p=.02$, and state anxiety, $F(2,67)=4.01$, $p=.02$. Tukey's HSD statistic revealed that the AD group endorsed significantly more depression than the NORM group, and the PD group endorsed significantly more state anxiety than the NORM group.

Table 6 presents the Pearson correlations between the adaptive functioning measures and the measures of mood status for each group. Due to the large number of correlations examined, the Bonferroni correction procedure was used resulting in an alpha level of .005. Inspection of the tables reveals a trend of more substantial correlations for the patient groups relative to the NORM group. The only significant correlation was between the BDI and the DAFS for the PD group.

Adaptive Functioning and Neuropsychological Test Performance. Table 7 presents Pearson correlations between the DAFS and neuropsychological measures by group. Once
Table 5

Means and standard deviations for mood variables by group

<table>
<thead>
<tr>
<th></th>
<th>BDI</th>
<th>State</th>
<th>Trait</th>
</tr>
</thead>
<tbody>
<tr>
<td>NORM</td>
<td>5.1 (3.9)</td>
<td>34.1 (27.9)</td>
<td>34.1 (27.9)</td>
</tr>
<tr>
<td>AD</td>
<td>11.6 (13.6)</td>
<td>49.5 (38.8)</td>
<td>49.0 (36.8)</td>
</tr>
<tr>
<td>PD</td>
<td>10.7 (7.3)</td>
<td>54.3 (34.0)</td>
<td>62.3 (31.2)</td>
</tr>
</tbody>
</table>

**Note.** Raw scores are presented for the BDI and percentile scores for the State-Trait Anxiety Inventory.

**Key.** Beck Depression Inventory (BDI).
Table 6

Pearson correlations between the DAFS and measures of mood status by group

<table>
<thead>
<tr>
<th></th>
<th>DAFS</th>
<th>BDI</th>
<th>State</th>
<th>Trait</th>
</tr>
</thead>
<tbody>
<tr>
<td>NORM</td>
<td>-.13</td>
<td>-.15</td>
<td>-.01</td>
<td></td>
</tr>
<tr>
<td>AD</td>
<td>-.49</td>
<td>-.11</td>
<td>-.34</td>
<td></td>
</tr>
<tr>
<td>PD</td>
<td>-.62</td>
<td>-.03</td>
<td>-.03</td>
<td></td>
</tr>
</tbody>
</table>

Note. *p < .005.

Key. Direct Assessment of Functional Status (DAFS) and Beck Depression Inventory (BDI).
Table 7

**Pearson correlations between neuropsychological measures and the DAFS by group.**

<table>
<thead>
<tr>
<th></th>
<th>DAFS</th>
<th>AD</th>
<th>PD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pegboard</td>
<td>.07</td>
<td>-.42</td>
<td>-.78*</td>
</tr>
<tr>
<td>PPVT</td>
<td>.38</td>
<td>.62</td>
<td>.30</td>
</tr>
<tr>
<td>Verbal fluency</td>
<td>.14</td>
<td>.76*</td>
<td>.46</td>
</tr>
<tr>
<td>Boston Naming</td>
<td>.</td>
<td>.67*</td>
<td>.40</td>
</tr>
<tr>
<td>MMSE</td>
<td>.27</td>
<td>.82*</td>
<td>.67*</td>
</tr>
<tr>
<td>Word List Recall</td>
<td>.18</td>
<td>.83*</td>
<td>.69*</td>
</tr>
<tr>
<td>Delay</td>
<td>-.06</td>
<td>.43</td>
<td>.48</td>
</tr>
<tr>
<td>Recognition</td>
<td>.13</td>
<td>.79*</td>
<td>.09</td>
</tr>
<tr>
<td>Construction</td>
<td>-.11</td>
<td>.63</td>
<td>.73*</td>
</tr>
<tr>
<td>Delay</td>
<td>-.05</td>
<td>.53</td>
<td>.45</td>
</tr>
</tbody>
</table>

**Note.** Restricted range did not allow correlations with the Boston Naming Test for the NORM group.

**Key.** Direct Assessment of Functional Status (DAFS), Peabody Picture Vocabulary Test (PPVT) and Mini-Mental State Exam (MMSE).
again, due to the large number of correlations, the Bonferroni correction procedure was used resulting in an alpha level of .004. Inspection of the tables reveals more substantial correlations for the patient groups relative to the NORM group. Restricted range made correlations with the Boston Naming Task impossible for the NORM group. A number of significant correlations were revealed among the patient groups. For the AD group, the DAFS was significantly correlated with verbal fluency (.76), MMSE (.82), word list recall (.83), and verbal recognition memory (.79). For the PD group, the DAFS was significantly correlated with Grooved Pegboard Test performance (-.78), MMSE (.67), word list recall (.69), and constructional praxis (.73).
SUMMARY AND CONCLUSIONS

Significant group differences were found for every neuropsychological variable except performance on the Pegboard Test. As all members of the PD group were receiving pharmacotherapy, it is not unexpected that their fine-motor functioning would not significantly differ from the other groups. Overall, the pattern of performance suggested more severe neuropsychological impairment among the AD patients relative to both NORM and PD patients. Broad-based cognitive status as measured by the MMSE, as well as delayed verbal recall, revealed differences among all three groups. This finding is in keeping with the results reported by Huber and Shuttleworth (1991). This could reflect either a difference in dementia severity (quantitative) between the groups (as some PD patients were not demented according to diagnostic criteria), or alternatively a difference in the nature of the clinical presentation of these disease mechanisms (qualitative).

The results of this study were not entirely in keeping with the findings of Huber and Shuttleworth (1991), as they reported more severe deficits in word fluency among PD patients, and equal impairment of vocabulary. However, those researchers matched subjects for cognitive impairment using the MMSE. Additionally, a grosser measure of vocabulary was employed relative to the PPVT employed in the present study. Given these methodological differences,
beyond a comparison of MMSE-assessed cognitive status, it is difficult to compare the subject sample used in this study to the sample of Huber and Shuttleworth (1991).

The present study represents the first attempt to distinguish prototypical subcortical and cortical diagnostic groups according to directly assessed level of adaptive functioning. The canonical correlation resulting from the significant function accounted for 62% of the group variance. All of the adaptive measures significantly added to group separation, with the exception of the dressing and eating scales of the DAFS. It is likely that such relatively rudimentary adaptive skills as dressing and eating are comparably intact across the three groups, while the other scales which require some degree of mentation show impairment.

The significant function correctly classified the vast majority of both NORM and AD subjects. The PD patients were correctly classified at a much lesser rate. Patients in the PD group were just as likely to be incorrectly classified as belonging in the NORM group (5) as they were the AD group (4). This highlights the overlap in adaptive functioning that PD patients share with the two other groups, despite relatively less overlap among the groups on neuropsychological measures. Thus, consistent with the findings of Eisdorfer et al. (1992), although cognitive impairment may be a primary symptom, dysfunction may be
evident in other areas (e.g., adaptive functioning) in varying degrees. Possibly, the overlap in adaptive functioning that the PD group exhibits with the other groups is once again due to the improvement in their motor performance given their pharmacotherapeutic regime. In support of this, no differences existed between the groups with regard to fine-motor functioning as measured by the Grooved Pegboard Test. Notably, the correlation between Grooved Pegboard Test performance and the DAFS was very high for the PD group relative to the other groups.

A regression analysis suggested that adaptive functioning shares variance with cognitive status. Indeed, inspection of the canonical loadings suggests that the most significant adaptive variables are those that appear to require an element of mentation. For future research, separating adaptive functioning from cognitive status may not be as important as measuring both facets of behavior in concert. This approach could potentially provide a more effective means of staging and isolating the effects of various dementing illnesses.

A single significant correlation was revealed between the BDI and the DAFS (-.62) for the PD group. Notably, this relation does not appear to be due to a relatively high rate of endorsement of somatic indices of depression by the PD group, as an investigative correlation between somatic indices on the BDI with the DAFS was nonsignificant
(-.42), and actually less than the correlation with the cognitive indices (-.58). Higher levels of depression have been reported among PD patients relative to AD patients (Huber and Shuttleworth, 1991). This finding was not replicated in this study. However, the above described correlation suggests a potential differential relation among the three groups between depressed mood symptoms and directly assessed adaptive functioning.

Overall, the lack of significant relations among the groups is grossly in keeping with the results reported by Haut et al. (1991) who also used the DAFS. However, Haut and his group did not subtype dementias, as they utilized a diffuse group of described as "referrals for possible dementia." The results of the present study provide further evidence suggesting that functional deficits are not widely associated with self-reported mood symptoms in a sample without clinically significant levels of depression. However, also like Haut et al. (1991), reliance upon simple self-reported mood is likely not a sufficiently sensitive measure. Furthermore, all patient groups were screened to rule-out subjects with co-existing psychiatric diagnoses, thus limiting the range of mood symptoms. Future research may examine this relation using subjects showing clinically significant levels of mood impairment. The results of this study to do suggest the utility of subtyping forms of dementia.
The results of the present investigation suggest that performance on behaviorally assessed adaptive behavior tasks is related to both global cognitive impairment (MMSE) and word list recall for the patient groups. Notably, these are the two neuropsychological variables on which each of the three groups significantly differed from one another. No significant relations were reported among the NORM group. For the PD group, non-verbal tasks (fine-motor functioning and constructional praxis) were significantly correlated with the DAFS. In contrast, for the AD group, verbal material (verbal fluency, verbal recognition memory, and confrontation naming) were significantly correlated with the DAFS. Thus, a pattern of subcortical versus cortical dysfunction was observed in terms of relation to adaptive functioning.

The relation between adaptive functioning and neuropsychological status is still unclear (Loewenstein et al., 1989; Loewenstein et al., in press). Loewenstein et al. (in press) reported that neuropsychological measures accounted for less than 50 percent of the variance in performance on various subtests of the DAFS for an AD patient sample. However, as discussed by Loewenstein et al. (in press), the degree of unexplained variance is substantial enough that predicting functional status for an individual is likely to be fraught with error.
The findings reported in this study would be in keeping with the notion that functional status is sufficiently independent of neuropsychological status to warrant a separate assessment. Additionally, it appears that performance on a number of functional tasks is related to global cognitive impairment for both patient groups. However, different specific neuropsychological variables are associated with functional status for the two patient groups. Future research in the area of adaptive functioning might focus on the differentiation of levels of impairment or declines in ability over time as they are associated with specific neuropsychological measures.

A disease mechanism (PD) responsible for producing a prototypical subcortical dementia syndrome appears to be characterized by a lesser degree of adaptive impairment than that shown by AD patients. Despite marked differences in neuropsychological functioning, considerable overlap existed when attempting to classify PD patients on the basis of functional status. Also, different patterns of association were revealed with regard to functional status, self-reported mood, and neuropsychological performance for the three groups. These findings suggest that both neuropsychological and functional measures may be necessary to gain a complete understanding of the individual patient.

A central issue with much meaning for future studies regards whether to match subjects for cognitive impairment.
It appears to be a relatively uniform finding that AD patients evidence both more severe cognitive impairment (Huber and Shuttleworth, 1991) and more severe adaptive impairment. Matching for this variation may obfuscate potentially enlightening findings.

As suggested by Huber and Shuttleworth (1991), the two central research issues related to subcortical dementia continue to be that of: (1) specifying differences among subcortical syndromes, and (2) developing objective procedures to delineate differences between cortical and subcortical syndromes. In this vein of thought, Dammers et al. (1993) have stated that adaptive functioning is perceived by the majority of clinicians as an important area of functioning to assess in the diagnosis of dementia. The results of that study and the present study, provide evidence suggesting that the assessment of adaptive functioning is worthy of additional investigation as a means of differentiating, and staging the effects of dementing illnesses. As progress is made in the definition and measurement of dementia, functions mediated by subcortical structures will be further clarified.
REFERENCES


Nadler, J.D., Richardson, E.D., Malloy, P.F., Marran, M.E., & Brinson, M.E. (1991, October). The ability of the Dementia Rating Scale to predict daily living skills. Paper presented at the annual meeting of the National Academy of Neuropsychology, Dallas, TX.


Appendix A

SUBCORTICAL SYNDROMES

Degenerative diseases
- Parkinson's disease
- Huntington's disease
- Progressive supranuclear palsy
- Idiopathic basal ganglia calcification
- Spinocerebellar degenerative syndromes
- Thalamic degeneration

Vascular disorders
- Lacunar state
- Thalamic infarction

Metabolic disorders
- Binswanger's disease
- Wilson's disease
- Hypoparathyroidism

Demyelinating disease
- Multiple sclerosis
- AIDS encephalopathy

Miscellaneous
- Subcortical sarcoidosis
- Normal pressure hydrocephalus
- Dementia pugilistica
- Neuro-Behcet's disease

Adapted from Cummings (1990)
### Appendix B

#### SUBCORTICAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>CHARACTERISTICS</th>
<th>SUBCORTICAL</th>
<th>CORTICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Language</td>
<td>No aphasias (anomia and comprehension deficit dementia is severe)</td>
<td>Aphasia early</td>
</tr>
<tr>
<td>Memory</td>
<td>Recall impaired; recognition normal or better preserved than recall</td>
<td>Impaired</td>
</tr>
<tr>
<td>Visuospatial</td>
<td>Impaired</td>
<td>Impaired</td>
</tr>
<tr>
<td>Calculation</td>
<td>Preserved</td>
<td>Impaired</td>
</tr>
<tr>
<td>Frontal function</td>
<td>Impaired early</td>
<td>Impairment equal to other areas</td>
</tr>
<tr>
<td>Cognitive speed</td>
<td>Slowed early</td>
<td>Normal until late</td>
</tr>
<tr>
<td>Personality</td>
<td>Apathetic, inert</td>
<td>Unconcerned</td>
</tr>
<tr>
<td>Mood</td>
<td>Depressed</td>
<td>Euthymic</td>
</tr>
<tr>
<td>Speech</td>
<td>Dysarthric</td>
<td>Normal until late</td>
</tr>
<tr>
<td>Posture</td>
<td>Bowed or extended</td>
<td>Upright</td>
</tr>
<tr>
<td>Coordination</td>
<td>Impaired</td>
<td>Normal until late</td>
</tr>
<tr>
<td>Movement</td>
<td>Chorea, tremor, tics, dystonia</td>
<td>Normal, some myoclonous</td>
</tr>
<tr>
<td>Motor speed</td>
<td>Slowed</td>
<td>Normal</td>
</tr>
</tbody>
</table>

Adapted from Cummings (1990)
Appendix C

QUESTIONNAIRE

We will be asking you several questions about your personal history. Please read each question carefully. Circle the appropriate answers or fill in the blank.

1. What is your age? _____

2. Please indicate your ethnic group.
   a. African-American
   b. Asian-American
   c. White
   d. Other _________

3. Is English your native language?
   a. Yes
   b. No, but I consider myself fluent in English.

4. How many years of formal education have you had? _____

5. If you are currently employed, what is your occupation?

6. If you are NOT currently employed, what was your main occupation?

7. Have you ever had, or do you now have, any of the following medical illnesses?
   a. Lung disease (e.g., COPD or emphysema)
   b. Kidney disease
   c. Heart disease
   d. High blood pressure
   e. Liver disease (e.g., cirrhosis or hepatitis)
   f. Cancer
   g. Neurological disorder (e.g., Parkinson's disease, Huntington's disease, multiple sclerosis, polio, cerebral palsy, etc.)

8. Have you ever had any of the following?
   a. Head injury with loss of consciousness for more than 10m.
   b. Stroke
   c. Brain tumor
   d. Seizures
   e. Electroconvulsive shock treatment
   f. Lack of oxygen for more than 5 minutes
   g. Having to be revived
   h. Fever of over 104 degrees for more than 3 days
i. Learning disability  
j. Infection of the nervous system  
k. Narcolepsy or sleep apnea  
l. Severe headaches/migraines  

9. Please list all your current medications and what you are taking them for.  
   a. _______________________________________________  
   b. _______________________________________________  
   c. _______________________________________________  
   d. _______________________________________________  
   e. _______________________________________________  
   f. _______________________________________________  

10. Have you ever  
   a. had psychotherapy for 6 months or more?  
      If so, for what problem? _______________________  
   b. been hospitalized for a psychological condition?  
      If so, for what problem? _______________________  
   c. been treated for more than 6 weeks with medications for a psychological condition?  
      If so, which medications?  
      _______________________________________________  
      _______________________________________________  

11. Have you ever  
   a. been treated for substance abuse (drug/alcohol) as an inpatient or outpatient?  
   b. drank alcohol excessively for more than 6 months?  
   c. used illicit drugs (e.g., cocaine, PCP, marijuana etc.)  
      If so, please list which substances, the approximate amount you took, and for how long.  
      _______________________________________________  
   d. used prescription or over-the-counter medications excessively?
If so, please list which substances, the approximate amount you took, and for how long.

12. Do you have any problems with your
   a. vision
   b. hearing
   c. sense of taste
   d. sense of smell
   e. sense of touch

13. Do you have any trouble telling the difference between colors?
   a. yes
   b. no

14. Are you
   a. right-handed
   b. left-handed
   c. ambidextrous (use either hand)

15. Have you ever had any tests of your
   a. coordination, strength, or speed of movement
   b. ability to name objects
   c. memory for words or stories
   d. memory for pictures
   e. ability to reason or solve problems
   f. ability to draw or put puzzles together
   g. general fund of information or IQ

THANK YOU FOR TAKING THE TIME TO FILL OUT THIS FORM.
VITA

Paul Matthew Dammers was born in a suburb of Chicago, Illinois on July 28, 1965. He was raised in Southern Illinois, the sixth child born of his father, a pediatrician, and his mother, a nurse. He was educated throughout the South, earning degrees at Auburn University and Wake Forest University before coming to Louisiana State University to earn his Ph.D. in Clinical/Medical Psychology. He completed his internship in clinical neuropsychology at Brown University.
Candidate: Paul Matthew Dammers

Major Field: Psychology

Title of Dissertation: Patterns of Adaptive Functioning in Cortical and Subcortical Diagnostic Groups of Dementia

Approved:

[Signatures]

Major Professor and Chairman
Dean of the Graduate School

EXAMINING COMMITTEE:

[Signatures]

Date of Examination: July 30, 1993