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DETECTING LATE-LIFE FORGETFULNESS USING THE BRIEF SDAT BATTERY

By

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ABSTRACT

DETECTING AGE-ASSOCIATED MEMORY IMPAIRMENT
USING THE BRIEF SDAT BATTERY

By

Daniel Malcolm Spica

This investigation evaluates the concurrent validity of the Brief SDAT Battery for the assessment of an age-associated memory impairment subtype known as late-life forgetfulness (LLF), a syndrome of memory decrements for which a downward catastrophic course is not assumed. Fifty-nine older individuals ranging from 65 to 85 years old who had been deemed relatively healthy, were tested to reformulate the Brief SDAT Battery's scoring weights to expand the battery's utility to diagnosing LLF. Classification of the 59 cases on the basis of discriminant function led to correct grouping of 72.9% of the subjects into their proper diagnostic category as determined by external criteria. Specifically, the modified coefficients yielded a success rate of 95.5% for the SDAT class alone, 66.7% success for the normal elderly group alone, and correctly classified 50.0% of the LLF cases. Implications for the assessment of LLF are discussed.

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INTRODUCTION

In recent years there has been a remarkable surge of interest in Alzheimer's disease both in the medical community and the general public. Evidence of this interest can be found in the sheer numbers of journal entries in the last ten years concerning Alzheimer's disease (AD) as well as coverage in the popular media.

There are many reasons for this interest including the graying of America and technological advances in the treatment of other medical conditions associated with old age. Although the prevalence of AD in this country, typically estimated around 6 percent in persons over 65 (Schneck, Reisberg, & Ferris, 1982), may not seem proportional with interest in the disease, undoubtably it is the tragic nature of AD's symptoms and prognosis that has made it so prominent. At present, AD is incurable and its symptoms untreatable. However, major advances have been made in the study of AD, primarily in diagnostic techniques differentiating it from other dementing disorders, some of which have a greater likelihood of remission than AD (Wells, 1984).

Memory loss, reputed to be among the best early indicators of dementia (Lezak,1983), has served as a valuable area of study for the differentiation of AD victims both from people with other dementing conditions or, perhaps more importantly, from forgetful elderly persons who truly do not deserve a label of "demented." It is this second class of differential diagnosis, between AD dementia and the less debilitating impairments associated with more "normal" aging, that is the focus of this investigation.

Memory Deficits in Normal Aging

In an effort to explore the cognitive changes associated with old age, Flicker and his colleagues believed it necessary to discriminate not only between performance capabilities of the young and the elderly, but also between the capabilities of the demented and nondemented aged (Flicker, Ferris, Crook, Bartus, & Reisberg, 1986). Among the findings of their comprehensive review, summarized here in Table 1, they reported that when compared to young normals, normal aged people are found to have impairment in recent (secondary) memory but not in either immediate (primary) memory or remote (tertiary) memory. This anomalous deficit in recent, or secondary,

TABLE 1: Performances of Young, Elderly, and Elderly Demented Subject.

	Relative Performance	
Cognitive Function	*Elderly Normal Versus Young Normal*	*Early Dementia Versus Elderly Normal*
Sensorimotor processing	Impaired	Impaired
Recent memory	Impaired	Impaired
Concept formation	Impaired	Impaired
Visuospatial praxis	Impaired	Impaired
Attention	Impaired	Impaired
Immediate memory	Unimpaired	Unimpaired
Language (syntax and phonology)	Unimpaired	Unimpaired
Language (naming)	Unimpaired	Impaired
Remote memory	Unimpaired	Impaired
Visual acuity	Impaired	Unimpaired
Visuoperceptual abilities	Impaired	Unimpaired

Note: From Flicker, C., Ferris, S.H., Crook, T., Bartus, R.T., & Reisberg, B. (1986). Cognitive decline in advanced age: Future directions for the psychometric differentiation of normal and pathological age changes in cognitive function. Developmental Neuropsychology, 2, 309-322. Reproduced with permission.

memory also has been documented in recall of both verbal (e.g., Buschke & Fuld, 1974; Parkinson, Inman, & Dannenbaum, 1985) and nonverbal stimuli (e.g., Crook, Ferris, & McCarthy, 1979; Poon, 1985).

According to many psychological theories of memory, tests of secondary memory recall actually detect the end product of several different steps in a continuous sequence of information processing (Murdock, 1967; Waugh & Norman, 1965). The first step may consist in seeing a printed word and thereby forming an internal photograph as a sensory register. The information is then transfered to primary memory for immediate recall, and then is encoded for more permanent retention and transfered to secondary memory. This encoding step essentially amounts to forming a mental representation of the word according to its phonemic, figural, or semantic properties. Generally, the more thorough the encoding, the greater the person's efficiency in retrieving and recalling the word from the secondary memory store. Research has found that normal elderly make less use of innovative and spontaneous active encoding strategies, such as visual imagery or verbal associations (Craik, 1977), and it appears that they are unable to recall recent information because it was never fully processed into secondary memory storage.

In their 1986 study, Coyne, Allen, and Wickens compared young and elderly participants on their ability to search lists of words stored in primary and secondary memory. Their results indicated that only the older adults were biased towards claiming probe items were not members of the original memory sets (sets of words to be stored into secondary memory). As a result of this bias, older adults committed a large number of errors in wrongly claiming that a word was not on the memorized list, and yet they made few errors in wrongly claiming a new (confederate) word was on the memorized list (Coyne, Allen, & Wickens, 1986). Interestingly, it has been found that the elderly, as with young adults, have a better chance of remembering such lists when they are asked to generate the words themselves (McFarland, Warren, & Crockard, 1985), which may have implications for memory training. Also, while investigating verbal memory in the elderly, Bowles and Poon (1985) found that older adults are less able than young adults to access word-name information in an orthographically organized lexical network when given stimulus information that is conceptual rather than orthographic (based on letters).

The Role of Cognition in Memory for the Aged

There exists a body of research evidence suggesting that age-related slowing of cognition plays a fundamental role in memory impairments found in the elderly. The research consists of three types of evidence. The first type supports the generalizability of findings in cognitive slowing. For instance, Salthouse (1977) analyzed the observed slower performances of older adults in comparison to younger adults on a variety of cognitive tasks. He found that the slower scores of the aged sample may be described by applying a constant multiplier to the scores of the younger adults. This suggests that the critical variable was the time required for the task by young adults, rather than its meaning in terms of an information-processing analysis (Salthouse, 1977). Likewise, a longitudinal analysis of age differences in performance on a mental ability task revealed that those young adults exhibiting skill in speeded tasks maintained greater functioning on similar tasks throughout aging (Witt & Cunningham, 1979). It was further hypothesized that individual differences on tests of performance speed can be used to predict the speed of memory processes (Costa & Fozard, 1978).

The second type of research evidence involves memorization. Salthouse (1980) found that memorization and retention of paired associates (a task commonly used to illustrate age differences in secondary memory) improves with speed of mental rehearsal (as cited in Fozard, 1980). Similar findings relating memorization to cognitive speed were reported by Wingfield and Sandoval (1980).

The third type of evidence may be characterized as demonstrating greater within-subject variability in cognition speed in old age than in the young. For example, in reaction time studies, Waugh, Fozard, and Thomas (1978) found that response times of older subjects were more variable than those of younger subjects relative to their own mean reaction times, both in easy and hard versions of the same tasks. Similar variability has been found in the retention times in the elderly (Waugh, Fozard, & Thomas, 1978).

Taken together, these lines of evidence suggest that (a) older adults exhibit cognitive slowing in a predictable way across a variety of tasks, (b) information retention is related to cognitive speed in memorization, and (c) the within-subject variability of performance in elderly samples in tasks of mental speed resembles the variability found in similar elderly samples on tests of retention time. Therefore, it is hypothesized that age-related slowing of cognition speed plays a fundamental role in memory impairment.

Normal Aging Compared With Dementia

Accurately delineating between normal aged patients and the demented has become of greater interest to clinicians along with advancements in differential diagnosis. In his review of progress of dementia assessment, Wells (1984) discusses the techniques of the 1960's and recounts:

> "It is only a slight exaggeration to state that there was no state of the art as far as differential diagnosis of dementia was concerned. Dementia was generally conceded to derive for the most part from hardening of the arteries, and diagnostic speculation seldom proceeded further, except for the occasional compulsive diagnostician who went so far as to insist that a brain tumor had to be ruled out in each instance before hardening of the arteries could be diagnosed, before the case could be accepted as untreatable, and before it could in effect be closed." (pp. 183-4)

Although some investigators have proposed diagnostic techniques unrelated to cognitive efficiency, such as evaluating the number of loops and whorls in the patient's fingerprints (Seltzer & Sherwin, 1986), techniques involving memory functions have indeed helped to provide the greatest diagnostic gains. As seen in Table 1 above, one way in which normal elderly persons are unlike the demented is that they do not exhibit impairment of remote, or tertiary, memory (Flicker et al., 1986). Tests demanding delayed recall and/or recognition of news events (similar to the fictitious news reports in the Logical Memory subtest of the Wechsler Memory Scale; Wechsler, 1945) are among the best to reveal this deficit (Wilson, Kaszniak, & Fox, 1981).

Tests of memory functions other than tertiary are also widely used in diagnosis for dementia. Although even normal adults show a significant decline of secondary memory function, they differ from demented samples in the extent to which they decline (Storandt, Botwinick, Danziger, Berg, & Hughes, 1984). In a longitudinal study of patients with mild AD, Storandt, Botwinick, and Danziger (1987) tested for secondary memory decline using, among other measures, the Logical Memory subtest of the Wechsler Memory Scale (Wechsler, 1945). They reported; "...it would seem that the logical memory is affected very early in the [AD] disease...the group effect on the Logical Memory subtest performance is so powerful that it accounts for a large percentage of the variance, leaving relatively little for the time effect" (p. 281).

Other measures used to differentiate normal aging from dementia include word fluency (Martin & Fedio, 1983). When used in a testing battery in conjunction with memory measures such as the Wechsler Memory Scale, these tests provide the clinician with a multi-modal means of evaluating dementia in a patient.

Benign Senescent Forgetfulness; Between Normality and Dementia

In his classic work "Types of memory dysfunction in senescence," V. A. Kral used the terms benign and malignant senescent forgetfulness to describe two types of memory impairment that he observed among groups of elderly subjects in retirement homes (Kral, 1959). By malignant forgetfulness, Kral signified a progressive amnestic syndrome in which recent memory is significantly impaired and may be accompanied by confabulation and disorientation. It is this malignant forgetfulness that probably corresponds to what we now call primary degenerative dementia, including AD.

Compared to malignant forgetfulness, Kral's benign form of forgetfulness is nonprogressive, is more apparent to the individual, and shows greater variability across time (Kral, 1959). Malignant forgetfulness is also characterized by shortened retention time, inability to recall events of recent past, distorted recall of some events in the form of confabulations, and disorientation to place and, gradually, to person. Conversely, benign forgetfullness describes phenomena such as recall failures limited to relatively unimportant facts (such as name, date or place), "forgotten" data belonging to remote as opposed to recent past, and subjects are aware of their shortcomings and apologize or compensate for them (La Rue, 1982).

In more recent times, Kral has been criticized for lacking specific criteria for discriminating between his classes of forgetfulness and for failing to demonstrate that benign forgetfulness and malignant amnestic syndrome are not simply points on a single continuum of disorder (Miller, 1977). Furthermore, Schneck, Reisberg, and Ferris (1982) described a "forgetfulness phase" occurring soon after the onset of AD, which they discriminated from benign forgetfulness solely by the fact that it progressed to severe cognitive deterioration. For these reasons, Larrabee and his colleagues set out to replicate Kral's work in 1985 (Larrabee, Levin, & High, 1986).

Larrabee et al. (1986) tested 88 healthy elderly individuals from 60 to 90 years of age on a variety of cognitive measures, including tasks of verbal, visual, and remote memory known to be sensitive to incipient dementia (Storandt, Botwinick, Danziger, Berg, & Hughes, 1984). Follow-up testing was conducted after one year for a longitudinal measure of decline.

From data analyzed by age-residualized score patterns and cluster analysis, Larrabee et al. (1986) found a distinct subgroup of 10 to 20 percent who showed reduced memory efficiency with otherwise preserved cognitive functioning. In addition, although their memory efficiency was reduced, the subjects in this subgroup performed at a significantly higher level than a group of patients with AD. Finally, although the forgetful subgroup did differ from the rest of the healthy elderly group both at baseline and at the one year follow-up, their performance was not found to deteriorate over this time period.

Larrabee and his colleagues concluded that there indeed exists a distinct subgroup of elderly people who, though not demented or believed to be at risk for dementia, show a consistent and relatively nonprogressive inferiority in memory functions when compared with normal subjects of their same age group, and also that these memory impairments have characteristics corresponding in part to Kral's description of benign senescent forgetfulness (BSF).

Introduction of a New Diagnostic Class by NIMH

In an effort to establish acceptable diagnostic terminology and criteria to describe healthy elderly individuals who experience the type of memory impairment documented in the Larrabee et al. (1986) study, a special work group was appointed by the National Institute of Mental Health (NIMH) in 1986.

They acknowledged objections to Kral's (1959) original less comprehensive conceptions of BSF, and, to divorce its work from those objections, the group proposed instead the term age-associated memory impairment (AAMI; Crook, Bartus, Ferris, Whitehouse, Cohen, & Gershon, 1986).

The essential elements of the AAMI diagnostic criteria (see Appendix) include (a) the identification of a genuine memory decrement from earlier functioning ; and (b) exclusion of dementia, delirium, depression, and other conditions that may impair memory (Crook et al., 1986). The term AAMI is to be applied to people over 50 years of age with complaints of memory dysfunction in tasks of daily living, substantiated by multi-modal psychological tests with adequate normative data. Furthermore, Crook et al. (1986) suggest that the term remain nonspecific with regard to etiology, and although the symptoms do not necessarily need to prove a lack of progression (unlike the BSF construct), deterioration beyond a certain point would call for a new diagnosis for the individual. The authors of the diagnostic criteria hoped it would prove useful in both clinical practice and research involving age-related conditions.

Of major importance is the fact that AAMI itself is not a direct correlate of Kral's benign senescent forgetfulness. The spirit of the AAMI construct is that these persons have experienced a memory decline from their earlier years that can be attributed to nothing other than the fact that they have grown older; like graying hair and changes in skin elasticity, these memory impairments could indeed be part of normal maturation in human development. Therefore, the AAMI construct is meant to subsume normal age-related decline as well as decline beyond that expected for the period of development. This is reflected in the lack of age-peer comparisons in part (a) above; the identification of a genuine memory decrement from earlier functioning.

To bring greater precision to the construct of AAMI, Blackford and La Rue (1989) proposed two additional subtypes within AAMI: age-consistent memory impairment (ACMI) and late-life forgetfulness (LLF). Along with other diagnostic criteria (e.g., exclusion of dementia, delirium, depression, and other conditions as in the original AAMI criteria; see Appendix), ACMI is meant to describe persons whose memory functions have declined at a rate and configuration consistent with normative expectations, and LLF is meant to be what probably constitutes a correlate of Kral's BSF; memory decline significantly beyond normative expectations, but without a corresponding decline in intelligence as is observed in AD. Secondary memory is of the greatest importance in differentiating between the three subtypes of AAMI. Summarizing the Blackford and La Rue (1989) revised criteria, the diagnostic guidelines pertaining to secondary memory for the three classes of AAMI are as follows:

> Age-associated Memory Impairment (AAMI)
> At least 1 SD below normative mean established for young adults.
>
> Age Consistent Memory Impairment (ACMI)
> Within ±1 SD of mean established for age peers.
>
> Late-Life Forgetfulness (LLF)
> Between 1 to 2 SD below mean established for age peers.

As can be seen from the descriptions above, the AAMI group includes persons who memory abilities may exceed that of their age-peers. This is also true of the ACMI group, but to lesser possible extent, since by definition their abilities are constrained within a standard deviation of the normative mean for their age group. Whereas the AAMI subtype (which, by the Blackford and La Rue revision, is a subtype still under the over-arching construct also labeled "Age-associated Memory Impairment") and the ACMI subtype may not appear to be of clinical concern since they do not suggest pathology beyond normal aging, those subtypes do have merit as theoretical constructs. Namely, if science is to accept any supposedly comprehensive model of memory and the brain, the model must be able to account for the observed phenomena of AAMI; what changes take place in the brain, and thereby in the theoretical interconnections of cognitive models, which cause an isolated decrease in the secondary memory functioning of some humans and not others? In posing such questions, the AAMI construct, like Kral's BSF before it, serves an important role in the advancement of memory research.

Following the reasoning of Blackford and La Rue, the current investigation focuses on the LLF subtype as a critical diagnostic issue for an aged population. As they stated; "In our opinion, it is this [LLF] group that is likely to be of greatest interest to clinicians, and whose performance should be followed more closely in longitudinal and treatment investigations. Although our criteria for assignment to this group are not identical to those used by Kral to define BSF (e.g., remote recall will not be evaluated), they may identify many of the same individuals." (p. 301).

The implications of improved understanding in age-associated memory decline for the medical and general community are, at the very least, three-fold: (a) By isolating the specific stage at which memory in the elderly deviates in efficiency from younger controls, it may be possible to devise techniques of cognitive re-training and rehabilitation to enable aged patients to function in their daily living at their full potential; (b) with greater precision in assembling groups of experimental and control subjects for study, it may be possible to make greater gains in pharmacological treatments for memory deficits in the aged; (c) knowing what impairments are to be expected with advanced age, as well as being cognizant of age-associated memory impairment and its benign nature, clinicians may be able to alleviate the profound distress needlessly experienced by some people due to indications that their memory is declining. The introduction of AAMI, ACMI, and LLF as diagnostic classes greatly improves the medical community's chances of eliminating false positives in the diagnosis of AD and other dementias.

Assessing Late-Life Forgetfulness

In their work with AD patients, Martha Storandt and her colleagues developed a short, easily administered battery to differentiate AD patients from normals (Storandt, Botwinick, Danziger, Berg, & Hughes, 1984). Although this time-efficient battery, referred to here as the Brief SDAT Battery, has proved its worth in screening for AD, no such single test has been devised for assessing the presence of LLF. However, the typical diagnostic procedure for an elderly person with memory complaints is to first conduct dementia screening. Therefore, a dementia screening battery with the additional capability of detecting LLF would be more useful than separate batteries requiring twice the time.

The Brief SDAT Battery

The Brief SDAT Battery is made up of the following four well established psychometric measures; the Mental Control and Logical Memory sections of the Wechsler Memory Scale (Wechsler, 1945), word fluency for letters S and P, and the Trail Making Test, part A, of the Halstead-Reitan Neuropsychological Battery (Reitan, 1985). The four subtest values are combined in a canonical function, and the resulting score classifies the subject as normal if the computed score is less than zero, and demented if the score is equal to or greater than zero. This battery has demonstrated an extremely high percentage of correct classifications (98% on cross validation) and is now widely used in medical centers across the country (Storandt, Botwinick, Danziger, Berg, & Hughes, 1984).

Considering the various facets of the LLF construct, the Brief SDAT Battery is a logical candidate as the suitable dual purpose diagnostic tool. Its usefulness for the differential diagnosis of AD versus normal aging has already been established, and the battery's subtests assess the functions integral to LLF.

Restating the intrinsic elements of AAMI (and therefore LLF), diagnosis of the condition requires (a) the identification of a genuine memory impairment; and (b) exclusion of dementia, and other conditions that may impair memory. In addition, the assessment should be done using multi-modal psychological tests with adequate normative data (Crook et al., 1986). The memory deficits of criteria (a), reputed to be the primary symptom associated with LLF, can be detected with the Brief SDAT Battery by the Logical Memory section, a subtest which was in fact recommended by the NIMH work group as a criterion measure for the AAMI diagnosis (see Appendix). The timed Trail Making Test, part A, in which the subject is asked to connect a sequence of numbered circles at their maximum speed, was designed to reflect the subject's processing speed, and Reitan notes, "speed and efficiency of performance may be a general characteristic of adequate brain functions" (Reitan, 1985, p.27). As noted above, processing speed has been implicated in memory impairments of the aged through a variety cognitive research studies, and therefore, such a task is expected to serve as a valuable device in detecting LLF.

The remaining two subtests of the Brief SDAT Battery, Mental Control and Word Fluency, do not directly correspond to deficits in the LLF construct, and hence, are expected in this investigation to retain their functions of delineating the AD subjects from the normal subjects and, further, distinguish those subjects with AD from the LLF subjects. In the Mental Control subtest, the subject is required to count backwards from 20 to 1, recite the alphabet, and add serial 3s, and each trial is done under a certain time limit. These tasks test well-learned material and simple conceptual tracking, and are difficult for only individuals with more advanced dementia (Storandt et al., 1987). The Word Fluency subtest challenges the subject to produce as many words as possible that begin with the letters S and P, given 60 seconds for each. This serves as a brief test of expressive aphasia, which is often found to be a feature in mild AD (Faber-Langendoen, Morris, Knesevich, La Barge, Miller, & Berg, 1988), but has not been reported to be involved in AAMI or LLF. These subtests, Mental Control and Word Fluency, are expected in this investigation to discriminate the AD protocols from both the normals and the LLF subjects.

The goal of this study is to document the concurrent validity of the Brief SDAT Battery in diagnosing Late-Life Forgetfulness. It should be noted that the battery is only intended to address the cognitive aspects of the LLF diagnosis, and although these performance factors tend to take precedence in the thoughts of the diagnostician, it remains the responsibility of the clinician (as stated in the AAMI diagnostic criteria listed in the Appendix) to evaluate the possibilities of other conditions as being responsible for the reported memory decrements, such as depression, life-long low intellectual functioning, medical events such as cerebral vascular infarction, etc. However, since these considerations are also integral to any evaluation for AD, it is hoped that expanding the utility of the Brief SDAT Battery to encompass LLF will substantively enhance the common process of dementia screening.

HYPOTHESIS

In light of the preceding discussion, the purpose of this study was to investigate a single global hypothesis; the Brief SDAT Battery was evaluated for concurrent validity in discriminating participants into three diagnostic classes. These classes comprise:

1. Subjects diagnosed as having Senile Dementia of the Alzheimer's type by external criteria.
2. Subjects diagnosed as having Late-Life Forgetfulness according to the traditional criteria measures.
3. Those subjects considered healthy through exclusion from classifications 1 and 2 above.

The external validity criteria for the classification of AD were provided by the following measures and cutting scores according to the respective manuals and associated literature:

Mini-Mental State < 24 (Folstein, Folstein & McHugh, 1975)
Selective Reminding Test < 9.52 Consistent Long-Term Retrieval (Masur, Fuld, Blau, et al., 1989)
Hachinski Ischemia Scale < 4 (Hachinski, Iliff, Zilhka, et al., 1975)
Hamilton Depression Rating Scale < 13 (Hamilton, 1967)
A clinical interview of daily functioning

The external validity criteria for the classification of LLF were provided by the following measures and cutting scores in accordance with both the NIMH and the Blackford and La Rue proposals (Crook et al., 1986; Blackford & La Rue, 1989):

Mini-Mental State > 24 (Folstein, Folstein & McHugh, 1975)
Selective Reminding Test < 9.52 Consistent Long-Term Retrieval (Masur, Fuld, Blau, et al., 1989)
Hachinski Ischemia Scale < 4 (Hachinski, Iliff, Zilhka, et al., 1975)
Hamilton Depression Rating Scale < 13 (Hamilton, 1967)
Vocabulary subtest of the Wechsler Adult Intelligence Scale > 9 scaled score (Wechsler, 1981)
A clinical interview of daily functioning

Using these three traditional classifications as reference, the regression coefficients of the Brief SDAT Battery were reformulated to facilitate a ternary discriminate function, maximizing its validity in correctly discriminating 59 subjects into their 3 proper diagnostic classes.

First Analysis

As a preliminary step, and congruous with the Storandt group's call for replication of their results (Storandt et al., 1984), the first stage of the present study's analysis was to assess the adequacy (in terms of percentage) of the Brief SDAT Battery in correctly classifying the cases in our sample into the non-demented and AD diagnostic classes. It was of interest to find how many (if any) of our subjects with LLF were misclassified as demented with the current version of the canonical equation.

Second Analysis

In the event that the original version of the Brief SDAT Battery canonical function was less than completely accurate in classifying the demented and normal subjects in our sample, it was planned that the regression coefficients would be reformulated to best classify the present sample. This reformulation process was performed using SYSTAT® 5.0 computer program software, which conducts the standard 2 discriminant phases of analysis and classification. In the first phase, standardized canonical discriminant coefficients were derived from the entire sample. Then as the second phase, unstandardized canonical discriminant coefficients (and the associated constants created in the conversion) were translated from the standardized coefficients, permitting the use of raw scores in calculating the canonical score from the Brief SDAT Battery subscales. These unstandardized coefficients should thereby help retain the practicality of the Brief SDAT Battery in clinical settings.

The entire sample was used in the discriminant analysis and classification to maximize the stability of the coefficients. From the classification of the entire sample, a success rate of classification (in terms of percentage) was obtained. Direct entry, rather than a stepwise method, was used to introduce the variables into the analysis due to the fact that the discriminating variables have already been selected by our use of the original version of the Brief SDAT Battery. These discriminating variables are the battery's 4 subscales; 1) Mental Control, 2) Logical Memory 3) Word Fluency for letters S and P, and 4) Trail Making Test - A.

Third Analysis

To discriminate into the three diagnostic classes of AD, LLF and healthy normal groups, the discriminant analysis process was repeated, this time classifying the subjects into all three groups. Once again, the entire sample was used in the discriminant analysis and classification to maximize the stability of the coefficients. This analysis allowed a final estimate (in percentage) of the battery's ability to classify subjects into the 3 diagnostic categories, as well as assess the new coefficient's relative diagnostic utility in comparison with the original version of the test.

It should be noted that, unlike the original version of the Brief SDAT Battery which used a single canonical equation, the computer software used in this study derives a different set of coefficients for each diagnostic class considered. Therefore, an individual's raw scores are applied to two sets of coefficients, in the case or the binary discrimination between normal and AD; or three sets of canonical coefficients, in the case or the ternary discrimination between normal, LLF and AD. Each set of coefficients represents one diagnostic class. The individual is to be assigned to the diagnostic class represented by the set of coefficients leading to the highest canonical value for that individual case.

METHOD

Participants

The participants were chosen from an ongoing Michigan State University (MSU) Psychological Clinic Aging Research Project. This pool contains protocols of older individuals ranging from 57 to 90 years old who have been deemed relatively healthy and free of significant emotional problems, have expressed concerns about memory problems, and were participating with informed consent in a longitudinal study of cognition. In addition, 24 subjects were chosen from the University of Michigan (UM) Hospitals Neuropsychology Program who matched the same description above and were participating in a similar ongoing study. The sample of 59 volunteers consisted of 29 males and 30 females, with a mean age of 71.90 years (standard deviation [SD] = 7.79), and mean education of 12.92 years (SD = 3.34). According to diagnostic criteria of each of the three classifications, our sample of 59 volunteers comprised of 21 normal healthy, 16 LLF, and 22 AD subject protocols.

Procedure

Participants with memory complaints volunteered for both the MSU and UM projects were tested with a brief but comprehensive battery of cognitive tests and interviews as part of the ongoing studies. They were also administered all of the conventional measures required for a diagnosis of AD and the NIMH diagnostic criteria for LLF, as listed above. Each participant was tested individually in a single session, typically lasting 1.5 hours. All participants were administered each measure according to the exact instructions provided in the respective manuals. Interpretive feedback on the memory examination was available to the participant on request.

RESULTS

First Analysis

The results of the first analysis, in which the original Brief SDAT Battery formula was used to classify our sample, are presented in Table 2. In grouping subjects into AD and non-AD groups, the measure correctly classified 53 of the 59 cases (89.8%). Of the 16 subjects found by external validation to have LLF, the original Brief SDAT Battery wrongly classified 2 cases as AD.

TABLE 2: Classifications Using the Brief SDAT Coefficients (Frequencies)

			Predicted Cassification			
			Non-AD (Normal)	Non-AD (LLF)	AD	TOTAL
Actual Diagnosis	Non-AD	(Normal)	19	0	2	21
		(LLF)	14	0	2	16
	AD		2	0	20	22
TOTAL			35	0	24	59

Second Analysis

In an effort to improve the Brief SDAT Battery's success rate beyond 89.8% for classifying the demented and non-demented subjects in our sample, the regression coefficients were reformulated. The resultant unstandardized coefficients and associated constants are presented in Table 3.

TABLE 3: Coefficients Discriminating Non-AD from AD Cases

	DIAGNOSIS	
	Non-AD	AD
Discriminating Variables:		
Mental Control	0.840	0.494
Logical Memory	1.203	0.464
Word Fluency (S & P)	0.073	0.013
Trail Making Test - A	0.074	0.051
Constant	-10.965	-2.899

The results of the second analysis are presented in Table 4. Utilizing these optimized coefficients to classify subjects into AD and non-AD groups, the measure again correctly classified 53 of the 59 cases (89.8%). The Pearson chi-square value equals 37.583 with a probability (*p*) less than .001 (degrees of freedom [df] = 1) suggesting significant interaction; Phi value equals 0.798.

TABLE 4: Classifications of AD Using Modified Coefficients (Frequencies)

			Predicted Classification			
			Non-AD		AD	TOTAL
			(Normal)	(LLF)		
Actual Diagnosis	Non-AD	(Normal)	20	0	1	21
		(LLF)	12	0	4	16
	AD		1	0	21	22
TOTAL			33	0	26	59

Third Analysis

To discriminate into the three diagnostic classes of AD, LLF and healthy normal groups, the discriminant analysis process was repeated, this time reformulating the regression coefficients to classify the subjects into all three groups. The consequent unstandardized coefficients and associated constants are presented in Table 5.

TABLE 5: Coefficients Discriminating Normal Elderly, LLF, and AD Cases

	DIAGNOSIS		
	Normal Elderly	LLF	AD
Discriminating Variables:			
Mental Control	0.842	0.826	0.490
Logical Memory	1.498	1.181	0.542
Word Fluency (S & P)	0.056	0.071	0.008
Trail Making Test - A	0.133	0.072	0.067
Constant	-14.255	-10.197	-3.533

The results of the third analysis, summarized in Table 6, reveal that the reformulated coefficients and constants correctly classified a total 43 of the 59 cases (72.9%) into their proper groups of normal elderly, LLF and AD. The

TABLE 6: Three-way Classifications Using Modified Coefficients (Frequencies)

		Predicted Classification			
		Normal	LLF	AD	TOTAL
Actual Diagnosis	Normal	14	6	1	21
	LLF	4	8	4	16
	AD	0	1	21	22
TOTAL		18	15	26	59

Pearson chi-square value equals 43.390 with a $p < 0.001$ (df = 4) suggesting significant interaction; Phi value equals .877.

In addition, a post hoc analysis examined the extent to which reformulating the Brief SDAT Battery canonical coefficients could successfully discriminate the LLF from the AD subjects, without attempting to accommodate the normal elderly scores. The resultant unstandardized coefficients and associated constants are presented in Table 7.

TABLE 7: Coefficients Discriminating LLF from AD Cases

	DIAGNOSIS	
	LLF	AD
Discriminating Variables:		
Mental Control	0.661	0.406
Logical Memory	1.440	0.636
Word Fluency (S & P)	0.116	0.029
Trail Making Test - A	0.106	0.098
Constant	-11.270	-3.543

The results of the post hoc analysis are presented in Table 8. In attempting to discriminate the LLF from the AD individuals, the reformulated coefficients correctly classified 33 of the 38 cases (86.8%). The Pearson

TABLE 8: LLF and AD Classifications Using Modified Coefficients(Frequencies)

		Predicted Classification		
		LLF	AD	TOTAL
Actual Diagnosis	LLF	12	4	16
	AD	1	21	22
TOTAL		13	25	38

chi-square value equals 20.430 ($p < 0.001$, df=1) suggesting significant interaction; Phi value equals .733.

An analysis was also conducted post hoc to determine if reformulating the Brief SDAT Battery canonical coefficients could successfully discriminate the elderly normals from the LLF subjects, without attempting to accommodate the AD subject scores. The unstandardized coefficients and associated constants yielded from this analysis are presented in Table 9.

TABLE 9: Coefficients Discriminating Elderly Normal From LLF Cases

	DIAGNOSIS	
	ELDERLY NORMAL	LLF
Discriminating Variables:		
Mental Control	1.623	1.674
Logical Memory	1.066	0.775
Word Fluency (S & P)	0.001	0.020
Trail Making Test - A	0.104	0.041
Constant	-13.297	-9.962

The results of this post hoc analysis are presented in Table 10. In attempting to discriminate the normal elderly from the LLF cases, the reformulated coefficients correctly classified 25 of the 37 cases (67.6%). The Pearson chi-square value equals 4.98 ($p = .026$, df = 1); Phi value equals .367 suggesting significant interaction of a smaller magnitude than the other analyses.

In addition, a post hoc hypothesis was made that a relationship existed between misclassification errors in the ternary discriminant function analysis (Table 6 above) and the extent of sub-clinical depression in the misclassified subjects. It was deemed inadequate to simply correlate depression score with diagnosis since reactive depression is likely to accompany genuine deficits in

TABLE 10: Normal and LLF Classifications Using Modified Coefficients

		Predicted Classification		
		NORMAL ELDERLY	LLF	TOTAL
Actual Diagnosis	NORMAL ELDERLY	13	8	21
	LLF	4	12	16
TOTAL		17	20	37

functioning. Therefore the Hamilton Depression Rating Scale scores were compared with the direction of misclassification for the wrongly diagnosed cases, and a Pearson correlation coefficient of -.46 (p = .07) was obtained. That is, a higher rating of depressive symptomology and a higher estimate of "pathology" (LLF or AD) are correlated at -.46.

It was also hypothesized that the measure we utilized for external validation of memory functioning, the Selective Reminding Test (Masur, Fuld, Blau, et al., 1989), may have been less than optimal. Re-classification of the entire sample was conducted using the Logical Memory test (Wechsler, 1945) to determine if using this measure for external validation of diagnostic class alters the three divisions of our sample. The results of this post hoc analysis are presented in Table 11.

To address the uniqueness of the LLF diagnosis, a final post hoc analysis was conducted in which, for each of the four experimental subscales, the test performances between the three diagnostic classes were compared. The results of these last post hoc analyses are summarized in Table 12 and Table 13.

TABLE 11: Frequencies of Re-classified Cases Using the Logical Memory Test

		Cases Re-classified by Logical Memory Normal	LLF	AD	TOTAL
Diagnosis By Selective Reminding Test	Normal	--	2	1	3
	LLF	10	--	3	13
	AD	0	0	--	0
TOTAL		10	2	4	16

TABLE 12: ANOVA Summary for the Brief SDAT Subtests Across Diagnoses

	Source of Variation	df	MS	F
Mental Control	Diagnosis	2	81.54	15.45*
	Error	56	5.28	
	Total	58		
Logical Memory	Diagnosis	2	185.06	36.20*
	Error	56	5.113	
	Total	58		
Word Fluency Total	Diagnosis	2	2414.14	22.77*
	Error	56	106.03	
	Total	58		
Trails A	Diagnosis	2	1869.82	8.39*
	Error	56	222.75	
	Total	58		

*$p < .001$

TABLE 13: Pairwise Comparison Probabilities for the Brief SDAT Subtests

	NORMAL ELDERLY	LLF	AD
Mental Control:			
NORMAL ELDERLY	1.000		
LLF	0.689	1.000	
AD	0.000	0.001	1.000
Logical Memory:			
NORMAL ELDERLY	1.000		
LLF	0.139	1.000	
AD	0.000	0.000	1.000
Word Fluency Total			
NORMAL ELDERLY	1.000		
LLF	0.382	1.000	
AD	0.000	0.000	1.000
Trails A			
NORMAL ELDERLY	1.000		
LLF	0.035	1.000	
AD	0.001	0.480	1.000

DISCUSSION

In the first analysis, presented above in Table 2, we attempted to replicate the findings of the Storandt group's findings for the Brief SDAT Battery. Their 1984 study (sample size of 84) found that this battery achieved 98% correct classifications on cross validation in discriminating between subjects in non-demented and AD diagnostic classes. (Storandt et al., 1984). The present investigation, with a 30% smaller sample size, found the Brief SDAT Battery's discriminating power to be somewhat less, but still impressive at 89.8% correct classification of non-demented and AD participants. Unfortunately, 4 of the 6 misclassifications were false positive diagnoses of AD. Furthermore, the fact that 2 of these were LLF cases illustrates the necessity of our goal to clinically identify LLF individuals, enabling their dissociation from the "catastrophic" diagnosis of AD.

Our initial finding led to the second analysis in an attempt to improve classification rates. Reformulation of the Brief SDAT Battery regression coefficients resulted in precisely the same success rate (53 of the 59 subjects correctly classified), with some relative cost to the profile of false positive diagnoses; whereas use of the original coefficients yielded 4 false positive AD classifications, our modified coefficients yielded 6. Furthermore, twice as many LLF subjects were wrongly identified as AD with the modified coefficients as with the original version of the canonical equation.

Considering the demographics of the samples, the ages in the Storandt, et al. (1984) and the present studies are quite similar (mean age 71.6 and 71.9 respectively). The mean level of education, however, was lower in the Storandt investigation than in the present study (mean education 12.4 and 15.5 respectively). The discrepant findings of the second analysis could be related to this potentially higher premorbid level of functioning in our sample. It is also possible that sample size and random error contributed to the different classification rates between the two studies. In addition, the possibility exists that the relatively "harsh" nature of our modified battery is a function of differing techniques used for external validation for the diagnostic groups; in the present study, AD diagnoses were based on performances on standardized tests, whereas it is unclear if such tests were used, and if so which tests, by the Storandt group. Conceivably, this could have led to a relatively more severely demented group in the Storandt sample than in the current study. For instance, on the Logical Memory test, the two AD groups gave discrepant performances of (mean $\pm$ SD) 2.01 $\pm$1.94 for the Storandt group (1984) versus 3.34 $\pm$1.66 for the present sample; a significant difference at the 1% level for a two-tailed test. The greater relative severity of dementia in the Storandt group could have made it relatively easier for the canonical function equation to classify that sample than it was to classify the present, less impaired sample.

Our third analysis involved reformulation of the regression constants and coefficients for each of the four subscales of the Brief SDAT Battery, allowing ternary discrimination of the normal elderly, LLF and AD groups. This resulted in a 72.9% success rate as seen in Table 6. This moderate rate of success appears, on closer scrutiny, to reflect the battery's varying abilities to differentiate the three types of conditions studied. Whereas the modified coefficients yielded a success rate of 95.5% for the AD class alone, and 66.7%

success for the normal elderly group alone, they only managed to correctly classify 50.0% of the LLF cases. Furthermore, an individual LLF participant had an equal probability to be misclassified as AD as being misclassified as normal elderly. These equivocal results are likely to be best explained by at least one of four trains of logic:

1) The Brief SDAT Battery is not capable of the ternary discrimination.
2) In this particular data set, some portion of the misclassified participants represent idiosyncratic outliers whose data confounded the findings.
3) The measures used for establishing external validation of the three diagnostic groups in the present study were insufficient.
4) The construct of Late-Life Forgetfulness is not viable, and these cases should in fact be considered variants of either normality or AD.

To address the first possibility listed above, post hoc analyses were conducted to determine the battery's ability to make the remaining binary discriminations within our sample; LLF versus AD, and elderly normal versus AD. It is conceivable that the three-way discrimination may have mathematically overburdened the canonical function coefficients, and indeed diagnosing LLF in binary discriminations appeared improved over determining all diagnoses at once. The success rate of 86.8% in correctly classifying LLF and AD protocols (Table 8) suggests that the Brief SDAT Battery does have clinical utility in differentiating LLF and demented patients. Such a differentiation requires, however, that the individual patient has been found previously to have impairments beyond that expected for a normal elderly person, since applying the coefficients given in Table 7 to a healthy normal person's scores would misclassify that individual as LLF due to ceiling effects. It would seem that this initial distinction could be accomplished by applying the same four test scores gathered from the client to the set of coefficients and constants given in Table 9. These coefficients were found to correctly classify 67.6% of the cases into the normal elderly and LLF groups. Doing this entire procedure would essentially add only one calculation to the evaluative process (four sets of coefficients and constants rather than three sets as is necessary for the ternary discriminant function).

However, examination of grouping results reveal that the four LLF cases that were mis-identified as AD in the ternary discriminatory function analysis were the same four cases wrongly classified as AD in the LLF versus AD discrimination. Therefore, the improvement in the success of classifying LLF cases to 75.0% in the LLF versus AD discrimination, up from 50.0% in the ternary discrimination, is actually a function of a ceiling effect, making it impossible to misclassify any cases as elderly normal. Likewise, the four misclassified LLF subjects in the ternary discrimination were also the same four mis-identified as normal elderly in the normal elderly versus LLF analysis (Table 10). To apply an LLF individual's four raw test scores to all four sets of coefficients and constants provided in Tables 7 and 9 would ultimately still ensure only a 50% chance of being correctly classified as LLF.

Therefore, in addressing the first of our evaluative hypotheses posed to account for the Brief SDAT Battery's moderate success in simultaneously discriminating between the three diagnostic groups, it does appear that the battery itself has some limitation that restricts its ability to make such three-way distinctions. Although the four measures included in the Brief SDAT Battery appeared theoretically well suited for the ternary differential diagnosis, further investigation is necessary to determine if some other measures could better serve the function.

The second explanatory hypothesis posed above, that the data may contain misclassified participants whose performances fell outside reasonable ranges, thereby confounding the results, was also considered. Errors in computer data entry having been ruled out through inspection, the effect of depression was examined as a possible interacting variable.

Psychomotor slowing and memory disturbance has long been attributed to depressed mood state, especially in the elderly (e.g., Caine, 1986). The Brief SDAT Battery, consisting of tasks which all require some element of speed or memory, would appear susceptible to the effects of depression. It is recognized that presence of depressed mood is one of the exclusionary criteria in the definition of all types of AAMI (see Appendix). Examination of the raw data gave the impression of relatively higher scores on the Hamilton Depression Rating Scale (HDRS) for the misclassified cases than for the properly classified cases. Although all of these values are below the cutting score of 13 points, we sought to determine if "sub-clinical" depression had an effect on our data. Therefore, our post hoc analyses of the HDRS examined the possible relationship between misclassification and sub-clinical depression. In the initial HDRS analysis, the correlation between depression ratings and proper or improper classification was not found to be significant. The next statistical analysis examined whether a misclassified individual's depression score predicted the direction of error. The resultant Pearson correlation coefficient of -0.458 (p = 0.074) suggests that a very mild relationship existed. That is, a higher depression rating was correlated with a false negative diagnosis.

A possible explanation for this relationship leads us to consider the relative susceptibilities of the external criteria and experimental measures to the effects of depression. Our external validation measure of secondary memory functioning (Selective Reminding Test), on which we based, in part, our decisions to group the cases into the three diagnostic classes, could possibly be relatively more sensitive to depression than any of the subscales in the Brief SDAT Battery. If this is the case, theoretically, the misdiagnoses could have taken place in the initial groupings of subjects by external criteria. This would account for higher depression ratings among the participants "under-diagnosed" (classified as being in a less impaired condition than that in which the external validation measures placed them). Further insight into this explanation will require carefully designed investigations into the sensitivity of the SRT and Logical Memory to sub-clinical depression. Within the data set presented here, no simple relationship was found to reach statistical significance. Furthermore, no relationship between misclassification and any other variable used was found to approach significance.

The above discussion of the Hamilton and SRT scales merges with our third explanatory hypothesis; the measures used in the present study for establishing external validation of the three diagnostic groups were less than optimal. Specifically, the NIMH work group presented Logical Memory as one of three suggested tests of secondary memory for classifying AAMI (see Appendix). Because Logical Memory is actually part of the experimental measure (Brief SDAT Battery), it was restricted from use as a classification device. The Selective Reminding Test was chosen to comply with the work group's recommendation to use a standardized test "...with adequate normative data" (Crook et al., 1986, p. 270). The SRT has been relatively well researched since its presentation in 1973, (Buschke, 1973), and has established its utility with aged and dementing samples (e.g., Masur et al., 1990; Masur et al., 1989). Nonetheless, the possibility exists that there is an unforeseen complication in using the SRT with an LLF sample. For example, post hoc analysis revealed that when our entire sample was re-classified into the normal elderly, LLF, and

AD groups using the Logical Memory test , 27% of the sample was assigned to a different group than that prescribed by the SRT (Table 11). Further, of the LLF cases misclassified in the ternary discrimination, post hoc examination of their raw scores reveals that 7 of the 8 cases would have been classified in the same diagnostic category as assigned by the reformulated coefficients and constants if Logical Memory could have been used as an external validity measure. Perhaps using the SRT as an external validation measure compromised the Brief SDAT battery's ability to make the ternary differential diagnoses. Again, this requires further examination of this test in carefully controlled studies to provide greater understanding of the SRT, depression, LLF, and the possible interactions between all three.

By similar reasoning, it may be beneficial in the future to compare the Hamilton scale to other measures of mood to determine to what extent the HDRS is appropriate for use with an LLF sample. The HDRS may also have an undetected characteristic that restricts its utility with individuals possessing isolated memory impairment.

The question remains, however, as to whether any collection of measures could make such a discrimination. That is (as our fourth and final potential explanation of our data asks), is LLF truly a distinct clinical entity? Informal monitoring of various grumblings from attendees of national neuropsychological conferences suggests to us that at least some members of the professional community believe that LLF will ultimately be discovered to represent early, mild dementia that has not come to full expression. Although we have not as yet found cogent research in the literature advancing this view, the data presented here could, in part, be interpreted as such. Certainly longitudinal tracking of our 16 LLF participants could help shed light on whether

LLF deserves it's own diagnostic class within AAMI, or if it does not belong under AAMI at all, and is truly part of another, separate process such as AD.

Undoubtedly, this uncertainty over the validity of the LLF construct will continue for some time. To the extent that the present investigation can contribute to answering this question, we will review the significant differences between LLF performances and those of the normal elderly and AD groups. Referring to post hoc analysis Table 12, it can be seen that ANOVA tests for each of the four subscales making up the Brief SDAT Battery reveal highly significant differences in performance between the three groups. In addition, the Tukey HSD comparisons in Table 13 demonstrate that the majority of the significant differences are generated by performance contrasts between normal elderly and AD individuals (all at the $p < .001$ level). However, three of the four tests comprising the Brief SDAT Battery yielded significant differences between the LLF and the AD subjects; Mental Control, Logical Memory, and Word Fluency (all at the $p < .001$ level). A significant difference was found between the normal elderly and the LLF groups on Trails A at the $p < .05$ level.

The fact that a probability of 0.139 was found when comparing normal elderly to LLF performances on the Logical Memory test further casts doubt on the external validation measure chosen here to document memory decline (SRT). Nevertheless, the preponderance of significant differences between the LLF and AD groups fails to directly support a hypothesis that LLF is a mild variant of AD. In this respect, the present study supports the existence of an intermediate condition, between normality and dementia, which is characterized by isolated impairments in cognitive functioning.

APPENDIX

APPENDIX

Age-Associated Memory Impairment

1. Inclusion criteria

a. Males and females at least 50 years of age.

b. Complaints of memory loss reflected in such everyday problems as difficulty remembering names of individuals following introduction, misplacing objects, difficulty remembering multiple items to be purchased or multiple tasks to be performed, problems remembering telephone numbers or zip codes, and difficulty recalling information quickly or following distraction. Onset of memory loss must be described as gradual, without sudden worsening in recent months.

c. Memory test performance that is at least 1 SD below the mean established for young adults on a standardized test of secondary memory (recent memory) with adequate normative data. Examples of specific tests and appropriate cutoff scores are listed below, although other measures with adequate normative data are equally appropriate.

Test	Cutoff Score
Benton Visual Retention Test (number correct, Administration A)	6 or less
Logical Memory subtest of the Wechsler Memory Scale (WMS)	6 or less
Associate Learning subtest of the WMS	13 or less

d. Evidence of adequate intellectual function as determined by a scaled score of at least 9 (raw score of at least 32) on the Vocabulary subtest of the Wechsler Adult Intelligence Scale.

e. Absence of dementia as determined by a score of 24 or higher on the Mini-Mental State Examination (Folstein, Folstein, & McHugh, 1975).

2. Exclusion criteria

a. Evidence of delirium, confusion, or other disturbances of consciousness.

b. Any neurologic disorder that could produce cognitive deterioration as determined by history, clinical neurological examination, and, if indicated, neuroradiologic examination. Such disorders include AD, Parkinson's disease, stroke, intracranial hemorrhage, local brain lesions including tumors, and normal pressure hydrocephalus.

c. History of any infective or inflammatory brain disease including those of viral, fungal, or syphilitic etiologies.

d. Evidence of significant cerebral vascular pathology as determined by a Hachinski Ischemia Score (Rosen, Terry, Fuld, Katzman & Peck, 1980) or 4 or more, or by neuroradiologic examination.

e. History of repeated minor head injury (e.g., in boxing) or single injury resulting in a period of unconsciousness for one hour or more.

f. Current psychiatric diagnosis according to DSM-III criteria (American Psychiatric Association, 1980) of depression, mania, or any major psychiatric disorder.

g. Current diagnosis or history of alcoholism or drug dependence.

h. Evidence of depression as determined by a Hamilton Depression Rating Scale (Hamilton, 1967) score of 13 or more.

i. Any medical disorder that could produce cognitive deterioration including renal, respiratory, cardiac, and hepatic disease; diabetes mellitus unless well controlled by diet or oral hypoglycemics; endocrine, metabolic, or hematologic disturbances; and malignancy not in remission for more that two years. Determination should be based on complete medical history, clinical examination (including electrocardiogram), and appropriate laboratory tests.

j. Use of any psychotropic drug or any other drug that may significantly affect cognitive function during the month prior to psychometric testing.

Note: From Crook, T., Bartus, R.T., Ferris, S.H., Whitehouse, P., Cohen, G.D., & Gershon, S. (1986). Age-associated memory impairment: Proposed diagnostic criteria and measures of clinical change -- Report of a National Institute of Mental Health work group. Developmental Neuropsychology, 2, 261-276. Reproduced with permission.

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