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# A New Scale for the Assessment of Functional Status in Alzheimer's Disease and Related Disorders

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*Assessment of the functional competencies of patients with dementia is typically conducted in an indirect manner. Psychological tests of cognition or descriptions by relatives or other caregivers are often used to make judgments as to the patient's ability to adapt to the demands of the environment. However, these methods have built-in biases. The need for direct assessment of functional status was addressed by developing a standardized operational procedure to examine areas of functional competence which may become impaired in Alzheimer's disease and other related memory disorders. The resulting instrument has high interrater and test-retest reliabilities. Convergent validity is evidenced by significant correlations between the scale and established measures of functional status. Patients with Alzheimer's disease exhibited deficits in functional capacities relative to age-equivalent normal controls and to elderly patients with a primary major depression.*

COGNITIVE and behavioral disturbances are hallmark features of dementing illness. Clinical rating instruments such as the Folstein Mini-Mental State Examination (Folstein, Folstein & McHugh, 1975), Dementia Rating Scale (Coblentz et al., 1973), and Alzheimer's Disease Assessment Scale (Rosen, Mohs, & Davis, 1984) are utilized to provide an overview of memory, language, and visuospatial/visuoconstructive skills. More extensive neuropsychological measures are often employed for purposes of diagnostic formulation and to document the course of neurological disease. They are also used to provide information as to the patient's ability to manage finances without supervision, drive, or make basic decisions in the workplace. Judgments as to patient competence derived from these measures also play a major role in legal proceedings, including guardianship of person and property. Because many of these instruments were developed on models of cognition or brain function, they often fail to provide sensitive measures of specific functional subskills or overall functional competency.

To tap the patient's ability to engage in activities of daily living, measures such as the Blessed Dementia Rating Scale (Blessed, Tomlinson, & Roth, 1968) or OARS: Instrumental Activities of Daily Living Scale (Duke University, 1978) have been developed. These rely either on the self-reports of the patient or, more often — particularly in instances of increasing disability — on the accounts of family members. While valuable, these approaches introduce reporter biases. Behaviorally based assessment instruments developed for use with head-injured and medically disabled patients (Keith, 1984; Granger, Albrecht, & Hamilton, 1979; Granger & Greer, 1976; Seitz, Allred, Backus, & Hoffman, 1987), psychiatric populations (Brown & Munford, 1983; Wallace, 1986), and the mentally disabled (Giller, Dial, & Chan, 1986; Nihira, Foster, & Spenser, 1968; Coons, Haley and Maharaj, 1984) typically assess functional deficits within circumscribed areas and do not examine a broad range of independent activities of daily living performed by older adults. The few instruments that have been developed to directly assess functional behaviors among the elderly, such as the PPG Instrumental Activities of Daily Living Scale (Lawton, 1972) or the Performance Activities of Daily Living Scale (Kuriansky & Gurland, 1976) focus on rudimentary skills that relate to institutional care but fail to provide an in-depth analysis of discrete higher-order functional abilities. Moreover, these measures may be insensitive to subtle changes in specific subskills which occur in the incipient phases of Alzheimer's disease (AD) and other dementias.

In addition to difficulties with sensitivity, specificity, and generalization to behaviors in the community and at home, a further limitation of many currently available rating scales is the lack of interrater and test-retest reliabilities. This is especially problematic when these instruments are used for purposes of longitudinal analyses (La Rue, 1987).

The behaviorally based rating scale reported here allows for the direct assessment of functional capacities that are often compromised in Alzheimer's disease and related dementing disorders. It measures a broad spectrum of behaviors within each of seven functional domains and is readily administered within an outpatient setting.

## METHODS

*Subjects.* — The patient population was drawn from 30 individuals who presented to the Wien Center for Alzheimer's Disease and Memory Disorders with reported cognitive impairment. It was our plan to establish test-retest and

interrater reliabilities as well as convergent validities, based on the heterogenous group of patients who typically present with memory complaints, since the functional scale was specifically designed for use with such populations. Thus, we studied patients who evidenced different types of neurological conditions and a broad range of cognitive and functional impairment. Different subsets of patients were utilized for specific reliability and validity studies. All subjects underwent the following procedures prior to acceptance into the study:

(a) a medical, neurological and psychiatric evaluation;
(b) complete laboratory studies including chest x-ray, EKG, EEG, and MRI scans of the head, to detect the presence of medical and neurological conditions;
(c) a cognitive/neuropsychological evaluation which included the Folstein Mini-Mental State Examination (MMSE), Blessed Dementia Rating Scale, and an extensive battery of neuropsychological tests that assess memory, language, visuospatial/visuoconstructive abilities and higher order cognitive processes.

Patients diagnosed with Alzheimer's disease met NINCDS-ADRDA criteria for possible or probable AD and evidenced no MRI abnormalities other than cerebral atrophy, ventricular dilatation, and a band of periventricular signal hyperintensity immediately adjacent to the ventricles. Patients classified as having multiple cerebral infarctions (MCI) evidenced multiple focal lesions outside of the immediate periventricular area on MRI scans and exhibited a clinical course and clinical neurological findings suggestive of a vascular etiology. Persons classified as having a memory disorder with a mixed etiology, i.e., mixed AD and MCI, had progressive memory loss with features consistent with AD but also evidenced significant MRI lesions outside of the periventricular region. The diagnosis of other medical, neurological, and psychiatric conditions was based on clinical and laboratory criteria.

Eleven depressed subjects were recruited from a pool of caregivers who accompanied their family members to the memory disorders center and from a support group consisting of elderly patients from a medical outpatient clinic within the hospital. None of these individuals had a history of neurological disease or had sought assistance because of memory impairment. Mental status was intact, and all subjects met DSM III criteria for major depression when examined by an experienced clinical psychologist. In addition, each subject obtained a Hamilton Depression Score of 16 or above ($M$ = 17.8; $SD$ = 2.6). Mean MMSE scores for the depressed group ranged from 23 to 30 ($M$ = 26.3; $SD$ = 2.4). Mean educational level was 10.7 ± 3.7 years.

The 18 normal controls were hospital volunteers recruited from Mount Sinai Medical Center. None of these subjects had a history of memory loss or neurological disease, and mental status was intact per a clinical interview. Mean MMSE scores for the control group ranged from 23 to 30 ($M$ = 28.0; $SD$ = 2.2). All controls had Hamilton Depression Scores of 10 or below, which indicated no ostensible evidence of major depression. Mean educational level was 13.8 ± 2.7 years.

*Rationale for domains tapped by the functional scale.* — The functional scale as depicted in the Appendix was administered by a psychometrically trained examiner.

Time orientation, communication skills, financial abilities, shopping subskills, eating and dressing behaviors were domains selected for investigation. These areas have been repeatedly identified in the literature as important to consider in the functional assessment of the older adult and have also been tapped by numerous IADL instruments utilized within geriatric settings. Kane and Kane (1981) provide an excellent review of research in this area as well as the specific domains that have been examined previously. Although not specifically addressed in the literature, identification of road signs was also targeted for study because we had observed that the issue of driving competency continually arose during the course of our clinical evaluations. After these seven domains had been selected, we assembled a number of experienced geriatricians who provided information as to: (a) the types of functional deficits that their patients evidenced within the domains that had been identified; (b) the types of behaviors that were subject to in vivo assessment within an outpatient setting; and (c) behaviors that were of practical significance with regards to clinical decision making and/or remediation efforts. After identification, functional behaviors were quantified and refined through extensive pilot work with cognitively impaired patients.

Wherever possible, specific subscales within a functional domain (i.e., financial skills) as well as individual behavioral items that composed a particular subscale (i.e. counting currency) were constructed in a hierarchical fashion per earlier work in preparation for this study. This indicated that particular functional behaviors were more difficult than others for patients. We were guided by Reisberg et al.'s (1984, 1985) functional model, which proposes that a breakdown in higher order functional abilities typically occurs before lower order subskills become compromised. Utilizing this hierarchical framework allowed us to determine whether higher or lower order skills were impaired within a specific functional domain and also permitted us to evaluate a patient's performance on a specific functional task at different levels of difficulty.

A description of each functional domain tapped by the scale is as follows:

(1) *Time Orientation:* The time orientation scale has eight items and a maximum of 16 points. Patients were asked to tell time at four progressively more difficult clock settings and to give the day of the week and month, name of the month and year.

(2) *Communication Abilities:* The communication scale has 17 items and a maximum of 17 points.

**Telephone Skills:** The patient was presented with a push-button telephone and asked to dial the operator, the number of a person from a list of names and numbers, dial a single number presented orally, and a single number presented in written form. More rudimentary skills such as the ability to dial, pick up and hang up the telephone receiver in proper sequence were also assessed.

**Preparing a Letter for Mailing:** In the letter preparation task, the patient was given credit for addressing an envelope (the patient was provided a written name and address),

putting a correct return address on the envelope, placing a stamp on the envelope, folding the letter, putting the letter into the envelope, and sealing the envelope.

**Taking a Telephone Message:** The patient was asked to take a dictated telephone message and was given credit for correctly identifying the person who called, the time he/she would call again, and the number where the caller could be reached.

(3) *Transportation:* The transportation scale has 13 items and a maximum of 13 points. The patient was presented with 13 commonly encountered road signs and asked how he/she would respond to each sign if driving an automobile.

(4) *Financial Skills:* The financial scale has 21 items and a maximum of 21 points.

**Identify Currency:** The patient was asked to identify a penny, nickel, dime, quarter, $1 bill, $5 bill, and $10 bill.

**Counting Currency:** The patient was asked to count change and currency on four different trials of increasing difficulty.

**High Order Financial Abilities:** Other financial subtests included making change at a cash register, writing a check, and balancing a checkbook at increasing levels of difficulty.

(5) *Shopping Skills:* The shopping skills scale has 8 items and a maximum of 16 points. The patient was orally presented with four grocery items (orange juice, soup, cereal, tuna fish) and asked to commit these items to memory. Ten minutes later, he was taken to a mock grocery store where he/she had to select these four items from among 16 other distractor grocery items, some which were similar and others dissimilar from the to-be-remembered targets. The patient was subsequently asked to select four other grocery items using a written shopping list.

(6) *Eating Skills:* The eating skills scale has 5 items with a maximum of 10 points. The patient was given eating utensils and was then required to pour water into a glass, demonstrate how to drink from a cup, and to properly use a fork, spoon, and knife.

(7) *Dressing/Grooming Skills:* The dressing/grooming skills scale has 13 items and a maximum of 13 points. The patient was asked to take the cap off a toothpaste container, put toothpaste on a toothbrush, and demonstrate how she would brush her teeth. Other subtests include turning water on and off and demonstrating the steps involved with washing one's face and brushing one's hair. The patient was also required to put on a coat and demonstrate the ability to button, tie, and zip.

The composite functional score (maximum = 93 points) was derived from all of these scales except the transportation measure, which is used as an optional subscale. This was done because a sizable number of elderly patients have never driven and the scale is applicable only for those who have done so. The entire functional assessment takes approximately 30–35 minutes to administer.

## RESULTS

*Interrater reliabilities.* — Interrater reliability for each functional subscale, as well as composite measures tapping each functional domain, was determined for 15 memory-disordered patients (8 males, 7 females; mean age = 75.8 ± 7.2 years). The two raters were blind to each other's scores but not to subject classification. Five of these patients were diagnosed as AD, five were diagnosed as mixed (AD + MCI), three were diagnosed with MCI alone, one was diagnosed with probable Pick's Disease, and one was diagnosed with a focal progressive dementing disorder of unknown etiology. Interrater reliabilities were also calculated for the data of 12 elderly controls (2 males, 10 females; mean age = 76.2 ± 4.7 years).

An examination of test protocols indicated that for each individual item on the functional scale there was at least 85% agreement between raters when the protocols of memory-impaired patients and controls were considered together or separately. As depicted in Tables 1 and 2, both composite functional measures and individual subscales had highly significant interrater reliabilities for memory-disordered patients with obtained Kappas ranging from .911 to 1.000 ($p < .001$). For control subjects, perfect reliabilities were established for all functional measures except identification of road signs, where interrater agreement was .988 ($p < .001$).

*Test-retest reliabilities.* — Fourteen memory-impaired patients (8 males and 6 females; mean age = 76.1 ± 6.8

Table 1. Interrater Reliabilities for Summary Functional Scales Among Memory Disordered Patients and Elderly Controls

| | Memory disorders group ($n$ = 15) | Normal elderly controls ($n$ = 12) |
|---|---|---|
| Time orientation | 1.000** | 1.000** |
| Communication skills | 0.933** | 1.000** |
| Financial skills | 0.993** | 1.000** |
| Identification of road signs | 0.956** | 0.988** |
| Shopping subskills | 1.000** | 1.000** |
| Eating subskills | 1.000** | 1.000** |
| Dressing/grooming subskills | 0.989** | 1.000** |

*Note.* Interrater reliabilities for each scale were calculated using Cohen's Kappa.
**$p < .001$.

Table 2. Interrater Reliabilities for Individual Functional Subscales Among Memory Disordered Patients and Elderly Controls

| | Memory disorders group ($n$ = 15) | Normal elderly controls ($n$ = 12) |
|---|---|---|
| Telling time | 1.000** | 1.000** |
| Orientation to date | 1.000** | 1.000** |
| Using the telephone | 0.950** | 1.000** |
| Preparing a letter for mailing | 0.911** | 1.000** |
| Taking a telephone message | 0.911** | 1.000** |
| Identifying currency | 1.000** | 1.000** |
| Counting currency | 1.000** | 1.000** |
| Writing a check | 1.000** | 1.000** |
| Balancing a checkbook | 0.956** | 1.000** |
| Memory for grocery items | 1.000** | 1.000** |
| Shopping with a list | 1.000** | 1.000** |

*Note.* Interrater reliabilities for each scale were calculated using Cohen's Kappa.
**$p < .001$.

years) and 12 normal controls (2 males and 10 females; mean age = 77.4 ± 4.7 years) were reassessed on the functional scale within 3 to 7 weeks of their initial evaluation. Five of the memory-impaired patients had a diagnosis of AD, six had a diagnosis of mixed (AD + MCI), and three had a diagnosis of MCI alone. For memory-disordered patients, Spearman rank order correlation coefficients were calculated for each composite functional measure. Because normal controls achieved extremely high scores on all functional indices, the extremely restricted range of scores prohibited the application of traditional correlational analyses. As such, composite reliabilities for each scale were calculated utilizing Cohen's Kappa (1960). This allowed for an analysis of the general stability of performance tapped by a particular scale over time after accounting for concordance that would be expected by chance. Test-retest reliabilities among patients and controls for composite scale scores are depicted in Table 3 and indicate that performances on these composite scales were highly stable over time.

For memory-impaired patients, the test-retest reliabilities of subscales which tapped orientation to date, using the telephone, preparing a letter for mailing, taking a telephone message, counting currency, writing a check, balancing a checkbook and memory for grocery items were also calculated using Spearman rank order correlation coefficients. Because ceiling effects were evidenced on measures tapping the ability to tell time, identify change, and shop with a written list, these reliabilities were calculated using the Kappa statistic. Coefficients of stability were calculated in a similar manner for normal control data. Table 4 indicates that for memory-impaired subjects, test-retest reliabilities were statistically significant with the exception of the subscale tapping into the patient's ability to take a telephone message. Because of the lack of stability, this subscale was dropped as part of the functional scale and not subjected to further analyses. Significant test-retest reliabilities ranged from .546 to .918. Individual subscales for normal controls were also quite stable over time, with Kappas ranging from .778 to 1.000.

*Convergent and discriminative validities.* — We attempted to establish the convergent validity of the functional instrument by comparing patients' performance on the measure to reported functional status at home. We chose the Blessed Dementia Rating Scale (BDRS), which is based on caregiver reports. This is a well established measure of general functional status in both research and clinical settings, and is one of the few scales established on the basis of neuropathological studies (Blessed, Tomlinson, and Roth, 1968). As the Blessed Scale includes items which are unrelated to functional abilities (i.e., changes in mood), we also examined the relationship between performance on the functional scale and a pool of Blessed Scale items (Mini Blessed Dementia Rating Scale: MBDRS) which specifically tap functional behaviors in the patient's home environment. Thirty memory-impaired patients were studied for purposes of these correlational analyses (16 males and 14 females; mean age = 75.1 ± 8.7 years). As depicted in Table 5, when all patients who presented to the memory disorders clinic were considered as a whole, the correlations between the functional scale and the full BDRS was −.588 while the correlation between the functional scale and the MBDRS was −.673. Both these measures of association were significant at $p < .01$. When the relationship between scores on the

Table 3. Test-Retest Reliabilities for Summary Functional Scales Among Memory Disordered Patients and Elderly Controls

| | Memory disorders group ($n$ = 14) | Normal elderly controls ($n$ = 12) |
|---|---|---|
| Time orientation | 0.719* | 0.979** |
| Communication skills | 0.770* | 0.917** |
| Financial skills | 0.883** | 0.968** |
| Identification of road signs | 0.813** | 0.923** |
| Shopping skills | 0.792** | 0.917** |
| Basic eating skills | 0.857** | 1.000** |
| Dressing/grooming skills | 0.912** | 1.000** |

*Note.* Test-retest reliability for each functional subscale was conducted using Spearman rank order correlation coefficients. Because the direction of the relationship between the pretest and posttest scores was specified a priori, all correlational analyses were one-tailed.

Because of ceiling effects that resulted in a restricted range of scores, the eating and dressing/grooming scales for memory disordered patients and all scales for normal controls were evaluated utilizing the Kappa statistic.

*$p < .01$.

**$p < .001$.

Table 4. Test-Retest Reliabilities for Individual Subscales Among Memory Impaired Subjects and Controls

| | Memory impaired subjects ($n$ = 14) | Normal elderly controls ($n$ = 12) |
|---|---|---|
| Telling time | 0.720** | 1.000** |
| Orientation to date | 0.693** | 0.958** |
| Telephone use | 0.546* | 0.979** |
| Telephone message | 0.501 | 0.833** |
| Preparing a letter | 0.814** | 1.000** |
| Identifying change | 0.918** | 1.000** |
| Counting change | 0.689** | 1.000** |
| Writing a check | 0.792** | 1.000** |
| Balancing a checkbook | 0.812** | 0.778** |
| Memory for groceries | 0.571** | 0.833** |
| Shopping with a grocery list | 0.607** | 1.000** |

*Note.* Test-retest reliabilities were conducted using Spearman's rank order correlation coefficients and the Kappa statistic. All correlational analyses were one-tailed.

*$p < .05$.

**$p < .01$.

Table 5. Correlation of Overall Performance on the Functional Scale with the Blessed and Modified Blessed Dementia Rating Scale Scores

| | Blessed Scale | Modified Blessed Scale |
|---|---|---|
| Patients evaluated in memory disorders clinic ($N$ = 30) | $r = -.588$ ($p < .01$) | $r = -.673$ ($p < .001$) |
| Alzheimer's patients ($N$ = 11) | $r = -.656$ ($p < .05$) | $r = -.689$ ($p < .01$) |

functional scale and Blessed Dementia Rating Scale was examined for AD patients alone, there was again a significant correlation of −.656 for the BDRS and −.689 for the MBDRS.

To further establish convergent validity, we conducted a retrospective analysis of patient charts, selecting those individuals who were judged as clearly impaired as well as those with no ostensible impairment in specific areas (as ascertained by the examining clinician and based largely on reports of the patient and family members). The performance of impaired versus nonimpaired groups on in vivo functional measures is presented in Table 6. Patients who were judged to have difficulties with driving were contrasted to those without reported deficits in this area on the driving subtest of the functional scale. Similarly, patients who had difficulties remembering a list of grocery items or telling time were contrasted to those with no ostensible deficits in these areas on shopping from memory and telling time subscales respectively. Those patients with and without reported difficulties with higher order and basic financial subskills were compared on composite in vivo measures (writing a check and balancing a checkbook or identifying plus counting change) respectively. All nonimpaired groups scored higher than their impaired counterparts on each respective in vivo functional measure. By taking the sum of the squares associated with the explained variance from each ANOVA and dividing it by the total sum of squares within the model, eta$^2$ was obtained, indicating the total percentage of explained variance that could be accounted for (analogous to the $R^2$ obtained in a multiple regression equation). This estimate ranged from 34.7% to 42.3% (corresponding to biserial correlation coefficients ranging from 0.59 to 0.65), indicating a relatively strong relationship between reports of patients' function and in vivo functional measures.

Using only items that constitute the final form of the functional scale, the performance of 12 patients with Alzheimer's disease (7 males, 5 females; mean age = 78.2 ± 10.11 years), 11 patients diagnosed with primary depression (3 males, 8 females; mean age = 79.8 ± 11.0 years), and 18 age-equivalent controls (5 males, 13 females; mean age = 75.4 ± 5.7 years) were assessed. There were no significant differences between groups with regard to age or educational attainment. The results of Kruskul Wallis one-way analyses of variance conducted for each of the functional measures with Mann-Whitney U tests used for post hoc analyses revealed significant differences among groups relative to most functional domains. Table 7 reveals that there were no statistically significant differences between depressives and normal elderly subjects on any functional scales or subscales. However, relative to normal controls, the AD group scored significantly lower on all scales except those which required telling time, identifying change, eating, and dressing/grooming skills. It is likely that deterioration in function tapped by these subscales does not occur until the later stages of the disease process. Taken together, these results indicate that AD patients with mild to moderate dementia exhibited considerable impairment across different functional domains relative to normal or depressed controls.

## Discussion

The newly developed Direct Assessment of Functional Status (DAFS) scale (see Appendix) was found to have excellent interrater and test-retest reliabilities for both patients presenting to a memory disorders clinic and normal controls. In addition, the test evidences both convergent and discriminative validity. As subjects are behaviorally rated on the identical tasks which they are required to perform as part of their routine ADLs at home, it is highly unlikely that patients would have derived any significant advantage by the use of familiar environmental cues. Indeed, the strong convergent validity evidenced by the in vivo functional measure suggests that the instrument taps the functional skills utilized in the patient's everyday life.

The assessment of functional skills becomes increasingly important as professionals are asked to judge their patients' ability to handle finances, drive, make basic decisions in the workplace, or to live independently. From a diagnostic point of view, an objective in vivo assessment possesses considerable value. According to the Diagnostic and Statistical Manual of Mental Disorders (3rd ed., rev., 1987) a diagnosis of dementia cannot be made unless there is evidence of functional impairment in either social or occupational domains. Further, the NINCDS-ADRDA workgroup has identified the assessment of objective functional capacities as important for the diagnosis of a dementia syndrome (McKhann et al., 1984). Moreover, a number of investigators have suggested that identification of specific stages of functional decline in different dementing illnesses may also

Table 6. Comparison of Reported Functional Impairment With Performance on Analogous in vivo Functional Measures

| Comparison Groups | *F*-Value | *P*-Value | Proportion of variance accounted for | Biserial *r* |
|---|---|---|---|---|
| Impaired drivers ($n$ = 10) vs unimpaired drivers ($n$ = 10) | 10.24 | .005 | .363 | .60 |
| Telling time impaired ($n$ = 11) vs nonimpaired ($n$ = 11) | 17.58 | .000 | .423 | .65 |
| Remembering a list (e.g., groceries) Impaired ($n$ = 12) vs nonimpaired ($n$ = 10) | 10.65 | .004 | .347 | .59 |
| Higher order financial skills Impaired ($n$ = 15) vs nonimpaired ($n$ = 12) | 16.32 | .000 | .395 | .63 |
| Basic financial skills Impaired ($n$ = 10) vs nonimpaired ($n$ = 10) | 10.24 | .005 | .363 | .60 |

Table 7. The Performance of Patients with AD, Primary Depression, and Normal Controls on Different Functional Tasks

| | Elderly controls ($n$ = 18) | | Alzheimer's disease ($n$ = 12) | | Primary depression ($n$ = 11) | |
|---|---|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* | *M* | *SD* |
| Total score* | 89.00[a] | (1.24) | 61.18[b] | (18.13) | 87.33[a] | (2.29) |
| Telling time | 8.00 | (0.00) | 6.33 | (2.23) | 7.81 | (0.60) |
| Orientation to date* | 7.89[a] | (0.47) | 3.00[b] | (2.89) | 8.00[a] | (0.00) |
| Total time orientation* | 15.89[a] | (0.47) | 9.33[b] | (4.12) | 15.82[a] | (0.60) |
| Telephone use* | 8.00[a] | (0.00) | 6.67[b] | (1.61) | 7.91[a,b] | (0.30) |
| Preparing a letter* | 6.00[a] | (0.00) | 3.92[b] | (1.93) | 5.82[a] | (0.40) |
| Total communication skills* | 14.00[a] | (0.00) | 10.58[b] | (3.34) | 13.70[a] | (0.47) |
| Identifying road signs* | 12.56[a] | (0.63) | 8.25[b] | (2.99) | 11.85[a] | (1.68) |
| Identifying change | 7.00 | (0.00) | 6.58 | (1.16) | 7.00 | (0.00) |
| Counting change* | 3.94[a] | (0.24) | 2.67[b] | (1.50) | 4.00[a] | (0.00) |
| Writing a check* | 4.94[a] | (0.24) | 2.83[b] | (2.08) | 4.78[a] | (0.44) |
| Balancing a checkbook* | 2.78[a] | (0.55) | 0.92[b] | (1.00) | 2.10[a] | (0.99) |
| Total financial skills* | 20.67[a] | (0.59) | 13.27[b] | (5.31) | 19.78[a] | (1.30) |
| Memory for groceries* | 7.44[a] | (1.15) | 1.33[b] | (2.46) | 7.09[a] | (1.38) |
| Shopping with a grocery list* | 8.00[a] | (0.00) | 5.17[b] | (3.46) | 7.82[a,b] | (0.60) |
| Total shopping skills* | 15.44[a] | (1.15) | 6.50[b] | (4.88) | 14.91[a] | (1.38) |
| Eating skills | 10.00 | (0.00) | 10.00 | (0.00) | 10.00 | (0.00) |
| Dressing/grooming skills | 13.00 | (0.00) | 11.42 | (3.18) | 13.00 | (0.00) |

*Note.* Discriminative validity does not imply that the functional scale has utility for differential diagnosis since the sensitivity and specificity of the instrument among AD patients with differing degrees of cognitive impairment has not been established.

*Indicates a significant difference between groups on the basis of the Kruskal-Wallis test. As these analyses were conducted for 17 measures, the criteria for significance for each individual comparison was set at $p < .003$.

[a,b]Different group subscripts indicate that mean *ranks* were significantly different from each other at $p < .05$ by the Mann-Whitney U procedure.

serve to enhance diagnostic accuracy (Reisberg et al., 1984, 1985).

Directly observed behaviorally based assessment such as that provided by the DAFS can provide objective information that can serve to enhance the quality of clinical decision-making. Further, from both a clinical and research perspective, data obtained through behavioral assessment are less likely to be prone to those biases inherent to subjective ratings and, as such, provide a superior method for assessment conducted longitudinally.

Another promising aspect of behavioral functional assessment is that obtained measures do not appear to be as subject to cultural biases relative to those commonly encountered with measures of cognition and language function. For example, DAFS has been translated and administered to non-English speaking patients without difficulty, and cognitively intact patients from different cultural backgrounds are able to successfully perform all of the tasks, provided they have had the opportunity to engage in activities assessed by the functional scale (e.g., driving in the United States).

The functional scale presented here evidences good reliability and validity for summary functional scales as well as individual subscales. Composite measures, such as those based on the ability to recall items on the shopping subtest, the ability to count change or balance a checkbook, are easily interpretable and meaningful since the reliabilities of summary measures are of interest rather than the individual items which compose the scale. While the majority of tests were reliable across repeated testings, it remains clinically prudent to test the patient on successive occasions if the intent is to examine a specific behavior which may be a focus of remediation efforts.

The strong correlations between the Blessed Dementia scale and the newly developed functional measure suggest that the latter is sensitive to changes in cognitive and functional status over time. However, the functional scale enables the investigator to assess decline across a variety of functional domains that relate directly to the patient's life style and ability to manage his or her affairs at home. In addition, it may be a valuable tool in evaluating the effects of pharmacological interventions on functional status.

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REFERENCES

American Psychiatric Association (1987). Diagnostic and Statistical Manual of Mental Disorders (DSM-IIIR). Washington, D.C.: Author.

Blessed, G., Tomlinson, B. E., & Roth, M. (1968). Association between quantitative measures of dementing and senile change in the cerebral grey matter of elderly subjects. *British Journal of Psychiatry, 114*, 797–811.

Brown, M. A., & Munford, A. M. (1983). Life skills training for chronic schizophrenics. *Journal of Nervous and Mental Disease, 171*, 466–470.

Coblentz, J. M., Matto, S., Zingesser, B. H., Kasoff, S. S., Wisniewski, H. M., & Katzman, R. (1973). Presenile dementia: clinical aspects and evaluation of cerebrospinal fluid dynamics. *Archives of Neurology, 29,* 299–308.

Cohen, J. (1960). A coefficient of agreement for nominal scales. *Educational and Psychological Measurement, 20,* 37–46.

Coons, W. H., Haley, G. A., & Maharaj, N. R. (1984). Behavioral assessment of disturbed, institutionalized retardates. *Canadian Journal of Psychiatry, 29,* 263–268.

Duke University Center for the Study of Aging and Human Development (1978). Multidimensional functional assessment: the OARS methodology. Durham, NC: Duke University Press.

Folstein, M. F., Folstein, S., & McHugh, P. R. (1975). Minimental state: A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research, 12,* 189–198.

Giller, V., Dial, J. G., & Chan, F. (1986). The Street Survival Skills Question aire: a correlational study. *American Journal of Mental Deficiency, 91,* 67–71.

Granger, C. V. & Greer, D. S. (1976). Functional status measurement and medical rehabilitation outcomes. *Archives of Physical Medicine and Rehabilitation, 57,* 103–109.

Granger, C. V., Albrecht, G. L., & Hamilton, B. B. (1979). Outcome of comprehensive medical rehabilitation: measurement by PULSES profile and Barthel Index. *Archives of Physical Medicine and Rehabilitation, 60,* 145–154.

Kane, R. A., & Kane, R. L. (1981). *Assessing the elderly: a practical guide to measurement.* Lexington, MA: Heath.

Keith, R. A. (1984). Functional assessment measures in medical rehabilitation: current status. *Archives of Physical Medicine and Rehabilitation, 65,* 74–68.

Kuriansky, J. B., & Gurland, B. (1976). Performance test of activities of daily living. *International Journal of Aging and Human Development, 7,* 343–352.

La Rue, A. (1987). Methodological concerns: longitudinal studies of dementia. *Alzheimer Disease and Associated Disorders, 1,* 180–192.

Lawton, M. P. (1972). Assessing the competence of older people. In D. Kent, R. Kastenbaum, & S. Sherwood (Eds.), *Research planning and action for the elderly.* New York: Behavioral Publications.

McKhann, G., Drachman, D., Folstein, M., Katzman, R., Price, D., & Stadlan, E. M. (1984). Clinical diagnosis of Alzheimer's disease: report of the NINCDS-ADRDA work group under the auspices of Department of Health and Human Services task force on Alzheimer's disease. *Neurology, 34,* 939–944.

Nihira, K., Foster, & Spenser, R. (1968). Measurement of adaptive behavior: a descriptive system for mental retardates. *American Journal of Orthopsychiatry,* 38, 622–634.

Reisberg, D., Ferris, S. H., Armand, R., DeLeon, M. J., Schenck, M. K., Buttinger, C., & Bornstein, J. (1984). Functional staging of dementia of the Alzheimer type. *Annals of the New York Academy of Sciences, 435,* 481–483.

Reisberg, B., Ferris, S. H., & Franssen, E. (1985). An ordinal functional assessment tool for Alzheimer's type dementia. *Hospital and Community Psychiatry, 36,* 593–595.

Rosen, W., Mohs, R. C., & Davis, K. L. (1984). A new rating scale for Alzheimer's disease. *American Journal of Psychiatry, 141,* 11.

Seitz, R. H., Allred, K. E., Backus, M. E., & Hoffman, J. A. (1987). Functional changes during acute rehabilitation in patients with stroke. *Physical Therapy, 67,* 1685–1690.

Wallace, C. J. (1986). Functional assessment in rehabilitation. *Schizophrenia Bulletin, 12,* 604–630.

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## APPENDIX

## DIRECT ASSESSMENT OF FUNCTIONAL STATUS (DAFS)

by David A. Loewenstein, Ph.D.

I. Time Orientation (16 points)

| A. Telling Time (Use large model of a clock) | Correct (2 points) | Incorrect (0 points) |
|---|---|---|
| 3:00 | _____ | _____ |
| 8:00 | _____ | _____ |
| 10:30 | _____ | _____ |
| 12:15 | _____ | _____ |

| B. Orientation to Date | Correct (2 points) | Incorrect (0 points) |
|---|---|---|
| What is the date? | _____ | _____ |
| What day is it today? | _____ | _____ |
| What month are we in? | _____ | _____ |
| What year are we in? | _____ | _____ |

II. Communication (14 points) (Using a pushbutton telephone) (If at any point the patient dials, picks up, or hangs up the phone, he/she is given credit for items tapping these specific subskills.)

| A. Using the telephone | Correct (1 point) | Incorrect (0 point) |
|---|---|---|
| Dial Operator (0) | _____ | _____ |
| Dial number from book | _____ | _____ |
| Dial number presented orally | _____ | _____ |
| Dial number written down | _____ | _____ |
| Pick up receiver | _____ | _____ |
| Ability to dial | _____ | _____ |
| Hang up phone | _____ | _____ |
| Correct sequence across all previous trials | _____ | _____ |

| B. Preparing a letter for mailing | Correct (1 point) | Incorrect (0 points) |
|---|---|---|
| Fold in half | _____ | _____ |
| Put in envelope | _____ | _____ |
| Seal envelope | _____ | _____ |
| Stamp envelope | _____ | _____ |
| Address (has to be exact duplicate of examiner's copy) | _____ | _____ |
| Return address (has to put correct address in upper lefthand corner) | _____ | _____ |

III. Transportation (13 points)
(Patient has to correctly identify a driver's correct response to these road signs).

| | Correct (1 point) | Incorrect (0 points) |
|---|---|---|
| Stop | | |
| Yield | | |
| One way | | |
| No right turn | | |
| Green light | | |
| Yellow light | | |
| Red light | | |
| No "U" turn | | |
| Railroad crossing | | |
| Do not enter | | |
| Double yellow line | | |
| Passing line | | |
| Speed limit | | |

At this point the examiner should instruct the patient that he/she will be going to a grocery store in 10 minutes and that the patient will be asked to pick out four grocery items from memory. Patient is given each grocery item, repeats it and again is asked to commit the list of four grocery items to memory.

IV. Financial (21 points) (Lay out one $10 bill, three $1 bills, one $5 bill, 3 quarters, 2 dimes, 1 nickel, 3 pennies.) Subskills include making change for grocery items.

| A. Identifying Currency | Correct (1 point) | Incorrect (0 points) |
|---|---|---|
| Identify penny | | |
| Identify nickel | | |
| Identify dime | | |
| Identify quarter | | |
| Identify dollar bill | | |
| Identify $5 bill | | |
| Identify $10 bill | | |

| B. Counting Change | | Correct (1 point) | Incorrect (0 points) |
|---|---|---|---|
| Lay out | | | |
| 1–$10 bill | 6 cents | | |
| 1–$5 bill | 102 cents (in change) | | |
| 3–$1 bill | $6.73 | | |
| 3–quarters | $12.17 | | |
| 2–dimes | | | |
| 1–nickel | | | |
| 3–pennies | | | |

| C. Writing a Check | Correct (1 point) | Incorrect (0 points) |
|---|---|---|
| Signature | | |
| Pay to order of | | |
| Written amount | | |
| Numeric amount | | |
| Date (location) (Does not have to be correct) | | |

| D. Balancing a Checkbook | Correct (1 point) | Incorrect (0 points) |
|---|---|---|
| Amount A ($500–$350) correct $150 | | |
| Amount B ($323–$23.50) correct $299.50 | | |
| Amount C ($21.75–$3.92) correct $17.83 | | |

V. Shopping (16 points) Patients told to look over the 20 grocery items and asked to select the four which were presented to him/her 10 minutes earlier.

| A. Memory for Grocery Items | Correct (2 points) | Incorrect (0 points) |
|---|---|---|
| Orange juice | | |
| Soup | | |
| Cereal | | |
| Tuna fish | | |

All of the items selected by the patient on the previous test are put back and the patient is given a written grocery list.

| B. Selecting Groceries Given a Written List | Correct (2 points) | Incorrect (0 points) |
|---|---|---|
| Milk | | |
| Crackers | | |
| Eggs | | |
| Laundry detergent | | |

| C. | Correct (2 points) | Incorrect (0 points) |
|---|---|---|
| Correct change | | |

Give the patient a $5 bill and say the bill is $2.49. Put the money out in front of them (currency from the Financial Subskills Test) and ask them to count out the change they should receive.

VI. Grooming (14 points)

The patient is taken to the bathroom and asked to:

| | Correct (2 points) | Incorrect (0 points) |
|---|---|---|
| Take cap off toothpaste | | |
| Put toothpaste on brush | | |
| Turn on water | | |
| Brush teeth | | |
| Dampen wash cloth | | |
| Put soap on cloth | | |
| Clean face | | |
| Turn off water | | |
| Brush hair | | |
| Put on coat | | |
| Button | | |
| Tie | | |
| Zip | | |

VII. Eating (10 points)
(Place eating utensils in front of patient.)

| | Correct (2 points) | Incorrect (0 points) |
|---|---|---|
| Fork | | |
| Knife | | |
| Spoon | | |
| Pour water | | |
| Drink from glass | | |