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Loss of functioning on complex tasks of daily living is an early indicator of dementia. The performance of 65 older adults with mild to moderate levels of Alzheimer's disease was examined on the Everyday Problems Test for the Cognitively Challenged Elderly (EPCCE), self-report inventories of functional performance, and a broad battery of clinical and neuropsychological measures. The EPCCE was designed to assess older adults on a set of complex tasks of daily living that involved not only global cognitive processes, but also higher-order executive functions. Participants solved an average of 45% of EPCCE tasks with significant differences in scores by disease severity. Performance was significantly related to global cognitive functioning and disease severity, and in particular to executive functions. Significant additional variance was accounted for by these executive functions beyond the variance accounted for by global cognitive measures.

Key Words: Cognition, Dementia, IADL, Neuropsychology, Functional abilities

Everyday Problem Solving Among Individuals With Alzheimer's Disease

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Loss of competence in complex tasks of daily living is a hallmark feature of dementing illness (American Psychiatric Association, 1994). Many older adults in the early phase of dementia are community-dwelling, sometimes living alone, and attempting to carry out many of the activities required in daily living. Indeed, it is the person's inability to perform demanding everyday tasks (e.g., taking medications, managing financial affairs, driving) that frequently motivates spouses and adult children to seek assessment and diagnoses. Earlier decline is often noted in performance of the higher-order instrumental activities of daily living (IADLs; Lawton & Brody, 1969), prior to decline in the self-maintenance tasks (PADLs; Ashford, Hsu, Becker, Kuman, & Bekian, 1986; Reisberg, Ferris, de Leon, & Crook, 1982). This finding has been replicated in longitudinal studies (e.g., Green, Mohs, Schmeidler, Aryan, & Davis, 1993).

Independent living from a neuropsychological perspective is closely associated with executive functions. Lezak (1995) states: "The executive functions consist of those capacities that enable a person to engage successfully in independent, purposive, self-serving behavior. . . . When executive functions are impaired, the individual may no longer be capable of satisfactory self-care, of performing renumerative [sic] or useful work independently, or of maintaining normal social relationship" (pp. 42–43). The syndrome of executive dyscontrol has traditionally been associated with frontal lobe brain damage.

Although loss of functioning in complex daily tasks is generally acknowledged as one of the earliest indicators of neuropathology, research on higher-order executive functions in early dementia is limited (Royall, Mahurin, & Gray, 1992). One reason for the paucity of research may be the lack of objective performance measures to assess executive functions as they are manifested in tasks of daily living. Some research suggests that traditional clinical measures employed in early diagnostic assessment may be less sensitive to impairments in everyday tasks involving executive functions. Ashford and colleagues (1986, 1992) examined the relation between Alzheimer's patients' MMSE scores and family reports of functional competence. At mild and moderate ranges of impairment, there was a substantial correlation between MMSE scores and combined IADL and PADL ratings. There was less of a relationship at very early and very late phases in the disease progression. The authors suggested that global cognitive scales may be less reliable in discriminating cases at the extremes of disease progression. Fitz and Teri (1994) found that depressive symptoms and stage of dementia were significantly associated with ratings of functional impairment; the degree of association varied, however, depending on the level of cognitive impairment and the functional ability investigated.

Because objective assessment of executive functions

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in the context of everyday activities is often lacking, clinicians frequently rely on patient reports or on the reports of collateral sources regarding the cognitively suspect individual's performance in order to reach a diagnosis of impairment (Morris et al., 1995). There are problems with the heavy reliance on the subjective report approach for the assessment of everyday competence. Although valuable, this approach has several limitations. Reporter biases have been noted in both unimpaired and impaired elderly adults. Normal elderly adults tend to overestimate their level of functional competence, when compared with clinicians' ratings of competence (Fillenbaum, 1978; Ford et al., 1988). Impaired patients diagnosed as having an organic disorder were more likely to overestimate their competence whereas those with a functional disorder were more likely to underestimate performance (Kuriansky, Gurland, & Fleiss, 1976). Ratings by clinicians can also be problematic due to the limited time period and contextual constraints (Green et al., 1993). Clinicians were more lenient in their assessments of individuals with more severe dementia (i.e., more likely to determine that such individuals had never performed the task) than individuals in the mild to moderate stages of dementia.

Assessment of executive functions in the context of real-life tasks, rather than with traditional clinical measures such as Trailmaking Part B (Reitan, 1955), is particularly important in the study of early phases of dementia. The face validity of the assessment instrument is especially salient in early diagnosis. The patient is often functioning within an acceptable range on simple tasks and problems have often only been noted in the more challenging daily tasks. Thus, an objective assessment of performance on complex everyday activities may provide particularly convincing evidence for early cognitive deficits given its face validity. Moreover, this type of assessment would provide family members with information on the types of daily activities still within the competence of the patient versus those that require supervision or assistance. There is a need for objective measures of everyday competence to enhance not only the identification of cases of at-risk elderly adults, but also to aid professionals in treatment planning and caregivers in decisions regarding the care recipients' needs. Clinicians and neuropsychologists are often asked to make judgments about an individual's ability to live alone. Little is known, however, about the relationship between a person's cognitive performance in traditional neuropsychological assessments and his or her ability to function independently in the community (Lowenstein et al., 1989; Marson, Ingram, Cody, & Harrell, 1995).

Complex daily tasks have the hallmark components of executive functions, including volition, planning, purposive action, and effective performance (Lezak, 1995). The executive functions orchestrate relatively simple ideas, movements, or actions into complex goal-directed behavior. Without executive functions, behavior important to independent living, such as cooking and dressing, can be expected to break down into more basic actions (Royall et al., 1992). Executive functions are conceptualized as global phenomena in that all of the components indicated previously are necessary for responsible and effective actions; deficits in all of the components are typically found in negative assessments of executive functions (Lezak, 1995). Vitaliano and colleagues (Vitaliano, Breen, Albert, Russo, & Prinz, 1984) examined the relation of performance ratings of everyday activities varying in complexity and various cognitive processes. Three levels of complexity in everyday activities were assessed, with self-maintenance representing the lowest level of complexity, communication (talking, listening) as an intermediate level, and reading and writing as the most complex level. Performance on more cognitively complex everyday activities was found to involve a broader array of cognitive processes (e.g., attention, calculation, recognition, and orientation). In contrast, less cognitively complex self-maintenance activities involved only attention and recognition processes.

These cognitively complex daily tasks have often been characterized in terms of the IADL domains: managing finances, taking medications, shopping, light housework, the ability to use the telephone, preparing meals, and managing transportation needs (Lawson & Brody, 1969). Wolinsky and colleagues (Wolinsky, Callahan, Fitzgerald, & Johnson, 1992) have identified a subset of IADL domains, including telephone usage, financial management, and shopping, in which cognitive functioning is a particularly salient predictor; this subset is known as advanced cognitive IADLs. The advanced cognitive tasks of daily living focus on the underlying mental functioning and cognitive capacity of older adults and often serve as earlier predictors of poor outcomes, such as greater health service utilization and institutionalization.

Purpose of the Study

This study had two aims. First, the performance of Alzheimer's patients in the mild to moderate range of dementia severity was examined on cognitively demanding everyday tasks. The tasks were chosen so as to require the use of executive functions in solving problems associated with activities of daily living. The difficulty level of the tasks is within the range of early stage demented persons and nondemented elderly people with low education level. The face validity of the measures was enhanced by the use of real-life task stimuli. This objective measure of everyday task performance is known as the Everyday Problems Test for Cognitively Challenged Elderly (EPCCE).

Second, the association between EPCCE scores and a battery of clinical and neuropsychological measures was assessed. The EPCCE is believed to involve higher-order cognitive functioning with respect to demanding tasks of daily living. Thus, it was predicted that EPCCE scores would not only be associated with global cognitive measures of disease severity, but that unique variance on the EPCCE would be accounted for by measures of higher-order executive functioning.

Method

Participants

Subjects ($N = 65$) were participants in a longitudinal study of Alzheimer's disease at the Stanford Aging Clinical Research Center (ACRC). The mean age was 73.87 years ($SD = 8.63$, range = 50–89). Two age cohorts were represented: young-old ($n = 34$, M age = 67.56, $SD = 6.76$, range = 50–75) and old-old ($n = 31$, M age = 80.81, $SD = 3.73$, range = 76–89). Forty-eight percent were men ($n = 31$), and 85% ($n = 55$) were Caucasian. Thirty-eight percent ($n = 25$) had a high school education or less, 25% attained a partial college education, 18% were college graduates, and 18% received some graduate or professional training.

All participants met the criteria for probable Alzheimer's disease according to NINCDS–ADRDA criteria (McKhann et al., 1984). Stage of cognitive decline was measured by the Global Deterioration Scale (GDS; Reisberg, 1983) and the Mini-Mental Status Examination (MMSE; Folstein, Folstein, & McHugh, 1975). The average GDS was 4.27 ($SD = .71$, range = 3–6). Ninety-three percent of the sample ($n = 56$) had a GDS score between 3 and 5, which is within the mild to moderate range of dementia severity. The average MMSE total score was 19.83 ($SD = 4.08$, range = 12–29); 47% ($n = 30$) scored between 11 and 19, indicating moderate cognitive impairment; 32% ($n = 20$) scored within the range of 20 and 23, marking mild cognitive impairment. Twenty-one percent ($n = 13$) scored at or above 24.

Materials and Procedure

The EPCCE is administered at 6-month intervals in conjunction with 6-month or yearly assessments conducted as part of the longitudinal research. This study reports only on the first occasion of measurement for the EPCCE. Patient and caregiver IADL ratings and ADL assessment were collected at the same time as the EPCCE. A clinician administered the EPCCE and ADL, and obtained patient and caregiver IADL ratings. Core cognitive measures reported in this study were administered by a clinician within a 3-month proximity to the first administration of the EPCCE with the exception of one subject. Scores on the higher-order neuropsychological test battery were administered in the same year as the first occasion EPCCE.

Measures of Everyday Functioning

Measures of functioning on everyday tasks included assessments of both basic self-maintenance (ADLs), and instrumental tasks of daily living (IADLs). Objective assessment of instrumental activity performance and self- and proxy-ratings were obtained.

The Everyday Problems Test for the Cognitively Challenged Elderly (EPCCE; Willis, 1993).—The EPCCE is a 32-item measure requiring individuals to solve problems of daily living that involve printed material encountered in everyday tasks (e.g., medication label, phone bill). The participant is shown 16 stimulus materials (e.g., emergency phone numbers) and asked to solve two problems related to each stimulus. The stimuli represent real-life materials (i.e., actual telephone bill), rather than laboratory derived materials. Four to six items represent each of the IADL domains, including meal preparation, medication use, telephone use, shopping, financial management, household maintenance, and transportation. Each item is scored right or wrong. The maximum score is 32 (total score range: 0–32). Reliability (Cronbach's alpha) for the total test is .90, with split-half reliability of .87. For a subsample of 38 individuals with 6-month retest data, the test-retest stability was $r = .81$. Exemplar items are presented in Table 1.

The EPCCE was designed for low cognitively functioning elders to provide an easier and shorter ver-

Table 1. Examples of Questions From the EPCCE in Each IADL Domain

Domain	Description	Question
Finances	Includes ability to manipulate information regarding finances as well as the ability to calculate financial sums.	This is a book order form. To order 2 Irresistible Desserts Recipe Books and 1 Vegetable Recipe Book, how much money should be sent?
Medications	Includes ability to understand directions for over-the-counter medications and deduce dosage information.	These are directions for taking cough medicine. What is the maximum number of teaspoons you should take in 24 hours?
Transportation	Includes ability to understand directions regarding the procedure to follow if involved in an auto accident or driver's right of way laws.	This is a statement of driver's right of way laws. If you are continuing on the same road through an intersection, who should yield to you?
Phone usage	Includes ability to understand charts or forms involving emergency phone numbers or phone bills or service.	This is a chart of emergency telephone numbers. If you lived in Spring Mills and your neighbor fell and broke her hip, what number would you need to dial?
Household	Includes ability to understand directions for operating or maintaining household appliances, or to use charts from *Consumer Reports*.	These are directions for cleaning a toaster. Before cleaning the outside of the toaster, what should you do?
Meal preparation	Includes ability to understand charts presenting nutrition information.	This is a chart of nutrition information. If your doctor prescribes a diet low in salt and calories, which product should you definitely NOT purchase?

sion of a parent measure of everyday problem solving developed in prior research for nondemented elders, the Everyday Problems Test (EPT; Willis, 1996). A major concern in the development of the EPCCE was that the range of item difficulty be broad enough so that a floor effect would not be reached immediately by participants as the disease progresses, yet the measure would be of sufficient difficulty to assess functioning among those participants in the very early stages of the disease. The 32 EPCCE items represent four levels of difficulty; eight items each were included that had been answered correctly by 90%, 80%, 70%, and 60% of a large representative sample of nondemented elders. Approximately half of the EPCCE items are represented in the parent EPT measure.

The validity of the EPT as a measure of functional competence has been examined by comparing EPT performance to three other functional measures. First, a significant relationship ($r = .67$) was found between EPT scores and direct observation of older adults in their homes performing everyday tasks related to the domains of medication, phone, and meal preparation (Diehl, Willis, & Schaie, 1995). Second, a significant relationship ($r = -.24$, $p < .05$) was also found between EPT scores and spousal ratings of the number of IADL limitations shown by the subject (Marsiske, 1992). Finally, the correlation between the EPT and the Basic Skills Test (Educational Testing Service, 1977), a measure of functional literacy, was $r = .87$.

Instrumental Activities of Daily Living (IADL; Lawton & Brody, 1969).—Both the patient and the caregiver were administered a self-report measure examining perceptions of the patient's functioning in each of the seven IADL domains. Each domain was assessed by a one-item Likert scale of 3 to 5 points. The total score range was from 0 to 31. Although traditionally a higher IADL score reflects greater limitation, patient and caregiver IADL scores were reversed so that higher scores across all measures reflected higher levels of functioning.

Physical Self-Maintenance Scale (PSMS; Lowenthal, 1964).—A clinician rated the patient's functional competence in each of the six personal Activities of Daily Living (ADL) domains: toileting, feeding, dressing, grooming, physical ambulation, and bathing. Each activity domain is represented by a 5-point Likert scale. (total score range: 6–30). PSMS scores were also reversed so that higher scores reflected higher levels of functioning.

Measures of Disease Severity and Global Cognitive Functioning

The cognitive test battery involved two subsets of measures. First, global cognitive functioning and disease severity were assessed by four measures.

Mini-Mental Status Examination (MMSE; Folstein et al., 1975).—The MMSE, a measure of global cognitive ability, has been widely used in epidemiological studies of cognitive function in community-dwelling older adults and in the staging of dementia (Fillenbaum, 1985; Galanos, Fillenbaum, Cohen, & Burchett, 1991; Zec, Landreth, Vicari, Belman, et al., 1992; Zec, Landreth Vicari, Feldman, et al., 1992). Domains of cognitive functioning include orientation, immediate and delayed recall for words, attention and concentration, language, and praxis (total score range: 0–30).

Global Deterioration Scale (GDS; Reisberg, 1983).—The GDS is a clinician rating scale indexing the degree of cognitive decline of individuals with dementia. Each stage describes cognitive and behavioral decline and severity of dementia. The GDS ranges from 1, indicating no cognitive decline, to 7, indicating very severe cognitive decline and late dementia. The scores were reversed in this analyses so that higher scores represent greater competency.

Brief Cognitive Rating Scale (BCRS; Reisberg, 1983).—The BCRS provides an estimate of dementia severity through clinician ratings in five areas of cognitive functioning including concentration, recent memory, past memory, orientation, and functioning or self-care. Scores on each item range from 0–7 (total score range: 0–35). Scores were reversed so that higher scores reflect higher functioning.

Alzheimer's Disease Assessment Scale (ADAS; Mohs, 1994; Rosen, Mohs, & Davis, 1984; Stern et al., 1994; Zec, Landreth, Vicari, Belman, et al., 1992; Zec, Landreth, Vicari, Feldman, et al., 1992).—The extended mental status exam consists of two subscales measuring cognitive and behavioral domains. Cognitive domains include: orientation, word list immediate recall, word list recognition, verbal comprehension and expression, confrontation naming, ability to follow instructions, constructional praxis, and ideational praxis (total score range: 0–70). Behavioral domains include: delusions, hallucinations, pacing, motor impairments, tremors, depression, tearfulness, and changes in appetite. Behavioral difficulties are assessed by the clinician based on interviews with caregivers and care recipients and on the care recipient's behavior during cognitive testing (total score range: 0–50). Total scores on combined ADAS subscales have been found to be sensitive to varying degrees of dementia severity, but not to differences in educational attainment (Zec, Landreth, Vicari, Belman, et al., 1992). Because high scores indicate greater cognitive and behavioral impairment, reversed scores for the cognitive and behavioral components of the ADAS were computed.

Higher-Order Neuropsychological Measures

The second subset of the cognitive test battery includes higher-order neuropsychological measures, some of which represent executive functioning.

WAIS–R Digit Symbol (Wechsler, 1981).—This timed section of the Performance Scale of the Wechsler Adult Intelligence Scale–Revised measures visual-motor speed and memory (i.e., new learning). It consists of a key with nine pairs of number-nonsense symbols and four rows of small blank squares with a randomly ordered number above each. The task is to use the key to copy as many nonsense symbols into the empty squares as possible in 90 seconds. The maximum total score is 93, with a higher score demonstrating greater levels of cognitive competency.

WAIS–R Block Design (Wechsler, 1981).—This timed test is part of the Performance Scale and measures perceptual organization, visuo-spatial construction, and reasoning ability. The task is to arrange red and white blocks so that they match a specific design in a specific time period. The maximum total score of 51 points represents a high degree of cognitive ability.

Trailmaking Parts A and B (Reitan, 1955; Reitan & Tarshes, 1959).—These timed tests measure visual scanning, visual-motor speed and executive function (Lezak, 1945; Royall et al., 1992). In Part A, participants are asked to draw a line connecting a series of randomly arranged numbers as quickly as possible. Maximum time allotment for completion of the task is 200 seconds. In Part B, participants must alternately connect numbers and letters, thus keeping two series in mind simultaneously. Maximum time allotment for completion of the task is 300 seconds. High scores indicate longer time periods required to complete each task, and thus reflect greater cognitive impairment. For the current analyses, Trails A and B totals were reversed by subtracting the maximum time to completion (i.e., 200 and 300 seconds, respectively) from each score. For the reversed Trailmaking scores, higher scores indicate better performance (i.e., faster time to completion).

Fuld Word Fluency (Fuld, 1980).—In this test, participants must name as many food items as they can in 60 seconds. It has been reported as a measure of executive function (Royall et al., 1992). The test is scored for the number of words generated and for the number of repetitions of food items given within the time frame. Greater cognitive competency is demonstrated by a higher score on the Fuld test.

Results

Individual Differences and EPCCE Scores

On average, subjects answered 45% of EPCCE questions correctly. The mean score was 14.43 (SD = 7.40, range = 2–32). A 2 × 2 × 2 ANOVA was carried out with the EPCCE score as the dependent variable, and gender (male, female), age (young-old, old-old), and education (high school, less than high school) as the independent variables. No significant main effects or interaction's were found using the EPCCE score as the dependent variable. However, low power may have precluded the emergence of significant effects. For example, the effect size for the largest mean difference (i.e., males M = 15.45, females M = 13.37) was .27. The power level for the present analysis is .56, indicating a low likelihood of identifying a significant main effect. To detect this effect with a power of .80, approximately 108 subjects would be needed. Thus, conducting this analysis with a larger sample size may reveal significant group differences on the EPCCE.

Level of dementia severity as measured by performance on the MMSE was examined in relation to total EPCCE scores. Disease severity was associated with EPCCE scores, $F(2, 60) = 9.85$, $p < .001$. Individuals with very mild cognitive impairments (MMSE ≥ 24) had an average EPCCE total score of 21.46 (SD = 6.63). Individuals with mild cognitive impairments (MMSE = 20–23) obtained EPCCE total scores of 14.20 (SD = 7.58). Participants with moderate cognitive impairments (MMSE ≤ 19) had an average EPCCE total score of 11.73 (SD = 5.89). Table 2 presents descriptive statistics for the EPCCE and cognitive measures.

Relationship of the EPCCE to Cognitive Measures

The relationship between the EPCCE, demographic variables, and measures of functional competence and cognition were examined (Table 3). No significant univariate associations were found between the EPCCE and age, gender, education, or race. The EPCCE was related to patient self-ratings of IADL performance ($r = .36$, $p < .01$), but not to caregiver IADL ratings. The relation to the PSMS was not significant.

Significant associations were found between the EPCCE and all cognitive measures. The EPCCE total score was significantly related to global measures of cognitive function such as the Brief Cognitive Rating Scale, the Global Deterioration Scale, the Mini-Mental Status Examination, and the cognitive subsection of Alzheimer's Disease Assessment Scale. These correlations indicate that higher scores on the EPCCE were associated with better cognitive performance and an earlier stage of dementia.

The EPCCE was also significantly associated with measures of more specific, higher-order executive functioning abilities as measured by Digit Symbol, Block Design, Trailmaking A and B, and Fuld Word Fluency. In all cases, better performance on the EPCCE was associated with better overall cognitive performance.

A simultaneous multiple regression including all correlated variables was highly significant, $F(9, 23) = 4.76$, $p < .01$, and accounted for over half of the variance in EPCCE scores, $R^2 = .65$, adjusted $R^2 = .51$. This model included as independent variables the MMSE, ADAS cognitive, GDS, BCRS, Trailmaking Parts A and B, Digit Symbol, Block Design, and Fuld Verbal Fluency.

Regression Analyses

Given the considerable multicollinearity among the cognitive measures (Table 3) and the sample size, summary indicators of cognitive functioning were formed from the cognitive measures. Principal components analyses were conducted separately for the global cognitive measures and for the higher-order executive functioning measures (Afifi & Clark, 1990). Principal

Table 2. Descriptive Statistics: Everyday Competency and Cognitive Measures

	Young-Old		Old-Old		
	Men	Women	Men	Women	Total
Everyday Competency					
EPCCE (0–32)					
n	18	16	13	18	65
M	16.5	12.19	14.77	14.11	14.43
SD	8.25	6.88	8.58	5.92	7.40
Range	4–32	4–28	2–29	3–24	2–32
IADL—Caregiver (0–31)[a]					
n	17	16	13	18	64
M	10.94	14.38	9.54	7.5	10.55
SD	3.17	4.47	5.88	3.75	4.93
Range	4–16	9–23	1–21	1–15	1–23
IADL—Patient (0–31)[a]					
n	17	16	13	18	64
M	12.94	16.44	12.69	14.0	14.06
SD	5.99	3.41	5.14	4.68	5.00
Range	4–23	9–20	1–22	5–22	1–23
PSMS (0–30)[a]					
n	17	16	13	18	64
M	29.41	29.13	27.92	26.72	28.28
SD	.62	1.82	1.38	2.40	2.0
Range	28–30	23–30	26–30	21–30	21–30
Cognitive Functioning					
MMSE Total (0–30)					
n	17	16	13	17	63
M	21.94	19.38	20.69	17.47	19.83
SD	3.94	3.77	4.59	2.90	4.08
Range	15–29	12–26	13–28	12–21	12–29
BCRS (0–35)[a]					
n	15	14	13	17	59
M	17.07	14.93	15.85	13.29	15.20
SD	3.22	3.65	3.02	2.39	3.32
Range	12–23	8–21	12–22	9–17	8–23
ADAS Cognitive (0–70)[a]					
n	15	14	11	16	56
M	54.13	51.71	53.64	51.0	52.54
SD	6.53	7.19	6.44	4.68	6.20
Range	43–63	35–60	40–61	44–58	35–63
ADAS Behavioral (0–50)[a]					
n	15	14	13	17	59
M	46.2	47.14	46.0	45.47	46.17
SD	2.6	2.14	3.34	3.69	3.02
Range	41–50	44–50	40–50	38–50	38–50
Digit Symbol (0–93)					
n	13	6	6	11	36
M	21.85	12.33	14.33	20.0	18.44
SD	14.53	8.64	10.13	10.3	11.93
Range	6–48	0–22	0–26	0–35	0–48
Block Design (0–51)					
n	13	6	7	11	37
M	22.38	5.0	9.71	14.73	14.89
SD	14.39	6.54	7.85	10.2	12.49
Range	0–44	0–16	0–22	0–30	0–44
Trailmaking A (0–200)[a]					
n	13	10	8	12	43
M	99.84	91.6	99.25	109.25	100.44
SD	62.98	63.61	43.43	62.62	58.16
Range	0–175	0–161	0–134	0–171	0–175
Trailmaking B (0–300)[a]					
n	13	8	8	11	40
M	88.31	54.75	52.75	68.36	69.0
SD	93.77	68.32	71.63	64.85	75.91
Range	0–223	0–158	0–156	0–200	0–223
Fuld Fluency					
n	12	9	7	13	41
M	10.92	10.89	7.85	12.31	10.83
SD	6.07	5.11	3.39	4.75	5.11
Range	2–21	4–18	2–12	6–20	2–21

Note. Higher scores indicate greater levels of competency. Possible ranges are listed after each test.
[a]Scores have been reverse coded.

Table 3. Correlation Matrix of EPCCE, Demographic, Everyday Competence, and Cognitive Measures

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. EPCCE																
2. Age	–.01															
3. Education	.14	–.16														
4. IADL—Caregiver[a]	.24	–.47*	.17													
5. IADL—Patient[a]	.36*	–.14	.24	.47*												
6. PSMS[a]	.23	–.48*	.13	.50*	.17											
7. BCRS Total[a]	.38*	–.34*	.03	.15	.18	.23										
8. GDS[a]	.36*	–.36*	.15	.32*	.32*	.50*	.63*									
9. MMSE Total	.55*	–.24	.20	.24	.13	.23	.73*	.49*								
10. ADAS Cognitive Errors[a]	.63*	–.15	.18	.33	.17	.23	.51*	.44*	.67*							
11. ADAS Behavioral Problems[a]	–.01	–.21	.11	.28	.16	.23	.27*	.29*	.08	.23						
12. Digit Symbol	.56*	.04	.19	.22	.42*	.16	.29	.33*	.36*	.48*	.17					
13. Block Design	.49*	–.09	.20	.19	.30	.32	.29	.21	.36*	.27	.26	.72*				
14. Trailmaking Part A[a]	.39*	.11	.10	.37*	.29	.20	.07	.26	.12	.40*	.19	.66*	.53*			
15. Trailmaking Part B[a]	.70*	–.08	.20	.37*	.46*	.30	.38*	.42*	.59*	.50*	–.04	.75*	.62*	.65*		
16. Fuld Fluency at 60 Seconds	.53*	–.10	–.10	.23	.28	–.14	.38*	.26	.45*	.50*	–.05	.43*	.28	.46*	.57*	

*Significant at .05 level.
[a]Scores have been reverse-coded so that higher scores for all measures indicate greater levels of competency.

components with eigenvalues greater than one were retained and then entered in a hierarchical regression analysis with the EPCCE as the dependent variable, as outlined in Cohen and Cohen (1983).

In each principal components analysis, only those variables demonstrating significant univariate associations with the EPCCE were included. Thus, MMSE total score, ADAS cognitive total, GDS, and BCRS total were included in the first principal component analysis examining global cognitive measures. One principal component with an eigenvalue greater than one (i.e., 2.77) was found, accounting for 69% of the variance. The individual measures contributed approximately equally to the principal component, with eigenvectors ranging from .46 for GDS to .53 for MMSE total score.

The second principal component analysis included Digit Symbol, Block Design, Trailmaking A and B, and Fuld Verbal Fluency. One principal component with an eigenvalue greater than one (i.e., 3.30) was found, accounting for 66% of the variance. The individual measures contributed approximately equally to the principle component, with eigenvectors ranging from .35 for verbal fluency to .49 for Digit Symbol.

A hierarchical regression model predicting EPCCE total scores was formed by entering factor scores for the principal component representing global cognitive ability in the first step followed by factor scores for the principal component representing higher-order executive functioning in the second step (see Table 4). The principal component representing global cognitive ability was found to account for significant variance in EPCCE total scores, $F(1,26) = 36.66$, $p < .001$, $R^2 = .59$, adjusted $R^2 = .57$. Additionally, the inclusion of the principal component representing higher-order functioning significantly increased the amount of variance explained in EPCCE total scores, $F(2,25) = 28.37$, $p < .001$, $R^2 = .69$, adjusted $R^2 = .67$. Performance on global cognitive measures and scores on higher-order executive abilities each accounted for a significant amount of unique variance in EPCCE performance.

Table 4. Summary of Hierarchical Regression Analyses for Variables Predicting EPCCE Total Scores ($N = 65$)

Variable	B	$SE\ B$	IR^2	R^2
Step 1				
General Cognitive Ability	6.30	1.04	.59	.59
Step 2				
Executive Functioning	3.21	1.07	.10	.69

Notes: The principal component representing general cognitive ability represents a linear combination of MMSE total score, ADAS cognitive, GDS, and BCRS totals. The principal component representing executive functions represents a linear combination of Trailmaking Parts A and B, WAIS-R Block Design and Digit Symbol, and Fuld verbal fluency. Values indicate the contribution of each variable as entered into a hierarchical regression analyses. Thus, beta weights are listed for a given variable in the presence of all preceding variables or variables included in a given step.

Discussion

The purposes of this study were twofold. First, the performance of Alzheimer's patients in mild to moderate phases of disease severity was examined on an objective measure of problem solving with respect to everyday tasks. Second, the question of whether performance of complex daily activities involved executive functions, as well as global cognitive processes, was considered.

Subjects answered correctly, on average, 45% of the items on the EPCCE. There was a significant relationship between level of disease severity, as measured by the MMSE, and EPCCE performance. Whereas subjects with very mild cognitive impairments responded correctly to 67% of the items, those with mild and moderate impairment had correct answers only 44% and 37% of the time, respectively. The EPCCE was not significantly related to age or education. As indicated in prior research, disease severity rather than age or education per se is the more salient variable in accounting for functioning with respect to cognitively complex tasks.

Although everyday functioning is a multidimensional phenomenon involving cognitive and physical aspects, the EPCCE was developed to focus on the cognitive domain, and the findings of the study indicate that this aim was achieved. EPCCE scores were not significantly related to clinician ratings of physical self-maintenance (PSMS), nor to the noncognitive, behavioral portion of the Alzheimer's Disease Assessment Scale.

EPCCE performance was significantly related to all four measures of global cognitive ability or disease severity, including the Mini-Mental Status Exam, the Global Deterioration Scale, the Brief Cognitive Rating Scale, and the cognitive domains of the Alzheimer's Disease Assessment Scale. Findings from hierarchical regression analyses indicate that approximately 60% of the variance in the EPCCE can be accounted for by these global ability measures. On the one hand, this is reassuring because the EPCCE was construed as a measure of everyday cognitive competence. On the other hand, however, the findings indicate that 40% of variance in EPCCE performance is not accounted for by these commonly used global ability measures, and thus these measures should not be used as the sole proxies for objective indicators of everyday cognitive functioning. Direct assessment of the cognitive demands of daily living appears to be measuring something beyond the cognitive abilities represented in global measures.

Of particular concern was the association between EPCCE performance and measures of higher-order executive functioning. These higher-order skills are known to exhibit earlier decline in both normal and pathological aging. Reports by patients or family of difficulty with the tasks of daily living that involve higher-order skills have been found to be the earliest indicators of cognitive impairment. Findings from our hierarchical regression analyses indicate that significant additional unique variance in EPCCE performance is accounted for by these higher-order executive functions. These results offer evidence of convergent validity for the EPCCE in that they represent everyday tasks involving both global cognitive processes and higher-order executive functions.

In previous research (Ashford et al., 1986, 1992; Fitz & Teri, 1994) the association between MMSE scores and subjective proxy IADL ratings has been found to vary with the level of disease severity. Less congruity was found in the early and later stages of disease progression. The lack of a significant association between caregiver IADL ratings and EPCCE scores may be due to the fact that approximately 40% of our subjects would be classified in the very mild to mild level of disease severity based on MMSE scores. In the early phases of coping with Alzheimer's, caregivers often overreact by either denying cognitive limitations in the patient or by severely underestimating the capabilities of the patient. Of interest is the modest association between patient ratings of IADL competence and EPCCE scores. The strong association between higher-order cognitive skills and the EPCCE suggests that these subjects can still employ these abilities in problem solving situations, and thus may have somewhat realistic assessments of their cognitive competence in daily tasks.

We view the EPCCE as a complement to other existing objective measures of functioning. The Lowenstein measure of the Direct Assessment of Functional Status has proven useful in assessing both cognitive and motoric aspects of functioning in tasks of daily living (Lowenstein et al., 1989). The EPCCE complements and extends the Lowenstein scale by assessing several IADL domains (e.g., medication use, meal preparation, household maintenance) not included in the Direct Assessment scale and by providing findings with respect to the association between objective measures and the higher-order executive cognitive domains. Likewise, the EPCCE complements Marson's measures of medical decision making by assessing a broader array of domains of everyday tasks (Marson, Cody, Ingram, & Harrell, 1995). The unique contribution of the EPCCE is that it represents a wide array of IADL-type problems that require higher-order executive functions for task solution.

Given the early stage of development of the EPCCE, there are several limitations to the findings reported in the current study. These findings are based on a small sample. In general, participants were Caucasian and more highly educated than the total population of Alzheimer's patients. Future research should focus on the exploration of everyday competence in more heterogeneous samples of Alzheimer's patients.

In conclusion, the EPCCE has been shown to provide an objective measure of problem solving with respect to cognitively demanding tasks encountered in the daily lives of community-dwelling older adults. We recommend that the EPCCE be conceptualized as a measure of everyday competence that can be used in conjunction with traditional measures of subjective ratings of functional ability and standard neuropsychological tests to provide a more complete assessment of a patient's ability to perform tasks of daily living. The recent development of several objective measures of functional ability should bridge the gap between current assessment tools and knowledge of everyday competence in cognitively challenged elderly adults.

References

Afifi, A. A., & Clark, V. (1990). *Computer-aided multivariate analysis* (2nd ed.). New York: Chapman & Hall.

American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (DSM-IV) (4th ed.). Washington, DC: Author.

Ashford, J., Hsu, L., Becker, M., Kuman, V., & Bekian, C. (1986, October). Mini-mental status and activities of daily living: Cross validation by scalogram and item analysis techniques. *The Gerontologist, 26* (Special Issue), 143A.

Ashford, J. W., Kumar, V., Barringer, M., Becker, M., Bice, J., Ryan, N., & Vicari, S. (1992). Assessing Alzheimer severity with a global clinical scale. *International Psychogeriatrics, 4,* 55–74.

Cohen, J., & Cohen, P. (1983). *Applied multiple regression/correlation analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Erlbaum.
Diehl, M., Willis, S. L., & Schaie, K. W. (1995). Everyday problem solving in older adults: Observational assessment and cognitive correlates. *Psychology and Aging, 10,* 478–491.
Educational Testing Service. (1977). *Basic Skills Assessment Test: Reading.* Princeton, NJ: Author.
Fillenbaum, G. (1978). Reliability and validity of the OARS multidimensional functional assessment questionnaire. In *Multidimensional functional assessment: The OARS methodology* (2nd ed.). Durham, NC: Duke University.
Fillenbaum, G. (1985). Screening the elderly: A brief instrumental activities of daily living measure. *Journal of the American Geriatrics Society, 33,* 698–706.
Fitz, A. G., & Teri, L. (1994). Depression, cognition, and functional ability in patients with Alzheimer's disease. *Journal of the American Geriatrics Society, 42,* 186–191.
Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). Mini-Mental State: A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research, 12,* 189–198.
Ford, A., Folmar, S., Salmon, R., Medalie, J., Roy, A., & Galazka, S. (1988). Health and function in the old and very old. *Journal of the American Geriatrics Society, 36,* 187–197.
Fuld, P. A. (1980). Guaranteed stimulus-processing in the evaluation of memory and learning. *Cortex, 16,* 255–271.
Galanos, A., Fillenbaum, G., Cohen, H., & Burchett, B. (1991). *Limitations of functional health status in the comprehensive assessment of community-dwelling elderly.* Unpublished manuscript, Duke University, Durham, NC.
Green, C. R., Mohs, R. C., Schmeidler, J., Aryan, M., & Davis, K. L. (1993). Functional decline in Alzheimer's disease: A longitudinal study. *Journal of the American Geriatrics Society, 41,* 654–661.
Kuriansky, J., Gurland, B., & Fleiss, J. (1976). The assessment of self-care capacity in geriatric psychiatric patients by objective and subjective methods. *Journal of Clinical Psychology, 32,* 95–102.
Lawton, M. P., & Brody, J. (1969). Assessment of older people: Self-maintaining and instrumental activities of daily living. *The Gerontologist, 9,* 179–185.
Lezak, M. D. (1995). *Neuropsychological assessment* (3rd ed.). Oxford, UK: Oxford University Press.
Lowenstein, D., Amigo, E., Duara, R., Guterman, A., Hurwitz, D., Berkowitz, N., Wilkie, F., Weinberg, G., Black, B., Gittelman, B., & Eisdorfer, C. (1989). A new scale for the assessment of functional status in Alzheimer's disease and related disorders. *Journal of Gerontology: Psychological Sciences, 44,* P114–P121.
Lowenthal, M. F. (1964). *Lives in distress.* New York: Basic Books.
Marsiske, M. (1992). *Dimensionality and correlates of everyday problem solving in older adults.* Unpublished doctoral dissertation, The Pennsylvania State University, University Park, PA.
Marson, D. C., Cody, H. A., Ingram, K. K., & Harrell, L. E. (1995). Neuropsychologic predictors of competency in Alzheimer's disease using a rational reasons legal standard. *Archives of Neurology, 52,* 955–959.
Marson, D. C., Ingram, K. K., Cody, H. A., & Harrell, L. E. (1995). Assessing the competency of patients with Alzheimer's disease under different legal standards: A prototype instrument. *Archives of Neurology, 52,* 949–954.
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 the DHHS Task Force on Alzheimer's Disease. *Neurology, 34,* 939–944.
Mohs, R. C. (1994). *Administration and scoring manual for the Alzheimer's Disease Assessment Scale.* New York: Mount Sinai School of Medicine.
Morris, J. C., Storandt, M., Rubin, E. H., McKeel, D. W., Jr., Price, J. L., & Berg, L. (1995). Clinical detection of very mild Alzheimer's disease. In M. Bergener & S. I. Finkel (Eds.), *Treating Alzheimer's and other dementias: Clinical application of recent research advances* (pp. 218–226). New York: Springer.
Reisberg, B. (1983). The Brief Cognitive Rating Scale and Global Deterioration Scale. In T. Crook, S. Ferris, & R. Bartus (Eds.), *Assessment in geriatric psychopharmacology* (pp. 19–35). New Canaan, CT: Mark Powley Associates.
Reisberg, B., Ferris, S. H., de Leon, M. J., & Crook, T. (1982). The Global Deterioration Scale for assessment of primary degenerative dementia. *American Journal of Psychiatry, 139,* 1136–1139.
Reitan, R. M. (1955). The relation of the Trailmaking test to organic brain damage. *Journal of Consultation Psychology, 19,* 393–394.
Reitan, R. M., & Tarshes, E. L. (1959). Differential effects of lateralizing brain lesions on the Trailmaking test. *Journal of Nervous Mental Disorders, 129,* 257–262.
Rosen, W. G., Mohs, R. C., & Davis, K. L. (1984). A new rating scale for Alzheimer's disease. *American Journal of Psychiatry, 14,* 1356–1364.
Royall, D. R., Mahurin, R. K., & Gray, K. F. (1992). Bedside assessment of executive cognitive impairment: The executive interview. *Journal of American Geriatrics Society, 40,* 1221–1226.
Stern, R. G., Mohs, R. C., Davidson, M., Schmeidler, J., Silverman, J., Kramer-Ginsberg, E., Searcey, T., Bierer, L., & Davis, K. L. (1994). A longitudinal study of Alzheimer's disease: Measurement, rate, and predictors of cognitive deterioration. *American Journal of Psychiatry, 151,* 390–396.
Vitaliano, P., Breen, A., Albert, M., Russo, J., & Prinz, P. (1984). Memory, attention, and functional status in community-residing Alzheimer type dementia patients and optimally healthy aged individuals. *Journal of Gerontology, 39,* 58–64.
Wechsler, D. (1981). *Wechsler Adult Intelligence Scale–Revised Manual.* New York: Psychological Corporation.
Willis, S. L. (1993). *Test manual for the Everyday Problems Test for Cognitively Challenged Elderly.* University Park, PA: The Pennsylvania State University.
Willis, S. L. (1996). Everyday cognitive competence in elderly persons: Conceptual issues and empirical findings. *The Gerontologist, 36,* 595–601.
Wolinsky, F. D., Callahan, C. M., Fitzgerald, J. F., & Johnson, R. J. (1992). The risk of nursing home placement and subsequent death among older adults. *Journal of Gerontology: Social Sciences, 47,* S173–S182.
Zec, R. F., Landreth, E. S., Vicari, S. K., Belman, J., Feldman, E., Andrise, A., Robbs, R., Becker, R., & Kumar, V. (1992). Alzheimer Disease Assessment Scale: A subtest analysis. *Alzheimer Disease and Associated Disorders, 6,* 164–181.
Zec, R. F., Landreth, E. S., Vicari, S. K., Feldman, E., Belman, J., Andrise, A., Robbs, R., Kumar, V., & Becker, R. (1992). Alzheimer's Disease Assessment Scale: Useful for both early detection and staging of dementia of the Alzheimer type. *Alzheimer Disease and Associated Disorders, 6,* 89–102.

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