Assessing Errors on Everyday Problem Solving Tasks Among Rural Older Adults

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Abstract

The present research examined the types of errors on tasks of everyday problem solving made by a representative sample of rural, low educated, nondemented elderly ($\underline{n}$ = 306). A qualitative analysis of errors made on the test of Everyday Problems for Cognitively Challenged Elderly (EPCCE) revealed seven categories. Tasks involving the functional domains of medication, finance, and computation yielded a high percentage of errors on the EPCCE. Further, the prevalence of prior knowledge errors suggests an indiscriminate use of experience among this sample of older adults. Analyses revealed significant relations between the total number of errors on the EPCCE and scores on clinical and neuropsychological measures commonly used in the screening for dementia. Age and education were significantly associated with errors generated in complex everyday problem solving tasks.

Assessing Errors on Everyday Problem Solving Tasks

Among Rural Older Adults

The expansion of the aged population in our society has elevated the maintenance of independence and community residence to an issue of critical importance. A salient factor in determining one's ability to function autonomously is the performance of complex cognitive tasks of daily living. Because the number and severity of cognitive and physical impairments increase dramatically with normal aging, the assessment of competence on these everyday tasks is crucial not only in cases of early dementia, but also in normal age-related decline.

This decline is particularly noteworthy in the domains classified as instrumental activities of daily living (IADLs; Fillenbaum, 1985; Lawton & Brody, 1969). It has been recognized that a decline in mental abilities, evident in both early dementia and normal aging, centers on skills within these instrumental domains, such as managing transportation, finances, or meal preparation, rather than on more basic self-care activities (i.e., ADLs) requiring physical performance (Willis & Ganguli, 1994; Willis, Jay, Diehl, Marsiske, 1992; Willis & Marsiske, 1990; Wolinsky & Johnson, 1991). Indeed, the earliest decline in cognitive functioning is typically associated with higher-order, complex IADL processes, and it is ultimately the adult's inability to carry out these everyday tasks that signal concern and motivate family members to seek assessment and diagnosis (Willis, 1991).

The current endeavor expands on previous research by identifying the types of errors that older adults commonly make on complex tasks of daily living. For example, researchers have noted increased problems in the functional domains of medication usage (Gien & Anderson, 1989; Park, Morrell, Frieske, & Kincaid, 1992; Salzman, 1991) and finance (Hershey, Walsh, Read, & Chulef, 1990; Wacker, 1995) in older adults, as well as declines in computational or number skills (Schaie, 1983; 1994; 1995).

Although declines in cognitive proficiency such as those mentioned above may accompany normative aging, the challenge of maintaining complex mental skills is magnified for older adults of low socioeconomic status. Utilizing the test of Everyday Problems for Cognitively Challenged Elderly (EPCCE), an objective, performance-based measure of cognitive competence tapping the seven IADL domains, the present research examines error types in a sample of rural, low SES, nondemented elderly conducted in collaboration with the Monongahela Valley Independent Elders Survey (MoVIES). It is anticipated that by analyzing specific types of errors most commonly made by older adults in everyday problem solving, the identification of those domains most critical for intervention and service efforts will result.

The relationship between errors on the EPCCE and traditional clinical and neuropsychological measures used in the screening of dementia will be examined to determine the viability of the EPCCE as an early detection device. Although clinical measures are currently being utilized, they may be less sensitive to capturing the very early functional declines associated with tasks of daily living.

Method

Participants

This sample included 306 community-dwelling older adults, 182 (59%) females and 124 (41%) males who ranged in age from 70 to 94 years (M = 77, SD = 4.58). Approximately 60% of participants (N = 178; 58%) were classified as old-old (75-84 years), approximately 36% (N = 109) as young-old (<75 years) and 6% (N= 19) as very old (>85 years). Nearly three-quarters of participants had achieved a high school education or less (N = 219; 71%), while 29% (N = 87) had completed formal education beyond the high school level.

Of the 334 participants who have been assessed with the EPCCE, 28 have been eliminated from the analyses based on a rating of .5 or higher on the Clinical Dementia Rating Scale (CDR)(Hughes, Berg, Danziger, Cohen, & Martin, 1982).

Procedure

Participants were assessed in their own homes on a battery of clinical and neuropsychological measures representing an expanded CERAD battery (Morris, et al., 1989). Upon completion of the MoVIES battery, subjects were asked to respond to the test of Everyday Problems for Cognitively Challenged Elderly (EPCCE).

Measures

Everyday Problem Solving. The test of Everyday Problems for Cognitively Challenged Elderly (EPCCE) was used to measure everyday cognition. This instrument is a shortened version of the Everyday Problems Test or EPT (Willis & Marsiske, 1992) that was developed to assess competence in low SES, low educated nondemented elderly, and in older adults in the early stages of dementia.

Participants are shown 16 printed stimulus materials encountered in tasks of daily living, such as an itemized phone bill or a nutrition label. Upon viewing each stimuli, subjects are asked to solve two problems related to the information presented. Test-retest reliability of .93, and internal consistency of .87 were reported for a sample of low

SES nondemented older adults (Willis, 1991).

Clinical and neuropsychological battery. The clinical and neuropsychological test battery (Ganguli et al., 1991) is an expansion of the Consortium to Establish a Registry for Alzheimer's Disease (CERAD) protocol (Morris et al., 1989).

The battery includes the Mini-Mental State Examination (MMSE; Folstein, Folstein & McHugh, 1975), Temporal Orientation (Benton et al., 1982), Word List Recall (Morris et al., 1989), Story Recall (Becker, Boller, Saxton, & McGonigle-Gibson, 1987), Construction Praxis (Rosen, Mohs, & Davis, 1984), Clock Drawing (Kaplan, 1990), a modified version of the Boston Naming Test (Morris et al., 1989), Verbal Fluency (Borkowski, Benton, & Spreen, 1967; Benton & Hamsher, 1976), and Trailmaking Tests A and B (Reitan, 1955; Reitan & Tarshes, 1959).

Development of Error Categories

Qualitative analysis was used to create a coding scheme to classify errors made by participants on the everyday problems test. Seven error types were classified: (a) inappropriate use of prior experience, (b) incomplete processing of information, (c) computational errors, (d) financial errors , (e) medication dosage errors, (f) random responses, and (g) a no attempt category. Table 1 provides a description and examples of items and responses classified according to the seven error types.

Insert Table 1 about here

Interrater reliability of the coding of error types on the EPCCE was examined. Two independent raters established 94 percent agreement across error categories. Raters' agreement on coding was not less than 88 percent for any error type.

Results

The data were scored according to the total number of errors made on the EPCCE, as well as the total number of errors within each of the seven error categories (i.e., prior experience, incomlete processing, financial, dosage, random response, no attempt).

A 2 Gender X 3 Age X 3 Education ANOVA revealed main effects for education and age, with total errors as the dependent variable. Participants with education below the high school level made significantly more errors than those with education at or beyond high school, $F(2,288) = 8.72$, $p < .001$. The main effect for age revealed fewer errors among the young-old than old-old, $F(2,288) = 7.40$, $p < .001$; the difference between young-old and very old did not reach statistical significance,

$F(2, 288) = .039$, $p = .84$.

Specific Types of Errors on the EPCCE

General Processing Errors. Approximately 73% of participants generated 1 or more prior experience errors. The average proportion of items missed due to an inappropriate use of prior knowledge was 4.4%, while the proportion of subjects making one or more incomplete processing errors representing 22.7% of all possible errors in this category. The greatest incidence of incomplete processing errors occurred in the functional domains of finance, dosage, and computation. Intercorrelations between error types are displayed in Table 2.

Insert Table 2 about here

Financial Errors. Approximately 29% of all possible financial items were answered incorrectly by participants. While approximately 78% of participants made at least one financial error, nearly 30% made 3 or more. Further, it appears that financial overestimates may be more problematic than underestimates, with 60% of the sample responding with 1 to 3 overpayment errors.

Medication Errors. Over 87% of participants exhibited difficulty identifying proper dosage, with over 69% of medication errors classified as overdosage errors. Participants were significantly more likely to overdose than underdose on medication items on the EPCCE, $X^2(1,306) = 7.04$, $p < .01$. The proportion of participant errors on medication items was quite high, with 38.9% of the total medication questions answered incorrectly.

Computation Errors. Nearly 83% of participants made at least one computation error, while over a quarter of the sample incorrectly responded to 3 or 4 items requiring the use of computational skills. The proportion of participant errors on computational items was 34.7% of all computation questions answered incorrectly.

Table 3 provides descriptive statistics for each EPCCE error category including the proprotion of participants making 1 or more errors in each categories and the proportion of overall possible errors made in each category.

Insert Table 3 about here

The Relation of Errors on the EPCCE to the Clinical Battery

Descriptive statistics for the total number of errors on the EPCCE, and for each measure in the cognitive battery are presented in Table 4. The average number of errors made on the EPCCE was 8 (SD = 3.8; Range = 0 - 19), indicating that on average, subjects ansered 25% of the items attempted incorrectly.

Insert Table 4 about here

The relation of the total number of EPCCE errors to scores on the clinical measures was examined. As shown in Table 5, errors were significantly, negatively related to scores on the MMSE, Word List Recall, Story Recall, Verbal Fluency, and the Boston Naming Test. Significant positive relations were found between error frequency and Trailmaking A and B; a larger score on Trails A & B indicates greater time requried to complete the task, thus a positive association with EPCCE errors would be expected.

Insert Table 5 about here

Measures in the cognitive battery which correlated with errors at the .01 level were selected for further analysis. However there was strong evidence for multicollinearity among some measures of the same phenomenon. When correlations among measures were exceptionally high, suggesting parallel measures, only one of the pair of measures was included in the regression equation. This occurred for Story Recall, Verbal Fluency, Word Recall, and Trailmaking. Five outcome variables were selected: (a) Story Recall, (b) Verbal Fluency for fruits and animals, (c) Mini-Mental State Exam, (d) Trailmaking B, (e) Construction Praxis.

Multivariate regression analyses are presented in Table 6. The amount of variance accounted for by the selected CERAD measures was 29%, while the inclusion of age and education increased the variance accounted for by errors to 31%.

Insert Table 6 about here

Discussion

The present study explored domain specific errors on complex cognitive tasks of daily living in order to identify the common difficulties which may hinder an older adult's ability to maintain independent living. In addition, preliminary analyses examined the relationship of errors on a direct, objective assessment of everyday tasks to traditionally used clinical and neuropsychological measures. The contribution of this study is particularly significant in its focus on the everyday functioning of a rural, low educated sample of older adults.

Previous research suggests that older adults may utilize prior knowledge as a compensatory mechanism for age-related decline in mental functioning (Ventis, 1992). The prevalence of errors in this category indicate an indiscriminate reliance on prior knowledge, and supports Sinnott's (1989) position that the dependence on experiential knowledge may not be an optimal strategy.

These results are also consistent with research indicating age-related reductions in the amount of information utilized in problem solving, as well as the extensiveness of the information search process (Johnson, 1990; Leventhal, Leventhal, Schaefer, & Easterling, 1993; Meyer, Russo, & Talbot, 1995; Walsh & Hershey, 1994). Similarly, this less effortful, shallow informational search is related to the high incidence of incomplete processing errors shown on the EPCCE.

Everyday problem solving tasks involving the functional domains of medication, finance, and computation tasks yielded a high percentage of errors. The importance of medications and finances to independent living is further magnified by the tendency of older adults in this sample to overestimate, rather than underestimate, payments and doses.

The vital connection between computational ability and the domains of medications and finances is clear, with 83% of participants making errors on everyday problems requiring simple arithmetic. The significance of computational skills to everyday tasks in the present study is particularly meaningful because this area of cognitive functioning is typically not assessed during clinical evaluation, with the possible exception of the WAIS number test.

Analyses indicated that older adults who failed to attain a high school education were at a distinct disadvantage in overall cognitive competence as demonstrated on scores on the EPCCE. This finding supports the notion that cutoff scores utilized in the determination of dementia should account for unique social, cultural, and educational circumstances among groups of older adults (Ganguli et al., 1991; Uhlmann & Larson, 1991; Wiederholt et al., 1993).

Additional preliminary analyses indicate that scores on the MMSE, Verbal Fluency, Trailmaking B, Story Recall, and Construction Praxis were predictive of the total number of errors on the EPCCE. These scales represent cognitive functions that exhibit decline fairly early in the disease progression. Even before the appearance of such deficits, however, the inability to perform instrumental tasks of daily living (IADLs) has been identified as an indicator of cognitive decline. As a result, the incidence of errors on the EPCCE should be a useful marker for early manifestation of dementia to supplement clinical or neuropsychological measures.

In conclusion, the identification in this study of a high frequency of errors in the domains of medication use, financial management, and computational tasks signal the need for greater intervention efforts in these areas. For example, the increased prevalence of polypharmacy (Gien & Anderson, 1989; Salzman, 1991) and consumer fraud (Wacker, 1995) among older populations further magnifies the importance of programmatic efforts designed to enhance cognitive competence and compensate for decline.

The secondary findings of this study support the hypothesis that errors on the EPCCE may be an earlier indicator of cognitive decline than traditional clinically based instruments. As failure in IADL domains among community-dwelling elderly serves as a precursor for cognitive evaluation, the EPCCE may be utilized as an early assessment tool.

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Table 1

Description of Error Types with Examples

Error Type	Description	Example	Incorrect Response
Prior Experience	Inappropriate use of prior knowledge in solving the problem.	What helps reduce the risk of making The bandage too snug?	Subject responds based on prior experience.
Incomplete Processing	Shallow processing - subject does not take into account all information needed to solve the problem.	If you are concerned about both low cost and low calories, which product would be the best choice?	Considers only cohort information regarding price. Does not consider price and calories.
Computational	Subject makes mathematical error.	It takes you 30 minutes to clear your Driveway of snow. About how many calories did you use?	Chart gives energy expenditure per hour. Failure to divide by 2.
Financial	Subject makes errors regarding financial decision making and payments	To order 2 Irresistible Desserts Recipe Books & 1 Vegetable Recipe Book, how Much money should by sent?	Incorrect computation of total cost. Failure to multiply and/or add.
Medication Dosage	Subject makes errors regarding medication dosage decisions.	Mr. Jones smokes and has a smoker's cough. What is the maximum number of doses he should take per day?	Incorrect answer of adult dosage; does not consider warning regarding medication usage with smoker's cough.
Random Response	Errors can not be classified according to the established coding scheme.	Any question on the test.	Response makes no logical sense in the context of the question.
No Attempt	Subject makes no attempt to answer the question.	Any question on the test.	For example, "I don't know".

Table 2

Correlation Matrix of Error Item Totals and Age and Education

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Prior Experience													
2. Incomplete Process	.54												
3. Random	.22	.22											
4. No Attempt	.12	.11	.13										
5. Dosage	.31	.57	.16	.12									
6. Overdose	.37	.45	.04	.12	.77								
7. Underdose	.11	.26	.07	-.03	.38	.10							
8. Financial	.43	.71	.22	.18	.36	.27	.21						
9. Overpayment	.36	.53	.17	.13	.27	.21	.15	.72					
10. Underpayment	.09	.31	.05	.01	.10	.07	.08	.44	-.03				
11. Computational	.05	.53	-.01	-.06	.39	.15	.21	.39	.22	.48			
12. Age	.13	.19	.09	.11	.00	-.03	-.03	.14	.08	-.02	-.01		
13. Education	.24	.32	.12	.20	.11	.06	.08	.28	.25	.01	.05	.06	

Note. $N = 306$; $r \geq .12$, $p < .05$ $r \geq .16$, $p < .01$; $r \geq .20$, $p < .001$
Note. Error types are not mutually exclusive.

Table 3

Description of EPCCE Error Categories

Variable	Mean	SD	Proportion Possible Errors	Proportion of Paricipants Marking 1 or More Error
Prior Experience	1.39	1.26	.04	.73
Incomplete Processing	7.26	3.46	.23	.98
Computational	1.74	1.22	.35	.82
Financial	1.74	1.36	.29	.78
Overpay	.83	.83	.17	.60
Underpay	.38	.52	.13	.36
Medication Dosage	1.56	.91	.39	.87
Overdose	.86	.69	.21	.70
Underdose	.28	.47	.07	.27
Random	.15	.42	.004	.12
No Attempt	.20	.53	.006	.15

Note. N = 306

Table 4

Description of Cognitive Variables

Variable	Possible Range	Actual Range	Mean	SD
Error Total	0 - 32	0 - 19	7.87	3.81
Story Recall	0 - 18	0 - 17	7.36	3.09
Story Recall Delay	0 - 18	0 - 16.5	6.48	3.19
Fluency - Letters	n/a	3 - 52	23.74	8.46
Fluency - Animals & Fruits	n/a	5 - 49	26.75	7.11
Boston Naming Test	0 - 15	8 - 15	14.25	1.17
MMSE	0 - 30	19 - 30	26.58	2.27
Temporal Orientation	0 - 113	0 - 61	.75	4.07
Word List - Trial 3	0 - 10	4 - 10	8.20	1.36
Word List - Delayed	0 - 10	0 - 10	6.90	1.92
Praxis	0 - 12	5 - 12	9.95	1.24
Clock	0 - 8	2 - 8	7.20	.86
Trail A	0 - 300	18 - 187	52.83	23.72
Trail B	0 - 300	50 - 300	142.64	71.55

Note. N = 306

Table 5

Correlation Matrix of CERAD with Error Total and Age and Education

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Story															
2. Story-Delay	.89														
3. Fluency-Letters	.34	.29													
4. Fluency-Animal&Fruit	.42	.40	.57												
5. Boston Naming	.41	.39	.35	.43											
6. MMSE	.38	.40	.26	.35	.35										
7. Temporal	-.15	-.15	-.09	-.16	-.12	-.22									
8. Word List-Trial 3	.42	.39	.31	.43	.22	.27	-.12								
9. Word Recall-Delay	.47	.45	.30	.39	.33	.34	-.14	.70							
10. Construction Praxis	.16	.12	.22	.16	.21	.30	.03	.15	.19						
11. Clock	.17	.18	.21	.24	.23	.29	-.04	.19	.26	.27					
12. Trail Making-A	-.29	-.31	-.23	-.35	-.26	-.31	.10	-.28	-.33	-.25	-.15				
13. Trail Making-B	-.39	-.37	-.35	-.44	-.44	-.51	.16	-.30	-.37	-.29	-.30	.60			
14. EPCCE Error Total	-.39	-.38	-.32	-.36	-.28	-.39	-.02	-.20	-.24	-.30	-.16	.30	.41		
15. Age	-.12	-.13	-.09	-.22	-.23	-.27	.02	-.15	-.16	-.16	-.15	.30	.38	.23	
16. Education	.34	.35	.38	.32	.21	.28	-.03	.14	.19	.27	.20	-.17	-.30	-.35	.06

Note. $N = 306$; $r \geq .12$, $p < .05$; $r \geq .15$, $p < .01$; $r \geq .20$, $p < .001$

Table 6

Summary of Regression Analysis for CERAD battery Predicting Error Total

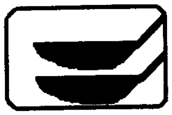
Variable	β	t	p	Total R^2
CERAD$_a$				
Story Recall	-.21	-3.41	.001***	
Word Fluency - Animals&Fruits	-.15	-2.44	.02*	
MMSE	-.13	-2.18	.03*	
Praxis	-.17	-3.22	.001**	
Trail B	.18	2.83	.01**	
Word Recall-Delay	.05	.83	.41	
Clock Drawing	.04	.67	.50	
Boston Naming Test	.05	.11	.91	.29
CERAD with Age and Education$_b$				
Age	.09	1.69	.09	
Story Recall	-.18	-2.94	.004**	
Word Fluency - Animals/Fruits	-.12	-1.91	.06	
MMSE	-.11	-1.88	.06	
Praxis	-.14	-2.65	.01**	
Trails B	.14	2.14	.03*	
Education	.15	2.73	.007**	
Boston Naming Test	.01	.11	.91	
Clock Drawing	.05	.86	.39	.31

Note. N = 306
$_aF = 23.77, p < .001$, $_bF = 18.59, p < .001$

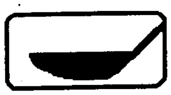
Sample EPCCE Stimuli

Indications: Temporarily Relieves Cough Due to Minor Throat and Bronchial Irritation as May Occur with A Cold.

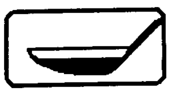
Directions: Follow dosage below:
DO NOT EXCEED 4 Doses in a 24-Hour Period.



ADULT DOSE (and children 12 years and over):
2 teaspoonfuls every 6 to 8 hrs.



CHILD DOSE
6 yrs. to under 12 yrs.
1 teaspoonful every 6 to 8 hrs.



2 yrs. to under 6 yrs.
1/2 teaspoonful every 6 to 8 hrs.

Under 2 -- Consult Your Doctor.

Warnings -- A persistent cough may be a sign of a serious condition. If cough persists for more than 1 week, tends to recur, or is accompanied by fever, rash, or persistent headache, consult a doctor. Do not take this product for persistent or chronic cough such as occurs with smoking, asthma, emphysema, or if cough is accompanied by excessive phlegm (mucus) unless directed by a doctor.

Emergency Numbers

Localities	Fire	Police	Ambulance
Pine Glen	355-1512	342-3370	355-1512
Pleasant Gap	355-1512	355-5441	355-1512
Port Matilda	234-0234	234-0234	234-0234
Potter Township	234-0234	863-4646	234-0234
Rebersburg	364-1451	863-4646	364-1451
Snow Shoe Boro.	355-1512	355-1512	355-1512
Snow Shoe Township	355-1512	342-3370	355-1512
Spring Mills	364-1451	863-4646	364-1541
Spring Township	355-1512	355-5441	355-1512
State College	911	911	911
University Park	863-1111	863-1111	863-1111

Note: Stimuli have been reduced for presentation purposes.