Change in Everyday Cognitive Competence Over Time: Predictors and Correlates of Status

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Abstract

The present study explored longitudinal change in everyday cognitive competence in a sample of 224 community-dwelling older adults. This endeavor utilized the test of Everyday Problems for Cognitively Challenged Elderly (EPCCE), an objective, performance-based measure of cognitive competence in IADL domains. Research was conducted in collaboration with the Monongahela Valley Independent Elders Survey, a longitudinal study of rural, low SES, nondemented older adults. At both occasions, participants who were older and who had lower levels of educational attainment had significantly lower scores on everyday competency. Mean level analyses indicated a significant effect of time, with participants declining an average of 2-3 points (8% decline), while individual level analyses revealed stability for the majority of participants (65%). Hierarchical regression indicated that verbal ability, executive functioning, age, and education significantly predict the level of functioning at Time 2. When change in the EPCCE is considered, however, only executive functioning remains a significant predictor . These results suggest that functioning in higher order cognitive tasks, as such as working memory and decision making ability, may best predict reliable decline in everyday competence.

Change in Everyday Cognitive Competence Over Time: Predictors and Correlates of Status

Everyday cognitive competence represents an individual's ability to perform those cognitively demanding instrumental tasks of daily living necessary to remain independent in society (Willis, 1991). Everyday competence in elderly individuals is often assessed through self ratings of performance on personal activities of daily living (PADLs; Katz, Ford, Moskowitz, Jackson, & Jaffee, 1963; Lawton & Brody, 1969) and instrumental activities of daily living (IADLs; Fillenbaum, 1985; Lawton & Brody, 1969). Difficulties performing instrumental activities, such as managing a checkbook or planning a shopping list, typically occur prior to impairments in self-maintenance activities and often signal an older adults' declining ability to function independently in the community. While global tests of cognitive functioning, such as the Mini-Mental State Exam (Folstein, Folstein, & McHugh, 1975) are often used to identify cognitive decline, such measures may be sensitive at the cutoff score for impairment, but lack specificity, particularly among low educated individuals (Murden, McRae, Kaner, & Bucknam, 1991). Thus, a focus on performance of cognitively demanding everyday activities may yield greater gains in the identification of early functional decline and implementation of intervention efforts.

Cognitively Challenging Instrumental Tasks

The negative impact of IADL disabilities on outcomes has been well established. Declining competency in instrumental tasks is associated with increased morbidity, service use, hospitalization, nursing home placement, and mortality (Branch & Jette, 1982; Fillenbaum, 1985; Kemper, 1992; Koyano et al., 1989; Manton, 1988; Wolinsky et al., 1992). Trajectories of functional disability have been found to be related to several demographic characteristics, with age, female gender, education, and income most consistently associated with impairment across investigations (Mor et al., 1989; Roos & Havens, 1991; Strawbridge, Camancho, Cohen, & Kaplan, 1993). Low education in particular has been well established as a major risk factor for decreased cognitive functioning and dementia (Fillenbaum et al., 1988; Ganguli et al., 1991; Willis, 1996). As Willis (1996) suggests, low educated adults may be particularly vulnerable to age-related declines in cognitive performance due to their initially lower competency in everyday decision making

While instrumental activities, in general, are more predictive than ADLs of functional decline, studies by Wolinsky and colleagues suggest that specific IADL domains may have differential predictive validity, with advanced cognitive ADLs (such as managing finances, using the telephone, etc.) often serving as more salient indicators of poor outcomes than household (i.e., laundry, housework) or basic (i.e., bathing, dressing) ADL domains. In a large scale epidemiological study of older adults, only difficulties in advanced cognitive ADLs significantly predicted number of disability days, hospital visits, and mortality (Wolinsky & Johnson, 1991). In addition, Johnson and Wolinsky (1993) found that cognitively demanding advanced activities of daily living were more closely associated to Alzheimer's disease and cerebrovascular disease--states that are reflective of memory problems and confusion. Further, several studies have reported specific associations among more cognitively focused instrumental activities and scores on mental status questionnaires (Barberger-Gateau et al., 1992; Fitzgerald et al., 1993).

Trajectories of Functional Disability

In order to understand how disability may impact future outcomes in the elderly, we must look to studies which have examined longitudinal trajectories of functional competence. One such investigation (Zarit, Johansson, & Malmberg, 1995) investigated the rates and patterns of change among the oldest old in Sweden (i.e., participants aged 84-90) across a 4-year longitudinal study. Results indicated a high rate of decline over time, with approximately one-half of previously nondisabled participants experiencing disability or death at both the 2-year and 4-year time intervals.

Similarly, in their study of age changes in everyday cognitive abilities, Willis and colleagues (Willis, Jay, Diehl, & Marsiske, 1992) found individual losses on a performance-based measure of everyday competency to be normative only for participants who moved into old-old age over the course of the 7-year interval. Taken together, these findings clearly illustrate the increasing incidence of new disability with age, particularly among the very old.

Using survey data from the Longitudinal Retirement History Study, a 10-year study of employed men and unmarried employed women between the ages of 58 and 63 years, Maddox and Clark (1992) examined the differential impact of demographic characteristics on trajectories of functional impairment. At the group level, results indicated that impairment increased monotonically over a decade. However, when specific personal characteristics were examined, it was revealed that women, those who had been persistently poor, and those with lower levels of education had higher levels of impairment at each measurement point. These authors emphasize that differences in trajectories of impairment cannot be explained by age or age-related change alone.

Crimmins and Saito (1993) examined transitions in functional status longitudinally in a sample of participants from the Longitudinal Study on Aging. These authors examined trajectories of disability, as well as potential demographic correlates of change or stability over time. On average, the percentage of older adults reporting difficulty with ADLs, IADLs, and measures of physical performance (e.g., walking, lifting, reaching) increased approximately 2-4% over two years. For instrumental activities specifically, the percentage increased from 3.3 (i.e., light housework) to 6.0 (i.e., using the telephone). In addition, those participants who experienced decline on one task typically experienced decline in 2-to-5 other tasks, as well.

Objective assessments of performance on everyday tasks indicate that examinations of longitudinal change focused solely at the group level may distort the prevalence of decline (Willis et al., 1992). Similarly, self-report data indicates that when functional trajectories are examined at the individual level, improvement, stability, and decline are all represented (Crimmins & Saito, 1993). Even in samples where the majority of older adults experienced functional disability over time, some individuals remained stable or even improved in functional and/or mental status across two-and four-year time intervals (Manton, 1988; Zarit et al., 1995). Research suggests that an improvement in (or a return to) prior functional levels is highly related to initial functional status, less severe impairments, and situations where the loss of a function has been fairly recent (Crimmins & Saito, 1993; Manton, 1988). Alternatively, participants may be most likely to experience decline when their general health and initial functional status are lower, when they have experienced vision and/or hearing deficits, and/or have experienced disease states such as arthritis or stroke (Crimmins & Saito, 1993).

To date, the vast majority of conclusions regarding age-related change in functioning have been based on self-reports of competence from the older adults themselves. Less data is available on age-related decline when more objective ratings of competence are employed. Some researchers have suggested that performance based instruments may be better equipped to identify functional limitations before the onset of disability (Hoeymans et al., 1996; Myers et al., 1993;

Rozzini et al., 1993). In addition, the vast majority of research on everyday competence has focused on its association with basic cognitive abilities. While studies suggest that that fluid abilities such as inductive reasoning or problem solving are most closely related to competency in everyday tasks (Camp et al., 1989; Cornelius & Caspi, 1987; Willis & Marsiske, 1991), it is unclear whether or not assessments with clinical/neuropsychological measures will exhibit correlational patterns.

The present study examined age-related change in performance on a measure of everyday cognitive competence, the Everyday Problems Test for Cognitively Challenged Elderly (EPCCE), over a 2-3 year interval. The current endeavor addressed the following research questions: (1) What is the nature of change in everyday cognitive competence over time, as measured on the EPCCE?, (2) How do results examining mean level change in competency differ from those assessing change at the individual level of analysis?, and (3) What factors are associated with age-related change in the everyday cognitive competence? Specifically, what is the association of clinical measures, demographic factors, and baseline status to everyday competence over time?

Method

Design

The present study represents a program of research that is currently being conducted in collaboration with the Monogahela Valley Independent Elders Survey (MoVIES), an ongoing, prospective epidemiological study of cognitive impairment and dementia begun in 1987 to establish a population-based dementia registry. The survey sample includes adults aged 65 years and older selected by age-stratified random sampling from voter registration lists of a group of communities in the Monongahela Valley of southwestern Pennsylvania. This is a rural blue-collar population of relatively low socioeconomic status and education. To be eligible for participation in the study, persons had to be living in the community, be fluent in English, and have at least 6 years of education. Since 1989, the survivors of the MoVIES cohort have been followed with repeated cognitive screening at 18-24 month intervals in order to identify cases of dementia, risk factors for dementia, and to examine normative and pathological patterns of cognitive change over time. The everyday cognitive competence measure that is the focus of this study was introduced during the third follow-up wave of the MoVIES study in 1994.

Since 1996, participants in the everyday competency phase of the MoVIES study have been retested in successive order depending on the date of their initial testing session. As of October 1997, longitudinal data have been collected on 255 of the 753 first occasion participants involved in the EPCCE phase of the study. The present sample represents first and second occasion data collected for those participants involved in the everyday competency phase of the study. Participants were retested on the EPCCE within a 23-36 month interval (M = 28 months; SD = 2.44).

Participants

The present analysis includes 224 (65% Female; 35% Male) low SES, community-dwelling older adults from rural southwest Pennsylvania. Participants were predominantly Caucasian (98%), with a mean age was 76 years (SD = 4.16; Range = 70-92). Thirty-nine percent of participants (n = 88) were young-old (70-75 years), while 61% (n = 136) could be classified as old-old (75 years and older). Approximately one-third of the sample had less than a high school education (6-9 years, n = 42, 19%; 10-11 years, n = 27, 12%); 41% (n = 92) completed high school; and 28% had post secondary education (trade or technical school, n = 31, 14%; some college, n = 17, 8%; college graduate, n = 7, 3%; graduate or professional training, n = 8, 4%).

Of the 255 MoVIES subjects administered the EPCCE at two occasions, 224 are included in this study. In the remaining 31 cases, the participant was excluded from the study based on a rating of 0.5 or higher on the Clinical Dementia Rating Scale (CDR; Hughes, Berg, Danziger, Cohen, & Martin, 1982), indicating possible dementia.

Procedure

MoVIES project. Subjects were assessed in their homes. Subjects were first administered the MoVIES protocol, involving an extensive interview and a battery of clinical and neuropsychological measures. The semi-structured interview focused on demographic information, sensory impairments, functioning in daily self-care and instrumental activities, health, nutrition, number and types of medications, and the use of formal and informal health and social services. The MoVIES battery was administered first in order to preserve the integrity of the protocol established in the first two waves of the study. Following the MoVIES battery, subjects were told that they had the opportunity to take part in a new phase of the study involving a measure of everyday problem solving. Subjects were paid $10 for their participation in the MoVIES project and an additional $10 for testing on the EPCCE measure.

Measures

Everyday Problem Solving

The test of Everyday Problems for Cognitively Challenged Elderly (EPCCE) measures older adults' cognitive ability to solve tasks associated with everyday activities. Participants are shown 16 printed stimulus materials which represented real-world stimuli encountered in tasks of daily living, such as an itemized phone bill, directions for over-the-counter medication, or a nutrition label. The printed materials involve charts, forms, or directions. Upon viewing each stimuli, subjects are asked to solve two problems related to the information presented (e.g., "What is the maximum number of teaspoons you would take in a 24 hour period?"). The test is untimed, but average administration time is 20-30 minutes.

This 32 item measure assesses complex cognitive functioning in each of seven IADL domains: managing medications, meal preparation and nutrition, household management, negotiating transportation, using the telephone, shopping for necessities, managing one's finances (Fillenbaum, 1985; Lawton & Brody, 1969). Prior analyses indicated a test-retest reliability of .93, and internal consistency of .87 for a sample of low SES nondemented older adults (Willis, 1991).

Clinical and Neuropsychological Battery

The MoVIES clinical and neuropsychological test battery (Ganguli et al., 1991) is an expansion of the protocol defined by the Consortium to Establish a Registry for Alzheimer's Disease (CERAD; Morris et al., 1989). The following measures are included in this

Story Recall: Immediate and Delayed (Becker, Boller, Saxton, & McGonigle-Gibson, 1987). A short story is read to participants and they are asked to report everything they can remember about the story. Later in the testing session, participants are asked to remember the story they heard earlier and to report what they can recall. Literal recall of story elements earns 1 point, while reporting the "gist" earns .5 point. This task assesses short-term memory recall for new information. Total scores for both immediate and delayed recall are computed. Scores range from 0-18.

Verbal Fluency (Borkowski, Benton, & Spreen, 1967; Benton & Hamsher, 1976). Participants are asked to name as many items as they can within 60 seconds in a given category (i.e., letters P and S, fruits, animals). Fluency assesses verbal production, semantic memory, and language. Scores have no upper limit. Fluency scores for each category are computed, as well as total fluency for letters combined and for fruits and animals combined.

Modified Boston Naming Test: CERAD subset (Morris et al., 1989). Participants are asked to name 15 objects when presented with drawings of those objects (i.e., tree, flower, dominoes). Participants are allowed 10 seconds per picture. Items are grouped into high (i.e., tree), medium (i.e., mask), and low (i.e., hammock) frequency of occurrence in the English language. This test also assesses verbal production, semantic memory, and language. Scores range from 0-15.

Mini-Mental State Exam (MMSE; Folstein, Folstein & McHugh, 1975). This cognitive screening test assesses participants' level of orientation to time and place, short-term and delayed recall, ability to follow simple directions, praxis, and language. In this study, the Serial 7's test was used to assess attention. Scores range from 0-30.

Temporal Orientation (Benton et al., 1982). This test also assesses the participant's orientation to time and place, and also asks for personal information, such as the county in which the participant resides. Scores range from 0-113, with a score of 0 indicating a perfect score. Errors in orientation result in increases in total score.

Word List Memory Task Recall: Immediate and Delayed (Morris et al., 1989). Participants are presented with a list of 10 words (tester reads 1 word every 2 seconds) and then asked to recall as many words as they can in 90 seconds. For the next two trials, the tester reads the words in a new random order and they are asked to recall as many words as possible on each trial. Later in the battery, delayed recall for the original list of words is assessed. Scores range from 0-10 per trial, and the total score ranges from 0-30.

Constructional Praxis (Rosen, Mohs, & Davis, 1984). Participants are given drawings of a circle, diamond, double rectangle, and cube and asked to copy the drawings. Two minutes are allowed for each figure and points are broken down by the important features of each drawing.

Scores range from 0-12. This test assesses constructional ability, planning, and executive functions.

Clock Drawing (Kaplan, 1990). This test asks participants to draw the face of a clock so that the hands are set for 11:10. Scores range from 0-8, with participants earning points for important elements of the drawing. This task assesses abilities similar to those of praxis.

Trail Making A (Reitan, 1955; Reitan & Tarshes, 1959) This task assesses reaction time, visual scanning, working memory, and set shifting and sequencing. Participants are asked to draw lines connecting numbers from 1-25. Scores indicate the amount of time to finish the task, the total number of errors, and the total number of points connected. Scores range from 0-300.

Trail Making B (Reitan, 1955; Reitan & Tarshes, 1959) This executive function task is more cognitively complex than Trail Making A and involves the same abilities. In this test, participants have to connect both numbers and letters in subsequent order. For example, 1-A-2-B, etc. Scores range from 0-300.

Results

Age-related Change in EPCCE Scores

Change on the EPCCE was examined at the mean level and individual level of analysis. The correlation between the two testing occasions was $r = .61$. The mean scores on the EPCCE at each of occasion were 22.9 ($SD = 5.59$) and 20.5 ($SD = 7.22$), respectively. An examination of mean level change indicated a significant decline in scores from Time 1 to Time 2, with scores decreasing approximately 2-3 points, ($t(1,223) = 6.05$, $p < .001$).

In order to examine intraindividual change in everyday competence, the standard error of the measurement was computed for the EPCCE. Change on the EPCCE was defined as one standard error of the measurement or greater over the 2-3 year interval (Schaie & Willis, 1986). Participants were classified as declining, remaining stable, or improving based upon their degree of change. Results indicated that the majority of the sample (65%; n = 147) exhibited stability in competence, 28% (n = 62) of participants had declined, and 7% (n = 15) showed improvement.

Individual Differences in EPCCE Change

A 4-way repeated measures ANOVA [2(age) X 2(gender) X 3(education) X 2(time)] revealed main effects of time, age, and education, but no interaction effects. Participants with education below the high school level were significantly disadvantaged on the EPCCE at

both occasions,as compared to participants who had attained a high school education or beyond, [$F(2,212) = 15.00$, $p < .001$]. In addition, differences among age groups indicated higher levels of performance among the young old than old-old, [$F(1,212) = 22.93$, $p < .001$]. It should be noted that in preliminary analyses, months between testing sessions was included as a covariate, but was not significant.

Prior research analyzing the structure of the clinical battery (Morris et al., 1989) has indicated suggested a 3-factor structure encompassing the areas of memory, verbal ability, and executive functioning. For the purposes of this study, three composite variables were created to represent functioning: (1) a Verbal Ability composite of verbal fluency measures and the Boston Naming Test, (2) a Memory composite of story recall and word recall measures, and (3) an Executive Functioning composite that includes clock drawing, construction praxis, and trailmaking. Correlations among everyday competence at both occasions, Time 1 cognitive composites, and demographic variables are shown in Table 1. EPCCE scores at both time points were significantly related to each of the cognitive composites, age, and education, with concurrent measures (i.e., Time 1 EPCCE--Time 1 composites) exhibiting higher associations. Correlations among the clinical composite variables were moderate, ($r = .4$ to $.5$)

Longitudinal Predictors of Change

Hierarchical regression was used to determine what Time 1 factors best predict Time 2 EPCCE status. Predictor variables were entered in 3 blocks: (1) Clinical composites, (2) Initial EPCCE status, and (3) Demographic variables. As illustrated in Table 2, Time 1 verbal ability, memory, and executive functioning significantly predicted the level of everyday competence at Time 2, accounting for approximately 33% of the variance in status. In the second step, age and education were added to the set of predictor variables. While both demographic factors were significant individual predictors of the level of competency at Time 2, the addition of these variables did not result in a significant change in the variance beyond that previously accounted for by the clinical composites. Initial status on the EPCCE was added in the third step in order to examine changes in status, resulting in a significant change in R-square and accounting for 42% of the variance. At this step, the analyses indicated that executive functioning tasks best predict change in competency.

Discussion

Competence in cognitively challenging instrumental activities of daily living is crucial in the evaluation of an older person's ability to live independently. Few studies have examined change in an objective assessment of everyday competence over time, or explored how such changes may relate to clinical measures typically used as screening tools for the diagnosis of dementia. The present study assessed change in everyday competence over a 2-3 year interval and examined the antecedents of competency status.

Findings indicate that it is crucial to examine age-related change at both the mean level and individual level of analysis. Although mean level change indicated significant age-related decline on the EPCCE, intraindividual change was characterized primarily by stability among this sample of predominantly low educated, old-old adults. Similar to the results to other longitudinal endeavors, stability, decline and improvement were each represented when individual functional trajectories were analyzed (Crimmins & Saito, 1993; Manton, 1988; Willis et al., 1992; Zarit et al., 1995). However, nearly one-third of participants experienced decline over time. In general, it appears that participants with very low levels of education may be particularly disadvantaged. At both time points, this group scored significantly lower than those with a high school education or above. Age also exerted an impact on performance across time, with old-old adults performing at a level significantly below that of young-old adults.

These analyses suggest that the clinical composite variables are important predictors of Time 2 EPCCE status, accounting for approximately one-third of the variance in cognitive competence. Demographic variables, such as age and education, account for a limited amount of additional variance in Time 2 status above that contributed by verbal ability, memory, and executive functioning. Particularly when baseline status is included as a predictor, the impact of demographic variables is further reduced, suggesting that earlier competence may be a more salient predictor of cognitive change than age or education-related effects. Not surprisingly, prior level of performance on the EPCCE was found to be a crucial predictor of subsequent status on the competence measure.

Interestingly, memory was a less meaningful predictor of the level of competence at Time 2 than either verbal ability or executive functioning. One explanation for this finding may be the nature of the EPCCE test itself. Because participants are allowed to refer to the stimuli to answer each question, rather than remembering the material for later recall, this measure may have low memory demand and thus not be as closely associated with the clinical tests that assess short-term and delayed memory recall and recognition. Alternatively, executive functioning was found to be a significant indicator of change in cognitive competence over time. As the EPCCE taps higher order skills and cognitive processes closely tied to executive functioning, such as working memory, inductive reasoning, and decision-making skills, it is not surprising that the associations among these measures was greater. It is these higher order, executive functioning abilities that have been found to decline prior to more basic cognitive abilities. Thus, declines in these complex skills may be the earliest and most salient predictor of longitudinal change in competence.

Table 1

Correlations Among EPCCE, Clinical Composites, and Demographic Variables

Variables	1	2	3	4	5	6	7
1. EPCCE Time1	1.00						
2. EPCCE Time2	.60	1.00					
3. Verbal Ability	.54	.42	1.00				
4. Memory	.43	.36	.52	1.00			
5. Exec Functioning	.57	.48	.42	.35	1.00		
6. Age	-.41	-.27	-.14	-.13	-.35	1.00	
7. Education	.40	.34	.31	.29	.35	.02	1.00

Note. $r >= .14$, $p < .05$; $r >= .18$, $p < .01$; $r >= .23$, $p < .001$.

Table 2

Hierarchical Regression: Prediction of Time 2 EPCCE

Predictors	**β**	**p**	**R^2**	**R^2 Change**
Model 1				
Verbal Ability	.20	.004*		
Memory	.14	.04*		
Exec Functioning	.37	.001*	.33	
Model 2				
Verbal Ability	.18	.009*		
Memory	.12	.08		
Exec Functioning	.28	.001*		
Age	-.14	.02*		
Education	.15	.02*	.35	.02
Model 3				
Verbal Ability	.07	.30		
Memory	.07	.24		
Exec Functioning	.18	.009*		
Age	-.03	.64		
Education	.07	.25		
EPCCE Time 1	.40	.001*	.42	.07*

References

Barberger-Gateau, P., Commenges, D., Gagnon, M., Letenneur, L, Sauvel, C., & Dartigues, J. (1992). Instrumental activities of daily as a screening tool for cognitive impairment and dementia in elderly community dwellers. Journal of the American Geriatrics Society, 40, 1129-1134.

Becker, J. T., Boller, F., Saxton, J., McGonigle-Gibson, K. L. (1987). Normal rates of forgetting verbal and nonverbal material in Alzheimer's disease. Cortex, 23(1), 59-72.

Benton, A. L. & Hamsher, K. D. (1976). Multilingual Aphasia Examination. Iowa City: University of Iowa.

Benton, A. L., Hamsher, K., deS., Varney, N. R., Spreen, O. (1983). Contributions to neuropsychological assessment. New York: Oxford University Press.

Borkowski, J. G., Benton, A. L. & Spreen, O. (1967). Word fluency and brain damage. Neuropsychologia, 5, 135-140.

Branch, L., & Jette, A. M. (1982). A prospective study of long-term care institutionalization among the aged. American Journal of Public Health, 72, 1373-1379

Camp, C. J., Doherty, K., Moody-Thomas, S., & Denney, N. W. (1989). Practical problem solving in adults: A comparison of problem types and scoring methods. In J. D. Sinnott (Ed.), Everyday problem solving: Theory and applications (pp. 211-228). New York: Praeger.

Cornelius, S. W., & Caspi, A. (1987). Everyday problem solving in adulthood and old age. Psychology and Aging, 2, 144-153.

Crimmins, E. M., & Saito, Y. (1993). Getting better and getting worse. Journal of Aging and Health, 5(1), 3-36.

Fillenbaum, G. G. (1985). Screening the elderly: A brief instrumental activities of daily living measure. Journal of the American Geriatrics Society, 33, 698-706.

Fillenbaum, G. G. (1988). Multidimensional functional assessment of older adults: The Duke Older Americans Resources and Services procedures. Hillsdale, NJ: Lawrence Erlbaum.

Fillenbaum, G. G., Hughes, D. C., Heyman, A., George, L. K. et al. (1988). Relationship of health and demographic characteristics to Mini-Mental State Examination score among community residents. Psychological Medicine, 18, 719-726.

Fitzgerald, J. F., Smith, D. M., Martin, D. K., Freedman, J. A., & Wolinsky, F. D. (1993). Replication of the multidimensionality of activities of daily living. Journal of Gerontology: Social Sciences, 48(1), S28-S31.

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.

Ganguli, M., Ratcliff, G., Huff, F. J., Belle, S., Kancel, M. J., Fischer, L., Seaberg, E. C., Kuller, L. H. (1991). Effects of age, gender, and education on cognitive tests in a rural elderly community sample: Norms from the Monongahela Valley Independent Elders Survey. Neuroepidemiology, 10, 42-52.

Hoeymans, N., Feskens, E. J. M., van den Bos, G. A. M., & Kromhout, D. (1996). Measuring functional status: Cross-sectional and longitudinal associations between performance and self-report (Zutphen Elderly Study 1990-1993). Journal of Clinical Epidemiology, 49(10), 1103-1110.

Hughes, C., Berg, L., Danziger, W., Cohen, L., & Martin, R. (1982). A new clinical scale for the staging of dementia. British Journal of Psychiatry, 140, 566-572.

Johnson, R. J., & Wolinsky, F. D. (1993). The structure of health status among older adults: Disease, disability, functional limitation, and perceived health. Journal of Health and Social Behavior, 34(June), 105-121.

Kaplan E. (1990). The process approach to neuropsychological assessment of psychiatric patients. Journal of Neuropsychiatry and Clinical Neuroscience, 2, 72-87.

Katz, S. C., Ford, A. B., Moskowitz, R. W., Jackson, B. A., & Jaffee, M. W. (1963). Studies of illness in the aged. The index of ADL: A standardized measure of biological and psychosocial function. Journal of the American Medical Association, 185, 914-919.

Kemper, P. (1992). The use of formal and informal home care by the disabled elderly. Health Services Research, 27, 421-451.

Koyano, W., Shibata, H., Nakazato, K., Haga, H., Suyama, Y., & Matsuzaki, T. (1988). Prevalence of disability in instrumental activities of daily living among elderly Japanese. Journal of Gerontology: Social Sciences, 43(2), S41-S45.

Koyano, W., Shibata, H., Nakazato, K., Haga, H., Suyama, Y., & Matsuzaki, T. (1989). Mortality in relation to instrumental activities of daily living: One-year follow up in a Japanese urban community. Journal of Gerontology: Social Sciences, 44(3), S107-S109.

Lawton, M. P. & Brody, E. (1969). Assessment of older people: Self maintaining and instrumental activities of daily living. The Gerontologist, 9, 179-185.

Maddox, G. L., & Clark, D. O. (1992). Trajectories of functional impairment in later life. Journal of Health and Social Behavior, 33(June), 114-125.

Manton, K. G. (1988). A longitudinal study of functional change and mortality in the United States. Journal of Gerontology: Social Sciences, 43, S153-S161.

Mor, V., Murphy, J., Masterson-Allen, S., Wiley, C., Razmpour, A., Jackson, M. E., Greer, D., & Katz, S. (1989). Risk of functional decline among well elders. Journal of Clinical Epidemiology, 42, 895-904.

Morris, J. C., Heyman, A., Mohs, R. C., Hughes, J. P., van Belle, G., Fillenbaum, G., Mettits, E. D., & Clark, C. (1989). The consortium to establish a registry for Alzheimer's disease (CERAD). Part I. Clinical and neuropsychological assessment of Alzheimer's disease. Neurology, 39, 1159-1165.

Murden, R. A., McRae, T. D., Kaner, S., & Bucknam, M. E. (1991). Mini-Mental State exam scores vary with education in Blacks and Whites. Journal of the American Geriatrics Society, 39, 149-155.

Myers, A. M., Holliday, P. J., Harvey, K. A., & Hutchinson, K. S. (1993). Functional performance measures: Are they superior to self-assessments? Journal of Gerontology: Medical Sciences, 48(5), M196-M206.

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 trail making test. Journal of Nervous Mental Disorders, 129, 257-262.

Roos, N. P., & Havens, B. (1991). Predictors of successful aging: A twelve-year study of Manitoba elderly. American Journal of Public Health, 81, 63-68.

Rosen, W. G., Mohs, R. C., & Davis, K. L. (1984). A new rating scale for Alzheimer's disease. American Journal of Psychiatry, 14(11), 1356-1364.

Rozzini, R., Frisoni, G. B., Bianchetti, A., Zanetti, O., & Trabucchi, M. (1993). Physical Performance Test and activities of daily living scales in the assessment of health status in elderly people. Journal of the American Geriatrics Society, 41(10), 1109-1113.

Schaie, K. W., & Willis, S. L. (1986). Can decline in intellectual functioning be reversed? Developmental Psychology, 22, 223-232.

Strawbridge, W. J., Camancho, T. C., Cohen, R. D., & Kaplan, G. A. (1993). Gender differences in factors associated with change in physical functioning in old age: A 6-year longitudinal study. The Gerontologist, 33, 603-609.

Willis, S. L. (1991). Cognition and everyday competence. In K. W. Schaie & M. P. Lawton (Eds.), Annual review of gerontology and geriatrics, Vol. 11. New York: Springer.

Willis, S. L. (1996). Assessing everyday competence in the cognitively challenged elderly. In M. A. Smyer, M. B. Kapp, & K. W. Schaie (Eds.), Older adults' decision-making and the law. Springer series on ethics, law, and aging (pp. 87-127). New York: Springer.

Willis, S. L., Jay, G. M., Diehl, M. D., Marsiske, M. (1992). Longitudinal change and prediction of everyday task competence in the elderly. Research on Aging, 14(1), 68-91.

Willis, S. L., & Marsiske, M. (1991). A life-span perspective on practical intelligence. In D. Tupper & K. Cicerone (Eds.), The neuropsychology of everyday life (pp. 183-198). Boston: Kluwer Academic Publishers.

Wolinsky, F. D., & Johnson, R. J. (1991). The use of health services by older adults. Journal of Gerontology, 46(6), S345-357.

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(4), S173-S182.

Zarit, S. H., Johansson, B., & Malmberg, B. (1995). Changes in functional competency in the oldest old. Journal of Aging and Health, 7(1), 3-23.