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Development and Psychometric Properties of the Instrumental Activities of Daily Living: Compensation Scale

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Abstract

The Instrumental Activities of Daily Living – Compensation (IADL-C) scale was developed to capture early functional difficulties and to quantify compensatory strategy use that may mitigate functional decline in the aging population. The IADL-C was validated in a sample of cognitively healthy older adults (N=184) and individuals with mild cognitive impairment (MCI; N=92) and dementia (N=24). Factor analysis and Rasch item analysis led to the 27-item IADL-C informant questionnaire with four functional domain subscales (money and self-management, home daily living, travel and event memory, and social skills). The subscales demonstrated good internal consistency (Rasch reliability 0.80 to 0.93) and test-retest reliability (Spearman coefficients 0.70 to 0.91). The IADL-C total score and subscales showed convergent validity with other IADL measures, discriminant validity with psychosocial measures, and the ability to discriminate between diagnostic groups. The money and self management subscale showed notable difficulties for individuals with MCI, whereas difficulties with home daily living became more prominent for dementia participants. Compensatory strategy use increased in the MCI group and decreased in the dementia group.

Keywords: Mild cognitive impairment; Everyday functioning; Functional status; Aging; Compensatory strategies; Rasch analysis

Introduction

Compensatory strategies (e.g., alarms, GPS, and to-do lists) can help older adults (OAs) overcome cognitive challenges and increase functional independence (West, 1989, 1995). This is important as functional impairment in OAs has been associated with a variety of negative outcomes, including increased healthcare utilization (Desai, Grossberg, & Sheth, 2004; Marson & Herbert, 2006), days in the hospital (Sonn, Grimbyand, & Svanborg, 1996), falls (Zimmerman & Magaziner, 1994), and conversion to dementia (Luck et al., 2011; Ouchi et al., 2012). This paper details validation of a questionnaire designed to capture early functional deficits and compensatory strategy use that may mitigate functional decline that occurs with normal aging and with development of cognitive impairment. Older adults report frequently using compensatory aids (e.g., lists and notes) to cue memories for daily tasks (Cavanaugh, Grady, & Perlmutter, 1983). Clinically, a functional measure that takes into account strategy use could increase understanding of everyday difficulties experienced by OAs and the types of compensatory strategies used to support functional independence, thereby improving treatment recommendations.

Presently, there are several approaches to assessing everyday functioning in OAs, including self- and informant-report questionnaires, as well as performance-based assessments. Advantages and disadvantages of these approaches include varying cost, accessibility, ease of administration, and availability of normative data. It has been argued that performance-based tests (e.g., revised observed tasks of daily living; Diehl et al., 2005) may be the most accurate in determining functional status (Marcotte, Scott, Kamat, & Heaton, 2010), as they are the least susceptible to reporter biases. However, the presence of a clinic or lab setting may not reflect the normal home routine and also removes both environmental cues (Sbordone, 2001) and the ability of

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participants to make use of many typical compensatory strategies (e.g., making a list). In addition, performance-based assessments typically occur at a single evaluation point and can be influenced by the individual's motivation or engagement during the tasks (Marson & Hebert, 2006; Myers, Holliday, Harvey, & Hutchinson, 1993; Zimmerman and Magaziner, 1994).

Questionnaire measures represent one of the easiest and cheapest options for administration and data gathering. Both self- and informant-report questionnaires are, however, subject to reporter bias (Bertrand & Willis, 1999; Dassel & Schmitt, 2008; Richardson, Nadler, & Malloy, 1995) and require insight and intact cognition to obtain accurate depictions of functional performance. Informant report further requires identification of an individual that spends adequate time with the patient such that they can report on daily functioning. Self-report measures have shown poor correspondence with objective measures of cognition and poor reliability in individuals who lack awareness of their deficits (Tabert et al., 2002), whereas informant-report measures have routinely shown moderate correlations with objective cognitive measures (e.g., Miller, Brown, Mitchell, & Williamson, 2011; Mitchell et al., 2010; Tsang, Diamond, Mowszowski, Lewis, & Naismith, 2012) and the ability to differentiate between diagnostic groups (e.g., Farias et al., 2008; Isella et al., 2006). Unlike data derived from performance-based measures, individuals are able to base their responses to questionnaire items on multiple observations of everyday tasks in a variety of real-world environments, taking into account compensatory strategy use and environmental supports.

Although the majority of functional questionnaires provide an adequate portrayal of significant functional change that occurs with dementia, and several newer scales are sensitive to more mild difficulties (everyday cognition [ECog]; Farias et al., 2008; the activities of daily living-prevention instrument, ADL-PI; Galasko et al., 2006), none of these scales capture compensatory strategy use for instrumental activities of daily living (IADL). Prior research suggests that OAs with better memory skills respond to subtle memory changes by implementing more compensatory strategies than individuals with poorer memory skills (Dixon & de Frias, 2007). A growing body of literature also suggests that individuals with MCI can learn to use both internal (e.g., mnemonics) and external (e.g., memory notebook) aids to help compensate in daily life for memory loss (Belleville et al., 2006; Greenaway, Duncan & Smith, 2013; Schmitter-Edgecombe & Dyck, 2014). Given the importance that OAs place on remaining in their own homes (American Association of Retired Persons, 2000; Gross, 2007) and cost of nursing home care (Metlife, 2010), understanding how individuals use compensatory strategies to assist in maintaining functional independence in their homes as cognitive changes occur is of significant value.

This paper discusses the development and validation of a questionnaire (IADL-compensation or IADL-C) to assess IADL performance and compensatory strategy use in cognitively healthy OAs and individuals with MCI and dementia. We also sought to understand the natural progression of coping with changes in functional capacity by examining the use of compensatory strategies ("aids"). For the purpose of this study, we defined an "aid" as any item used to assist in the completion of an activity or to remind the individual to complete an activity (e.g., to-do list, GPS, grocery list, or PDA). Each questionnaire item was answered using an 8-point Likert-type scale; responses were also available for "does not need to complete activity" and "no basis for judgment." Four response options referred to independent functioning and additional choices were available to report the use of aid(s) to assist and/or indicate change from previous ability (see Table 2 for the list of response options).

Factor analysis and Rasch item analysis were used to determine the final items to include in the questionnaire and to examine items associated with poor functioning (Embretson, 1996; Lamb, Annetta, Meldrum, & Vallett, 2012). This mixed evaluation approach allowed for commonality of the outcome regarding the IADL-C and strengthened scale development. To provide reliability and validity for the scale, we examined test–retest reliability, assessed for convergent and discriminant validity, and examined whether the scale was sensitive to the normal aging process, MCI, and dementia. Compensatory strategy use was also evaluated. Previous research suggests that having average or better memory skills increases the amount of compensatory strategies used when faced with memory difficulties (Dixon & de Frias, 2007). We therefore hypothesized that individuals with MCI would be more likely to implement compensatory strategies following perceived decline, whereas individuals with dementia would exhibit issues with insight or impairment such that strategies would no longer be helpful, and instead informants would report varying levels of help needed (e.g., "sometimes, usually, or always).

Methods

Participants

Participants were 300 community-dwelling OAs (i.e., lived in own homes or within a retirement community) and their knowledgeable informants. Participants completed one of four different studies in our laboratory between March 2009 and September 2013. Only participants with an informant who completed the IADL-C were included in this study. Recruitment methods and screening processes were similar across studies. That is, participants were recruited through advertisements, community health and wellness fairs, physician referrals, referrals from local agencies working primarily with OAs, and from past studies in our laboratory. For all studies, participants first completed a phone-based medical screening interview to rule out the following exclusion criteria: history of

head trauma with a period of coma, current or recent (past year) psychoactive substance abuse, history of cerebrovascular accidents, or other known medical, neurological or psychiatric causes of cognitive dysfunction (e.g., epilepsy and stroke). The Telephone Interview for Cognitive Status (TICS; Brandt, Spencer, & Folstein, 1988) was also administered during the phone screening to exclude participants with significant cognitive impairment who therefore could not complete the respective study protocol. In addition, the clinical dementia rating (CDR; Hughes, Berg, Danzinger, Coben, & Martin, 1982; Morris, 1993; Morris et al., 1991) was administered by a certified examiner to study participants and an informant to assess dementia staging.

Identical criteria were applied across the four studies to define the participant sample as cognitively healthy OAs ($N = 184$), and individuals with MCI ($N = 92$) and dementia ($N = 24$). However, because the administered battery of neuropsychological tests varied across studies, the specific neuropsychological tests used to provide evidence of objective cognitive impairment differed across studies. For all studies, clinical interview, neuropsychological testing, and collateral medical information (e.g., results of laboratory and brain imaging data when available) were carefully evaluated by two experienced neuropsychologists to determine diagnostic group (i.e., healthy OAs, MCI, or dementia). See Table 1 for the inclusion criteria that were used for each diagnostic group. The majority of MCI participants met criteria for amnestic MCI ($N = 84$). Participants diagnosed with both single-domain MCI ($N = 35$) and multi-domain MCI ($N = 57$; attention and speeded processing, memory, language, and/or executive functioning deficits) are represented in the MCI sample.

Each participant was asked to provide the name and phone number of an individual who knew their daily routine well. Knowledgeable informants had a mean age of 63.50 years ($SD = 13.80$, range = 18–88) and a mean education level of 16.10 years ($SD = 2.72$, range = 10–24). Sixty-four percent ($N = 193$) of the informant sample was female and 36% ($N = 107$) was male. The informant sample consisted of 51% spouses, 22% children, 10% friends, 8% parents, 5% other relative, and 4% other. Seventy-four percent of informants indicated that they lived with or saw the participant almost daily, whereas 7%, 14%, and 8% of informants indicated seeing the participant 3–5× per week, 1–2× per week, and less than once per week, respectively. Because cognitive impairment can impair insight and awareness, informant data rather than participant data were used for the initial testing and validation of the IADL-C. No formal cognitive testing of informant cognitive status was conducted.

Cognitive, Functional, and Psychosocial Measures

The following cognitive, functional, and psychosocial measures were used to evaluate the convergent and discriminant validity of the IADL-C. Because the IADL-C data were collected across four different studies, not all participants completed each of the measures.

Global cognitive status. The TICS (Brandt et al., 1988) is a brief mental status exam that can be administered over the phone. The repeatable battery for assessment of neuropsychological status (RBANS; Randolph, Tierney, Mohr, & Chase, 1998) is a more comprehensive measure of global cognitive status.

Table 1. Inclusion criteria for healthy older adult, mild cognitive impairment, and dementia groups

Inclusion criteria for healthy older adult ($N = 184$)
- (a) No report of cognitive changes.
- (b) Within normal limits on the Telephone Interview for Cognitive Status (TICS) as confirmed by a score of ≥27, which is equivalent to the normality cutoff score of 24 on the Mini Mental Status Exam (Ferrucci et al., 1998; Measso et al., 1993).
- (c) Scored 0 on the Clinical Dementia Rating (CDR), which indicates no impairment.

Inclusion Criteria for MCI ($N = 92$) consistent with Petersen colleagues (1999), Petersen and Morris (2005)
- (a) Self- or informant report of a change in cognition from a person's prior level for at least 6 months.
- (b) Objective evidence of impairment in single or multiple cognitive domains (memory, executive, speeded processing, and/or language) as assessed by a battery of standardized neuropsychological tasks (see Schmitter-Edgecombe & Dyck, 2014; Schmitter-Edgecombe & Parsey, 2014); scores falling >1.5 *SD* below age-matched norms or in comparison with prior testing data.
- (c) Non-fulfillment of the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM-IV-TR*) dementia criteria (American Psychiatric Association, 2000).
- (d) Generally preserved global cognitive functions (TICS score ≥ 24).
- (e) No significant impact of cognitive deficits on daily activity completion, generally confirmed by a score of 0.5 on the CDR, which is consistent with minimal disruption in everyday routines.

Inclusion Criteria for Dementia ($N = 24$)
- (a) Met DSM-IV-TR dementia criteria.
- (b) Objective evidence of cognitive deficits in two or more cognitive domains.
- (c) Cognitive deficits significantly impact everyday activities.
- (d) Gradual onset of cognitive difficulties with continuing decline.
- (e) Cognitive deficits represent a decline from a prior higher level of functioning.

Daily functioning. The CDR (Hughes et al., 1982; Morris, 1993; Morris et al., 1991) uses informant-report information as well as self-report questions and cognitive tasks to determine dementia staging. The "sum of boxes" (CDR-SOB) was used as the measure of everyday functioning given its sensitive to longitudinal change between and within dementia stages (O'Bryant et al., 2008). Two questionnaire measures of everyday functioning were also available. The Lawton IADL scale (Lawton & Brody, 1969), which measures participant's skill level on nine IADL domains (e.g., travel and shopping) using a Likert-type scale ranging from 1 (completely unable to do) to 3 (can complete without help), and the 15-item ADL-PI(Galasko et al., 2006), which measures participant's functional capacity over the past 3 months on a Likert-type scale ranging from 4 (as well as usual) to 1 (with a lot of difficulty). For both IADL instruments, the total score was used in analyses and consisted of summed responses.

Psychosocial measures. The total score from the Geriatric Depression Scale 15-item short form (GDS-15; Sheikh & Yesavage, 1986) was used to assess depressive symptomology. The sum of the stress severity ratings from the Elders Life Stress Inventory (ELSI; Aldwin, 1990, 1991), a 31-item questionnaire that measures the number and severity of stress associated with life events, was used as a measure of life stressors in the present study.

IADL-C Questionnaire

The 50-item IADL-C took an average of 15–20 min to administer to informants and for participants to complete. Standardized instructions explained the purpose of the survey and the response options (see Table 2). To capture the participant use of compensatory strategies or aids in completing everyday activities, an 8-point response scale was developed. As seen in Table 2, ratings included levels of independent functioning (1–4), as well as indicators for needing increasing amounts of assistance (5–7) and options for "unable to complete" (8) and "does not need to complete" or "no basis for judgment" (informant version only).

Table 2. Instrumental Activities of Daily Living-Compensation (IADL-C) instructions and Item Rating Scale for the 27-item IADL-C questions

I will be asking you questions about everyday activities that many people engage in. I would like you to tell me how your (*provide relationship*: *spouse*, *mother*, and *friend*) completes each activity. Please indicate this by using the rating scale and providing me with the most appropriate response for each question. PLEASE NOTE that Responses 1 and 2 indicate that (*use participant's name*) performs the activity *independently (on* his/her *own*) and as well as he/she *ever has*. Choose Response 1 if (*use participant's name*) does not use an aid to help with activity completion and Response 2 if (*use participant's name*) uses an aid, such as a to-do list, GPS, grocery list, or PDA to assist with the activity. Responses 3 and 4 indicate that (*use participant's name*) performs the activity *independently but not as well as ever*, for example, it may take (*use participant's name*) longer to complete the activity or he/she makes more errors. Choose 3 if (*use participants' name*) is not performing the activity as well but now uses an aid to assist with activity completion. Choose 4 if (*use participant's name*) is not performing the activity as well and uses no aid to help with activity completion. If you choose Response 3 or 4, indicating that (*use participant's name*) is not performing the activity as well as ever, I will follow-up with a few additional questions to get a better sense of the difficulties that (*use participant's name*) may be experiencing. Specifically, I will ask you to tell me whether one or more of the statements labeled a thru d on your rating scale is now true of (*use participant's name*) activity performance. More specifically, I will ask if he/she is: (a) now making more errors when completing the activity, (b) is not engaging in the activity as often, (c) needs more time to complete the activity, and/or (d) must be told to complete the activity, that is, *he/she* has difficulty initiating the activity on own

For the remaining response options, if (*use participant's name*) requires some degree of help or supervision to complete the activity, choose from Responses 5 through 7: sometimes needs help, usually needs help, or always needs help. A response of 8 would indicate that (*use participant's name*) is no longer able to complete the activity, while a response of 9 would indicate that *he/she* has never completed the activity or does not need to complete the activity because it is always completed for *him/her* by someone else (e.g., someone else prepares meals). If you have no basis for judging (*use participant's name*) ability to complete the activity, then you should choose Response 10.

Rating	Descriptor	Aid level
1	Independent; as well as ever	No aid
2	Independent; as well as ever	Uses aid to assist
3	Independent but not as well as ever	Now uses aid to assist
4	Independent but not as well as ever	No aid
	(a) now makes more errors when completing the activity	
	(b) is not engaging in the activity as often	
	(c) needs more time to complete the activity	
	(d) must be told to complete the activity, has difficulty initiating the activity on own	
5	Sometimes needs help	
6	Usually needs help	
7	Always needs help	
8	Not able to complete activity anymore	
NA	Does not need to complete activity	
NJ	No basis for judgment	

The IADL-C items were selected to assess a broad range of complex activities that were expected to be sensitive to aspects of normal aging, MCI, and mild dementia; thus, basic ADLs (e.g., bathing and grooming) were not considered for the IADL-C. To assist in developing items for the IADL-C, other IADL scales were reviewed (e.g., ECog, Farias et al., 2008; Lawton IADL scale, Lawton & Brody, 1969). IADL-C items were generated by experts and doctoral students studying in the area of aging and everyday functioning. Items were divided into 10 super-ordinal categories (i.e., shopping, travel/driving, financial management, meal preparation, medication management, phone use, household activities, organization, conversation, and social activities). Items that appeared redundant and/or likely to measure identical constructs were eliminated from the list. Common transitions in daily activity completion (e.g., uses a phone book, address book, or other tool to look up unfamiliar numbers) were accounted for as much as possible. Items that asked general questions about functional abilities (e.g., remembers scheduled social events) were also emphasized over those that involved specific tools for completing tasks. In addition, items were chosen to reflect different aspects of cognition, particularly memory and executive functioning, as these cognitive domains have demonstrated significant relationships with decline in functional performance in OAs and individuals with MCI (e.g., Bell-McGinty, Podell, Franzen, Baird, & Williams, 2002; Farias et al., 2006; Lewis & Miller, 2007; Schmitter-Edgecombe, McAlister, & Weakley, 2012). Items for activities that could benefit from compensatory aid use were also favored. A final list of 50 items (∼5 per super-ordinal category) were then selected and subject to further evaluation.

Results

IADL-C Item Reduction and Validation

The IADL-C was developed and validated using an evaluative reductive process, which included classical psychometric analysis (CPT) methods and the Rasch model analysis (Lamb et al., 2012). (CPT has two conceptual limitations that can be addressed with Rasch modeling. First, with CPT the lack of a unidimensional construction of the measured construct through an ordered item continuum results in scales which cannot be additive in nature and thus cannot produce composite scores. Rasch analysis overcomes this limitation through the use of an ordering continuum of items within the unidimensional construct related to the underlying attribute (theta) being examined. This ordering of items creates a unidimensional construct allowing for development of a composite score. A second limitation of CPT is that items scales are not fixed because item responses relate to true score outcomes, and standard errors of measurement are normally distributed around the mean of the responses on the individual measure. Rasch analysis by contrast creates a fixed additive scale because items are expressed as a fixed ratio between the underlying construct theta and the probability of endorsement using a discrimination set equal to 1. Therefore, the use and comparison of CPT and Rasch modeling as a confirmatory analysis method provides for a more robust picture of the mechanics of the measure.) In addition, the Rasch model is robust to a sample size of 30 at a 95% confidence with an item stability of ± 1 logit. At a sample size of $n = 24$ (dementia group) with 95% confidence, the item stability decreases to ± 1.2 logits and is acceptable for exploratory studies such as this one (Wright & Stone, 1979). Analyses were conducted using WINSTEPS 3.81 (Linacre & Wright, 1999), SAS JMP 11.0 Statistical Discovery Software, and SPSS Statistics 21. Missing data from responses endorsed by informants as “does not need to complete activity” or “no basis for judgment” accounted for $<5\%$ of the sample data. These data were dropped from the analysis and treated as missing data; Rasch analysis is robust to missing data (Ludlow & O’Leary, 1999).

An exploratory factor analysis with varimax rotation was first conducted on the 50 IADL items. This analysis yielded a four-factor solution based on the scree test (Cattell, 1966) and resulting Eigenvalues that were close to the root 1 general criterion (Dimitrov, 2008; Lamb & Annetta, 2013; Lamb, Annetta, Vallett, & Sadler, 2014). Factor loadings were set at 0.50 for factor retention resulting in a 28-item questionnaire with four factors explaining 76.1% of the variance; all cross-loading factors were <0.50 and were not retained on the cross-loaded factor. Examination of the four-factor solution model fit using χ^2 analysis indicated adequate fit, $\chi^2(3) = 1.24$, $p = .074$, using *k*-fold validation.

Item response analyses using the Rasch model were then conducted on each factor independently to determine the retention or deletion of items using infit and outfit statistics (Wright, 1996). (Rasch measurement provides a theoretical model to create equal-step measure construction of the IADL-C instrument (Boone, Townsend, & Staver, 2011). The nature of the model is probabilistic based upon logits (Stewart-Brown et al., 2009). This probabilistic model allows for an adequate measure of the items that informants are less likely to endorse (affirm). Informants who show a greater likelihood of exhibiting higher levels of endorsements are more likely to rate participants as requiring more assistance with everyday activities due to a greater level of cognitive decline. Consequently, when an informant of a more cognitively impaired participant does not endorse items that are ranked lower than those endorsements, the result is considered unexpected and the overall model fit is reduced because of the response on the item, this reduces validity. An acceptable range of item fit ensures that differences among response slopes are not a factor in the resultant precision of the measurement instrument. The use of the Rasch model assumes that responses and endorsements resulting from survey questions are due to individual variation along a single underlying construct (Liu, 2010), which is cognitive decline in this study.) When response patterns of informants fit the Rasch model, the difference between infit and outfit should fall

Table 3. Rasch model statistics for the IADL-C

Factor	Rasch reliability	Separation	χ^2 model fit	*p*-value
1	0.93	3.6	944.53	.078
2	0.87	2.6	968.16	.071
3	0.79	1.9	606.79	.063
4	0.93	3.5	600.75	.063

into a range of 0.6–1.4 (Linacre, 1998). Examination of item fit resulted in removal of one item (i.e., completes necessary grocery shopping, including selecting needed items and quantities and paying for groceries) that had an outfit residual much >1.5. Removal of this item resulted in greater model fit as assessed by examination of the change in χ^2, $\Delta\chi^2 = -2.82$, $p = .043$ (Satorra & Bentler, 2010). Some items close to the infit and outfit range were retained in the measure for conceptual and substantive reasons. This process resulted in the final 27 items retained in the four-factor structure of the IADL-C.

The four factors of the final 27-item IADL-C questionnaire accounted for 75.3% of the variance. The 27-item questionnaire was subject to *k*-fold cross-validation methods resulting in a non-significant χ^2, $\chi^2\,(3) = 5.56$, $p = .135$, indicating that the findings should generalize to a separate independent data structure. So as not to violate the requirements of the Rasch model for unidimensionality (Lamb, Vallett, & Annetta, 2014), each scale was examined separately for fit to the Rasch model. Rasch model statistics for each factor can be seen in Table 3. Chi-square values for each factor indicated adequate Rasch model fit.

Further development of the psychometric properties of the measure was accomplished through examination of separation, discrimination, and differential item function outcomes. The level of separation as an indicator of group discrimination, revealed that all but the travel and event memory factor were able to discriminate between three groups (i.e., OAs vs. MCI, MCI vs. dementia, and OAs vs. dementia). Analysis for differential item functioning (DIF) was also conducted to determine whether informant endorsed items behaved differently when comparing across levels of education and gender. There was no DIF based on educational level, which was dichotomized as some college (1) or none (0). The following two items were less likely to be endorsed by informants for men when compared with woman (DIF item measure > 2.00): “engages in social activities appropriately (e.g., avoids offensive remarks, tells appropriate jokes)” and “checks answering machine or voice mail messages and appropriately returns calls or responds to messages.” These gender differences may, however, be a product of the higher percentage of male participants in the MCI and dementia groups when compared with the control group (see Table 6). Supporting this supposition, Mann–Whitney *U* tests conducted separately for each diagnostic group on these two items revealed no gender differences, $p > .18$.

Table 4 presents the factor loadings, infit and outfit statistics, and the items for each factor. Eigenvalues and percent variance accounted for each of the four factors are also included. There were no inter-item correlations above 0.73 (Spearman’s rho), reducing the likelihood of repetitive items. In addition, all items correlated with the item-total correlation at 0.41 or above, suggesting that the items are measuring the same underlying construct.

The items making up each factor were then examined by several experts and doctoral students studying everyday functioning in the aging population and named. The four factors showed good reliability as assessed by both Rasch reliability statistics and Cronbach’s alpha statistics. The first factor is made up of 13-items and was labeled “money and self-management” (Rasch reliability = .93; Cronbach’s alpha = 0.98). The second factor, which was labeled “home daily living,” is made up of 7-items (Rasch reliability = 0.87; Cronbach’s alpha = 0.93). Factor 3 contains 4 items (Rasch reliability = 0.80; Cronbach’s alpha = 0.86) and was labeled “travel and event memory,” while Factor 4 was made up of 3 items (Rasch reliability = .93; Cronbach’s alpha = 0.84) and labeled “social skills.” (Differences between Rasch reliability and Cronbach’s alpha arise because of the necessity of measure independence. Within the Rasch context all estimates are the ratio of “true measure variance” to “observed measure variance” creating a more conservative measure of reliability if items are interrelated. Cronbach’s alpha on the other hand requires measure independence. If that assumption is not met then Cronbach’s alpha may be inflated and less conservative.)

In addition to an overall total IADL-C score, composite scores were created for each of the four factors. Lower scores indicate better ability to manage everyday activities in the four skill domain areas. We also obtained an overall total aid usage score by counting the number of questions that were answered with a 2 or 3 response option, indicating that an aid was being used in task completion. Aid use scores were also computed for each of the four skill domains.

Statistical Analyses

Because the data were not normally distributed, non-parametric statistics were used in the data analysis to evaluate test–retest reliability, convergent and discriminant validity and external validity. Details of how the analyses were conducted are provided in the respective sections.

Table 4. IADL-C factor structure

	Loading	Infit	Outfit
Factor 1: Money and self-management skills			
Keeps financial records organized.	0.80	1.04	1.03
Can manage a budget and business affairs.	0.80	1.10	0.64
Balances a check book or credit card statement	0.75	1.34	1.46
Remembers whether bills were paid.	0.71	0.81	0.70
Returns efficiently to household tasks after being interrupted.	0.69	1.59	1.01
Able to prioritize and complete tasks in order of importance.	0.68	0.96	0.93
Can plan an efficient sequence of stops on a shopping trip.	0.68	0.66	0.71
Can plan and prepare a meal for six, including appropriate portions.	0.68	1.14	0.97
Can organize complex activities such as travel, running errands, or participation in group activities.	0.66	0.78	0.82
Appropriately recalls where items were placed and where to find items or papers when needed.	0.65	0.81	0.67
Can fill out insurance claims and doctor's records, including providing health history and medication dosages.	0.64	0.86	0.82
Can find way back to a meeting spot in the shopping mall or other location.	0.55	1.04	0.88
Can identify the names and understand the purpose of all medications being taken.	0.54	0.99	1.00
Eigenvalues	17.88		
% of variance	66.23%		
Factor 2: Home daily living skills			
Can prepare own meals, including measuring correct amounts of cooking ingredients and managing the stove.	0.70	0.93	0.64
Uses the telephone to make calls.	0.68	1.73	1.01
Performs household chores regularly (e.g., sweeping, dusting, and watering plants).	0.66	1.33	1.28
Plans and cooks efficiently (e.g., puts water on to boil before cutting carrots, cooks multiple items so that they finish at the same time).	0.63	0.86	0.82
Selects appropriate clothes for social outings taking into account the weather and the events of the day.	0.63	1.70	1.33
Checks answering machine or voicemail messages and appropriately returns calls or responds to messages.	0.62	1.07	0.93
Uses a phone book, address book, or other tool to look up unfamiliar numbers.	0.61	1.00	0.73
Eigenvalues	1.19		
% of variance	4.42%		
Factor 3: Travel and event memory skills			
Reads and follows a map when traveling.	0.78	0.99	0.66
Travels to frequently visited, familiar places without getting lost.	0.74	1.23	0.85
Remembers scheduled social events, such as church on Sundays.	0.56	1.07	0.93
Knows and remembers numbers to call in case of a problem or an emergency.	0.54	1.45	0.80
Eigenvalues	0.99		
% of variance	3.56%		
Factor 4: Social skills			
Participates meaningfully in conversations with others (e.g., adds to the conversation, initiates new conversation).	0.91	0.46	0.46
Engages in social activities appropriately (e.g., avoids offensive remarks, tells appropriate jokes).	0.82	1.49	1.63
Participates in group events and community activities, such as religious services or volunteer activities.	0.66	0.95	1.01
Eigenvalues	0.99		
% of variance	1.10%		

Test–Retest Reliability

Test–retest reliability was examined using Spearman correlation coefficients. Forty-one informants of healthy OAs participants ($N = 10$) and individuals with MCI ($N = 31$) participated. The interval between the initial and follow-up interview with informants was an average of 4.03 months (range 2–6 months). To determine whether participants may have declined during the test–retest interval, a correlation between the test–retest interval and change in the IADL-C total score was performed separately for each group. The results of the correlation analyses were non-significant for both the OAs ($r = .01$; $p = .97$) and MCI ($r = .15$; $p = .43$) groups. The Spearman coefficient for the IADL-C total score ($r_s = .91$) and the money and self-management subscale ($r_s = .91$) were high and indicated acceptable test–retest reliability (Kline, 2000). Spearman coefficients for the home daily living ($r_s = .76$), travel and event memory ($r_s = .70$), and social skills ($r_s = .70$) subscales fell in the satisfactory to good range.

Convergent and Discriminant Validity

Spearman coefficients were used to examine convergent validity with other IADL measures and discriminant validity with psychosocial measures. We hypothesized low correlations (0.0–0.3) between the IADL-C scales and measure of depression

Table 5. Spearman coefficients between informant-reported IADL-C scores and measures of everyday functioning, cognitive status, psychosocial wellbeing, and demographics

	IADL-C scores				
	Total score	Medication and self-management	Home daily living	Travel and event memory	Social skills
Everyday functioning					
CDR-SOB, $n = 178$	0.75**	0.72**	0.61**	0.67**	0.55**
L&B IADL, $n = 182$	0.58**	0.57**	0.66**	0.50**	0.62**
ADL-PI[a], $n = 41$	0.62**	0.59**	0.49**	0.53**	0.46*
Global cognitive status					
TICS[a], $n = 288$	0.43**	0.40**	0.36**	0.36**	0.34**
RBANS[a], $n = 68$	0.57**	0.58**	0.44**	0.49**	0.50**
Psychosocial measures					
GDS-15, $n = 237$	0.24**	0.24**	0.17*	0.22*	0.27**
ELSI, $n = 172$	0.04	0.05	−0.02	0.01	0.09
Demographics					
Gender, $n = 300$	0.16*	0.15	0.15*	0.09	0.09
Education[a], $n = 300$	0.14	0.12	0.11	0.10	0.09

Notes: [a]Reversed scoring; CDR-SOB = Clinical Dementia Rating—Sum of Boxes; L&B IADL = Lawton & Brody IADL questionnaire; ADL-PI = Activities of Daily Living-Prevention Instrument; TICS = Telephone Interview for Cognitive Status; RBANS = total scale score for the Repeatable Battery for the Assessment of Neuropsychological Status; GDS-15 = Geriatric Depression Scale 15-item Short Form; ELSI = Elders Life Satisfaction Inventory.
$*p < .01$; $**p < .001$.

(GDS-15), stressful life events (ELSI), gender, and education. Moderate correlations (0.4–0.6) were expected with measures of global cognitive status (TICS, RBANS total score), and moderate to high correlations (0.5–0.8) with measures of the similar construct of everyday functioning (CDR, ADL-PI, Lawton IADL). These correlations are reported in Table 5 along with sample size, as the data came from four different studies and not all measures were given across all studies. Consistent with expectations, the total IADL-C score and all domain subscale scores correlated in the moderate to high range with other measures assessing everyday functioning, while moderate correlations were generally found with the global cognitive status measures and low correlations with gender, education, depressive symptomology, and life stressors.

External Validity: Relationship to Clinical Diagnosis

External validity was evaluated by examining differences on the IADL-C scales as a function of diagnostic group (i.e., healthy OAs, MCI, and dementia) using Kruskal–Wallis tests followed by a series of Mann–Whitney test to determine significant group effects. A p-value of $<.01$ was set for statistical significance for the pairwise comparisons. Item-level analyses were also conducted, with pairwise comparisons set at $p \leq .001$ for significance.

Table 6 shows demographic data and median and interquartile range IADL-C scores for the healthy OAs, MCI, and dementia groups. Fig. 1 shows box plots of each IADL-C measure by diagnostic group. For the IADL-C total score and each of the four skill domains a stepwise pattern is observed such that the healthy OAs showed the least difficulties, the dementia group the most, and the MCI group is intermediate. These observations are supported by Kruskal–Wallis tests which revealed significant group effects for the total score, χ^2 (2, $n = 300$) = 98.53, $p < .001$, and all four skill domains: money and self-management, χ^2 (2, $n = 300$) = 92.98, $p < .001$, home daily living, χ^2 (2, $n = 300$) = 77.09, $p < .001$, travel and event memory, χ^2 (2, $n = 300$) = 77.55, $p < .001$, and social skills, χ^2 (2, $n = 300$) = 67.17, $p < .001$. Post hoc tests for the IADL-C total and subscale scores revealed that informants endorsed fewer everyday difficulties for healthy OAs compared with individuals with MCI, Us > 11,296, ps < .001, rs > .49, and for individuals with MCI compared with the dementia group, Us > 1,449, ps < .001, rs > 24. Item-level analysis revealed significant pairwise differences between the groups at $p \leq .001$ for all but 7 items. Items for which the difference between the OAs and MCI groups did not reach significance are marked with an asterisk in Table 7. Differences between the MCI and dementia groups that did not reach significance are marked with a caret (^) in Table 7.

Analysis of total aid use revealed a significant group effect, χ^2 (2, $n = 300$) = 17.50, $p < .001$. As seen in Table 6, post hoc tests revealed that informants endorsed greater compensatory strategy use by MCI participants compared with healthy OAs, U = 11,030, $p < .001$, $r = .25$. No significant differences in compensatory strategy use were found between the healthy OAs and dementia group, $p = .46$, or between the MCI and dementia group, $p = .07$. Group differences in compensatory strategy use also emerged for the money and self-management, χ^2 (2, $n = 300$) = 7.21, $p < .05$, home daily living, χ^2 (2, $n = 300$) = 25.31,

Table 6. Demographic variables and median and interquartile range values for proposed IADL-C factors for the healthy aging, MCI, and dementia groups

Variable or test	OAs (n = 184)		MCI (n = 92)		Dementia (n = 24)	
	M	*SD*	*M*	*SD*	*M*	*SD*
Demographics						
Age	69.53	10.93	72.85	8.16	77.04[ab]	6.98
Education	16.51	2.81	15.23	3.13	15.58	3.12
Gender (% female)	72.8%		51.1%		45.8%	
TICS score	#34.89	2.66	±32.51[a]	3.29	27.63[ab]	4.89
	Mdn	*IR*	*Mdn*	*IR*	*Mdn*	*IR*
IADL-C total score	1.11	0.30	1.69[a]	1.28	5.50[ab]	3.91
Money and self-management	1.08	0.38	2.00[a]	2.13	6.05[ab]	4.36
Home daily living	1.00	0.14	1.29[a]	0.85	4.36[ab]	4.47
Travel and event memory	1.25	0.33	1.50[a]	1.21	4.00[ab]	4.50
Social skills	1.00	0.00	1.00[a]	1.00	2.17[ab]	2.58
Aid total score (count)	2.00	4.00	3.50[a]	5.00	2.00	2.00
Money and self-management	1.00	2.00	1.00[a]	3.00	1.00	1.00
Home daily living	0.00	0.00	0.00[a]	1.00	0.00	1.00
Travel and event memory	1.00	1.00	1.00[a]	2.00	1.00	1.00
Social skills	0.00	0.00	0.00	0.00	0.00	0.00

Notes: OAs = healthy older adult; MCI = Mild Cognitive Impairment; *Mdn* = median; *IR* = interquartile range; TICS = Telephone Interview for Cognitive Status; Scheffe post hoc tests significant difference from OAs[(a)] or MCI[(b)]; #N = 180; ±N = 84.

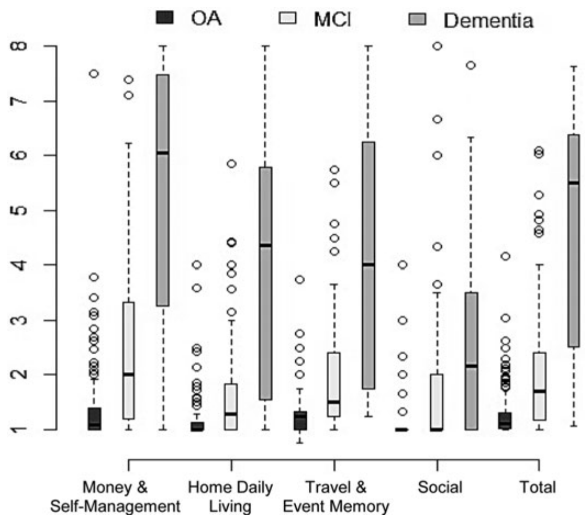

Fig. 1. Box and Whisker plots of the Instrumental Activities of Daily Living-Compensation (IADL-C) total and subscale scores for the healthy older adult (OAs), mild cognitive impairment (MCI), and dementia groups.

$p < .001$, and travel and event memory, χ^2 (2, n = 300) = 9.04, p = .01, subscales with post hoc tests revealing greater strategy use by the MCI group compared with the healthy OAs for all three domains, Us > 10,004, ps < .01, rs > 15.

Table 7 shows the percent of participants in each diagnostic group (labeled "% diff") that informants reported were not performing the task "as well as ever" or needed some help (responses 3–8 on the IADL-C). For the healthy OAs, there was only one question for which >25% of the sample was endorsed by informants as having difficulty (i.e., appropriately recalls where items were placed and where to find items or papers when needed). The remainder of the items for the healthy OAs had endorsement rates of 10% or less. In contrast, informants indicated that 25% or more of the MCI participants were having difficulties with 10 of the 13 items (77%) in the money and self-management domain, 1 of 7 items (14%) in the home daily living domain, and 2 of 4 items (50%) in the travel and event memory domain. For the dementia group, 25% or more of the sample was endorsed by informants as having difficulty with each of the 27 items, with 75% or more reported as having difficulty with 9 of the 13 items in the money and self-management domain (see Table 7). In addition, while difficulties in the home daily living domain were endorsed by informants at <5% for the healthy OAs, and between 10% and 26% for the MCI participants, difficulties in these skills were reported to be significantly more pronounced for the dementia group, 42%–74%.

Table 7. Knowledgeable informant endorsed compensatory aid use and difficulties on IADL-C items for the healthy OAs, MCI, and dementia groups

	Healthy OAs		MCI		Dementia	
	% aid	% diff	% aid	% diff	% aid	% diff
Factor 1: Money and self-management skills						
Keeps financial records organized.	9.5	7.1	13.4	29.3	11.8	76.5
Can manage a budget and business affairs.	5.6	6.8	17.1	23.7	12.5	75.0
Balances a checkbook or credit card statement	4.1	4.1	14.9	29.7	5.6	77.8
Remembers whether bills were paid.	24.6	3.6	30.6	25.0	17.7	76.5
Returns efficiently to household tasks after being interrupted.	8.5	10.2	12.5	36.4	4.3	69.6
Able to prioritize and complete tasks in order of importance.	11.5	7.1	20.4	31.8	8.6	73.9
Can plan an efficient sequence of stops on a shopping trip.	6.7	3.9	26.1	20.5	15.8	84.2
Can plan and prepare a meal for six, including appropriate portions.	14.4	7.8	18.2	31.8	0.0	87.5
Can organize complex activities such as travel, running errands, or participation in group activities.	10.0	6.1	19.3	33.0	0.0	85.7
Appropriately recalls where items were placed and where to find items or papers when needed.^	19.7	25.8	20.9	62.6	12.5	79.2
Can fill out insurance claims and doctor's records, including providing health history and medication dosages.	9.7	2.3	20.7	27.6	10.0	85.0
Can find way back to a meeting spot in the shopping mall or other location.	3.8	2.2	11.4	25.3	13.0	73.9
Can identify the names and understand the purpose of all medications being taken.*	11.3	2.8	12.3	16.9	20.8	70.8
Factor 2: Home daily living skills						
Can prepare own meals, including measuring correct amounts of cooking ingredients and managing the stove.	4.4	3.4	12.8	20.9	0.0	60.0
Uses the telephone to make calls.*	2.2	0.5	9.8	9.8	16.7	41.7
Performs household chores regularly (e.g., sweeping, dusting, watering plants).*	4.9	4.6	5.7	13.8	4.8	57.1
Plans and cooks efficiently (e.g., puts water on to boil before cutting carrots, cooks multiple items so that they finish at the same time).	4.9	3.6	11.3	26.2	7.1	74.3
Selects appropriate clothes for social outings taking into account the weather and the events of the day.	2.7	1.1	6.5	14.1	4.2	50.0
Checks answering machine or voicemail messages and appropriately returns calls or responds to messages.	5.0	3.9	15.6	13.3	9.1	63.6
Uses a phone book, address book or other tool to look up unfamiliar numbers.	4.9	1.1	16.3	15.2	8.4	62.5
Factor 3: Travel and event memory skills						
Reads and follows a map when traveling.	16.9	3.5	25.9	23.5	15.8	63.2
Travels to frequently visited, familiar places without getting lost.	4.3	1.6	5.5	19.8	8.3	50.0
Remembers scheduled social events, such as church on Sundays.	25.0	4.9	32.6	28.5	20.9	44.2
Knows and remembers numbers to call in case of a problem or an emergency.	30.1	2.7	43.8	26.9	47.8	52.2
Factor 4: Social skills						
Participates meaningfully in conversations with others (e.g., adds to the conversation, initiates new conversation).^	0.5	0.5	4.4	21.1	4.2	25.0
Engages in social activities appropriately (e.g., avoids offensive remarks, tells appropriate jokes).*	1.6	1.6	3.3	20.1	8.3	32.3
Participates in group events and community activities, such as religious services or volunteer activities.^	5.0	3.4	8.3	20.0	4.5	45.5

Notes: *Differences between OAs and MCI did not reach $p \leq .001$ level of significance; ^differences between MCI and dementia did not reach $p \leq .001$ level of significance.

Table 7 also shows the percent of participants in each diagnostic group (labeled "% aid") that informants reported were using an aid to assist with the task (Responses 2 and 3 on questionnaire). Informants reported highest aid usage ($\geq$20%) by healthy OAs for four activities, all of which required remembering types of information (i.e., bill payment, item placement, social events, and emergency numbers). In addition to these four activities, informants reported high aid usage ($\geq$20%) by individuals with MCI for activities that involved: prioritizing tasks, planning an efficient sequence of stops when shopping, filling out claims/records, and using a map when traveling. Aid use for the dementia group was $\geq$20% for three items, which largely represented important safety items (e.g., understanding medications, remembering emergency numbers, and scheduled events). Wilcoxon tests showed that when aid use was endorsed it was most often associated with performing a task "independently and as well as ever" (Response 2) when compared with "independently but not as well as ever" (Response 3) for the healthy OAs, $Z = -8.877, p < .001$, MCI, $Z = -5.45, p < .001$, and dementia, $Z = -1.98, p < .05$, groups.

External Validity: Relationship to Normal Aging

Table 8 shows demographic data and median and interquartile range IADL-C scores for healthy OAs as a function of age group. Because prior research suggests that OAs age 75+ are at greater risk for limitations in functional status (Lafortune & Balestat, 2007), to determine whether the IADL-C was sensitive to the normal aging process, we divided the healthy OAs into middle-aged

Table 8. Demographic variables and median and interquartile range values for proposed IADL-C factors for middle-aged, young-old, and old-old groups

Variable or test	Group					
	Middle-aged ($n = 40$)		Young-old ($n = 81$)		Old-old ($n = 63$)	
	M	*SD*	*M*	*SD*	*M*	*SD*
Demographics						
Age	54.35	3.12	67.67[a]	4.16	81.56[ab]	4.89
Education	16.10	2.66	16.15	3.01	17.22	2.52
Gender (% female)	77.5%		75.3%		66.7%	
TICS score	#34.97	2.57	±35.48	2.16	¥34.08[b]	3.10
	Mdn	*IR*	*Mdn*	*IR*	*Mdn*	*IR*
IADL-C total score	1.04	0.14	1.11	0.20	1.21[ab]	0.53
Money and self-management	1.08	0.22	1.08	0.28	1.23	0.67
Home daily living	1.00	0.00	1.00	0.00	1.00	0.29
Travel and event memory	1.00	0.25	1.25[a]	0.42	1.25[a]	0.50
Social skills	1.00	0.00	1.00	0.00	1.00	0.00
Aid total score (count)	1.00	2.75	2.00[a]	4.00	2.00[a]	4.00
Money and self-management	0.50	2.00	1.00	2.00	1.00	2.00
Home daily living	0.00	0.00	0.00	0.00	0.00[a]	1.00
Travel and event memory	0.00	1.00	1.00[a]	1.00	1.00[a]	1.00
Social skills	0.00	0.00	0.00	0.00	0.00	0.00

Notes: Mdn = median; *IR* = interquartile range; TICS = Telephone Interview for Cognitive Status; Scheffe post hoc tests significant difference from middle-aged[(a)], or young-old[(b)]; #$N = 38$; ±$N = 80$; ¥$N = 62$.

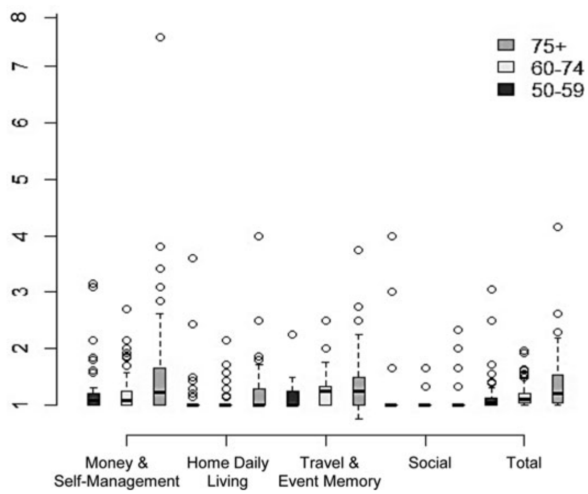

Fig. 2. Box and Whisker plots of the IADL-C total and subscale scores for the middle-aged (50–59), young-old (60–74), and old-old (75+) groups.

(50–59), young-old (60–74) and old-old (75+) groups. Fig. 2 shows box plots of each IADL-C measure with the median score and the upper and lower quartiles by age group. A Kruskal–Wallis test revealed significant group effects for the total score χ^2 (2, n = 184) = 13.99, p = .001. With the exception of the social skills domain, χ^2 (2, n = 184) = .253, p = .88, significant group effects were found for the remaining three domains of money and self-management χ^2 (2, n = 184) = 6.64, $p < .05$, home daily living, χ^2 (2, n = 184) = 8.65, p = .01, and travel and event memory, χ^2 (2, n = 184) = 12.33, p = .002. At $p < .01$, post hoc comparisons for the IADL-C total score revealed that, compared with the old-old group, informants endorsed better everyday functioning for the middle-aged, U = 1,740, $p < .001$, r = .32, and young-old, U = 3,244, $p < .005$, r = .23, groups. For the travel and event memory domain, informant ratings of the middle-aged group were better than those of both the young-old, U = 2,100, $p < .005$, r = .26, and old-old, U = 1,721, $p < .005$, r = .33, groups. For the home daily living and money and self-management domain, none of the age group comparisons reached the adjusted significance level, ps > .01.

Analysis of the total number of compensatory aids used approached significance, χ^2 (2, n = 184) = 4.86, p = .09 (see Table 8). Analysis of aid use for each domain revealed a significant group effect for travel and event memory only, χ^2 (2, n = 184) = 11.12, p = .004, with the middle-aged group reported as using fewer aids than both the young-old, U = 2,091, $p < .005$, r = .26, and old-old, U = 1,692, $p < .005$, r = .32, groups.

Participant Self-Report Data

Self-report data were available for 281 of the participants (176 healthy OAs, 88 individuals with MCI, and 17 individuals with dementia). With the exception of the travel and event memory subscale (Cronbach's alpha = .65), the overall IADL-C score and all domain scores showed good internal consistency: IADL-C total (Cronbach's alpha = 0.95), money and self-management (Cronbach's alpha = 0.93), home daily living (Cronbach's alpha = 0.85), and social skills (Cronbach's alpha = 0.87). As evident when compared with Table 6, median scores and interquartile ranges for the participant self-report IADL-C total score and the four domain subscales were highly similar to those reported by informants for both the healthy OAs group [IADL-C total = 1.17 (0.43); money and self-management = 1.23 (0.53); home daily living = 1.00 (0.29); travel and event memory = 1.25 (0.50); social skills = 1.00 (0.00)] and the MCI group [IADL-C total = 1.53 (1.01); money and self-management = 1.77 (1.29); home daily living = 1.14 (0.57); travel and event memory = 1.50 (1.25); social skills = 1.00 (1.00)]. In contrast, the dementia group significantly underreported their degree of everyday difficulties when compared with informants [IADL-C total = 2.48 (3.73); money and self-management = 2.67 (4.67); home daily living = 1.46 (3.96); travel and event memory = 2.25 (2.81); social skills = 1.50 (1.07)].

Analysis of total compensatory strategy use revealed a significant group effect, χ^2 (2, n = 281) = 17.50, $p < .001$. Similar to the informant data, median self-reported aid use was higher for the MCI participants, *Mdn* = 4.00 (6.50), compared with the healthy OAs, *Mdn* = 2.00 (4.00), U = 10,240, $p < .001$, r = .27. The dementia group, *Mdn* = 2.00 (6.95), did not differ in self-reported aid use from either the healthy OAs, $p > .09$, or the MCI group, $p > .10$. Group differences in self-reported compensatory aid use were also found for all subscales, χ^2s (2, n = 281) > 8.40, ps < .01,with post hoc pairwise comparisons revealing greater self-reported aid use by the MCI group compared with healthy OAs for all four skill domains, Us > 9,215, ps < .01, rs > 17.

Spearman correlations were used to compare participant self-report IADL-C scores with informants. Correlations generally fell in the low-to-moderate range, with a Spearman coefficient for the IADL-C total score of r_s = .41. Coefficients for the money and self-management, home daily living, travel and event memory, and social skills domains were r_s = .39, .35, .39, and .29, respectively. Spearman coefficients examining relationships between the IADL-C scales and measures of everyday functioning, global cognition, depression, life stressors, education, and gender are presented in Table 9. As expected, the IADL-C showed the lowest correlations with gender and education, and the highest correlations with the ADL-PI (a self-report measure of everyday functioning). Unlike informant data, moderate correlations emerged between the depression measure and the IADL-C scores.

Table 9. Spearman coefficients between self-reported IADL-C scores and measures of everyday functioning, cognitive status, psychosocial wellbeing, and demographics

	IADL-C scores				
	Total score	Medication and self-management skills	Home daily living skills	Travel and event memory skills	Social skills
Everyday functioning					
CDR-SOB, n = 170	0.42	0.39	0.36	0.45	0.40
L&B IADL, n = 172	0.35	0.31	0.33	0.25	0.22
ADL-PI*, n = 41	0.74	0.73	0.67	0.57	0.51
Global cognitive status					
TICS*, n = 271	0.20	0.18	0.20	0.21	0.25
RBANS*, n = 67	0.52	0.49	0.43	0.39	0.41
Psychosocial measures					
GDS-15, n = 236	0.48	0.47	0.35	0.30	0.33
ELSI, n = 171	0.31	0.31	0.22	0.20	0.13
Demographics					
Gender, n = 281	0.19	0.19	0.18	0.15	0.21
Education*, n = 281	0.10	0.07	0.14	0.10	0.18

Notes: *Reversed scoring; Correlations > .17 significant at $p < .001$. CDR-SOB = Clinical Dementia Rating-Sum of Boxes; L&B IADL = Lawton & Brody IADL questionnaire; ADL-PI = Activities of Daily Living-Prevention Instrument; TICS = Telephone Interview for Cognitive Status; RBANS = Total Score for the Repeatable Battery for the Assessment of Neuropsychological Status; GDS-15 = Geriatric Depression Scale 15-item Short Form; ELSI = Elders Life Satisfaction Inventory.

Discussion

Compensatory aids can help reduce, or even eliminate, everyday functional deficits in the aging population (e.g., Cavanaugh et al., 1983). To improve development of rehabilitation strategies and optimize recommendations for maintenance of functional independence, it is important to understand not only the early nature of functional deficits but how compensatory strategies are used to cope with changing functional capacity. The IADL-C was developed as an informant-report instrument designed to be sensitive to early functional difficulties and compensatory strategy use that may help OAs compensate for everyday limitations.

The final 27-item instrument includes a total score and four skill domain subscales representing: money and self-management, home daily living, travel and event memory, and social skills. Item fit indicators showed that each item fit the Rasch model appropriately. Analyses for DIF revealed that items behaved similarly across levels of education and gender, suggesting that the scale is unlikely to show gender or education bias. All four subscales also showed good internal consistency and Rasch reliability. While the total score is highly weighted towards the first factor (i.e., money and self-management), the use of Rasch analysis makes it possible to analyze the individual subscales to gather information about performance in the four separate skill domains.

The IADL-C total score and money and self-management subscale showed high levels of test–retest reliability, whereas the remaining three subscales showed satisfactory to good test–retest reliability across a 2- to 6-month period. Evidence for convergent and discriminant validity was also provided for the IADL-C total score and subscale scores. As expected, informant responses to the IADL-C showed moderate-to-high correlations with other measures of everyday functioning, including two IADL questionnaires and a combined interview and cognitive test measure (i.e., CDR-SOB). Consistent with prior research that has shown moderate relationships between objective cognitive measures and informant report of everyday functioning (Miller et al., 2011; Mitchell et al., 2010; Tsang et al., 2012), moderate correlations were found between informant responses to the IADL-C and two neuropsychological measures of general cognitive status (i.e., TICS and RBANS). Demonstrating discriminant validity, small correlations were found between informant responses to the IADL-C and psychosocial measures (i.e., depression and life stressors) and the demographic variables of gender and education.

The total IADL-C score and all four domain subscales also showed the expected pattern of greater everyday functional impairment with increasing cognitive compromise. That is, informants reported poorer everyday functioning for individuals with dementia compared with MCI, and for individuals with MCI compared with healthy OAs. Item-level analysis revealed that the MCI participants were experiencing the greatest difficulties with the money and self-management domain followed by the travel and event memory domain. These findings are consistent with prior literature (e.g., Farias et al., 2008; Kim et al., 2009; Marson et al., 2009), including the results of a recent meta-analysis (Gold, 2012) which found that finances may be one of the first areas of notable everyday change in individuals with MCI. The current findings further suggest that, in addition to money management, individuals with MCI may experience early difficulties in other areas of self-management including prioritizing tasks, managing task interruptions, organizing and planning complex activities, completing tasks efficiently, and recalling where items were placed.

Informant data suggested that the dementia group was experiencing the most significant difficulties in the money and self-management domain. Consistent with the diagnostic criteria for dementia, difficulties with home daily livings skills were more pronounced for individuals with dementia (range 42%–74%) compared with individuals with MCI (range 10%–26%); very few difficulties were reported for healthy OAs (range 0.5%–5%). Although the home daily living items assess for more complex IADL behaviors, the items represent basic skills needed for functional independence within the home, including ability to prepare meals, perform household chores, select appropriate clothes, and use the telephone. For all diagnostic groups, informants endorsed the lowest level of difficulty in the social skills domain.

With the exception of the social skills domain, age effects were found for the IADL-C subscales and the total score. The earliest age effects were evident in the travel and event memory domain. This was because the young-old and old-old groups were using significantly more compensatory aids to support these activities compared with the middle-aged group. Of note, $< 5\%$ of the OAs sample was reportedly continuing to experience difficulty when an aid was used, which suggests that compensatory strategy use was successfully enabling the healthy OAs to complete these task performances (see Table 7). Informants endorsed greater difficulties for the old-old group compared with the young-old and middle-aged groups on the IADL-C total score. This is consistent with prior research that suggests that individuals age 75+ are at greater risk for limitations in everyday functioning (Lafortune & Balestat, 2007; Schmitter-Edgecombe, Parsey, & Cook, 2011).

Compensatory strategy use was both self- and informant reported to be higher for the MCI group in comparison with the healthy OAs and dementia groups, for the IADL-C total score and subscales except for the social skills domain. This is consistent with our hypothesis that individuals with MCI would implement compensatory strategies following perceived cognitive decline, whereas individuals with dementia would have difficulty using aids and/or recognizing the need for their use. Aid use by healthy OAs was highest for tasks that involved a strong memory component (e.g., remembering scheduled events or bill payment). Informants reported that the MCI sample used aids to support memory-related tasks as well as activities that involved prioritizing tasks

and planning efficient sequences. Aid use for dementia patients was reported to be highest for safety-related items (e.g., number to call in an emergency). When compensatory strategy use was reported by informants, the aids appeared to successfully support independent functioning for all diagnostic groups.

Correlations between informant and participant self-reported IADL-C scores were in the low-to-moderate range, likely reflecting a lack of insight by the more cognitively compromised individuals with dementia (Clare et al., 2013; Tabert et al., 2002). Supporting this supposition, informant and participant median IADL-C total and subscale scores were very similar for the healthy OAs and MCI groups, whereas the dementia group significantly underestimated their everyday functioning in comparison with informants. Clinically, in some cases it may be helpful to assess for insight by comparing self and informant IADL-C scores. Consistent with prior literature (Farias, Mungus, & Jagust, 2005; Tabert et al., 2002), the strength of correlations between the IADL-C and measures of everyday functioning and global cognitive status were weaker for participant ratings than for informant ratings. Of note, depressive symptomology may have also altered self-report responses. Moderate correlations were found between the self-report measure of depression and the IADL-C scales for the participant self-ratings, suggesting that individuals endorsing a greater number of depressive symptoms were also more likely to report experiencing greater everyday difficulties.

Future research on more diverse samples of OAs participants are necessary to further validate and support the generalizability of these findings. The current study was limited by the small sample size (particularly for the dementia group) and by the diagnostic criteria used to define the groups. In addition, the sample of participants was largely Caucasian and highly educated. We also assumed informants of individuals with MCI and dementia would be more reliable raters than participants themselves; however, the cognitive status of informants was not assessed. In the current study, when informants indicated that an aid was being used, they were not asked to explicitly identify the type of aid. Future research should focus on identifying the types of compensatory strategies used by older individuals to successfully support complex everyday task performances. This is of particular interest because when compensatory strategy use was reported, the strategies generally allowed the person to complete the task "as well as ever." By identifying compensatory aids that successfully help older individuals maintain independent functioning, we can improve upon and develop new compensatory strategies for independent living. In a clinical setting, understanding what prompted the decision to use an aid (i.e., at what stage of functional difficulty was a strategy implemented), what aids are being used, or how frequently/consistently aids are used could inform treatment recommendations and should be asked of participants when compensatory strategy use is endorsed. In addition, knowing where aids are not being used but could be used to increase functional independence is also of clinical importance.

In summary, the IADL-C was developed to be sensitive to early changes in functional abilities and to capture compensatory strategy use that may help individuals cope with change in functional capacity. Informants endorsed more everyday functional difficulties for old-old adults, and both young-old and old-old adults reportedly used more compensatory strategies to assist with the travel and event memory items relative to middle-aged adults. Compared with the healthy OAs, the most notable early functional difficulties for the MCI group were evident in the domain of money and self-management. Tasks in this domain showed continued decline with progression to dementia, while problems with home daily living skills also became significantly notable. In addition, the ability to use compensatory aids to support independence in everyday activities increased in MCI and declined in dementia. With further validation, the IADL-C could be used by researchers and clinicians as a tool to assess early functional change and to inform understanding of compensatory strategy use and assist with treatment recommendations. This measure may also have value as an outcome instrument in studies designed to increase everyday functioning by teaching the use of compensatory strategies.

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Conflict of Interest

None declared.

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