Original Article

Development and Validation of a Performance-Based Test to Assess Instrumental Activities of Daily Living in Spanish Older Adults

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Abstract: A key feature of the autonomy and quality of life of the elderly is their ability to perform instrumental activities of daily living (IADLs). When older people have difficulty in performing IADLs, many of their social and community activities may be affected, leading to their progressive isolation from society. This study describes the development and validation of a test that assesses six areas of daily functioning in the elderly: use of medication and healthcare management, administrative, financial management, transportation, meal preparation, and shopping. The study evaluated 164 healthy individuals without cognitive impairment using an extensive cognitive battery. The construct validity and reliability of test were examined. Findings revealed a good internal consistency and high inter-rater and test-retest reliability. As for construct validity, the instrument tasks were grouped into two dimensions, based on the cognitive components involved in each task: fluid and episodic memory tasks and crystallized tasks. The developed instrument may be useful for evaluating IADLs in those elderly who live at home and are somewhat dependent.

Keywords: instrumental activities of daily living, cognitive functioning, elderly, performance-based test

There is an increasing interest in assessing the everyday functioning of elderly individuals. This may be somewhat due to the fact that with the growing aging population, there are more people with difficulties in living independently (Moye & Marson, 2007). Everyday functioning activities tend to be divided into two groups: basic activities of daily living (BADLs) and instrumental activities of daily living (IADLs) (Lawton & Brody, 1969). BADLs are tasks related to self-care, such as feeding and dressing. IADLs are more complex behaviors that allow individuals to achieve goals or to perform other actions. IADLs are heterogeneous and tend to be strongly related to cognitive functioning (Farias et al., 2009; Royall et al., 2007). It has been found that the ability to perform IADLs, for instance, the use of communication and transportation systems, money management, administrative management, healthcare maintenance, shopping, etc., involves the application of basic cognitive abilities (e.g., speed processing, episodic memory, inductive reasoning, etc.) and domain-specific knowledge (Allaire & Marsiske, 1999; Burton, Strauss, Hultsch, & Hunter, 2006).

The ability of elderly individuals to perform daily activities or tasks is determined by distinct factors, which may be cognitive, social, physical, or emotional (Galanos, Fillenbaum, Cohen, & Burchett, 1994; Galasko, 1998). As for the cognitive factors, various studies have shown that several cognitive abilities serve to predict everyday competence, known as the ability to solve problems associated with everyday life (Marcotte, Scott, Kamat, & Heaton, 2010; Schaie, Boron, & Willis, 2005). Lawton (1982) believes that fluid intelligence is essential to the performance of IADLs and cognitive decline in the elderly is often associated with fluid intelligence, verbal memory, and inductive reasoning. Allaire and Marsiske (1999) found that verbal knowledge and declarative memory, in addition to inductive reasoning, predict the everyday cognitive performance of community-dwelling older adults. Although there is a clear relationship between cognitive functioning and everyday competence, it is necessary to determine which cognitive abilities are the most predictive. In addition, the relationship between IADLs' performance and cognitive functioning depends on the particular type of IADL being analyzed and the means of evaluation used (Farias et al., 2008). Often, IADLs are evaluated using self-report or proxy (e.g., a relative, friend, or caregiver) assessment systems. But these procedures do not necessarily assess

the ability to perform multiple tasks within a single domain and the items tend to refer to general domain issues (e.g., medication use) while ignoring the multidimensional nature of the task (e.g., remembering to take medication, taking the correct dosage, understanding the label). Furthermore, self-report scales do not reveal subtle differences in performance ability (Dassel & Schmitt, 2008; Schmitter-Edgecombe, Parsey, & Cook, 2011).

Performance-based measures often present subjects with tasks that are similar to those performed in everyday life yet in a standardized format (Moore, Palmer, Patterson, & Jeste, 2007). For instance, instead of merely asking a patient or a relative about the patient's cooking (medication or money management) skill (which is limited by patient insight and objectivity), a performance-based measure would have the patient actually prepare a meal (use a pillbox, give change, etc.). Thus, performance-based measures assess the individual's ability to perform daily IADLs or what they "can do" under directed optimal conditions, as opposed to what they claim that they can do (Glass, 1998). Performance-based measures tend to have a structured sequence of events, and the subject is often cued by the examiner to complete each task. A variety of performance-based measures have been developed over the past 30 years (see Moore et al., 2007, for a review). However, no scale is available for these features for the Spanish population.

It is also important to note that IADLs have a strong environmental and cultural context. For example, in the US, medication is provided to patients in the hospitals, in personalized containers, whereas in Spain it is necessary to go to a pharmacy with a prescription in order to receive medication. These cultural differences make it difficult to apply the validated instruments from other countries in our home country.

This paper describes the development of a performance-based test to assess six functional domains or IADLs: use of medication and healthcare management, administrative issues, financial management, transportation, meal preparation, and shopping.

These IADLs were selected because they have been found to be associated with a higher use of health services (Dartnell et al., 1996; Tafreshi, Melby, Kaback, & Nord, 1999), to predict institutionalization (Branch & Jette, 1982) and cognitive impairment or dementia (Barberger-Gateau, Dartigues, & Letenneur, 1993; Cahn-Weiner et al., 2007; Peres et al., 2006). Furthermore, IADLs are major predictors of death in the elderly (Bernard et al., 1997; Carey, Walter, Lindquist, & Covinsky, 2004; Inouye et al., 1998; Johnson & Bootman, 1995). Two prospective memory tasks have also been introduced (one based on an event and another based on time), given the importance of prospective memory on attention, planning, and management of everyday activities (Pirogovsky, Woods, Vincent Filoteo, & Gilbert, 2012). We also analyzed the construct validity of the test by examining the relationship between the score obtained on the different tasks of the test and the cognitive performance over different cognitive domains. The aim is to determine what cognitive processes are involved in the tasks that make up the test.

First, a literature review was conducted and it was found that executive functions seem to play a major role in the performance of everyday tasks such as finances, meal preparation, housekeeping, and shopping (Cahn-Weiner et al., 2007; Jefferson, Paul, Ozonoff, & Cohen, 2006; Okonkwo, Wadley, Griffith, Ball, & Marson, 2006; Royall et al., 2007). It has also been found that working memory predicts performance on tasks related to treatment adherence (Insel, Morrow, Brewer, & Figueredo, 2006) and tasks that are necessary to understand a bus schedule, a map, or meal preparation instructions (Allaire & Marsiske, 1999; Kirasic, Allen, Dobson, & Binder, 1996). Processing speed and attention seem to be related to the use of finances (Barberger-Gateau, Fabrigoule, Rouch, Letenneur, & Dartigues, 1999; Okonkwo et al., 2006). Episodic memory is associated with finances, meal preparation, and use of medication (Greenaway, Duncan, Hanna, & Smith, 2012; Hughes, Chang, Vander Bilt, Snitz, & Ganguli, 2012; Tuokko, Morris, & Ebert, 2005). Significant relationships have also been found between inductive reasoning and daily tasks such as the use of medication and finances (Diehl et al., 2005). Finally, crystallized intelligence was associated with tasks such as meal preparation and the use of medication (Diehl, Willis, & Schaie, 1995).

Second, an exploratory analysis was carried out on the test tasks in relation to the cognitive components. Subsequently, a confirmatory factor analysis was conducted on the data. Finally, the results of the test reliability analysis are presented.

Materials and Methods

Participants and Procedure

The sample consisted of 164 healthy individuals without cognitive impairment; 78 were from rural locations and 86 from urban locations, they were between 60 and 94 years of age (mean age = 71.57; *SD* = 7.44), 117 were female and 47 male, with an average of 8.62 years of education (*SD* = 3.76). There were four testing sessions, each held on a different day. In the first session participant data was collected (date of birth, marital status, years of education, occupation, etc.). A psychosocial questionnaire and several screening tests (Table 1) were administered. The psychosocial questionnaire included the following

Table 1. Descriptive statistics for the cognitive assessment tests

Cognitive measures	Mean	Standard deviation	Range score
Screening			
Mini-mental state examination (MMSE)	29.43	0.84	26–30
Comprehension sentences and texts (Barcelona Test)	21.84	2.43	12–24
Geriatric depression scale (GDS)	6.54	4.39	0–22
Semantic memory			
Picture naming (PALPA)	37.98	2.29	29–40
Associative match task (BORB)	29.54	0.78	27–30
Crystallized intelligence			
Vocabulary (WAIS)	13.59*	2.06*	8–19*
Comprehension (WAIS)	11.91*	1.80*	8–18*
Reasoning			
Matrix (WAIS)	10.63*	2.36*	6–18*
Factor G (CATTELL)	5.62	1.93	2–11
Processing Speed			
Symbol search (WAIS)	11.41*	2.50*	3–17*
Digit-symbol coding (WAIS)	11.15*	2.07*	5–18*
D2 Test of Attention – TN	47.45*	12.60*	17–91*
D2 Test of Attention – CP	47.66*	12.80*	17–91*
Verbal Working Memory			
Arithmetic (WAIS)	12.92*	2.74*	7–19*
Digit span (WAIS)	11.99*	2.37*	6–18*
Letter-number sequencing (WAIS)	11.80*	2.65*	6–18*
Executive functions			
Action Program (BADS)	4.27	0.71	2–5
Six Elements (BADS)	4.30	1.37	2–6
Rule Shift cards (BADS)	1.05	1.74	0–9
Interference Stroop index	1.30	6.68	(−19.07)–24.86
Immediate episodic verbal memory			
Word List I – first attempt (WMS)	11.23*	2.71*	5–18*
Word List I – fourth attempt (WMS)	11.33*	3.77*	5–32*
Learning slope (WMS)	11.77*	3.02*	4–18*
Immediate nonverbal episodic memory			
Faces I (WMS)	10.67*	2.67*	4–18*
Delayed verbal episodic memory			
Word List II – recall (WMS)	12.24*	2.52*	7–18*
Word List II – recognition (WMS)	11.47*	2.46*	4–15*
Word List II – percentage retention (WMS)	11.55*	2.54*	7–19*
Delayed nonverbal episodic memory			
Faces II – Recognition (WMS)	11.58*	2.49*	4–17*
Faces II – percentage retention (WMS)	11.44*	2.61*	5–14*

Notes. *Scaled scores for WAIS, WMS (mean = 10, standard deviation = 3) and D2 Test of Attention (mean = 50, standard deviation = 20). MMSE = Mini-mental state examination; GDS = Geriatric Depression Scale; PALPA = Psycholinguistic Assessment of Language Processing in Aphasia; BORB = Birmingham Object Recognition Battery; WAIS = Wechsler Adult Intelligence Scale; BADS = Behavioral Assessment of the Dysexecutive Syndrome; WMS = Wechsler Memory Scale.

sections: data classification, living together, informal support, social participation, level of physical and mental activity, health resources, and quality of life.

In this first session, a questionnaire was administered to evaluate the dependence level in IADLs. This questionnaire, which was created specially for this study, included 17 items grouped in seven areas. The elderly individuals were to respond to whether or not they needed help in order to complete the different activities. The areas in which the elderly needed more help were (in this order): administrative issues (19%), financial management (10%), cooking (7%), free time activities (4%), traveling (3.7%),

shopping (2.4%), and telephone use (1%). The Lawton scale was not used since it may have a gender bias due to the inclusion of housework tasks that men are assumed to perform less frequently than woman, according to traditional gender roles (Allen, Mor, Raveis, & Houts, 1993; Graf, 2008; Ward, Jagger, & Harper, 1998).

In the second and third assessment sessions, different neuropsychological tests were administered to measure various cognitive domains: semantic memory, crystallized intelligence, reasoning, processing speed and visual search, verbal working memory, executive functioning, and episodic memory (Table 1).

Finally, in the fourth session, the test on performance-based assessment of instrumental activities of daily living (PA-IADL) was administered. The assessments were conducted mainly in Elderly Social Centers. Test evaluators were trained in the application of assessment tools, with special attention being paid to the PA-IADL test.

Cognitive Assessment

A battery of tests designed to assess multiple cognitive functions were selected for use in this study. As screening tests, the Mini-Mental State Examination (MMSE; Folstein, Folstein, & McHugh, 1975), which assesses the presence of cognitive impairment and whose scores were corrected for age and level of education, in accordance with the Spanish adaptation (Blesa et al., 2001), the Geriatric Depression Scale (GDS; Yesavage et al., 1982), and the comprehension sentences and texts subtest of the Barcelona test (Peña-Casanova, 2004) were used. To assess semantic memory, the picture naming EPLA test (Spanish adaptation of the Psycholinguistic Assessment of Language Processing in Aphasia, PALPA, Cuetos & Valle, 1996) and the associative match task of the Birmingham Object Recognition Battery (BORB; Riddoch & Humphreys, 1993) were used. Then the following cognitive domains were assessed: crystallized intelligence included the comprehension and vocabulary subtests of Wechsler Adult Intelligence Scale-III (WAIS-III; Wechsler, 1999), speed of processing included the symbol search and digit symbol substitution subtests of WAIS-III, and TN (total items processed) and CP (concentration performance) indices D2 test of attention (Brickenkamp, 2002), reasoning measures included matrix reasoning subtest of the WAIS-III and Factor G test (Catell & Catell, 1959), executive measures included the action program test, the modified six elements test, and the rule shift cards test of Behavioral Assessment of the Dysexecutive Syndrome (BADS; Wilson, Alderman, Burgess, Emslie, & Evans, 1996), and the Stroop Color-Word test (Golden, 1994), verbal working memory measures included arithmetic, forward, and backward digit span and letter-number sequencing subtests of WAIS-III, verbal episodic memory measures included Word list I and learning slope (immediate) and Word list II (delayed) subtests of Wechsler Memory Scale (WMS-III; Wechsler, 2004), and nonverbal episodic memory measures included Faces I (immediate) and Faces II (delayed) subtests of WMS-III.

Test for Performance-Based Assessment of Instrumental Activities of Daily Living

Initially, the test included 14 tasks that were designed separately to assess various activities of daily living, using real-life materials (medication bottles, pill, bankbook, etc). Each task consists of different steps to be completed by the elderly individuals. The evaluator observes how they solve the tasks, recording a corresponding score for each step in a record book. In the case in which the participant is unaware of how to perform the task, the evaluator provides a clue or assistance for its completion and the task continues.

The tasks represent practical problems having solutions that are not immediately evident and therefore require inferential thinking and the use of information from previous tasks. For example, participants were asked to fill pill boxes for two days of the week. To complete this task, they needed to consult a medical report that was previously provided and which contained the treatment. Similar inferences were required for the completion of the other tasks. All of the tasks were videotaped so that any necessary changes could be made in order to improve the understanding of the statements, evaluator instructions, the scores given to each step, and the materials used. Later, all of the tasks were combined to create a story with two fictitious personages, to allow for the evaluation of aspects such as delayed recall or prospective memory.

Results

Analysis of the Internal Consistency of the PA-IADL test

The psychometric properties of the 14 tasks were examined to obtain a reliable set. Correlations were calculated between each task and the total score for each corrected PA-IADL task. All tasks correlated significantly with the total score ($p \leq .01$) except for task 7 ($r = .19$, $p = .05$) and task 11 ($r = .14$, $p > .05$). Therefore, tasks 7 and 11 were removed and were not considered in the subsequent analysis. Internal consistency was examined for the

remaining 12 tasks using Cronbach's α which obtained a value of .82. The final test consisted of the following 12 tasks:

1) fill in pill boxes (fill two pill boxes with the medication from the medication bottles),
2) delayed recall of medical check (recall two observations from the medical information which was read at the beginning of the evaluation),
3) control of medication (know how many days of medication is in the rheumatism bottle),
4) event-based prospective memory (receive an appointment sheet to request a new medical visit with a code given from the evaluator),
5) payment of workshop via bank account (write the bank account number in a direct debit payment),
6) documentation management (choose a specific application form and locate information within the model),
7) time-based prospective memory (15 min after receiving an instruction, perform the referred action),
8) money management (provide change after a shopping at the supermarket),
9) management of bank documents (knowledge of how much money is in the bank before and after paying the electric bill),
10) cooking recipe preparation (carry out different steps to prepare a cooking recipe),
11) bus route planning (tell the time to take the bus in order to arrive on time to two appointments), and
12) recall/recognition of ingredients (remember different ingredients needed in task 10).

The mean raw score for the PA-IADL test is 42.46 (SD = 7.75). The total score correlated with age (r = −.561, $p \leq .001$), years of education (r = .417, $p \leq .001$), degree of IADL autonomy of the questionnaire of subjective estimation (r = .244, p = .002), health (r = −.209, p = .007), medication intake (r = −.177, p = .023), and score on the Geriatric Depression Scale (r = −.253, p = .001). Neither gender nor sample origin (rural/urban) correlated with the PA-IADL test. Because different tasks involved in the test used different numbers of behavioral steps, tasks were rescaled to a common metric, resulting in profile scores ranging from 1 to 4. In order to obtain these scores, an analysis of the frequency distribution of the raw score of each task was conducted. Based on this analysis, it was possible to obtain the percentage of participants who correctly performed each step of each task. These percentages allowed for a grouping of the raw scores of each task into four profile scores. Raw scores and profile scores are shown in Table 2 along with the percentage of the sample attaining each profile score.

Table 2. Raw and profile (ranged from 1 to 4) scores of the tasks comprise the test for performance-based assessment of instrumental activities of daily living

				Profile score								
				1		2		3		4		
Tasks	Maximum raw score	Mean raw score	*SD* raw score									
1. Fill in pill boxes	5	3.93	1.35	0–2	16%	3	13%	4	23%	5	48%	Raw score and % sample
2. Delayed recall of medical check	2	1.14	0.79	0	25%			1	36%	2	39%	achieving each score
3. Control over medication	5	3.12	1.19	0–1.5	13%	2–2.5	33%	3–4	29%	4.5–5	25%	
4. Event-based prospective memory (medical management)	2	0.86	0.78	0	32%	0.5	21%	1–1.5	26%	2	21%	
5. Payment of workshop via bank	4	3.33	0.74	0–2.5	12%			3	40%	4	48%	
6. Documentation Management	4	3.65	0.69	0–2	8%	3	17%			4	75%	
7. Time-based prospective memory(administrative management)	2	0.44	0.56	0	54%	0.5	15%	1	20%	1.5–2	11%	
8. Money Management	2	1.65	0.57	0	5%	1	26%			2	69%	
9. Management of bank documents	4	2.96	1.16	0–1	17%	2	12%	3	26%	4	45%	
10. Preparation of cooking recipe	7	5.13	1.94	0–3.5	22%	4–5	27%	5.5–6.5	17%	7	34%	
11. Bus route planning	8	6.07	1.79	0–3	7%	4–5	26%	6–7	38%	8	29%	
12. Recall/Recognition of ingredients	12	10.20	1.29	0–9	22%	9.5–10	23%	10.5–11	32%	11.5–12	23%	

Analysis of PA-IADL Test Construct Validity

Table 1 shows the descriptive statistics of the cognitive assessment tests. Given the large number of tests used in cognitive assessment and in order to avoid the problem of multicollinearity, composite scores were created. Raw scores were converted to *z*-scores which were used to calculate the composite scores (Spreen & Strauss, 1998). Executive function tests were not averaged since little or no correlation was found among them, so each test was considered as an independent measure. For episodic memory, a global measure based on the scores of immediate and delayed memory (verbal and nonverbal) of the WMS-III was obtained.

Age, years of education, and GDS score correlated with the composite cognitive measures (all correlations with $p < .003$). Then, partial correlations were calculated between the composite cognitive measures and each of the 12 tasks of the PA-IADL test, controlling for age, years of education, and GDS score. The cognitive measures having significant correlations with the PA-IADL tasks ($p \leq .01$) were crystallized intelligence, reasoning, processing speed, verbal working memory, executive function tests of six elements and rule shift cards, and episodic memory. Subsequently, different hierarchical multiple regression analyses were conducted, simultaneously entering the ratings of age, years of education, and GDS in the first block. In the second block, cognitive measures that significantly correlated with the PA-IADL tasks in the previous partial correlation analyses were introduced using the stepwise regression method.

Table 3 shows the predicted performance of the composite cognitive measures for each of the PA-IADL tasks and their total score. Age was predictive in almost all tasks; years of education were associated with time-based prospective memory task and cooking recipe preparation task, while scores on the GDS were not associated with any task. As for composite measures of cognitive functioning, all measures were associated with different PA-IADL tasks, except for processing speed. Verbal working memory, reasoning, and the six elements test predicted a higher number of tasks, while crystallized intelligence was associated with administrative or bank documentation tasks. Episodic memory was associated with tasks in which information had to be recalled. The total PA-IADL score was predicted by age (44.5%), verbal working memory (16.5%), and crystallized intelligence (1.8%), managing to explain 62.8% of the total variance.

Based on the results of the hierarchical regression analyses, it is seen that the PA-IADL tasks can be classified into three groups (fluid processes, crystallized processes, and episodic memory) according to the components involved in each task. Next, a confirmatory factor analysis was performed with Mplus (Muthen & Muthen, 2004) to verify that it is indeed possible to group tasks according to these three groups. The adjusted Maximum Likelihood Mean (MLM) was used to estimate the model parameters. This procedure is indicated for small samples and corrects the goodness-of-fit test and standard errors caused by non-normality. Multiple goodness-of-fit indices were used to evaluate model fit: χ^2/gl ratio, root mean square error of approximation (RMSEA), comparative fit index (CFI), Tucker-Lewis index (TLI), and standardized root mean squared residual (SRMR). Results confirm that the proposed model is suitable and the tasks are grouped into the three latent factors ($\chi^2 = 48.30$, gl = 51, $p = .58$, χ^2/gl = .94, CFI = 1.00, TLI = 1.00, RMSEA = 0.000, SRMR = .04). All of the tasks are strongly related to each latent factor (Figure 1). However, a high correlation (.92) was found between the fluid and episodic memory processes. Therefore, a new confirmatory factor analysis was carried out with two factors: fluid/episodic memory processes on one hand and crystallized process on the other hand (Figure 2). The results did not differ substantially from the analysis with three factors ($\chi^2 = 49.53$, gl = 53, $p = .60$, χ^2/gl = .934, CFI = 1.00, TLI = 1.00, RMSEA = 0.000, SRMR = 0.04). The values obtained for CFI, TLI, RMSEA, and SRMR in both analyses indicate a very good model fit. Given that both models appear to be equally valid and due to the high correlation between the factor of fluid processes and episodic memory factor, we felt that the two-factor model was more appropriate. Thus, the reliability coefficients of the two factors were calculated.

Reliability Analysis of the PA-IADL Test Factors

The reliabilities (Cronbach's alpha) of the two factors were .80 (fluid and episodic memory processes) and .46 (crystallized processes). The Pearson correlation between the scores of two raters (inter-rater reliability) and the Pearson correlation of test scores at two different times (test-retest reliability) were also calculated for the two factors and the total score. For inter-rater reliability, 32 individuals from the total sample were evaluated in the presence of a second rater, who scored the responses from each of the steps for each task in another assessment booklet. High correlations between the scores of the two raters were found for fluid and episodic memory factor ($r = .99$; $p \leq .001$), crystallized factor ($r = .95$, $p \leq .001$), and the total PA-IADL score ($r = .99$; $p \leq .001$). In the test-retest procedure, the PA-IADL test was administered to a sample of 45 elderly individuals at two different times at an interval ranging from one to two months. Statistically significant

Table 3. Regression analysis between composite cognitive measures and tasks of PA-IADL test

PA-IADL tasks	Predictor variables	R^2	R^2 Change	*B*	*SE*	β	*t*
T1. Fill in pill boxes	Age			−.04	.01	−.23	−3.14**
	Years education			.02	.02	.05	0.730
	GDS			−.01	.02	−.04	−0.692
		.238	.238***				
	Verbal W.M.	.308	.07***	.42	.14	.25	2.99**
	Six elements	.332	.024*	.20	.10	.15	2.05*
	Rule shift cards	.349	.017*	−.19	.10	−.14	−2.02*
T2. Delayed recall of medical check	Age			−.02	.008	−.19	−2.46*
	Years education			.01	.01	.08	1.00
	GDS			.01	.01	.08	1.05
		.131	.131***				
	Verbal W.M.	.181	.05**	.27	.08	.28	3.11**
T3. Control over medication	Age			−< .01	.01	−.01	−0.20
	Years education			.03	.02	.09	1.25
	GDS			−.02	.01	−.09	−1.35
		.164	.164***				
	Verbal W.M.	.255	.091***	.51	.12	.35	4.08***
	Six elements	.281	.025*	.21	.09	.18	2.37*
T4. Event-based prospective memory (medical management)	Age			−.03	.008	−.25	−3.32***
	Years education			−.01	.01	−.07	−0.931
	GDS			−< .01	.01	−.02	−0.332
		.121	.121***				
	Reasoning	.176	.054***	.25	.08	.28	3.24***
T5. Payment of workshop via bank	Age			−.02	.008	−.24	−3.15**
	Years education			−< .01	.01	−.01	−0.150
	GDS			−.01	.01	−.07	−1.00
		.166	.166***				
	Verbal W.M.	.232	.066***	.29	.008	.32	3.68***
T6. Documentation Management	Age			−.01	.007	−.18	−2.27*
	Years education			−.02	.01	−.13	−1.52
	GDS			−< .01	.01	−.05	−0.747
		.091	.091**				
	Crystallized I.	.146	.055**	.22	.07	.30	3.20**
T7. Time-based prospective memory (administrative management)	Age			−.02	.006	−.25	−3.37***
	Years education			.03	.01	.22	3.14**
	GDS			−.01	.009	−.10	−1.50
		.214	.214***				
	Episodic M.	.259	.046**	.06	.02	.23	3.13**
T8. Money management	Age			−.02	.006	−.22	−2.98**
	Years education			−.01	.01	−.08	−1.08
	GDS			.01	.009	.14	2.01*
		.144	.144***				
	Verbal W.M.	.276	.133***	.32	.06	.46	5.39***
T9. Management of bank documents	Age			−.03	.01	−.20	−2.76**
	Years education			.03	.02	.09	1.18
	GDS			< .01	.01	.01	0.257
		.18	.18***				
	Crystallized I.	.238	.058***	.39	.11	.31	3.48***

(Continued on next page)

Table 3. (Continued)

PA-IADL tasks	Predictor variables	R^2	R^2 Change	*B*	*SE*	β	*t*
T10. Preparation of cooking recipe	Age			−.06	.02	−.21	−3.00***
	Years education			.12	.04	.24	3.00***
	GDS			−.05	.03	−.11	−1.53
		.224	.224***				
	Rule shift cards	.270	.045*	−.40	.14	−.20	−2.89***
	Verbal W.M	.292	.022*	.83	.24	.35	3.46***
	Reasoning	.328	.037*	−.62	.21	−.29	−2.92****
T11. Bus route planning	Age			−.03	.01	−.12	−1.60
	Years education			< .01	.03	< .01	0.102
	GDS			−.03	.02	−.07	−1.03
		.174	.174***				
	Verbal W.M.	.280	.106***	.84	.18	.38	4.52***
	Six elements	.299	.019*	.28	.13	.15	2.06*
T12. Recall/Recognition of ingredients	Age			−.03	.01	−.18	−2.34*
	Years education			.04	.02	.13	1.84
	GDS			−.01	.02	−.04	−0.581
		.117	.117***				
	Episodic M.	.178	.062***	.15	.04	.26	3.45***
Total score	Age			−.33	.06	−.32	−5.96***
	Years education			.08	.12	.04	0.68
	GDS			−.10	.09	−.05	−1.05
		.445	.445***				
	Verbal W.M.	.610	.165***	3.85	.71	.40	5.48***
	Crystallized I.	.628	.018**	1.41	.66	.21	2.78**

Notes. GDS = Geriatric Depression Scale; W.M. = working memory; M. = memory; I. = intelligence. *$p \leq .05$. **$p \leq .01$. ***$p \leq .001$.

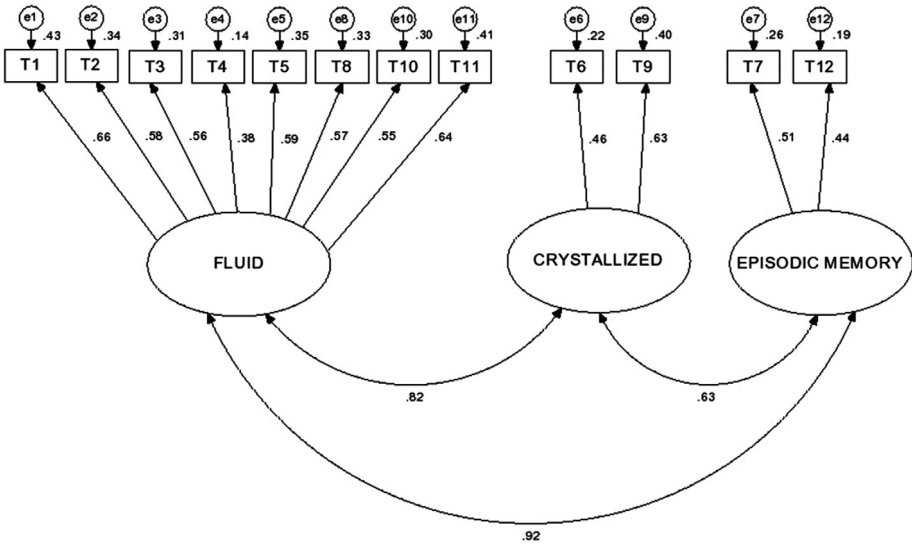

Figure 1. Confirmatory analysis of the factorial structure of PA-IADL for three factors.

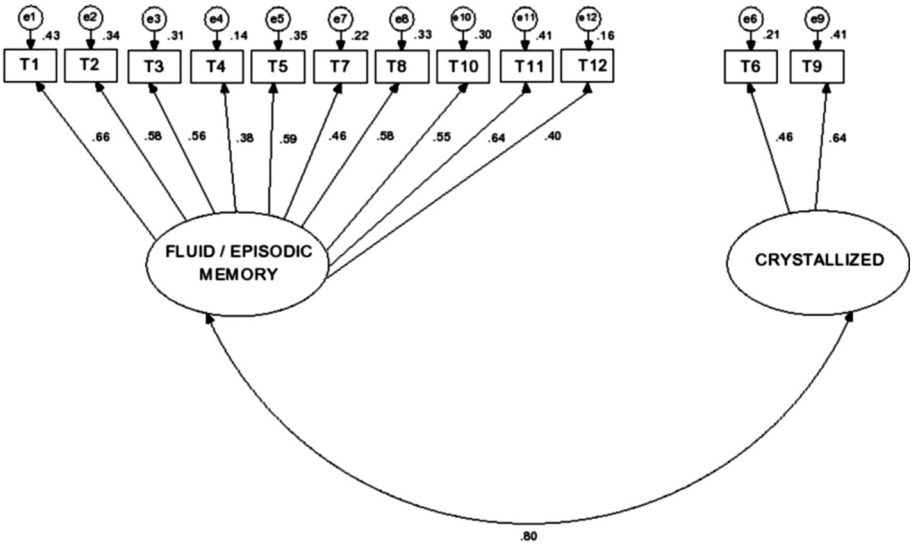

Figure 2. Confirmatory analysis of the factorial structure of PA-IADL for two factors.

correlations were found between test scores and the retest in fluid and episodic memory factor (r = .64; $p \leq .001$), crystallized factor (r = .63, $p \leq .001$), and total score (r = .75; $p \leq .001$).

Discussion

This paper describes a test that allows for the assessment of different instrumental activities of daily living through performance. It is the first test used with these features that has been validated for the Spanish elderly population. To date, only subjective assessment or proxy scales have been used. Originally, the test consisted of 14 tasks. However, after analyzing reliability of the PA-IADL tasks, two of these were eliminated due to their low and insignificant correlations with the total test score. Thus, the final version of the test contains 12 tasks.

Following the hierarchical regression analyses, the PA-IADL tasks were pooled according to the cognitive domains involved. Confirmatory factor analysis found that the tasks may be pooled into three factors. However, the high correlation between the factors of fluid and episodic memory processes led us to select the two-factor model.

The first factor consists of tasks of episodic memory and fluid processes, such as verbal working memory, executive functions of planning and cognitive flexibility and inductive reasoning. Episodic memory encompasses two tasks. The first includes two subtests: free recall and recognition of the ingredients used in the cooking recipe task. Thus, its format is typical of an episodic memory test. Some studies have shown the importance of episodic memory in everyday functioning tasks (Farmer & Eakman, 1995; Gross, Rebok, Unverzagt, Willis, & Brandt, 2011). The second is a time-based prospective memory task. Although studies have indicated that this type of prospective memory has an executive component (Bissiachi, 1996; McDaniel, Glisky, Rubin, Guynn, & Routhieaux, 1999; Shapiro, Shapiro, Russell, & Alper, 1998), in our study, none of the executive functioning measures were significant predictors of this task. As seen in different studies, episodic memory has been related to financial tasks, meal preparation, and medication management (Greenaway et al., 2012; Hughes et al., 2012; Tuokko et al., 2005). In contrast, in this study, episodic memory did not predict any of these tasks.

Verbal working memory is present in seven of the nine tasks that make up this factor. Several studies have shown that working memory may predict performance on tasks such as using and controlling medication, understanding bus schedules, using a map, or preparing a cooking recipe (Allaire & Marsiske, 1999; Insel et al., 2006; Kirasic et al., 1996). As for executive functions, both cognitive flexibility and the ability to plan an activity appear as predictors in four tasks (filling pillboxes, medication management, preparation of a cooking recipe, and bus route planning); however, they did not predict performance in tasks related to finances and shopping, as found in other studies (Jefferson et al., 2006; Okonkwo et al., 2006). Different studies have found that executive functions are some of the most important predictors of IADLs' performance (Cahn-Weiner, Malloy, Boyle, Marran, & Salloway, 2000; Chevignard et al., 2008; Perna, Loughan, & Talka, 2012; Schillerstrom et al., 2013). It should be kept in mind, however, that executive functioning refers to a complex domain of multiple components including inhibition, cognitive flexibility, sequencing, and planning, among others. In some studies, it has been suggested that sequencing is

the most important executive process applied to the IADLs. Other authors, however, have found that susceptibility to interference and cognitive flexibility are the most relevant processes (Jefferson et al., 2006, Martin & Ewert, 1997). Finally, reasoning appears to be a predictor of the event-based prospective memory task and the cooking recipe task. In various studies, reasoning is also found to be a predictor of daily functioning (Farias, Harrell, Neumann, & Houtz, 2003; Goverover & Hinojosa, 2002; Willis et al., 2006). Nevertheless, the reasoning used in this research did not relate to tasks of medical and financial use as was the case in the other studies (Diehl et al., 2005).

The second factor, crystallized processes, encompasses two tasks: document management tasks and the management of bank documents tasks. In both of these tasks, familiarity and practice with this type of document are important for successful performance. Therefore, they reflect the knowledge that elderly individuals have of their education and cultural level. This specific domain knowledge may permit older adults to implement compensatory strategies into these new tasks (Suchy, Kraybill, & Franchow, 2011). In contrast, the crystallized processes did not predict performance in tasks such as meal preparation and medical use as found in other studies (e.g., Diehl et al., 1995).

Other domains of cognitive functioning such as visual search and processing speed measurements were not found to contribute to PA-IADL performance. This is somewhat surprising given the fact that one of the explanations of cognitive aging is the decrease in processing speed (Salthouse, 1996) and since involvement in everyday tasks has been proven in several studies (Burton et al., 2006; Diehl et al., 2005; Miloyan, Razani, Larco, Avila, & Chung, 2013; Owsley, Sloane, McGwin, & Ball, 2002). Therefore, one would expect it to be a good predictor of tasks that require a visual search, such as money management or the management of bank documents tasks (Barberger-Gateau et al., 1999; Okonkwo et al., 2006).

Another aspect that contributes to the construct validity of the PA-IADL test is its correlation with the scores from the subjective estimation questionnaire of dependence in the AIDLs. However, the correlation is not very high and this data has already been seen in other studies in which the correlations obtained between the subjective measures and the objective measures tend to be low (Burton, Strauss, Bunce, Hunter, & Hultsch, 2009; Finlayson, Havens, Holm, & Van Denend, 2003; Jefferson et al., 2008; Schmitter-Edgecombe et al., 2011; Tabert et al., 2002).

Reliability analysis shows that the PA-IADL test has good internal consistency and that its components and tasks are closely related to the total score and that inter-rater and test-retest reliability are high. However, internal consistency in the second factor, crystallized processes, is low, possibly because this factor is only made up of two tasks, task 6 and task 9.

There are other tests that are similar to the PA-IADL test (see Moore et al., 2007, for a review). Among the most representative are the Observed Tasks of Daily Living (OTDL; Diehl et al., 1995), the Everyday problem test (EPT; Willis & Marsiske, 1993), and the Independent Living Scale (ILS; Loeb, 1996). In the OTDL, the authors found significant correlations with measures of crystallized intelligence, working memory, reasoning, and processing speed (Diehl et al., 2005; Schaie et al., 2005). In the studies conducted with EPT, the most significant predictor was found to be executive functioning, while episodic memory and verbal ability offered minor contributions, and the contribution of processing speed was virtually nonexistent (Burton et al., 2006). This disparity of results for the different tests may be due in large part to the type of tasks used to assess IADLs. Depending on how the tasks are designed, their complexity may be greater or less, as is the involvement of different cognitive processes.

One of the criticisms of the performance-based measures is that they create an artificial situation that does not adequately represent everyday functioning, something that is characteristic of multitasking (Farias et al., 2008). However, in the PA-IADL test the examinee is introduced to a fictional account in which two fictitious individuals must perform different related tasks. This is similar to real-life situations, where while performing one task, we must be simultaneously aware of other activities or postpone them.

In summary, the PA-IADL test was found to globally consider the required skills of working memory and planning ability while at the same time reflecting the effects of acquired knowledge that allows the elderly to better perform the tasks making up the PA-IADL test. Although cognitive functioning explained a significant amount of the total variance, a non-negligible percentage remains to be explained, possibly caused by another set of noncognitive social, motivational, or related factors of experience and life.

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