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Preliminary cognitive scale of basic and instrumental activities of daily living for dementia and mild cognitive impairment

María Rodríguez-Bailón[1,2], Nuria Montoro-Membila[2,3], Tamara Garcia-Morán[2,4], María Luisa Arnedo-Montoro[2], and María Jesús Funes Molina[2]

[1]Facultad de Ciencias de la Salud y el Bienestar, Universidad de Vic–Universidad Central de Cataluña, Vic, Barcelona, Spain
[2]Centro de Investigación Mente, Cerebro y Comportamiento, Universidad de Granada, Granada, Spain
[3]Servicio de Neurología. Hospital Universitario San Cecilio, Granada, Spain
[4]Asociación Granadina de Familias para la Rehabilitación del Daño Cerebral Adquirido "AGREDACE," Granada, Spain

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In the present study we explored cognitive and functional deficits in patients with multidomain mild cognitive impairment (MCI), patients with dementia, and healthy age-matched control participants using the Cognitive Scale for Basic and Instrumental Activities of Daily Living, a new preliminary informant-based assessment tool. This tool allowed us to evaluate four key cognitive abilities—task memory schema, error detection, problem solving, and task self-initiation—in a range of basic and instrumental activities of daily living (BADL and IADL, respectively). The first part of the present study was devoted to testing the psychometric adequateness of this new informant-based tool and its convergent validity with other global functioning and neuropsychological measures. The second part of the study was aimed at finding the patterns of everyday cognitive factors that best discriminate between the three groups. We found that patients with dementia exhibited impairment in all cognitive abilities in both basic and instrumental activities. By contrast, patients with MCI were found to have preserved task memory schema in both types of ADL; however, such patients exhibited deficits in error detection and task self-initiation but only in IADL. Finally, patients with MCI also showed a generalized problem solving deficit that affected even BADL. Studying various cognitive processes instantiated in specific ADL differing in complexity seems a promising strategy to further understand the specific relationships between cognition and function in these and other cognitively impaired populations.

Keywords: Activities of daily living; Mild cognitive impairment; Dementia; Executive functions; Neuropsychology.

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Address correspondence to: María Rodríguez Bailón, Facultad de Ciencias de la Salud y el Bienestar. Universidad de Vic–Universidad Central de Cataluña, Calle Sagrada Familia, 7, 08500 Vic, Barcelona, Spain (E-mail: maria.rodriguez1@uvic.cat or mariarbailon@ugr.es).

Many studies have demonstrated that patients with dementia make numerous errors when performing various activities of daily living (ADL) and exhibit an increasing decline in everyday functioning as their cognitive abilities deteriorate (Arrighi, Gelinas, McLaughlin, Buchanan, & Gauthier, 2013; Mioshi, Hodges, & Hornberger, 2013). A moderate dependence in simple or basic activities of daily living (BADL) and more complex or instrumental activities of daily living (IADL) has become a critical diagnostic criterion for dementia (Mioshi et al., 2007; Reisberg et al., 2001; Zanetti, Frisoni, Rozzini, Bianchetti, & Trabucchi, 1998).

In patients with mild cognitive impairment (MCI), however, the degree of functional alterations is a more controversial issue (e.g., Gold, 2012; Petersen et al., 2001; Petersen et al., 1999; Winblad et al., 2004). While early diagnostic criteria (Petersen et al., 1999) established that ADL performance was preserved in MCI patients, the same authors later reworded their diagnostic criteria using the expression "relatively intact" to accommodate critical findings suggesting alterations in ADL functioning in this population (Petersen, 2004). Along the same lines, recent studies have shown that patients with MCI are relatively independent in BADL but exhibit some impairment in IADL (Gure, Langa, Fisher, Piette, & Plassman, 2013; Weston, Barton, Lesselyong, & Yaffe, 2011). Importantly, several studies have shown that the degree of complexity of ADL tasks is a critical aspect that increases functional alterations in patients with MCI (Griffith et al., 2003; Reppermund et al., 2013; Reppermund et al., 2011).

Consequently, determining what type of daily activities (e.g., basic vs. instrumental tasks) are most altered in each patient group seems to be a critical factor for diagnostic purposes to distinguish between patients with dementia, patients with MCI, and healthy participants.

The impact of cognitive alterations on ADL performance in dementia and MCI

In addition to task complexity, recent research is interested in elucidating which cognitive deficits are mostly responsible for the functional alterations that characterize dementia and MCI.

A number of studies using correlation and regression analyses between cognitive measures after neuropsychological screening and global measures of functional impairment have found significant relationships between executive deficits and ADL functioning in both dementia and MCI (Aretouli & Brandt, 2010; Hughes, Chang, Bilt, Snitz, & Ganguli, 2012).

Similar conclusions have been reached by more direct performance-based studies in which participants have been asked to perform real ADL. For example, a recent study using a novel ADL performance-based multitasking situation revealed that patients with MCI had more difficulties completing this type of task with demanding executive requirements than healthy aged participants (Schmitter-Edgecombe, McAlister, & Weakley, 2012). Studies based on the standardized Naturalistic Action Test (NAT) are particularly relevant for analyzing the relationships between cognition and function in dementia and MCI (Schwartz, Segal, Veramonti, Ferraro, & Buxbaum, 2002). The NAT proposes a comprehensive error coding system for the execution of three instrumental ADL tasks: preparing coffee, preparing a packed lunch, and wrapping a gift. Using this methodology, the authors distinguish between two broad types of errors: step omissions (i.e., when the person omits necessary steps to complete the target task) and commission errors (i.e., errors related to the online execution of the task, which include a large number of error subtypes such as object substitutions, object manipulations without any purpose—toying—and repetitions of the task steps, among others). The distinction between omission and commission errors has proven to be useful to differentiate between two separate patterns of everyday cognitive impairment: (a) deficits in the hardwired knowledge of the task and (b) errors related to alterations in executive functioning (Giovannetti, Bettcher, Brennan, Libon, Kessler, et al., 2008). Several studies using the NAT have revealed that patients with dementia have alterations in both error categories, thus reflecting an overall cognitive decline (Giovannetti, Bettcher, Brennan, Libon, Kessler, et al., 2008; Seidel et al., 2013). To our knowledge, this is the only study to directly compare ADL performance in patients with dementia, patients with MCI, and healthy elderly controls. It found that dementia patients made a similar proportion of errors in both categories whereas patients with MCI typically made commission errors, which were interpreted as a manifestation of executive deficits (Giovannetti, Bettcher, Brennan, Libon, Burke, et al., 2008). However, the pattern of commission errors of this patient group did not significantly differ from that of healthy elderly participants. Finally, even if the NAT includes several instrumental activities (with different levels of complexity), more research is still needed to test whether memory schema deficits in dementia patients would also alter the execution of even simpler ADL tasks, like BADL.

In an attempt to isolate more specific error types related to executive control in both dementia and MCI, several studies using the NAT have proposed new error categories such as *error detection*. A number of studies have reported that patients with dementia (Bettcher, Giovannetti, Macmullen, & Libon, 2008) but also patients with MCI failed to detect a large proportion of their own errors (Seligman, Giovannetti, Sestito, & Libon, 2013). This pattern is consistent with the idea that executive and monitoring deficits are a key source of everyday action impairment in both dementia and MCI. Unfortunately, such studies did not include a control group of healthy elderly participants or comparisons between patients with dementia and patients with MCI. Therefore, it is not clear yet whether failure to detect errors can be used to discriminate between such groups or whether it is a broader problem related to ageing.

A second potential ability related to executive functions that seems promising to discriminate between patients with dementia, patients with MCI, and healthy individuals is *problem solving*. This term refers to the ability to find a solution after making a mistake or more broadly to the ability to find a solution when faced with an unexpected situation during the execution of a current ADL. Very few tools have been proposed to study this ability within the context of ADL in patients with dementia or MCI. One of these tools, a performance-based paper and pencil assessment, such as the Everyday Problems Test (EPT; Willis & Marsiske, 1993) and its observational version, the Observed Tasks of Daily Living (OTDL; Diehl, Willis, & Schaie, 1995), focuses on the ability of older healthy individuals to solve a practical problem for which a solution is not immediately apparent or in which the usual way of proceeding has to be modified (e.g., preparing a cake for someone following a low-cholesterol diet). Studies using this tool have identified significant differences between patients with MCI and nonimpaired elderly participants in this ability (Thomas & Marsiske, 2014). Consequently, it can be concluded that this executive function in everyday problem solving may be useful to distinguish between patients with dementia, patients with MCI, and healthy elderly participants. We consider that performance-based paradigms might be too artificial and that the ability to solve problems would be more easily captured by caregivers through direct observation when real situations take place in patients' familiar environments (e.g., when an unexpected situation spontaneously occurs and requires that the patient find a solution).

Finally, a third executive ability that may be critical to discriminate between the two groups and healthy participants is the ability to *self-initiate* a given ADL when necessary. This ability has previously been described as a common problem in dementia and MCI (Boyle et al., 2003; Drijgers, Verhey, Leentjens, Kohler, & Aalten, 2011), although the processes involved in it are not fully understood yet. Similarly to problem solving, we believe that self-initiation is likely to be difficult to measure in laboratory settings in which the evaluator directly asks the patient to initiate a given task at a certain time. Instead, patients' lack of self-initiation is likely to be more easily observed by a direct caregiver in a familiar environment.

Based on the review mentioned above, we can conclude that more research is still needed to better understand the relationship between the degree of cognitive impairment and its impact on ADL differing in complexity.

The overall aim of the present study was to provide further knowledge about the specific relationships between cognitive deficits and everyday life impairments in dementia, MCI, and healthy ageing. More specifically, we intended to use a single instrument to test whether a given cognitive aspect was affected differently by task difficulty and whether this potential modulation differed between the three groups of patients. To that end, we designed an informant-based tool to simultaneously measure two critical factors for diagnosis—that is, a measure of *key cognitive impairments* instantiated in a range of ADL with different degrees of *task complexity* (i.e., BADL vs. IADL). We tested the tool in the three critical groups. A key aspect of this design is that each cognitive ability was required and contextualized within each ADL task.

METHOD

Participants

Twenty-eight multidomain patients with MCI and 23 patients with dementia were recruited from the Dementia Outpatient Program of San Cecilio Hospital in Granada, Spain. The dementia group was heterogeneous: A total of 47% of participants were diagnosed with probable Alzheimer's disease, 35% had frontotemporal dementia, and 17% had vascular dementia. Diagnoses were conducted by a neurologist and a neuropsychologist specialized in dementia and MCI based on a comprehensive medical and cognitive assessment. The assessment included at least a physical examination, laboratory testing, a neuropsychological evaluation, and a brain neuroimaging study. The diagnostic criteria for MCI (Albert et al., 2011) were the following: (a) presence of subjective complaints by either the patient or the informant; (b) objective evidence of impairment in more than one cognitive domain; (c) normal or minimal impairments in functional abilities; (d) Level 2 or 3 on the Global Deterioration Scale (GDS); and (e) absence of dementia according to the *Diagnostic and Statistical Manual of Mental Disorders–Fourth Edition, Text Revision* (*DSM–IV–TR*; American Psychiatric Association, 2000) criteria. Scores of participants with MCI ranged between 20 and 30 on the Mini-Mental State Examination (MMSE), with lower scores in individuals with lower education level. Participants with dementia (i.e., Alzheimer's disease, vascular dementia, or frontotemporal dementia) met the criteria for dementia according to the *DSM–IV–TR*. Specifically, the criteria for Alzheimer's disease were impairments in memory in one or more domains of cognitive functioning, progressive decline in these functions with deficits in activities of daily living, and an insidious onset (McKhann et al., 2011). Regarding behavioral variant frontotemporal dementia, in addition to progressive decline in cognitive domains, it was necessary to observe three behavioral and cognitive symptoms related to personality, emotional blunting, loss of empathy, and/or executive deficits (Rascovsky et al., 2011). Finally, the core criteria for vascular dementia were evidence of a cognitive disorder and a history of clinical stroke or vascular disease related to the cognitive deficits observed (Gorelick et al., 2011). The age-matched control group (N = 20) was recruited from the community. Healthy elderly control participants exhibited no cognitive or functional deficits.

Exclusion criteria were the presence of psychiatric illness and motor/sensory deficits. Participants had to be able to maintain their attention over time and exhibit preserved language comprehension.

Medical reports of patients were obtained after patients had given informed consent, and the Ethics Committee of the hospital had authorized the research, in compliance with the Spanish legislation on the protection of personal data (Ley Orgánica de Protección de Datos de Carácter Personal 15/1999, 1999). The study was conducted in accordance with the ethical standards of the 1964 Declaration of Helsinki.

A one-way analysis of variance (ANOVA) and a chi-square test revealed that the groups did not differ in age or years of education [$F(2, 68) = 1.54$, $p = .22$; $F(2, 68) = .63$, $p = .534$, respectively], or gender, $\chi^2 = 0.95$. Details of patients' relevant sociodemographic and clinical data are shown in Table 1.

Development of the Preliminary Cognitive Scale of Basic and Instrumental Activities of Daily Living

ADL activities included in the informant-based cognitive scale

The selection of ADL activities to include in the scale was based on some of the BADL and IADL proposed in the occupational therapy field (Youngstrom et al., 2002). Such activities are included in the classification made by the American Occupational Therapy Association (2008) and in most traditional global scales of everyday functioning commonly used for the clinical diagnosis of dementia or MCI. The protocol included the following ADL: brushing teeth, having a shower, putting on makeup/shaving, getting dressed, cooking, home care (cleaning, washing up, hanging out the laundry, and setting the table), and managing finances/shopping.

Everyday cognitive items included in the informant-based cognitive scale

To select the critical cognitive errors that best discriminated between dementia, MCI, and healthy ageing, we conducted an empirical and theoretical selection based on critical findings obtained in previous studies, such as those described in the introduction. First, we selected

TABLE 1
Sociodemographic data of participants

		Evolution(months)		*Age(years)*		*Education(years)*		*Gender*	
Group	*N*	*N*	*SD*	*Mean*	*SD*	*N*	*SD*	*Men*	*Women*
Control	20	—	—	68.3	8.40	9.00	3.31	8	12
MCI	28	21.8	13.58	72.1	7.99	8.11	3.11	11	17
Dementia	23	26.1	17.78	68.8	7.96	8.87	2.68	10	13

Note. MCI = mild cognitive impairment.

the category *task memory schema* by asking caregivers whether participants usually completed all the necessary steps of the task in the right order. This category was mainly related to the omission and sequence alteration error types described in the NAT. Second, we included the cognitive item *error detection*, also operationalized by new versions of the NAT error-coding system, which refers to participants' ability to detect their own errors (Bettcher et al., 2008; Seligman et al., 2013). The third cognitive item caregivers were asked about was *problem solving*, operationalized as the ability to find a solution after making an error or, more broadly, the ability to solve any unexpected situation occurring during the execution of an ADL. Fourth, we included the cognitive item *task self-initiation*, which can be measured by direct informants when patients fail to self-initiate a relevant and necessary ADL in their familiar environment.

For each ADL, a set of cognitive questions was included. Questions were equivalent for each ADL. The Appendix shows the entire tool and illustrates how these different everyday cognitive items were instantiated in every ADL. As can be observed, the four everyday cognitive categories were included in every ADL, with the exception of managing finances/shopping, for which it was only possible to measure the error detection and self-initiation items. An additional question about the knowledge of steps in more complex tasks was included in the cooking and home care activities.[1]

Direct caregiver participants were asked whether each everyday cognitive ability was present or absent in the patient's behavior and how often it occurred. Each question (i.e., item) had four possible response choices: Never (1), Sometimes (2), Frequently (3), or Always (4); lower scores were associated with greater impairment. Caregivers were spouses, daughters, or sons, most of whom lived with patients. We ensured that participants could understand the questions based on clinical criteria and that they knew the everyday routines of care recipients.

A trained professional guided informants about the items and solved any questions. At the beginning of each ADL, we asked informants how often the participant performed that activity at the time of the study and in the past (before being diagnosed or at least two years before). Everyday cognitive items associated with an activity for which the informant answered the option "Never" in the past or the present (regarding the frequency with which each of the activities was completed) did not have to be completed and consequently were not included in further analyses. Table 2 shows the percentage of patients who continued performing a given ADL at the time of the study in each group and ADL type.

TABLE 2
Number and percentage of patients per group and ADL type that kept performing at least one activity of each type at the time of testing

	BADL		*IADL*	
Group	*%*	*N*	*%*	*N*
Control	100	20	100	20
MCI	100	28	82.14	23
Dementia	100	23	56.52	13

Note. BADL = basic activities of daily living; IADL = instrumental activities of daily living; MCI = mild cognitive impairment.

Complementary functional instruments (functional convergent validity)

To assess the functional convergent validity of the scale, we obtained two additional functional measures. In addition, a subset of patient caregivers (27%) was also asked to respond to the Blessed Dementia Rating Scale (BDRS; Blessed, Tomlinson, & Roth, 1968, 1988). In this scale, patients are rated based on the reports of direct caregivers. The items of the BDRS assess the presence of altered behavior but also evaluate both BADL (labeled as "changes in habits") and IADL (labeled as "changes in ADL"). We compared the overall score—which included patients' scores on the sections "alterations in behavior," "changes in habits," and "changes in ADL"—and the scores of each separate section with scores on the two ADL categories obtained with our instrument.

In addition, we asked participants to complete a performance-based task derived from the NAT. A subset of the sample was composed of 11 control participants, 9 patients with MCI, and 14 patients with dementia. Participants were placed in front of a table with various target and distractor objects, ensuring that they could grasp every object in the table. They were instructed to perform one ADL: prepare a cup of coffee with milk and sugar or toast with butter and jam. The task was counterbalanced across participants. Semantic-related

[1]In order to avoid a major loss of data on these important ADL, we decided to include two items to measure the same cognitive process. For participants reported to have never prepared complex meals or performed difficult home care tasks in their lives, the task memory schema category was still assessed based on their score on preparing simple meals and performing easy home care tasks.

distractor objects were intermixed with the target items. The performance of each participant was recorded on video for later analysis. Errors made by patients were classified according to the criteria used by Humphreys and Forde (1998) and Schwartz, Reed, Montgomery, Palmer, and Mayer (1991) into the following categories: perseverations, repetitions, failures in sequence, action additions, substitutions, manipulations/toying, tool omissions, omissions, and tangential actions (i.e., action sequences that are correct but are performed with a distractor object). All the errors were computed together to obtain a single ADL index of functional performance to be compared with the functional measures obtained with our informant-rated scale.

Neuropsychological screening (cognitive convergent validity)

To determine the convergent validity of the everyday cognitive items proposed in our scale, a standardized neuropsychological screening was administered to all participants. It included a thorough assessment of memory and executive functions that took approximately one hour prior to completing the scale. The MMSE (Folstein, Folstein, & McHugh, 1975) was used to assess participants' overall cognitive status. Participants' short- and long-term memory was assessed with the Rey Auditory Verbal Learning Test (AVLT; Rey, 1964). Two measures of this test were used: number of words recalled after the first time in a free recall test and number of words recalled in the long-term in a free recall test. We measured executive functions with several neuropsychological tests typically used to that end. More specifically, we used the INECO Frontal Screening (IFS; Torralva et al., 2009), which has proved to be useful to explore several types of executive functions such as response inhibition and set shifting, abstraction, and working memory. We also used the semantic fluency test by asking participants to name as many animals as possible within 60 s (Ardila, Ostrosky-Solis, & Bernal, 2006). Our hypothesis was that the memory schema items of our scale would show convergent validity with the memory test and/or with global cognitive impairment measures such as that provided by the MMSE. We also predicted that the executive items of our scale (i.e., error detection, problem solving, and self-initiation) would show convergent validity with the executive tests—that is, with the INECO and/or the fluency test.

A subset of patients was not able to complete the whole assessment due to low education level, fatigue, or lack of motivation. The statistical analysis included the neuropsychological tests that were completed by at least 80% of participants. Part of this evaluation was also included in the standardized diagnostic procedure. Table 3 shows the cognitive processes assessed by each neuropsychological test.

Design and data analyses

First, we performed an exploratory principal component analysis (PCA) with varimax rotation to verify that the ADL activities included in the scale were in fact grouped in the two classic categories of BADL and IADL in our sample. To that end, we used data from the informant-based ADL cognitive scale (i.e., the four-choice response scale) for the whole sample of participants (N= = 71). In

TABLE 3
Mean scores of the control, MCI, and dementia groups on neuropsychological tests

Test	*Control*	*MCI*	*Dementia*	*F*	*Sig. differences*
MMSE	29.6 (0.70)	24.8 (4.41)	19.7 (4.17)	36.54**	Control–MCI** MCI–dementia** Control–dementia**
Rey AVLT Short-term free recall	39.6 (7.20)	24.5 (9.65)	16.3 (8.12)	39.04**	Control–MCI** MCI–dementia** Control–dementia**
Rey AVLT Long-term free recall	8.05 (2.46)	3.61 (2.88)	0.95 (1.29)	47.26**	Control–MCI** MCI–dementia** Control–dementia**
INECO Frontal Screening	24.1 (2.29)	14.3 (7.80)	8.5 (5.96)	34.89**	Control–MCI** MCI–dementia** Control–dementia**
Semantic fluency	20.2 (5.54)	11.5 (4.88)	8.9 (4.01)	30.88**	Control–MCI** Control–dementia**

Note. MCI = mild cognitive impairment; MMSE = Mini-Mental State Examination; Rey AVLT = Rey Auditory Verbal Learning Test (Rey, 1964); sig. = significant. Standard deviations are included in parentheses.
**$p < .01$.

this analysis we included variables resulting from the mean of all items in each activity of the scale. The PCA was performed with the eigenvalue criterion (>1) to determine the number of factors extracted and varimax rotation to simplify the interpretation of factors. As described above, the four cognitive items were included in every ADL except for managing finances/shopping, in which we were only able to measure the error detection and self-initiation items. Consequently, data on this ADL did not include participants' scores on the memory schema and problem solving items.

Second, to explore the functional convergent validity of the scale, we conducted Spearman correlations between the two main components obtained from the PCA (i.e., BADL and IADL) in the informant-based scale and the BDRS score and between the same components and the number of total errors obtained by each participant in the performance-based ADL task.

Third, in order to ensure that each everyday cognitive item of the same type measured the same cognitive construct across ADL activities, we used Cronbach's alpha to calculate the reliability of the mean of each cognitive item of the scale across ADL activities. Again, the measure related to problem solving and memory schema cognitive items did not include scores on the managing finances/shopping ADL.

Fourth, in order to study the relationship between demographic variables and the everyday cognitive categories of our scale, we performed several correlation analyses to explore the relationship between participants' age and years of education on one side and everyday cognitive categories on the other.

Fifth, to obtain independent evidence of the convergent validity of the everyday cognitive items proposed in our informant-based scale, we performed stepwise regression analyses to identify the neuropsychological variables that best predicted the specific cognitive process involved in ADL[2] We used SPSS 20 software (IBM Corporation, 2011) to conduct statistical analyses.

Finally, and most importantly for the purpose of the research, we intended to measure the external validity of the scale—that is, its ability to discriminate among the three groups in each of the four everyday cognitive categories and for each level of ADL complexity (i.e., for both BADL and IADL activities). Given that a subset of participants had stopped performing more IADL than BADL due to the progression of their illness, separate analyses were conducted for each of the two ADL categories obtained in the PCA analysis. Group differences in each cognitive–functional category were explored with nonparametric tests (i.e., multiple between-group Kruskal–Wallis analyses and later the Mann–Whitney *U* Test for two-by-two group comparisons) because scores were not normally distributed. Effect sizes were estimated using Cohen's *d* calculations.

[2]We used stepwise regressions because there is no corpus of previous research to support specific predictions about the relationship between our four cognitive items and specific neuropsychological scores.

RESULTS

PCA analysis of ADL based on the informant-based Cognitive Scale of Basic and Instrumental Activities

First, we calculated the mean of all items in each ADL. Preliminary analyses showed that the data were appropriate for PCA [Kaiser–Meyer–Olkin measure of sampling adequacy = 0.73; Bartlett's test of sphericity, $\chi^2(21) = 185.19$, $p < .001$]. The PCA yielded a two-component solution that accounted for 81.60% of the variance. It revealed that the items were grouped into two main categories. The mean of "brushing teeth," "having a shower," "putting on makeup/shaving," and "getting dressed" loaded on the first component (showed loadings of value between .74 and .90), which is congruent with the traditional BADL category, while the mean of "cooking," "home care," and "economical finances/shopping" loaded on the second component (with factor loadings ranged from .78 to .97), which is congruent with the traditional IADL category. None of the items loaded on both factors.

Functional convergent validity: Relationship between ADL scores on our informant-based scale and scores on other measures of global functioning

First, the total number of errors of each participant in the performance-based task was correlated with the two functional components (i.e., basic vs. instrumental) obtained by the PCA of the informant-based scale. We found significant and negative correlations between participants' total number of errors in the performance-based task and their mean IADL scores ($r = -.465$, $p = .01$) and BADL scores ($r = -.350$, $p < .05$) on the informant-based scale.

A similar pattern was obtained between the ADL scores obtained with the present scale and the global functioning scores obtained with the BDRS. Participants' global score on the BDRS exhibited a significantly negative correlation with IADL scores obtained with our scale ($r = -.348$; $p < .05$) but not with BADL scores obtained with our scale ($r = .176$, $p = .55$). More specific comparisons between the "changes in ADL" score on the BDRS and the instrumental score on our scale also confirmed a strong relationship between such scores ($r = .747$, $p < .005$). By contrast, the relationship between the "changes in habits" score on the BDRS and the basic score obtained on our scale was not significant ($r = .164$; $p = .58$).

Internal consistency of the informant-based Cognitive Scale of BADL and IADL

To test the internal consistency of the four cognitive variables included in the informant-based scale (i.e., memory schema, error detection, problem solving, and self-initiation), we used Cronbach's alpha to calculate the reliability of the mean of each cognitive item of the scale across all ADL activities. We found a high internal consistency for memory schema (α = .78), error detection (α = .83), problem solving (α = .87), and self-initiation (α = .83).

Cognitive convergent validity: Relationship between everyday cognitive items in the informant-based scale and the neuropsychological assessment

First, we used one-way ANOVAs to analyze group differences in each neuropsychological test and verify that cognitive performance decreased with growing level of impairment. We found significant differences between groups in the neuropsychological screening. As shown in Table 3, participants' performance in executive functions and memory tests became progressively worse with increasing levels of impairment. As expected, scores of MCI patients were significantly lower than those of the control group but significantly higher than those of participants with dementia.

Spearman correlations with the whole sample revealed a null relationship between (a) the four everyday cognitive variables of the scale and (b) age and education. Therefore, neither age (memory schema, $r = -.03$, $p = .82$, error detection, $r = -.11$, $p = .37$, problem solving, $r = -.13$, $p = .26$, and self-initiation, $r = -.07$, $p = .56$) nor years of education (memory schema, $r = .19$, $p = .10$, error detection, $r = .07$, $p = .57$, problem solving, $r = .00$, $p = .97$, and self-initiation, $r = .09$, $p = .45$) were correlated with such categories.

TABLE 4
Results of a stepwise regression analysis using neuropsychological factors to predict the cognitive–functional variables: memory schema, error detection, problem solving, and self-initiation

Cognitive–functional variables	*Predictors*	β	*t*	*p*
Memory schema	**AVLT Long-term**	.501	4.33	.000
	Failed to enter			
	MMSE	.247	1.69	.097
	INECO	.116	.729	.469
	AVLT Short-term	.070	.353	.726
	Semantic fluency	–.056	–.382	.704
Error detection	**MMSE**	.521	4.57	.000
	Failed to enter			
	INECO	.291	1.59	.116
	AVLT Long-term	.272	1.89	.063
	AVLT Short-term	.110	0.63	.527
	Semantic fluency	.147	1.05	.299
Problem solving	**INECO**	.662	6.60	.000
	Failed to enter			
	MMSE	.152	.934	.354
	AVLT Short-term	.130	.714	.478
	AVLT Long-term	.269	2.00	.050
	Semantic fluency	–.018	–.118	.907
Self-initiation	**AVLT Long-term**	.527	4.63	.000
	Failed to enter			
	MMSE	.247	1.72	.092
	AVLT Short-term	.280	1.47	.146
	INECO	.292	1.91	.061
	Semantic fluency	.249	1.78	.080

Note. MMSE = Mini-Mental State Examination; INECO = INECO Frontal Screening; AVLT long-term = Rey Auditory Verbal Learning Test long-term free recall; AVLT short-term = Rey Auditory Verbal Learning Test short-term free recall; memory schema = task memory schema.

We performed four stepwise multiple regression analyses for the whole sample including the following neuropsychological variables: MMSE, INECO Frontal Screening, AVLT short-term, AVLT long-term, and semantic fluency (Table 4). In the first regression analysis, the mean of memory schema was introduced as the dependent variable, and the five neuropsychological variables were introduced as predictor variables. The best model accounted for 25.1% of the variance, $F(1, 56) = 18.77$, $p < .01$, with AVLT long-term free recall, $\beta = .501$, $p < .01$, as the only significant predictor variable.

In the second regression analysis, the mean of the error detection variable was introduced as the dependent variable, and the five neuropsychological variables were introduced as predictor variables. The best model accounted for 27.1% of the variance, $F(1, 56) = 20.86$, $p < .01$, with MMSE $\beta = .521$, $p < .00$, as the only significant predictor.

In the third regression analysis, the mean of the problem solving variable was introduced as the dependent variable, and the five neuropsychological variables were introduced as predictor variables. The best model accounted for 43.8% of the variance, $F(1, 56) = 43.60$, $p < .01$, with INECO Frontal Screening $\beta = .662$, $p < .01$, as the only significant predictor.

In the fourth regression analysis, the mean of the self-initiation factor was introduced as the dependent variable, and the five neuropsychological variables were introduced as predictor variables. The best model accounted for 27.7% of the variance, $F(1, 56) = 21.48$, $p < .01$, with long-term memory $\beta = .527$, $p < .01$, as the only significant predictor variable.

Relationship with clinical diagnosis (i.e., external validity) and task complexity

Finally, we analyzed the ability of our informant-based cognitive scale to discriminate between the three groups in each of the four everyday cognitive categories for each level of ADL complexity (i.e., BADL vs. IADL).

Analysis of BADL

Results showed significant diagnostic group effects in the four everyday cognitive categories: memory schema, $\chi^2(2, N = 71) = 13.76$, $p < .001$, error detection, $\chi^2(2, N = 71) = 12.50$, $p < .001$, problem solving, $\chi^2(2, N = 71) = 23.96$, $p < .001$, and self-initiation, $\chi^2(2, N = 71) = 16.66$, $p < .001$.

Comparisons between the dementia and control groups revealed significant differences between the four types of everyday cognitive categories after Bonferroni correction: memory schema ($Z = -3.31$, $p < .001$, $d = 1.07$), error detection ($Z = -3.40$, $p < .001$, $d = 1.29$), problem solving ($Z = -4.77$, $p < .001$, $d = 1.84$), and self-initiation ($Z = -3.93$, $p < .001$, $d = 1.43$).

Patients with MCI and patients with dementia differed in memory schema ($Z = -2.52$, $p = .012$, $d = 0.60$) and self-initiation ($Z = -2.43$, $p = .015$, $d = 0.77$). By contrast, they did not differ significantly in error detection ($Z = -2.01$, $p = .044$, $d = 0.62$) or problem solving ($Z = -1.96$, $p = .050$, $d = 0.58$) after Bonferroni correction.

Comparisons between patients in the control and MCI groups revealed significant differences in problem solving ($Z = -3.60$, $p < .001$, $d = 1.20$). A similar pattern was obtained for error detection ($Z = -1.96$, $p = .050$, $d = 0.64$) and self-initiation ($Z = -2.13$, $p = .033$, $d = 0.69$), although these differences did not reach significance after Bonferroni correction. No significant differences were obtained between these two groups regarding memory schema ($Z = -1.33$, $p = .184$, $d = 0.41$).

Analysis of IADL

We also found a significant diagnostic group effect for each everyday cognitive category: memory schema, $\chi^2(2, N = 56) = 8.37$, $p = .015$, error detection, $\chi^2(2, N = 56) = 19.84$, $p < .001$, problem solving, $\chi^2(2, N = 56) = 17.45$, $p < .001$, and self-initiation, $\chi^2(2, N = 56) = 13.77$, $p = .001$.

Comparisons between control participants and patients with dementia showed significant differences in all everyday cognitive categories: memory schema ($Z = -2.64$, $p = .008$, $d = 0.98$), error detection ($Z = -4.13$, $p < .001$, $d = 1.84$), problem solving ($Z = -3.81$, $p < .001$, $d = 1.57$), and self-initiation ($Z = -3.47$, $p < .005$, $d = 1.26$).

Comparisons between patients with MCI and patients with dementia revealed significant differences in error detection ($Z = -2.64$, $p = .008$, $d = 1.07$). In the remaining variables, differences did not reach significance ($p = .075$, $d = 0.82$; $p = .190$, $d = 0.48$; $p = .10$, $d = 0.61$, for memory schema, problem solving, and self-initiation scores, respectively). Comparisons between participants in the control and MCI groups revealed significant differences between both groups in the three executive conditions after Bonferroni correction: error detection ($Z = -2.73$, $p = .006$, $d = 0.26$), problem solving ($Z = -3.55$, $p < .001$, $d = 1.06$), and self-initiation ($Z = -2.84$, $p = .005$, $d = 0.73$). Similarly to the previous analysis of BADL, control participants and patients with MCI did not differ significantly in the memory schema condition ($Z = -1.73$, $p = .084$, $d = 0.27$). (See Figure 1.)

DISCUSSION

In this study we propose a new caregiver informant-based tool to further understand the functional cognitive deficits that differ between patients with MCI, patients with dementia, and healthy elderly participants. There have been several proposals to detect the above-mentioned deficits in the past. Nevertheless, in most cases the study design was not exhaustive enough to capture different cognitive failures contextualized within a whole range of ADL with several levels of task difficulty within the same tool.

A second advantage of the internal structure of this proposal comes from the fact of converting part of the error-coding system typically used in

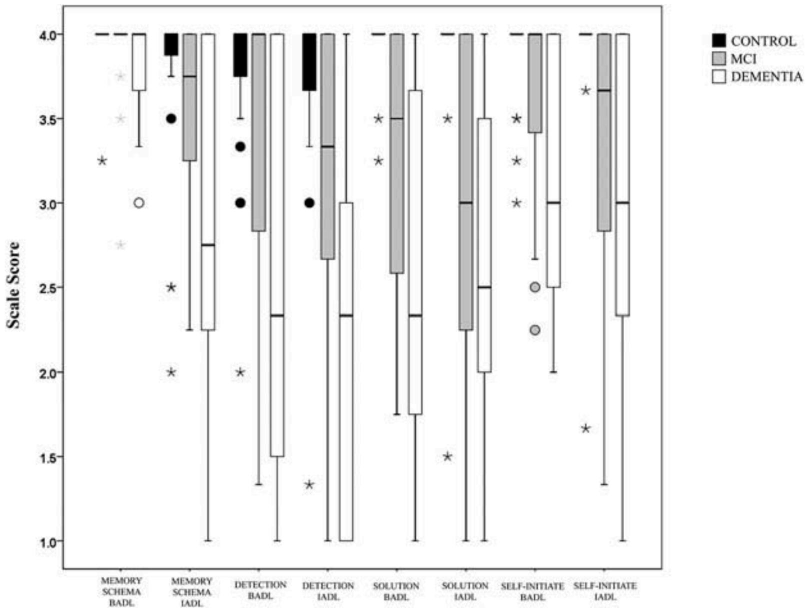

Figure 1. Box plot with cognitive processes in basic activities of daily living (BADL) and instrumental activities of daily living (IADL) in the control, mild cognitive impairment (MCI), and dementia groups. Higher scores reflect better functioning. Memory schema = task memory schema; detection = error detection; solution = problem solving. Asterisks (stars) represent extreme outliers. Dots represent the conjunction of more than one extreme outliers.

performance-based studies into informant-based items contextualized in a given ADL. This may help caregivers retrieve patients' performance more accurately as it occurs in real life. This is in contrast with other cognitive scales whose items often require an overgeneralization and abstraction of patients' behavior (e.g., the item "Thinking ahead" in the Everyday Cognition scale, ECog; Farias et al., 2008, compared to the item "He/she is able to notice if he/she has put on the right clothes" in the present tool). Moreover, the present tool includes some critical cognitive aspects that have not been tested in previous ADL studies or that are difficult to assess in artificial laboratory settings.

Third, very few studies with performance-based or informant-based tools have systematically included comparisons between individuals with dementia or MCI and a healthy elderly control group to distinguish between deficits due to normal ageing and deficits that are specific to dementia or MCI. In the present study we systematically compared caregiver informant-based reports on participants in these three groups.

On a functional level, a first PCA analysis conducted on our sample corroborated the classic division between basic and instrumental activities (American Occupational Therapy Association, 2008; Youngstrom et al., 2002). Functional convergent validity, explored with a performance-based task based on the NAT and with a well-established and previously validated informant-based measure of global functioning (the BDRS), was confirmed. Regarding the relationship with the BDRS, we found a strong relationship between the instrumental ADL measured by both scales; however, a null relationship was obtained between the basic ADL measured by our scale and the "Change in habits" score on the BDRS. This lack of relationship in basic ADL might be due to the fact that the basic ADL measured by our scale are more complex in nature than those measured by the BDRS, which includes very basic or even physiological activities such as eating or sphincter control. On a cognitive level, the reliability analysis confirmed the high internal consistency of four everyday cognitive categories in our informant-based scale (i.e., task memory schema, error detection, problem solving, and self-initiation) across BADL and IADL. In order to further understand the cognitive processes measured with these everyday cognitive categories, a group of neuropsychological tests was also administered to our sample. Next, multiple regression analyses were conducted on the results of the whole sample (patients with MCI, patients with dementia, and control participants) to explore the specific relationships between them. First of all, consistent with previous research, the variable task memory schema was predicted by AVLT long-term free recall, a valid test to measure episodic memory. This is also consistent with results of studies that have measured memory schema with performance-based tasks (e.g., the NAT), which have systematically found significant relationships between omission-like errors and similar memory measures to those used here (e.g., Giovannetti, Bettcher, Brennan, Libon, Kessler, et al., 2008). Second, we found that the category error detection was best predicted by a global cognitive measure, the MMSE (Folstein et al., 1975). This finding was surprising, as we had predicted that participants' ability to detect their own errors would be associated with more specific and complex executive functions. A possibility that requires further testing is that undetected errors may be a reflection of cognitive deficits in both memory retrieval and executive function. More specifically, if participants' task memory is impaired, they may not be able to detect their own errors partly because they are starting to forget how the correct task needs to be done (Reason, 1990; Seligman et al., 2013). This could explain why this cognitive item was best predicted by a global cognitive measure such as the MMSE in our study. More thorough memory tests in combination with executive measures will be necessary to further clarify the underlying processes of error detection.

Third, consistent with our predictions, the variable problem solving was highly predicted by the INECO Frontal Screening test, a specific tool to assess a broad range of executive functions in patients with dementia (Torralva et al., 2009), Finally, we found that the main predictor of our self-initiation item was long-term memory. Based on this result, we believe that this item may reflect several processes, including the executive control process that we initially proposed but also emotional (e.g., low motivation) and/or prospective memory processes. In fact, the specific ADL questions included in our study emphasized participants' ability to remember to initiate various ADL when necessary. Thus, it is not surprising to find a relationship with memory measures, as a necessary condition to self-initiate a given task in the future. Obviously, further research is still needed to further clarify the relationship between the cognitive and motivational processes involved in this aspect of behavior. However, we acknowledge that relationships between cognitive measures and their cognitive–functional items could be a reflection of the specific tests used in the study.

As regards demographic variables, we found that neither age nor years of education were related with the outcome variables from the scale. The finding of a null relationship between demographic variables and the cognitive scores obtained on this scale might represent a strong advantage of our scale compared to most neuropsychological tests, which are strongly dependent on such demographic variables. We consider that this is an important property of any scale intended to be used as a tool for future diagnostic purposes.

Regarding differences between groups, the present study made it possible to isolate the specific alterations of patients with dementia and patients with MCI compared to age-matched healthy participants. Specifically, the fact of taking into account both levels of analysis (i.e., various cognitive aspects—cognitive level—and different ADL—functional level) led us to obtain the following diagnostic results:

In agreement with previous studies (Mioshi et al., 2007; Reisberg et al., 2001; Zanetti et al., 1998), the present assessment tool discriminated between patients with dementia and healthy participants in all four cognitive aspects in both BADL and IADL tasks. The separate analysis of the four everyday cognitive categories in BADL and IADL also revealed a pattern of preserved and altered abilities in the MCI group that may be relevant for diagnostic purposes. This group showed evidence of preserved task memory schema in both types of ADL tasks when compared to healthy participants. This result is also consistent with previous performance-based studies that have shown that MCI patients make few step omissions (Giovannetti, Bettcher, Brennan, Libon, Burke, et al., 2008). These studies have usually associated the presence of omissions to deficits in episodic memory. However, given that multidomain MCI patients usually show deficits in this domain, we wonder whether—at least in this scale—their preserved task memory schema is a reflection of semantic or procedural memory. Future studies including additional neuropsychological tests that distinguish between different memory systems may help further understand the nature of this everyday cognitive category included in the present scale.

By contrast, MCI patients exhibited major problems compared to healthy participants in the remaining everyday cognitive categories included in the scale (i.e., error detection, problem solving, and self-initiation). In error detection and self-initiation, however, group differences only reached significance in complex instrumental activities. In such patients, deficits in problem solving were similar for BADL and IADL.

Altogether, the pattern of alterations shown by MCI patients in this study indicated that such patients usually report small problems with BADL, probably because their hardwired stored memory schema about the task is still well preserved. However, when an unexpected situation prevents them from retrieving such memory schema (e.g., if they realize that the kettle is not working as usual or is not located in the usual place), they tend to have difficulties finding a novel or alternative solution to complete the task (e.g., heat water in the microwave). Importantly, these types of unexpected situations can occur in any kind of activity, even BADL. Although many neuropsychological tests have been proposed to isolate alterations in this executive ability, as far as we know this is the first time that such ability is contextualized in basic everyday situations to compare alterations in MCI and dementia.

To conclude, our results support previous studies in which executive functions have shown to be a core problem in multidomain MCI patients (Traykov et al., 2007; Zheng et al., 2012). Moreover, many studies have related these cognitive impairments to functional problems that are typically present in MCI (Aretouli & Brandt, 2010; Hughes et al., 2012). The present pattern of results is also consistent with studies that have shown that patients with MCI have special difficulties in instrumental activities (Farias et al., 2006; Gure et al., 2013; Perneczky et al., 2006; Weston et al., 2011). However, our study suggests that these previous findings need to be further clarified, as not all everyday cognitive factors involved in instrumental activities are altered in patients with MCI (i.e., task memory schema was not impaired), while others (i.e., problem solving) may already be altered even for BADL.

A limitation of the present study is its small sample size, particularly regarding the dementia group, given the high proportion of such patients that had stopped performing IADL activities. In fact, the study suggests that the present scale is likely to be most appropriate for assessing initial impairments in patients at early stages of MCI or dementia, who are still functionally active but are starting to show some difficulties. Future studies using this scale should include a larger sample with different education levels or ethnicity types, which would make it possible to improve its psychometric properties and provide more powerful statistical comparisons. In addition, future versions of this scale could include additional participants divided into groups of more homogenous cognitive impairments in order to distinguish between various everyday cognitive error patterns in different subtypes of MCI or dementia. In future studies, it would also be desirable to include test–retest reliability analyses. Finally, new versions of this tool could broaden the type of everyday cognitive items to better understand the relationships between cognition and function in this population.

Although we are fully aware of the limitations of the present study, we believe that this proposal is a promising strategy to further specify future diagnostic criteria. For example, regarding the well-established criterion that MCI patients have difficulties with instrumental but not with BADL, the present tool suggests that this might be true for some types of cognitive abilities but not for others. More specifically, we found that some cognitive abilities such as problem solving led to overall functional impairment and affected participants' performance even in BADL in this population.

REFERENCES

Albert, M. S., DeKosky, S. T., Dickson, D., Dubois, B., Feldman, H. H., Fox, N. C., … Phelps, C. H. (2011). The diagnosis of mild cognitive impairment due to Alzheimer's disease: Recommendations from the National Institute on Aging–Alzheimer's Association workgroups on diagnostic guidelines for Alzheimer's disease. *Alzheimer's & Dementia*, *7*(3), 270–279. doi:10.1016/j.jalz.2011.03.008

American Occupational Therapy Association. (2008). Occupational therapy practice framework: Domain & practice 2nd edition. *American Journal of Occupational Therapy*, *62*(6), 625–683. doi:10.5014/ajot.62.6.625

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.

Ardila, A., Ostrosky-Solis, F., & Bernal, B. (2006). Cognitive testing toward the future: The example of semantic verbal fluency (ANIMALS). *International Journal of Psychology*, *41*(5), 324–332. doi:10.1080/00207590500345542

Aretouli, E., & Brandt, J. (2010). Everyday functioning in mild cognitive impairment and its relationship with executive cognition. *International Journal of Geriatric Psychiatry*, *25*(3), 224–233. doi:10.1002/gps.2325

Arrighi, H. M., Gelinas, I., McLaughlin, T. P., Buchanan, J., & Gauthier, S. (2013). Longitudinal changes in functional disability in Alzheimer's disease patients. *International Psychogeriatrics*, *25*(6), 929–937. doi:10.1017/s1041610212002360

Bettcher, B. M., Giovannetti, T., Macmullen, L., & Libon, D. J. (2008). Error detection and correction patterns in dementia: A breakdown of error monitoring processes and their neuropsychological correlates. *Journal of the International Neuropsychological Society*, *14*(2), 199–208. doi:10.1017/s1355617708080193

Blessed, G. T., Tomlinson, B. E., & Roth, B. E. (1988). Roth Dementia Scale. *Psychopharmacology Bulletin*, *24*, 705–708.

Blessed, G. T., Tomlinson, B. E., & Roth, M. (1968). The association between quantitative measures of dementia and of senile change in the cerebral grey matter of elderly subjects. *British Journal of Psychiatry*, *114*, 797–811.

Blessed, G. T., Tomlinson, B. E., & Roth, B. E. (1988). Blessed–Roth Dementia Scale. *Psychopharmacology Bulletin*, *24*, 705–708.

Boyle, P. A., Malloy, P. F., Salloway, S., Cahn-Weiner, D. A., Cohen, R., & Cummings, J. L. (2003). Executive dysfunction and apathy predict functional impairment in Alzheimer disease. *American Journal of Geriatric Psychiatry*, *11*(2), 214–221. doi:10.1176/appi.ajgp.11.2.214

Diehl, M., Willis, S. L., & Schaie, K. W. (1995). Everyday problem solving in older adults: Observational assessment and cognitive correlates. *Psychology and Aging*, *10*(3), 478–491.

Drijgers, R. L., Verhey, F. R. J., Leentjens, A. F. G., Kohler, S., & Aalten, P. (2011). Neuropsychological correlates of apathy in mild cognitive impairment and Alzheimer's disease: The role of executive functioning. *International Psychogeriatrics*, *23*(8), 1327–1333. doi:10.1017/s1041610211001037

Farias, S. T., Mungas, D., Cahn-Weiner, D., Baynes, K., Reed, B. R., Jagust, W., & DeCarli, C. (2008). The measurement of Everyday Cognition (ECog): Scale development and psychometric properties. *Neuropsychology*, *22*(4), 531–544. doi:10.1037/0894-4105.22.4.531

Farias, S. T., Mungas, D., Reed, B. R., Harvey, D., Cahn-Weiner, D., & DeCarli, C. (2006). MCI is associated with deficits in everyday functioning. *Alzheimer Disease & Associated Disorders*, *20*(4), 217–223. doi:10.1097/01.wad.0000213849.51495.d9

Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). Mini-Mental State. Practical method for grading cognitive state of patients for clinician. *Journal of Psychiatric Research*, *12*(3), 189–198. doi:10.1016/0022-3956(75)90026-6

Giovannetti, T., Bettcher, B. M., Brennan, L., Libon, D. J., Burke, M., Duey, K., … Wambach, D. (2008). Characterization of everyday functioning in mild cognitive impairment: A direct assessment approach. *Dementia and Geriatric Cognitive Disorders*, *25*(4), 359–365. doi:10.1159/000121005

Giovannetti, T., Bettcher, B. M., Brennan, L., Libon, D. J., Kessler, R. K., & Duey, K. (2008). Coffee with jelly or unbuttered toast: Commissions and omissions are dissociable aspects of everyday action impairment in Alzheimer's disease. *Neuropsychology*, *22*(2), 235–245. doi:10.1037/0894-4105.22.2.235

Gold, D. A. (2012). An examination of instrumental activities of daily living assessment in older adults and mild cognitive impairment. *Journal of Clinical and Experimental Neuropsychology*, *34*(1), 11–34. doi:10.1080/13803395.2011.614598

Gorelick, P. B., Scuteri, A., Black, S. E., DeCarli, C., Greenberg, S. M., Iadeacola, C., … Seshadri, S. (2011). Vascular contributions to cognitive impairment and dementia. A statement for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke*, *42*(9), 2672–2713. doi:10.1161/STR.0b013e3182299496

Griffith, H. R., Belue, K., Sicola, A., Krzywanski, S., Zamrini, E., Harrell, L., & Marson, D. C. (2003). Impaired financial abilities in mild cognitive impairment—A direct assessment approach. *Neurology*, *60*(3), 449–457.

Gure, T. R., Langa, K. M., Fisher, G. G., Piette, J. D., & Plassman, B. L. (2013). Functional limitations in older adults who have cognitive impairment without dementia. *Journal of Geriatric Psychiatry and Neurology*, *26*(2), 78–85. doi:10.1177/0891988713481264

Hughes, T. F., Chang, C. C. H., Bilt, J. V., Snitz, B. E., & Ganguli, M. (2012). Mild cognitive deficits and everyday functioning among older adults in the community: The Monongahela–Youghiogheny Healthy Aging Team Study. *American Journal of Geriatric Psychiatry*, *20*(10), 836–844. doi:10.1097/JGP.0b013e3182423961

Humphreys, G. W., & Forde, E. M. E. (1998). Disordered action schema and action disorganisation syndrome. *Cognitive Neuropsychology*, *15*(6–8), 771–811.

IBM Corporation. (2011). IBM SPSS statistics for windows (Version 20.0) [Computer software]. Armonk, NY: Author.

Ley Orgánica de Protección de Datos de Carácter Personal 15/1999. (1999). Boletín Oficial del Estado. Madrid. España, 13 Diciembre de 1999.

McKhann, G. M., Knopman, D. S., Chertkow, H., Hyman, B. T., Jack, C. R., Jr., Kawas, C. H., … Phelps, C. H. (2011). The diagnosis of dementia due to Alzheimer's disease: Recommendations from the National Institute on Aging–Alzheimer's Association workgroups on diagnostic guidelines for Alzheimer's disease. *Alzheimer's & Dementia*, *7*(3), 263–269. doi:10.1016/j.jalz.2011.03.005

Mioshi, E., Hodges, J. R., & Hornberger, M. (2013). Neural correlates of activities of daily living in frontotemporal dementia. *Journal of Geriatric Psychiatry and Neurology*, *26*(1), 51–57. doi:10.1177/0891988713477474

Mioshi, E., Kipps, C. M., Dawson, K., Mitchell, J., Graham, A., & Hodges, J. R. (2007). Activities of daily living in frontotemporal dementia and Alzheimer disease. *Neurology*, *68*(24), 2077–2084. doi:10.1212/01.wnl.0000264897.13722.53

Perneczky, R., Pohl, C., Sorg, C., Hartmann, J., Tosic, N., Grimmer, T., … Kurz, A. (2006). Impairment of activities of daily living requiring memory or complex reasoning as part of the MCI syndrome. *International Journal of Geriatric Psychiatry*, *21*(2), 158–162. doi:10.1002/gps.1444

Petersen, R. C. (2004). Mild cognitive impairment as a diagnostic entity. *Journal of Internal Medicine*, *256*(3), 183–194. doi:10.1111/j.1365-2796.2004.01388.x

Petersen, R. C., Doody, R., Kurz, A., Mohs, R. C., Morris, J. C., Rabins, P. V., … Winblad, B. (2001). Current concepts in mild cognitive impairment. *Archives of Neurology*, *58*(12), 1985–1992. doi:10.1001/archneur.58.12.1985

Petersen, R. C., Smith, G. E., Waring, S. C., Ivnik, R. J., Tangalos, E. G., & Kokmen, E. (1999). Mild cognitive impairment—Clinical characterization and outcome. *Archives of Neurology*, *56*(3), 303–308. doi:10.1001/archneur.56.3.303

Rascovsky, K., Hodges, J. R., Knopman, D., Mendez, M. F., Kramer, J. H., Neuhaus, J., … Miller, B. L. (2011). Sensitivity of revised diagnostic criteria for the behavioural variant of frontotemporal dementia. *Brain*, *134*(9), 2456–2477. doi:10.1093/brain/awr179

Reason, J. (1990). *Human error*. Cambridge: Cambridge University Press.

Reisberg, B., Finkel, S., Overall, J., Schmidt-Gollas, N., Kanowski, S., Lehfeld, H., … Erzigkeit, H. (2001).

The Alzheimer's disease Activities of Daily Living International Scale (ADL-IS). *International Psychogeriatrics*, *13*(2), 163–181. doi:10.1017/s1041610201007566
Reppermund, S., Brodaty, H., Crawford, J. D, Kochan, N. A., Draper, B., Slavin, M. J., … Sachdev, P. S. (2013). Impairment in instrumental activities of daily living with high cognitive demand is an early marker of mild cognitive impairment: The Sydney Memory and Ageing Study. *Psychological Medicine*, *43*, 2437–2445. doi:10.1017/S003329171200308X
Reppermund, S., Sachdev, P. S., Crawford, J., Kochan, N. A., Slavin, M. J., Kang, K., … Brodaty, H. (2011). The relationship of neuropsychological function to instrumental activities of daily living in mild cognitive impairment. *International Journal of Geriatric Psychiatry*, *26*(8), 843–852. doi:10.1002/gps.2612
Rey, A. (1964). *L'examen clinique en psychologie* [Clinical examination in psychology]. Paris: Presses Universitaires de France.
Schmitter-Edgecombe, M., McAlister, C., & Weakley, A. (2012). Naturalistic assessment of everyday functioning in individuals with mild cognitive impairment: The Day-Out Task. *Neuropsychology*, *26*(5), 631–641. doi:10.1037/a0029352
Schwartz, M. F., Reed, E. S., Montgomery, M., Palmer, C., & Mayer, N. H. (1991). The quantitative description of action disorganization after brain damage—A case study. *Cognitive Neuropsychology*, *8*(5), 381–414. doi:10.1080/02643299108253379
Schwartz, M. F., Segal, M., Veramonti, T., Ferraro, M., & Buxbaum, L. J. (2002). The Naturalistic Action Test: A standardised assessment for everyday action impairment. *Neuropsychological Rehabilitation*, *12*(4), 311–339. doi:10.1080/09602010244000084
Seidel, G. A., Giovannetti, T., Price, C. C., Tanner, J., Mitchell, S., Eppig, J., & Libon, D. J. (2013). Neuroimaging correlates of everyday action in dementia. *Journal of Clinical and Experimental Neuropsychology*, *35*(9), 993–1005. doi:10.1080/13803395.2013.844773
Seligman, S. C., Giovannetti, T., Sestito, J., & Libon, D. J. (2013). A new approach to the characterization of subtle errors in everyday action: Implications for mild cognitive impairment. *Clinical Neuropsychologist*, *28*(1), 97–115. doi:10.1080/13854046.2013.852624
Thomas, K. R., & Marsiske, M. (2014). Verbal prompting to improve everyday cognition in MCI and unimpaired older adults. *Neuropsychology*, *28*(1), 123–134. doi:10.1037/neu0000039
Torralva, T., Roca, M., Gleichgerrcht, E., Lopez, P., & Manes, F. (2009). INECO Frontal Screening (IFS): A brief, sensitive, and specific tool to assess executive functions in dementia. *Journal of the International Neuropsychological Society*, *15*(5), 777–786. doi:10.1017/s1355617709990415
Traykov, L., Raoux, N., Latour, F., Gallo, L., Hanon, O., Baudic, S., … Rigaud, A.-S. (2007). Executive functions deficit in mild cognitive impairment. *Cognitive and Behavioral Neurology*, *20*(4), 219–224.
Weston, A., Barton, C., Lesselyong, J., & Yaffe, K. (2011). Functional deficits among patients with mild cognitive impairment. *Alzheimer's & Dementia*, *7*(6), 611–614. doi:10.1016/j.jalz.2010.12.011
Willis, S. L., & Marsiske, M. (1993). *Manual for the Everyday Problem Test*. University Park: Pennsylvania State University.
Winblad, B., Palmer, K., Kivipelto, M., Jelic, V., Fratiglioni, L., Wahlund, L. O., … Petersen, R. C. (2004). Mild cognitive impairment—Beyond controversies, towards a consensus: Report of the International Working Group on Mild Cognitive Impairment. *Journal of Internal Medicine*, *256*(3), 240–246. doi:10.1111/j.1365-2796.2004.01380.x
Youngstrom, M. J., Brayman, S. J., Anthony, P., Brinson, M., Brownrigg, S., Clark, G. F., … Commission, P. (2002). Occupational therapy practice framework: Domain and process. *American Journal of Occupational Therapy*, *56*(6), 609–639.
Zanetti, O., Frisoni, G. B., Rozzini, L., Bianchetti, A., & Trabucchi, M. (1998). Validity of Direct Assessment of Functional Status as a tool for measuring Alzheimer's disease severity. *Age and Ageing*, *27*(5), 615–622. doi:10.1093/ageing/27.5.615
Zheng, D., Dong, X., Sun, H., Xu, Y., Ma, Y., & Wang, X. (2012). The overall impairment of core executive function components in patients with amnestic mild cognitive impairment: A cross-sectional study. *BMC Neurology*, *12*, 1–10. doi:10.1186/1471-2377-12-138

APPENDIX

Cognitive questions on activities of daily living (ADL)

Frequency questions common to all ADL

How often did he/she used to do this activity in his/her life?
How often does he/she currently do this activity?

Brushing teeth

(1) He/she knows the necessary steps to brush his/her teeth and performs them in the right order (i.e., putting the toothpaste on the toothbrush, brushing the teeth and finally rinsing out).
(2) He/she is able to notice if he/she has got toothpaste on him-/herself, if he/she has got wet, if he/she has put too much or too little toothpaste or has not rinsed out enough (i.e., ability to detect that there has been an error).
(3) He/she is able to find a solution if there is no toothpaste left, if he/she does not have a towel or if a problem arises (e.g., looking for another toothpaste tube).

(4) He/she remembers to brush when necessary (e.g., after meals or before going to bed).

Having a shower

(1) He/she knows the necessary steps to have a shower and performs them in the right order [i. e., undressing, getting into the shower, getting wet, soaping (body and head), rinsing, drying].
(2) He/she is able to notice if he/she is not soaping, rinsing or drying a part of his/her body (i.e., ability to detect that there has been an error).
(3) He/she is able to find solutions if there is no soap or shampoo left, if he/she does not have a towel or if a problem has occurred.
(4) He/she remembers to have a shower when necessary.

Putting on makeup/shaving (choose depending on the gender)

(1) He/she knows the steps for applying makeup or shaving and performs them in the right order (makeup: if she puts on cream, this must always be done before makeup or rouge; shaving: applying shaving cream, shaving, rinsing, drying his face).
(2) He/she can tell if he/she has not put on makeup/shaved well (e.g., if there are areas left without makeup/shaving or if only one part of the face has makeup/has been shaved).
(3) He/she is able to find a solution if there is no foam or makeup left or if he/she faces other problems.
(4) He/she remembers to put on makeup/to shave when it is necessary.

Getting dressed

(1) He/she knows the steps to get dressed and performs them in the right order (first underwear, then interior garments and finally a coat; socks before shoes).
(2) He/she is able to notice if he/she has put on the right clothes.
(3) He/she corrects the situation if he/she detects an error.
(4) He/she remembers to get dressed when it is necessary.

Cooking*

(1) He/she knows the steps to cook simple meals (e.g., omelet, salad, toast, sandwich, coffee) and performs them in the correct order.
(2) He/she knows the steps to cook complex meals (e.g., stews, casseroles, meat dishes, rice, pasta) and performs them in the right order.
(3) He/she is able to notice if he/she has skipped an essential step, or if he/she has made a mistake in the order of steps or has used a wrong ingredient for this meal (i.e., ability to detect that there has been an error).
(4) He/she is able to find solutions to the errors that he/she has made (e.g., adding the missing ingredient or spices).
(5) He/she remembers to cook when it is necessary.

Home care: cleaning, washing up, hanging out the laundry, and setting the table

(1) He/she remembers the steps to operate the washing machine and performs them in the right order (i.e., introduce the clothes, add detergent and softener, select a program).
(2) He/she knows the steps to clean up, wash up, sweep, mop and set the table and performs them in the right order.
(3) He/she is able to realize that he/she has not done the cleaning properly or has missed a step when operating the washing machine or setting the table (i.e., ability to detect that there has been an error).
(4) He/she is able to find solutions to the mistakes he/she has made (e.g., cleaning more).
(5) He/she remembers to clean the house, do the laundry or set the table when it is necessary.

Managing finances/shopping

(1) He/she is able to notice whether the change given is correct.
(2) He/she remembers to do the shopping when necessary.

*In participants who usually prepared complex meals in the past, the memory schema item was obtained as the mean between their score in preparing both basic and complex meals.