Performance-based assessment of telephone use in three patients with a major cognitive disorder

Lisa Quillion-Dupré PhD[a,*]

Emmanuel Monfort PhD[a]

Clotilde Lissot MSc[b]

Vincent Rialle PhD[c]

Pascal Couturier PhD[b]

[a]Inter-university laboratory for Psychology, Personality, Cognition, and Social Change (LIP/PC2S), Univ. Grenoble Alpes, France; [b]Grenoble University Hospital, France; [c]University laboratory for Autonomy, Gerontology, E-health, Imagery Society (AGEIS, EA7407), Univ. Grenoble Alpes, France; *Corresponding author: lisa.quilliondupre@gmail.com

L. Quillion-Dupré, E. Monfort, C. Lissot, V. Rialle, P. Couturier. Performance-based assessment of telephone use in three patients with a major cognitive disorder. Gerontechnology 2020;19(1):54-65; https://doi.org/10.4017/gt.2020.19.1.006.00 **Background** In Major Neurocognitive Disorders (MND), cognitive deficits have considerable consequences on patients' daily living, compromising their social, professional, or leisure activities. In this context, technologies may provide innovative solutions to support home support and boost loss-making capacity. Therefore, it is necessary to design appropriate devices but also rehabilitation interventions, considered early on in order to minimize the impact of cognitive impairments on daily living. This requires undertaking a detailed assessment of autonomy. **Research aim** In this context, we wanted to confirm the contributions of a performance-based assessment to define the challenges faced by people with a diagnosis of MND using the telephone, the most common communication tool, and to specify their ability to benefit from hierarchical cueing. **Methods** We compared three patients with a diagnosis of MND to 17 elderly people aged 74 to 91, living in the community, and without any cognitive impairment. We evaluated the telephone useability in an ecological structured context with three tasks of increasing difficulty adapted from the Observed Tasks of Daily Living-R (Diehl, Marsiske, & Horgas, 2005). Performances were analyzed with an observation grid from the Profinteg tool (Anselme et al., 2013), completed by an error taxonomy based on Schwartz description (Schwartz et al., 1998; Schwartz et al., 1995). **Results** Results highlighted that the three patients, who presented cognitive deficits and who apparently did not face obvious difficulties in telephone use assessed with a pencil-and-paper questionnaire, presented different error patterns and needed more specific aids, and in greater number. **Conclusion** The findings indicate a dissociation between neuropsychological tests' performances and telephone use in daily life. This result underlines the need for direct structured observation of older persons' daily activities requiring technical and technological tools, in the way to predict the practical consequences of cognitive impairments, and for designing appropriate gerontechnologies.

Keywords: Activities of daily living (ADL), telephone, performance-based assessment, Major Neurocognitive Disorder

Introduction

Technologies are today an essential determinant of the life of aging people with neurocognitive disorders especially when they limit difficulties in daily life (Lorenz et al., 2019). Unfortunately, these technologies do not always fit with the life of older people (Hirt et al., 2019). The characterization of actual usage capacities by means of valid indicators is therefore of major importance, especially because of the short period of usefulness of technologies due to the changing cognitive status of aging people with cognitive disorders (they need to be accessible at the right time, and able to adapt to changing needs).

Major Neurocognitive Disorders (MND) affect heterogeneously multiple cognitive functions such as learning and memory, executive func-

tions, complex attention, etc. (American Psychiatric Association, 2013). These cognitive deficits have considerable consequences on the patients' daily life, compromising their social or professional activities. As a matter of fact, this loss of capacity is the main cause of admission to institutions for retired and elderly people (Verbeek et al., 2015). In a clinical setting, activities of daily living (ADL) are usually assessed using questionnaires. Unfortunately, these paper-and-pencil methods are not sufficient to evaluate the real nature of difficulties in home settings. More precisely, performance-based studies highlighted those brain-damaged people, but also young healthy people, are likely to commit errors even in routine tasks (Giovannetti, Schwartz, & Buxbaum, 2007). The most represented errors in patients with MND are, in order: errors of omission, commission, object substitution, and action addition (Giovannetti et al., 2008; 2012). These authors also found that measures of episodic memory significantly predicted omission errors, whereas general dementia severity and executive control measures better predict execution errors. According to Giovannetti et al. (2012), difficulties encountered cannot be explained by a general construct. Different neuropsychological impairments should be associated with different patterns of everyday action impairment.

The assessment of autonomy implies targeting meaningful activities, which are critical situations in pathological aging (Barberger-Gateau et al., 1992). In this context, using the phone is of major interest. This tool is currently indispensable to organize home support and call for help, thus contributing to ensuring the safety of people (Mitzner et al., 2010; Topo, Jylhä, & Laine, 2002). It is also a source of stimulation, promotes social relationships (Topo et al., 2002), and appears to be a way to keep some control over his or her own life, for example by making medical appointments by oneself (Nygård & Starkhammar, 2003). With over 7 billion subscribers to mobile phone throughout the world in 2017, the telephone has become an integral part of people's lives, and thus an essential tool to maintain independence and autonomy in aging people living at home (e.g., to be assured of maintaining relationships and security; Topo et al., 2002).

Nygård and Starkhammar (2007) emphasized that elderly people with cognitive disorders experienced difficulties with technologies including the most common and mainstream. Additionally, difficulty with phone use has been identified as a sign of early cognitive decline associated with MND (Nygård, Pantzar, Uppgard, & Kottorp, 2012), and in the French epidemiological survey PAQUID, phone use is considered as one of the four instrumental activities of daily living (IADL) that predict a diagnosis of MND (Barberger-Gateau et al., 1992). When telephone use is taken into account in MND functional skills evaluation, with tests based on systematic observation or on caregivers reports (Moore, Palmer, Patterson, & Jeste, 2007; Nygård & Starkhammar, 2003), there is generally limited information about the exact nature of patients' difficulties and the way they respond to them (Nygård & Starkhammar, 2003). As a matter of fact, either these evaluation tools are generally limited to a single item, or they only enable a dichotomous or low-sensitive measure. It must be stressed that this particular field suffers from a lack of detailed research: none of the performance-based evaluation tools of ADL identified by Moore et al. (2007) have been dedicated to the telephone, whilst performance-based assessment instruments provide accurate and relevant information on the patient's deficits, and are particularly useful when a caregiver is not available.

We propose to evaluate the ability to use the phone with a performance-based measure including a description and an analysis of errors as well as the human help provided. In this context, we wanted to confirm the contributions of a performance-based assessment to define the challenges faced by people with a diagnosis of MND using the telephone. We explored the ability to use the phone in 3 patients suffering from MND, relative to 17 healthy aging adults, all living in the community. According to Giovannetti et al. (2008) and Giovannetti et al. (2012), who found that measures of episodic memory significantly predicted omission errors, whereas general dementia severity and executive control measures better predict execution errors, we expected to find a greater number of omissions in each patient and a higher number of executions for those who have a lower level of cognitive functioning.

Methods

We assessed the ability to use the phone with an adaptation of the phone-related tasks from the Observed Tasks of Daily Living-R (OTDL-R; Diehl et al., 2005), a performance-based measure of three IADLs. The OTDL-R limits rater bias, is not time-consuming, and makes comparisons between groups feasible. To be able to analyze verbal and non-verbal elements, we videotaped participants while they were using the telephone. Then, we analyzed the videos by means of an observation grid based on the Profinteg tool (Anselme et al., 2013), completed by an error taxonomy based on Schwartz description (Schwartz et al., 1995) and by an assistance taxonomy distinguishing verbal assistance from physical assistance (Neistadt, 1994). The daily functioning was assessed with the Lawton IADL Scale (Juillerat Van der Linden, 2008; Lawton & Brody, 1969) and the Index of Independence in ADL (Katz,

Table 1. Sample characteristics

	Age *m* (SD)	Sex (W/M)	Education level Years of education *m* (SD)	Education level Mill Hill *m* (SD)	MMSE *m* (SD)
Control group (n = 17)	78.52 (4.15)	9/8	11.24 (3.19)	38.24 (5.29)	29.00 (0.93)
Mr. B	78.8	M	12	37	26*
Mrs. G	87.6	W	14	32	22**
Mrs. H	75.5	W	9	31	21**

*$p < .01$** $p < .001$

Ford, Moskowitz, Jackson, & Jaffe, 1963). The IADL Scale particularly assesses the ability to use the telephone in patients' real life. We compared performances of 3 aging patients with MND with those of 17 healthy aging adults, older than 74 years old living in the community, without any history of psychiatric disorders or of stroke, and scoring more than 26 at the Mini Mental State Examination (MMSE; Folstein, Folstein, & McHugh, 1975; Hugonot-Diener, 2008). The characteristics of the control group are detailed in *Table 1*. In order to provide a detailed description of the 3 patients' characteristics, the third author, as a specialized neuropsychologist, conducted an in-depth evaluation. The neuropsychological tests encompass all cognitive functions with each patient in the geriatric day unit of the Grenoble Alpes University Hospital. We also administered a vocabulary test (Mill Hill Vocabulary Test part B, French version; Deltour, 1993) to all participants, in order to estimate the comprehension level of the participants. All participants signed an approved informed consent form.

Participants

Mr. B

Mr. B is a 78.8-year-old man living alone at home. After graduating from high school, he had worked as a civil servant. He is now retired. The difficulties would have appeared insidiously 2.5 years ago and became worse in spurts (due to cardiac problems). During the interview, Mr. B reports some difficulties in remembering names and describes his memory as selective, and his son speaks about his forgetting recent facts. The patient has maintained some activities like watching the news and game shows, reading and going to the library, but his son doubts the truth of this last information. Nonetheless, he still goes shopping and goes out every day to drink his coffee. Mr. B describes himself as optimistic and says he prefers "*living from day to day*". His son finds him "*easier to get on with*" and is convinced his father would never have accepted this assessment a few months before. During the neuropsychological assessment, the patient is very jovial and jokes (even if sometimes inappropriately) to hide his difficulties.

The neuropsychological assessment highlighted a preserved overall efficiency (MMSE = 26), but with temporal disorientation. With regard to the verbal modality of episodic memory, the encoding was preserved, and there was no "forgetting little by little": the performances in delayed recall were better than in immediate recall, even if they remained pathological (The RL/RI-16 memory test; Adam & GREMEM, 2008; Van der Linden et al., 2004). On the visual modality, memory process was impaired both in free recall (immediate and delayed) and recognition, and a loss of information was observed in delayed recall (The Doors test; Baddeley, Emslie, & Nimmo-Smith, 1994; the complex figure of the Signoret Memory Battery-BEM 144; Signoret, 1991). No effect of learning was found in memory tasks. In the language domain, the vocabulary (Mill Hill vocabulary test part B) was preserved. Nonetheless, Mr. B experienced speech difficulties as highlighted by his poor performance in naming objects (32/36) (the 36-items test of Bachy-Langedock, 1989), and his decrease in verbal fluency (both in letter and semantic fluency). Motor programming ability explored with the bimanual test of reciprocal coordination of Luria (1966) and the object identification assessed with the 36-item test of Bachy-Langedock (1989) were effective. Focused attention was preserved in its inhibition dimension (Stroop Test; Meulemans, 2008), but maintaining attention seemed challenging (Trail-Making Test-TMT, Army Individual Test, 1944, in its modified version; Meulemans, 2008). In addition, the frequency of perseverations (20%) produced in the verbal fluency task was abnormal (Ramage, Bayles, Helm-Estabrooks, & Cruz, 1999). Finally, Mr. B had no impairment in praxis such as gesture production and copy drawing tasks (Mahieux, Fabre, Galbrun, Dubrulle, & Moroni, 2009). He also was independent in ADL assessed with the Lawton IADL Scale and the Index of Independence in ADL. Working memory was also preserved (digital span, WAIS-III; Wechsler, 1997). In conclusion, Mr. B presented episodic memory (disorientation, encoding, strengthening, and recovery difficulties) and language difficulties (objects' naming, verbal fluency). The final diagnosis was early Alzheimer disease, in reference to the NINCDS-ADRDA (McKhann et al., 1984) and DSM 5 (American Psychiatric Association, 2013) criteria.

Mrs. G

Mrs. G is an 87.6-year-old woman. The geriatrician referred her to the neuropsychologist, in order to identify accurately the nature of her memory and executive function deficits. Mrs. G studied 2 years after high school before becom-

Table 2. Error typology

Error type	Description
Initiation	The participant does not spontaneously start the activity after 15 sec (for any reason) or says, "I don't know".
Omission	The participant does not execute a step (including forgetting the contents) (e.g. He/she doesn't read the number). To be considered as an omission, an error must not be a consequence of any other error type.
Erroneous execution	Realization in an incorrect, inappropriate way, or not at the right time (e.g. He/She make a mistake in dialing the number or doesn't read the right number), including perseverations: A step is executed more than once (e.g. Read the number, look at the instructions and then read the number again)

ing a housewife. During the interview, Mrs. G asserts to have a good memory but describes difficulties in staying focused on books and reports that she has to write information on Post-it stickers and on an appointment diary. Her daughter also mentions short-term memory problems over the past year: Mrs. G does not withhold information and asks iterative questions. At the time of the neuropsychological assessment, the patient is living alone at home and appears to be independent (IADL score = 8/8; ADL score = 6/6; the Index of Independence in ADL). She has not reduced her leisure activities (painting lessons, daily outings, trips, and museum visits). However, she says she gets no more enjoyment from cooking, which results in lunches in restaurants and eating takeaways. Mrs. G does not express any mood or behavior complaint. Nonetheless, her son has personal worries that cause her anxiety, and her daughter describes a degree of irritability, causing light aggressive reactions. All along with the evaluation, Mrs. G is well adapted, warm, and smiling.

The neuropsychological assessment objectified a mild impaired global efficiency (MMSE = 22) with Spatio-temporal orientation, abstract, and calculation abilities in a normal range and no dysorthographia. She referred to personally experienced events in a satisfactory manner, but with a few inaccuracies for the most recent events. Semantic knowledge was good if using cues. Free recall scores for visual material (the Doors Test) were in a pathological range but recognition was preserved. Verbal memory screening using RL/RI-16 also showed preserved encoding capacities, but impaired free recall associated with many intrusions and recognition errors. Learning and semantic cues effects in the immediate recall were affected by the patient's fatigability, and semantic cues were not sufficient in delayed recall. Gestures and graphomotor praxis were preserved, as were the identification of objects and the visuospatial analysis. Language skills were characterized by deficits on tests of verbal, alphabetical and categorical, fluency and by word-finding problems. The vocabulary (Mill Hill vocabulary test part B) was also abnormal, but repetition and automatic series were preserved. Lastly, the naming of the objects was pathological (the 36-items test of Bachy-Langedock). Concerning the executive functions, inhibition capacities were preserved (Stroop Test), and working memory performances were weak. Focused attention, in its attention-holding component ("attention gaps"), and divided attention (TMT; Army Individual Test, 1944, in its modified version) were impaired, with some perseverative behaviors. Pre-motor programming (Luria's motor sequences) was preserved, although noisy from attention disorders. No loss of initiative action was observed. In conclusion, the patient presented attention, speech, and episodic and working memory disorders. The incipient mnemonic deficit was of hippocampal type, the neuropsychological profile suggesting a possible incipient neurodegenerative process. After completing the geriatric assessment, the final diagnosis was vascular neurocognitive disorder.

Mrs. H

Mrs. H is a retired 75.5-year-old person, who used to be a secretary (9 years of schooling). She lives in an apartment with her son and says to be autonomous. She describes recall difficulties for recent events, which is confirmed by her son, with no worsening since it began 1 year ago. Her son has provided assistance for the preparation of medicines (*"too many drugs"*) as well as account and administrative management (*"don't want any more"*) for 2 years. She no longer goes out alone, because she says she is afraid of being mugged. Yet she continues to go to the senior citizens' club, walk with friends, watch TV, and read women's magazines. However, she has stopped painting 3 years ago, because of her lack of motivation in connection with the deaths of people who shared this activity. An assessment of independence showed a deficit in IADL (score = 4/8), but the item assessing the telephone use was reported as successful. During the neuropsychological assessment, the patient is slightly euphoric and shows a slight lack of inhibition.

The neuropsychological evaluation showed a moderately altered overall cognitive efficiency (MMSE = 21), with a little spatial disorientation,

Table 3. Typology of the provided cues

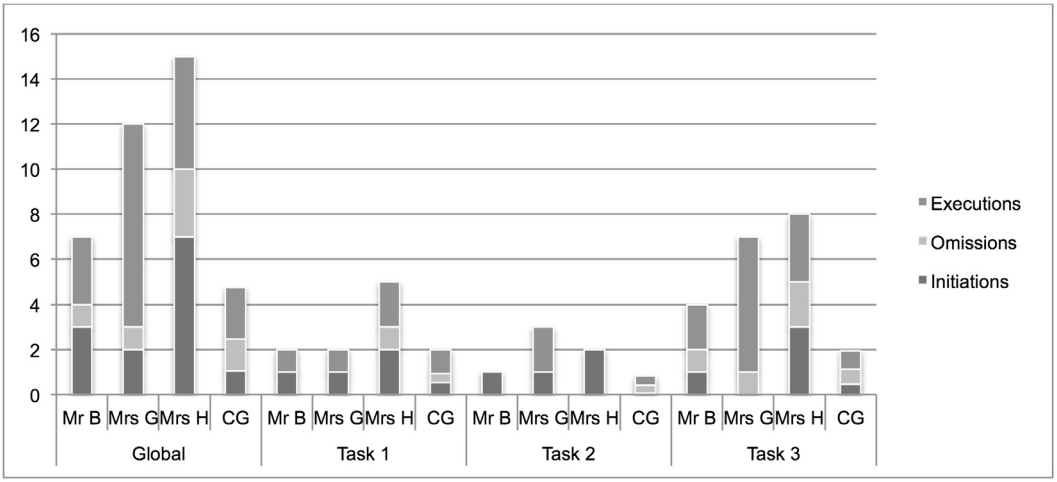
Cue type	Description
General	Encouraging to continue or advising the participant of an error but without specifying which one and where (e.g. "Be careful!", "Hm hm")
Specific	Verbal indication on the nature of the error but without providing information about what needs to be done or how to do it (e.g. "You are forgetting something.")
Total	Detailed explanation of what the participant has to do (e.g. "You have to pick up the handset")
Physical	Performing the step for the participant (e.g. Hanging up correctly)

and a concept of abstraction capacity in low range for verbal capacities (WAIS III similarities test) and in pathological range for visual capacities (Modified Card Sorting Test, MCST; Nelson, 1976), probably because of fatigue. Mrs. H evoked personally experienced events with success, with a discrete temporal gradient, and semantic knowledge required cueing. Memory for verbal data was altered (RL/RI-16): Free recalls were pathological with no improvement in the normal range by semantic cueing, recognition was impaired, and encoding was nearly pathological with a slight learning effect. Visual memory capacities for immediate and delayed free recalls were pathological (BEM 144), and recognition was in the low range (the Doors test; Baddeley et al., 1994). Picture identification and visual synthesis (Visual Object and Space Perception Battery-VOSP; Warrington & James, 1991) were preserved despite some spatial errors. On language skills, categorical fluency was weak, and picture naming was slightly pathological. Alphabetical fluency, vocabulary, repetition, and automatic series were preserved, as were the gestures and graphomotor praxis. Concerning the executive functions, working memory was preserved and information-processing speed was in a normal range, but playback speed was in the low standards. Focused attention was in low range for inhibition, and attention span was altered (Stroop Test). In addition, many perseverative responses were observed when performing the verbal fluency test and the MCST. There was no loss of action initiation and divided attention was preserved (TMT, Army Individual Test, 1944, in its modified version). Finally, the pre-motor programming (Luria's motor sequences) was altered, the achievement of the complex gestural series being impossible. Mrs. H had overall poor memory capacities (disorientation, encoding, strengthening, and recovery difficulties), and executive disturbances were manifested by a deficit in processing speed, focused attention, perseverative errors, and motor programming. Following the global geriatric assessment, the conclusion was a mixed dementia diagnosis (probable incipient vascular encephalopathy with possible degenerative component).

Procedures

The phone-related domain from the OTDL-R (Diehl et al., 2005) includes 3 tasks using real-life material. In the first one, participants have to look for a telephone number in a paper page listing services for seniors and then to dial it. In the second one, the aims are identical but the document is an extract of the Yellow Pages directory. Finally, the last task focuses on the understanding of a table showing telephone charges for different days and time periods. ADL assessed have to rely on the cultural context of the person, yet the third task is not relevant for French people, so we kept the first two tasks but modified the third one. With reference to the third task of the UPSA-2 (Patterson & Mausbach, 2008), we asked participants to look for an appointment date in a medical letter, then to check their availability in a page of a fictitious diary (in order to keep the notion of time of the OTDL task), before calling the practitioner, using the phone number written in the medical letter.

We initially sequenced the three tasks in reference to the Action thesis Coding System (ACS; Reed, Montgomery, Schwartz, Palmer, & Pittenger, 1992; Schwartz et al., 1995): We established the nature, the number, and the chronological order of the necessary steps required to carry out the activity, thus defining a reference script. Each task was described by simple actions grouped in more inclusive units. For example, in our first two tasks, the analysis of calling someone assumed two inclusive units: looking for a number and using the telephone. The latter consisted of the smallest components: picking up the phone, dialing the number, and hanging up. In reference to Anselme et al. (2013), Giovannetti et al. (2008), and Schwartz et al. (1998), errors were coded as omissions, erroneous executions, and initiation errors (*Table 2*). We also listed all assistance cues that could be provided by the observer (*Table 3*), using an adapted scorecard developed on the basis of the Profinteg grid (Anselme et al., 2013), in adding specific verbal assistance ("*Would this not be written somewhere?*") and total verbal assistance ("*You have to…*"). The order was pre-determined, based on a graduated set of responses, from the less informative to the most informative one. Thus, integrating these different elements, we focused our analysis on tracing when and how often assistance had to be given.



CG = Control group

Figure 1. Types of errors produced (sum for the 3 patients and mean for the control group)

Statistical analyses

We used the Singlims program (Crawford, Garthwaite, & Porter, 2010), a specific statistical test, to compare the individual values of each patient subject (number of errors and cues, type of errors produced and assistance provided) with those of the control sample of modest size, for each of the three tasks.

Results

Mr. B

There were no significant differences between Mr. B and the control group according to age (t = 0.07, *ns*), number of years of education (t = 0.24, *ns*), or the Mill Hill score (t = -0.22, *ns*). He only differed for the MMSE score (t = -3.24, $p < 0.01$).

Mr. B didn't show any difficulty in using the telephone, except in the first task when he improperly hung up the handset. He quickly understood the instructions, did not encounter difficulties in reading documents and was able to find the information easily for the first two tasks. Regarding the formal evaluation of telephone use (*Figure 1*), Mr. B distinguished himself from the control group by his greater number of initiations (t = 1.94, $p < 0.05$) but not by the total number of errors (t = 0.77, *ns*), neither by his erroneous executions (t = 0.39, *ns*) or omissions (t = -0.40, *ns*).

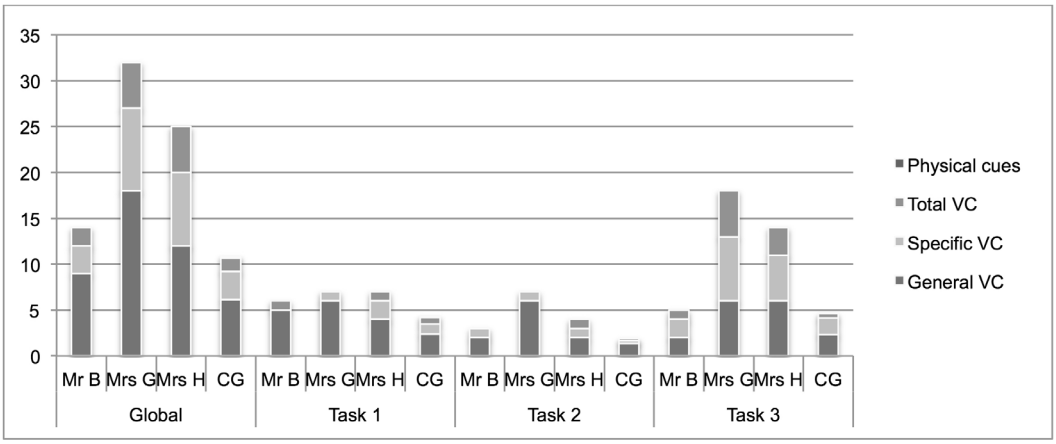
He did not significantly need more assistance (t = 0.56, *ns*), whether it was general (t = 0.85; *ns*), specific (t = -0.07, *ns*), total (t = 0.30, *ns*) verbal cues, or physical (t = -0.35, *ns*) assistance (*Figure 2*). However, he asked for assistance connected with the situation ("*I have no dial tone, is it normal?*") and requested confirmation to ensure that he understood what was expected ("*I will read it to find it?*"), or that he found the required information ("*That is accommodation?*"). In task 3, he did not refer spontaneously to the necessary documents to find the correct information ("*The phone number isn't there.*") and found difficult to identify on his own the exact time of the appointment in the calendar ("*15h, where is it on it??*"). He also sought the confirmation of the researcher to identify the documents to be used ("*Pff! The page of the agenda?! That's the page of the agenda, eh?*", indicating the medical mail he put down on the agenda page after looking at the two documents when they were given to him).

Task 1

Mr. B did not produce significantly more errors than the control group in the first task (t = 0.00), whether it was initiations (t = 0.74, *ns*), omissions (t = -0.78, *ns*), or erroneous executions (t = -0.05, *ns*). He did not also need more assistance (t = 0.57, *ns*), nonetheless, general verbal assistance tended to be higher (t = 1.52, $p = 0.07$). Differences were not significant for specific (t = -1.06, *ns*) and total verbal cues (t = 0.24, *ns*), as well as for physical assistance (t = -0.35, *ns*).

Task 2

In the second task, there were no significant differences for the sum of errors (t = 0.16, *ns*), the number of omissions (t = -0.69, *ns*) and of erroneous execution (t = -0.40, *ns*), but Mr B committed more initiations (t = 3.81, $p < 0.001$). The differences with the control group were not significant considering the sum of assistance (t = 0.66, *ns*) and general verbal cues (t = 0.54, *ns*). The number of specific verbal cues tended to be significantly different (t = 1.47, $p = 0.08$) and the number of total verbal cues was comparable with that of the control group (t = -0.53, *ns*). None physical assistance was required, neither by the control group nor by Mr. B.



CG = Control group; VC = Verbal cues

Figure 2. Types of assistance required (sum for the 3 patients and mean for the control group)

Task 3

In the last task, neither the sum of assistance (t = 0.13, *ns*), nor the number of general (t = -0.22, *ns*), specific (t = 0.15, *ns*), and total (t = 0.74, *ns*) verbal cues of Mr B was higher than the control group. None physical assistance was required, neither by him nor by the control group. Neither the number of initiations (t = 1.01, *ns*), of omissions (t = 0.49, *ns*), or of erroneous executions (t = 1.21, *ns*) was significantly higher. Nonetheless, Mr B tended to produce more errors (t = 1.38, $p = 0.09$).

Mrs. G

Mrs. G was significantly older than participants in the control group (t = 2.13, $p < 0.05$) and has a significant lower MMSE score (t = -7.56, $p < 0.001$), but she did not differ from the control group in her study (t = 0.85, *ns*) and vocabulary level (t = -1.14, *ns*).

When using the phone (*Figures 1* and *2*), Mrs G made a total of 12 errors, which is significantly more than the control group (t = 2.50, $p < 0.05$). Specifically, erroneous execution errors (t = 3.71, $p < 0.001$) were higher but not initiations (t = 0.94, *ns*) or omissions (t = -0.40, *ns*). She needed significantly more assistance (t = 3.70, $p < .001$), whether general (t = 3.52, $p < 0.01$), specific (t = 3.30, $p < 0.01$), or total verbal cues (t = 1.97, $p < 0.05$), but not physical assistance (t = -0.35, *ns*).

Among the three patients, Mrs. G produced a greater number of erroneous executions and needed the greater number of cues to achieve all the tasks. She also was the only one of them to produce omission. Regarding the erroneous executions, we could notice a difficulty to replace the handset, which was spontaneously corrected after several attempts. After picking up the phone and dialing the number, Mrs. G also systematically asked which button she had to push next. In addition, she did not hang up spontaneously. Among commission errors, we observed three omission tool errors: for example, she said "*That is, I do not know it [the doctor's phone number] by heart*", without reference to the given document. In the third task, after experiencing difficulties to understand what was asked, and having pointed out several times that it never happened to her to have to confirm an appointment, she picked up the phone and "play" a fake dialogue, never using the documents in her possession. After picking up the phone, she did not dial the number, even after encouragement. The last task was the only one demanding total verbal help as well as assistance to move on to the next step. Finally, Mrs. G asked for more assistance than the two other patients and read several times the instructions to check what she had to do, albeit these actions seemed insufficient to support her understanding of the problem situation.

Task 1

Mrs. G did not produce significantly more errors than the control group (t = 0.00, *ns*), whether it was initiations (t = 0.74, *ns*), omissions (t = -0.78, *ns*), or erroneous executions (t = -0.05, *ns*). Overall, she did not need significantly more assistance (t = 0.905, *ns*), nor specific (t = -06, *ns*) or total verbal (t = -0.59, *ns*), or physical (t = -0.53, *ns*). Nonetheless, the number of general verbal cues was significantly higher than in the control group (t = 2.10, $p < 0.05$).

Task 2

The differences were not significant for the sum of errors (t = 1.81, *ns*) and the number of omissions (t = -0.69, *ns*), but Mrs. G committed more initiations (t = 3.81, $p < 0.001$), and the number of erroneous executions tended to be higher than in the control group (t = 1.55, $p = 0.07$). Mrs. G's overall sum of assistance (t = 3.02, $p < 0.01$) and

the number of general verbal cues (t = 3.86, $p < 0.001$) were significantly higher than in the control group. The number of specific verbal cues only tended to be significantly higher (t = 1.47, $p = 0.08$), but the number of total verbal cues was comparable with that of the control group (t = -0.53, *ns*). None physical assistance was required, neither by the control group nor by the patient.

Task 3
Mrs. G produced more errors (t = 3.35, $p < 0.01$), in particular erroneous executions (t = 5.30, $p < 0.001$) than the control group. Neither the number of initiations (t = -0.90, *ns*) or of omissions (t = 0.49, *ns*) was significantly higher. She globally needed more assistance (t = 5.05, $p < 0.001$). Her number of general (t = 2.30, $p < .05$), specific (t = 3.35, $p < 0.01$), and total (t = 7.01, $p < 0.001$) verbal cues was higher. None physical assistance was required, neither by the control group nor by the patient.

Mrs. H
Mrs. H differed significantly from the control group only for the MMSE score (t = -8.64, $p < 0.001$), but not for age (t = -0.71, *ns*), and for study (t = -0.67, *ns*) and vocabulary level (t = -1.32, *ns*).

Using the telephone (*Figures 1* and *2*), Mrs. H produced significantly more errors (t = 3.53, $p < 0.01$), specifically more initiations (t = 5.95, $p < 0.001$). The number of omissions and erroneous execution only tended to be higher (respectively, t =1.55, $p = 0.07$ and t = 1.50, $p = 0.08$). She also needed a greater number of cues (t = 2.47, $p < 0.05$), whether it was specific (t = 2.74, $p < 0.01$) or total (t = 1.97, $p < 0.05$), but she was not significantly different from the control group for physical assistance (t = -0.35, ns). Her number of general verbal cues tended to be higher (t = 1.74, $p = 0.05$).

Mrs. H made more mistakes than the other two patients, and particularly more omissions and initiations. From the onset, going from one activity to the next, during the task, was not spontaneous; Mrs. H pointed out the number but did not read it, then, after encouragement, read the number but did not dial it. This was even more manifest in the third task in which, she, for example, read aloud the date of the appointment but did not initiate the next step, that is, to check it on the page of the diary. Mrs. H also made several comments on the fictional situation of the task, asking whether somebody would answer to the phone, saying that she didn't need anything, or telling about her personal experience. Mrs. H hardly made any execution errors in the two first tasks (she only had some difficulty finding the number in the first document). On the other hand, in the third task, a mistake in the number dialed was noted as well as several tool omissions: the patient referred to the preceding task for the telephone number, without using the document at her disposal. She also referred to what she did in life in general, without using the agenda or reading the mail. As a consequence, it was necessary to put the pertinent documents in front of her.

Task 1
Mrs. H produced significantly more errors than the control group (t = 2.21, $p < 0.05$). But considering each type of errors, the difference was only significant for initiations (t = 2.30, $p < 0.05$), not for the omissions (t = 1.12, *ns*) or erroneous executions (t = 0.84, *ns*). Nonetheless, globally she didn't need significantly more assistance (t = 0.91, *ns*), whether it was general (t = 0.93, *ns*), specific (t = 0.94, *ns*), and total verbal cues (t = 0.24, *ns*), or physical assistance (t = -0.53, *ns*).

Task 2
There were no significant difference with the control group for the sum of errors (t = 0.99, *ns*), the number of omissions (t = -0.69, *ns*) and of erroneous execution (t = -0.40, *ns*), but Mrs H committed more initiations (t = 7.86, $p < 0.001$). She did not need more assistance than the control group to perform task 2 (t = 1.25, *ns*). Nonetheless, if the number of general assistance was clearly not higher (t = 0.54, *ns*), the number of specific verbal cues tended to be significantly higher (t = 1.47, $p = 0.08$), like the number of total verbal cues (t = 1.68, $p = 0.06$). None physical assistance was required, neither by the control group nor by the patient.

Task 3
Globally, Mrs H produced more errors (t = 4.01, $p < 0.001$), whether it were initiations (t = 4.82, $p < .001$), omissions (t = 1.97, $p < 0.05$), or erroneous executions (t = 2.23, $p < 0.05$). She also needed more assistance than the control group (t = 3.54, $p < 0.01$). Her number of general (t = 2.30, $p < 0.05$), specific (t = 2.07, $p < 0.05$), and total (t = 3.87, $p < 0.001$) verbal cues was higher. None physical assistance was required, neither by the control group nor by the patient.

Discussion
The aim of these case studies was to examine the relevance of a performance-based assessment in real-life situations in order to define the challenges faced by people with MND in the use of a common communication tool and to specify their ability. Consistent with Diehl's original method (Diehl et al., 2005), we proposed three different tasks with different constraints measuring errors produced and assistance required, for better determining the actual performances in telephone use. According to Giovannetti et al. (2008) and Giovannetti et al. (2012), the most represented errors in patients with MND are, in

order: errors of omission, commission, object substitution, and action addition.

Mr. B's performances are characterized by a higher number of initiations errors, generally and in the second task involving finding a telephone number in an extract of the Yellow Pages directory, including some unstructured and irrelevant information. Contrary to our expectations, the ecological assessment didn't show up a significant number of omissions, but some mild difficulties in planning out the action. This is apparently non-congruent with the neuropsychological evaluation, which mainly highlighted impairments in language and memory, in particular in episodic memory, and reported no significant difficulties in daily living activities. These difficulties occurred concurrently with a focused attention deficit in his goal-maintaining dimension, which is necessary to organize the smooth sequencing of the steps. Additionally, he didn't need more assistance, even if he tended to come up against difficulties in the most complex task.

Mrs. G's neuropsychological evaluation showed episodic and working memory impairment, as well as speech and attention deficits, but no significant difficulties in IADL. Nonetheless, the performance-based situation shows that Mrs. G produces more errors and needs more assistance than the control group. Despite her memory difficulties, her performances were not characterized by omissions but by execution errors in general and in the most complex task (i.e., she mainly doesn't know how to do). In particular, she repeated requests about "pressing a button after picking up the phone and dialing the number", which raises the question about the type of phone she uses to have at home or about possible confusion with the use of her cell-phone. Therefore, it would be worthwhile, in further study, to gather this type of information. Moreover, the ecological assessment highlighted a lack of progress in her flexibility ability across the 3 tasks: she remained interfered with unwanted information, which is congruent with the attention deficit highlighted by her neuropsychological evaluation. Mrs. G is the patient who required the highest number of assistance, especially in tasks 2 and 3. In this last task, all types of verbal cues are represented. On the contrary of the 2 other participants, her performances are not better in the second task. This could be congruent with the lack of learning effects observed in the neuropsychological evaluation.

The neuropsychological evaluation of Mrs. H showed overall memory deficits, as well as executive function impairment characterized by focused attention and programming disorders. Difficulties in IADL were also reported but not for telephone use. Mrs. H, whose level of education was the lowest and whose cognitive status was one of the most eroded, was also the one who made a higher number of errors, mainly of initiation type. As a matter of fact, Mrs. H didn't hang up spontaneously revealing difficulties to initiate actions, even if we have to acknowledge that, as the situation was a fictive one there was no external incitation for participants to hang up. While delayed recall disorders, assessed by neuropsychological testing, seem to be the key factor for beginning the AD (Gainotti, Quaranta, Vita, & Marra, 2014), initiations difficulties for new complex tasks, with needs for positive reinforcement could characterize the beginning of the AD in everyday life. Then, depending on more impaired cognitive functions, limitations in telephone use could be characterized by execution errors, reflecting an executive deficit in terms of working memory and focused attention impairment, or by initiation errors, reflecting an executive deficit leading to difficulties in planning, intention, and execution of the action, or by the presence of all types of error, reflecting a more severe and general cognitive impairment.

Gathered data go against the widespread representation of the MND, in which the cognitive limitations are dominated by memory disorders (e.g., Kawas et al., 2003) and may reflect the gradual influence of the pathology on the loss of autonomy. The difficulties faced by the patients seem to be partially linked to the characteristics of the situations, but also to the memorization and to the organization of the action sequences useful to complete the tasks. Our results do not confirm the quantitative hypothesis expressed by Giovannetti et al. (2008) and Giovannetti et al. (2012). Indeed, in our study, each type of error was present in the control group, in a relatively comparable way, the number of erroneous executions being barely higher. However, we have observed patterns that do not correspond to those being assumed: Considering the patients' error profiles, omissions were underrepresented, and the 3 patients with MND showed 3 different telephone use patterns. Mr. B barely distinguished himself from the control group producing more initiations, whilst Mrs. G produced a higher proportion of execution errors, and Mrs. H made more initiation errors and tended as well to produce more omissions and erroneous executions. According to an alternative qualitative hypothesis, the results suggest different patterns for different patients. The difference observed concerning the production of omissions might be explained by the inclusion of initiation errors in our taxonomy, and further studies are needed to confirm the relevance of including this error type. Limitations should be followed by more specific support (specific and total verbal cues),

indicating the evolution of functional difficulties. The observation of the telephone use in MND patients shows a hierarchical organization of the needed aids, independently of the cognitive deficits. Further research is needed to confirm whether, in order to maintain capacities as long as possible, a hierarchical approach of aids, from verbal general to physical ones, may be useful to all patients, whatever their difficulties.

The results obtained about the support provided to participants are substantially different. It supports a hierarchical need of aid, from the more general to the more specific, regardless of the type of errors. If the 3 patients needed or tended to need more assistance (up to 32 times for Mrs. G), a low level of cueing ("general verbal") was generally sufficient to succeed in the phone use tasks. Mrs. G was the one who needed the greatest number of assistance, particularly general verbal cues, corresponding to a great number of requests for support or confirmation, reflecting difficulties in understanding the proposed fictive situation and heeding the help proffered by the investigator. Whilst Mrs. H was requiring less help than Mrs. G, they both needed a greater number of specific and total verbal cues than Mr. B. While analyzing errors gives indications on the level of autonomy, as the ability to plan, anticipate, and choose, analyzing assistance tells us something different about the dependence, that is, about the need for help to do everyday tasks and to adapt to the environment. In order to better describe the difficulties encountered, future research should relevantly include, in the categorization of assistance, some information about the content, particularly concerning general verbal aids that can be of a different kind: confirmation, aid for understanding, etc. (Nygård & Starkhammar, 2003).

Even if our objective was not to generalize the results obtained in the 3 patients to daily functioning, we acknowledge several limitations to this study. First, the case study approach does not enable us to clearly analyze the relation between the number of each type of error and the severity of the MND. Secondly, we did not explore the inter-rater reliability to verify the objectivity of our analysis grid and to avoid errors of categorization. It would also have been pertinent to consider the time required for each task. We also did not take into account, in our evaluation of the telephone use, the communication and conversation domain. Finally, in our study, contrary to Diehl's findings, participants did not perform better in the first task, then the hierarchical difficulty of the tasks is not confirmed. Thus, more research is needed to confirm our results and to advance in the understanding of the data compiled. Especially, further experiments may take into account individual preferences (Doig, Fleming, Kuipers, & Cornwell, 2010) that could motivate the resolution of the daily task, and also the nature of some errors. Further research is needed to confirm whether, in order to maintain capacities as long as possible, a hierarchical approach of aids, from verbal general to physical ones, may be useful to all patients, whatever their difficulties. In order to better describe the difficulties encountered, it should be relevant to include, in the categorization of assistance, some information about the content, particularly concerning general verbal aids that can be of a different kind: confirmation, aid for understanding, etc.

Conclusion

The main result of this study is the demonstration of dissociation between the decontextualized cognitive performances and the cognitive performances highlighted in the context of the use of current technology. This result is particularly important because it is still widely considered that the cognitive performances of aging people with loss of autonomy evaluated by neuropsychological tests can predict the actual use of technologies (e. g., Schmidt & Wahl, 2018). A second result is the demonstration of dissociation between the hetero-assessment of the ability to use current technology and the observation of real difficulties in a contextualized situation. None of the evaluations usually carried out, therefore, make it possible to affirm that an older person is able to use the technology without making errors. As such, the association of these two results leads us to propose a paradigm shift in the way of characterizing cognitive difficulties for the use of technologies. In fact, this double dissociation invites to move from a conception of the evaluation based on efficiency to a mechanistic conception, focused on true cognitive effects, which will allow to conceive technological solutions and associated human means better adapted to the reality of the varieties of functioning. As claimed by Peine and Neven (2018), we were able to show that older people can be seen as heterogeneous groups and more particularly that the difficulties of using technology can be due to various disabilities. If performances are observed in an accurate and well-structured manner, MND patients, who apparently don't face obvious difficulties in telephone use (assessed with a self- and caregiver-report questionnaire), present specific difficulties (initiating actions, planning out the action, and being flexible across the situations) and different needs of assistance.

The method used in our study could be a useful direct observation complementary tool for neuropsychological examination, since it provides significant information, not only about errors profiles but also about compromised steps and cues

profiles. We consider this knowledge as fundamental to provide better guidance for designing appropriate gerontechnology, but also new ways to support the use of these technologies, taking into account the variety of user profiles. In addition, contrary to direct observation in the daily environment, this method is not time-consuming, even if we can question the ecological validity of our standardized tasks. As the presence of the observer might influence the patients' performance, and as it is necessary to avoid their defects in front of evaluation tasks, the observation of the manner they use human supports seems to be a great opportunity to better understand their learning and self-correctness abilities.

References

Adam, S., & GREMEM, I. (2008). Tâche de rappel libre/Rappel indicé à 16 items. In L. Hugonot-Diener, E. Bardeau, B. F. Michel, C. Thomas-Antérion, & P. Robert (Eds.), GREMOIRE: tests et échelles de la maladie d'Alzheimer et des syndromes apparentés (pp. 126-128). Marseille, France: Solal.

American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders (DSM 5th ed.). Arlington, VA: American Psychiatric Publishing.

Anselme, P., Poncelet, M., Bouwens, S., Knips, S., Lekeu, F., Olivier, C., Majerus, S. (2013). Profinteg: a tool for real-life assessment of activities of daily living in patients with cognitive impairment. Psychologica Belgia, 53(1), 3-22. https://doi.org/10.5334/pb-53-1-3.

Bachy-Langedock, N. (1989). Batterie courte spécifiquement adaptée à l'examen des troubles en dénomination chez le sujet âgé. Batterie d'examen des troubles en dénomination. Bruxelles, Belgique: Editest.

Baddeley, A., Emslie, H., & Nimmo-Smith, I. (1994). The Doors and People Test: a test of visual and verbal recall and recognition. Bury St Edmunds, UK: Thames Valley Test Company.

Barberger-Gateau, P., Commenges, D., Gagnon, M., Letenneur, L., Sauvel, C., & Dartigues, J.-F. (1992). Instrumental activities of daily living as a screening tool for cognitive impairment and dementia in elderly community dwellers. Journal of the American Geriatrics Society, 40, 1129-1134. https://doi.org/10.1111/j.1532-5415.1992.tb01802.x.

Crawford, J. R., Garthwaite, P. H., & Porter, S. (2010). Point and interval estimates of effect sizes for the case-controls design in neuropsychology: Rationale, methods, implementations, and proposed reporting standards. Cognitive Neuropsychology, 27, 245-260. https://doi.org/10.1080/02643294.2010.513967.

Deltour, J. J. (1993). Echelle de vocabulaire Mill Hill de J. C. Raven : Adaptation française et normes comparées du Mill Hill et du Standard Progressive Matrices (PM38). Manuel et Annexes. Braine le Château: Application des Techniques Modernes.

Diehl, M., Marsiske, M., & Horgas, A. L. (2005). The Revised Observed Tasks of Daily Living: A performance-based assessment of everyday problem solving in older adults. Journal of Applied Gerontology, 24(3), 211-230. https://doi.org/10.1177/0733464804273772.

Doig, E., Fleming, J., Kuipers, P., & Cornwell, P. L. (2010). Clinical utility of the combined use of the Canadian Occupational Performance Measure and Goal Attainment Scaling. American Journal of Occupational Therapy, 64(6), 904-914. https://doi.org/10.5014/ajot.2010.08156.

Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). Mini-mental state. A practical method for grading the cognitive state of patients for the clinician. Journal of Psychiatric Research, 12(3), 189-198. https://doi.org/10.1016/0022-3956(75)90026-6.

Gainotti, G., Quaranta, D., Vita, M. G., & Marra, C. (2014). Neuropsychological predictors of conversion from mild cognitive impairment to Alzheimer's disease. Journal of Alzheimer's Disease, 38(3), 481-495. https://doi.org/10.3233/jad-130881.

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. https://doi.org/10.1037/0894-4105.22.2.235.

Giovannetti, T., Britnell, P., Brennan, L., Siderowf, A., Grossman, M., Libon, D. J., Seidel, G. A. (2012). Everyday action impairment in Parkinson's disease dementia. Journal of the International Neuropsychological Society, 18(5), 787-798. https://doi.org/10.1017/s135561771200046x.

Giovannetti, T., Schwartz, M. F., & Buxbaum, L. J. (2007). The Coffee Challenge: a new method for the study of everyday action errors. Journal of Clinical and Experimental Neuropsychology, 29(7), 690-705. https://doi.org/10.1080/13803390600932286.

Hirt, J., Burgstaller, M., Zeller, A., & Beer, T. (2019). Needs of people with dementia and their informal caregivers concerning assistive technologies-a scoping review. Pflege, 32, 295 – 304.

Hugonot-Diener, L. (2008). Mini-Mental-Status de Folstein (MMS) version GRECO consensuelle. In L. Hugonot-Diener, E. Barbeau, B. F. Michel, C. Thomas-Antérion, & P. Robert (Eds.), GRÉMOIRE: tests et échelles de la maladie d'Alzheimer et des syndromes apparentés (pp. 65-69). Marseille, France: Solal.

Juillerat Van der Linden, A.-C. (2008). Démence de type Alzheimer et évaluation des activités de la vie quotidienne. In A.-C. Juillerat Van der Linden, G. Aubin, D. Le Gall, & M. Van der Linden (Eds.), Neuropsychologie de la vie quotidienne. Marseille, France: Solal.

Katz, S., Ford, A. B., Moskowitz, R. W., Jackson, B. A., & Jaffe, M. W. (1963). Studies of illness in the aged. The index of ADL: A standardized measure of biological and psychosocial function. The Journal of American Medical Association, 12(185), 914-919.

Kawas, C. H., Corrada, M. M., Brookmeyer, R., Morrison, A., Resnick, S. M., Zonderman, A. B., & Arenberg, D. (2003). Visual memory predicts

Alzheimer's disease more than a decade before diagnosis. Neurology, 60, 1089–1093. https://doi.org/10.1001/archneur.60.8.1089.

Lawton, M. P., & Brody, E. M. (1969). Assessment of older people: Self-maintaining and instrumental activities of daily living. Gerontologist, 9, 179-186.

Lorenz, K., Freddolino, P. P., Comas-Herrera, A., Knapp, M., & Damant, J. (2019). Technology-based tools and services for people with dementia and carers: Mapping technology onto the dementia care pathway. Dementia, 18(2), 725-741.

Luria, A. R. (1966). Higher cortical functions in man. New York, NY: Basic Books Inc Publishers.

Mahieux, F., Fabre, C., Galbrun, E., Dubrulle, A., & Moroni, C. (2009). Validation d'une batterie brève d'évaluation des praxies gestuelles pour Consultation Mémoire. Evaluation chez 419 témoins, 127 MCI et 320 patients souffrant d'une démence. Revue Neurologique (Paris), 165, 560-567. doi:10.1016/j.neurol.2008.11.016.

McKhann, G. M., Drachman, D., Folstein, M., Katzman, R., Price, D., & Stadlan, E. M. (1984). Clinical diagnosis of Alzheimer's disease: Report of the NINCDS-ADRDA Work Group under the auspices of Department of Health and Human Services Task Force on Alzheimer's Disease. Neurology, 34(7), 939-944. https://doi.org/10.1212/wnl.34.7.939.

Meulemans, T. (2008). La batterie GREFEX. In O. Godefroy & le GREFEX (Eds.), Fonctions exécutives et pathologies neurologiques et psychiatriques. Évaluation en pratique clinique (pp. 217-229). Marseille, France: Solal.

Mitzner, T. L., Boron, J. B., Fausset, C. B., Adams, A. E., Charness, N., Czaja, S. J., Sharit, J. (2010). Older adults talk technology: Technology usage and attitudes. Computers in Human Behavior, 26(6), 1710-1721. https://doi.org/10.1016/j.chb.2010.06.020.

Moore, D. J., Palmer, B. W., Patterson, T. L., & Jeste, D. V. (2007). A review of performance-based measures of functional living skills. Journal of Psychiatric Research, 41, 97-118. https://doi.org/10.1016/j.jpsychires.2005.10.008.

Neistadt, M. E. (1994). A meal preparation treatment protocol for adults with brain injury. American Journal of Occupational Therapy, 48(5), 431-438. https://doi.org/10.5014/ajot.48.5.431.

Nelson, H. E. (1976). A modified card sorting test sensitive to frontal lobe defects. Cortex, 12, 313-324. https://doi.org/10.1016/S0010-9452(76)80035-4.

Nygård, L., Pantzar, M., Uppgard, B., & Kottorp, A. (2012). Detection of activity limitations in older adults with MCI or Alzheimer's disease through evaluation of perceived difficulty in use of everyday technology: A replication study. Aging & mental health, 16(3), 361-371. https://doi.org/10.1080/13607863.2011.605055.

Nygård, L., & Starkhammar, S. (2003). Telephone use among noninstitutionalized persons with dementia living alone: mapping out difficulties and response strategies. Scandinavian Journal of Caring Sciences, 17(3), 239-249. https://doi.org/10.1046/j.1471-6712.2003.00177.x.

Nygård, L., & Starkhammar, S. (2007). The use of everyday technology by people with dementia living alone: mapping out the difficulties. Aging Ment Health, 11(2), 144-155. https://doi.org/10.1080/13607860600844168.

Patterson, T. L., & Mausbach, B. T. (2008). The UCSD Performance-based Skills Assessment Administration Manual. Ver. 2.4 (UPSA-2-VIM). San Diego, CA: University of California, Department of Psychiatry.

Peine, A., & Neven, L. (2018). From intervention to coconstitution: new directions in theorizing about aging and technology. The Gerontologist, 59(1), 15-21.

Ramage, A., Bayles, K., Helm-Estabrooks, N., & Cruz, R. (1999). Frequency of perseveration in normal subjects. Brain Lang, 66(3), 329-340. doi:10.1006/brln.1999.2032.

Reed, E. S., Montgomery, M., Schwartz, M., Palmer, C., & Pittenger, J. B. (1992). Visually based descriptions of an everyday action. Ecological Psychology, 4(3), 129-152. https://doi.org/10.1207/s15326969eco0403_1.

Schmidt, L. I., & Wahl, H. W. (2018). Predictors of performance in everyday technology tasks in older adults with and without mild cognitive impairment. The Gerontologist, 59(1), 90-100.

Schwartz, M. F., Montgomery, M. W., Buxbaum, L. J., Lee, S. S., Carew, T. G., Coslett, H., Mayer, N. (1998). Naturalistic action impairment in closed head injury. Neuropsychology, 12(1), 13-28. https://doi.org/10.1037/0894-4105.12.1.13.

Schwartz, M. F., Montgomery, M. W., Fitzpatrick-desalme, E. J., Ochipa, C., Coslett, H. B., & Mayer, N. H. (1995). Analysis of a disorder of everyday action. Cognitive Neuropsychology, 12(8), 863-892. https://doi.org/10.1080/02643299508251406.

Signoret, J.-L. (1991). Batterie d'efficience mnésique: BEM 144. Paris, France: Elsevier.

Topo, P., Jylhä, M., & Laine, J. (2002). Can the telephone-using abilities of people with dementia be promoted? An evaluation of a simple-to-use telephone. Technology and Disability, 14(1), 3-13.

Van der Linden, M., Coyette, F., Poitrenaud, J., Kalafat, M., Calicis, F., Wyns, C., les membres du GREMEM. (2004). L'Épreuve de Rappel Libre/Rappel Indicé à 16 Items (RL/RI-16). In M. Van der Linden, S. Adam, A. Agniel, & les membres du GREMEM (Eds.), L'évaluation des troubles de la mémoire: Présentation de quatre tests de mémoire épisodique (avec leur étalonnage) (pp. 25-47). Marseille, France: Solal.

Verbeek, H., Meyer, G., Challis, D., Zabalegui, A., Soto, M. E., Saks, K., Hamers, J. P. (2015). Inter-country exploration of factors associated with admission to long-term institutional dementia care: evidence from the RightTimePlaceCare study. Journal of Advanced Nursing, 71(6), 1338-1350. https://doi.org/10.1111/jan.12663.

Warrington, E. K., & James, M. (1991). The Visual Object and Space Perception Battery. Bury St Edmunds, UK: Thames Valley Test Company.

Wechsler, D. (1997). Wechsler Adult Intelligence Scale (Third edition). San Antonio, TX: The Psychological Corporation.