

Original articles

Compensating strategies for impaired episodic memory and time orientation in a patient with Alzheimer's disease

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Abstract

A dedicated training program for teaching a patient with Alzheimer's disease to independently use an agenda is presented. This training capitalises on preserved cognitive abilities and incorporates principles from learning theories. This case study reports the effective use of a memory book for daily life activities and of a digital clock for time reorientation.

Key words : Alzheimer's disease ; memory deficit ; cognitive rehabilitation ; prosthetic aid.

Introduction

It is now acknowledged that Alzheimer's disease (AD) patients do not necessarily present a global clinical deterioration and that the disease can selectively impair some cognitive processes or systems, while sparing others. It is well documented that AD is mainly characterised by a poor performance on episodic memory tests. A disorientation in time and an impairment of executive functions are also observed from the early stages of the disease. However, AD patients show some spared cognitive abilities. For example, they can acquire new perceptual-motor skills, suggesting that procedural memory may be preserved (e.g. Deweer *et al.*, 1994). Using preserved abilities, it is now possible to design early cognitive interventions in AD patients (Van der Linden *et al.*, 1991 ; Juillerat *et al.*, 2000) in order to improve their autonomy in daily life activities. Taking into account the complexity of mental processes and the heterogeneity of their disorganisation, the intervention will aim, by means of individual and tailored interventions, to help the patients to maintain an autonomous and pleasant life for as long as possible. A rehabilitation program begins with an assessment of a patient's cognitive deficits by using tests underpinned by a model of normal cognitive functioning, and an identification of the patient's daily life impairments, by use of questionnaires, observation and simulations. The clinical management of memory problems in patient with AD could follow three directions (see Van der Linden, 1995 ; Camp &

Foss, 1997 ; Juillerat *et al.*, 2000, for reviews) : (1) temporary facilitation of encoding and/or retrieval using optimising factors (Bäckman *et al.*, 1991 ; Bird & Luszcz, 1993) ; (2) teaching of specific facts or skills in order to make the patient more independent in everyday life using techniques that rely on preserved memory systems (Abrahams & Camp, 1993 ; Bird, Alexopoulos & Adamowicz, 1995 ; Vanhalle *et al.*, 1998) ; and (3) structuring the patient's environment and providing external memory aids in order to compensate for defective memory functions (see for example Camp *et al.*, 1996).

We report a cognitive rehabilitation programme that aimed at teaching an AD-patient to use an external aid to palliate her memory problems. This programme was based on the techniques described by Sohlberg & Mateer (1989) in which a structured training sequence is designed for teaching individuals with severe memory impairments (amnesic without dementia) to utilise a compensatory memory book. According to these authors, the training has to contain three phases : an acquisition stage, in which the patient becomes familiar with the purpose and use of each different section in the memory book ; an application stage, in which the patient learns when and where to use a note book ; and an adaptation stage, in which the patient demonstrates appropriate use in natural settings. We capitalized on techniques that take advantage of procedural and implicit abilities which were demonstrated to be preserved in various studies on AD. An adapted use of a digital clock allowed our patient to deal with time disorientation. This rehabilitation required the active participation of the patient's husband. Effectively, the caregiver should be trained to adapt the patient's physical environment, to help with use of external aids and to facilitate their use (see Day *et al.*, 2000 ; Teresi *et al.*, 2000).

Patient's history

The patient MA, a right-handed female, was a 66-year-old when she first visited our memory clinic. She was accompanied by her husband who

reported her progressive memory deficits for recent information and the patient's tendency to ask the same questions several times. MA had 12 years of education. She worked as a decorator with her husband. MA could not give any precise information concerning her medical history and her husband did not report previous clinical problems that might account for these deficits. He reported an episode of confusion four years earlier without consequences apart from anxiety. There was no family history of memory disorder.

A neurological examination demonstrated a disorientation in time as well as memory impairments. An early stage of degenerative dementia was suspected, and complementary neuropsychological investigations were undertaken.

NEUROPSYCHOLOGICAL INVESTIGATIONS

MA obtained a Mini Mental State Examination score of 21/30 (Folstein *et al.*, 1975) and a score of 123/144 on the Dementia Rating Scale (DRS ; Mattis, 1973). A standard battery of neuropsychological tests was administered, including tasks sensitive to early signs of Alzheimer's disease (see table 1). MA spoke fluently, without word finding difficulty. There were no signs of object agnosia. Her short-term memory, measured with the forward digit span test and the Corsi block-tapping procedure (Milner, 1971), was normal. She also showed normal performance in several attentional and executive tasks, the Trail Making Test (Reitan & Wolfson, 1995) and the Stroop task (Stroop, 1935). A severe episodic memory deficit was observed at a cued episodic memory test (The RI-48 task, Adam *et al.*, in press). In this task, the patient had to memorise 48 words belonging to 12 different categories. These words were presented on 12 cards of four items each. In the encoding phase, the subject was asked to name aloud each item when its category cue was presented (semantic encoding). After a short interfering task, a category cue was given and the patient was asked to recall the words. A severe visual episodic memory deficit was also shown in the Form Test (Baddeley *et al.*, 1994) in which MA had to copy and reproduce from memory four drawings. A low performance was observed in the Alpha Span task testing the central executive of working memory (Belleville *et al.*, 1998). This task measured the ability to manipulate information stored in working memory by comparing the recall of words in serial order (implicating only storage of information) and alphabetical order (implicating storage and manipulation of information). Finally, MA performed poorly in a phonemic and semantic fluency task in which the patient had to generate, within two minutes, as many words as possible beginning with de letter "p" or belonging to the animal semantic category.

DIAGNOSIS

Taking into account MA's clinical history and the neuropsychological examination, a diagnosis of probable AD was proposed (McKhann *et al.*, 1984). A CT-Scan revealed no abnormality. A positron emission tomography (18FDG-PET) examination showed a moderate decrease of metabolism in the left temporal regions, consistent with a diagnosis of Alzheimer's disease. A treatment with an acetylcholinesterase inhibitor was initiated.

One year later, a new neuropsychological evaluation was undertaken. The patient was again administered a standard battery of neuropsychological tests. MA's language was still fluent. There were no signs of apraxia. Her short-term memory was low but still within the norms. MA performed lower than the previous year at the RI-48 task, at the Alpha Span task (with a deficit at the span part of the test) and at the phonemic and semantic fluency tasks. A severe visual episodic memory deficit persisted in the Form Test and a decreased performance was observed in the Door Test, although performance on the latter remained within the normal range. In the Stroop task, the patient produced many errors in the interference condition, suggesting an inhibition deficit. Finally, the increased number of errors in the Trail Making Test Part B indicated a cognitive flexibility problem.

Medication was not sufficient to resolve existing daily life problems and the possibility of a rehabilitation programme at the University Hospital Memory Centre was discussed with MA and her husband when she was 68 years old.

Initial Evaluation at the Memory Centre

On admission, MA's husband reported memory deficits, repetitive questions, forgetting of telephonic conversations, temporal disorientation, inefficient use of a personal diary (wrong page, forgetting to take notes, use of other supports). MA accepted her memory difficulties but minimised them and thought she used her diary correctly. The complaints were identified by MA's husband in the Revised Memory and Behaviour Checklist (Teri *et al.*, 1992) : a high frequency of memory deficits (repetitive questioning, difficulties in recalling recent events) generated an important feeling of annoyance for the husband (table 2). This scale also showed that the patient slept more than before, difficulties in concentrating on a task, and a temporal disorientation. The husband sometimes observed that MA expressed sad feeling about the future, seemed anxious, and gave up activities earlier than she used to. The IQ-code scale (Jorm *et al.*, 1992) confirmed these observations by showing a memory reduction in information about friends, recent

Table 1
Assessment of MA's general neuropsychological abilities

	Raw score	Normative data mean (SD)	Performance
<i>Working memory</i>			
• Digit span	4	6.14 (1.22)	low
• Block Tapping Test	5	4.77 (0.95)	normal
• Alpha-Span			
Word Span	5	4.86 (0.78)	normal
Serial Recall Condition	7/10	8.76 (1.30)	normal
Alphabetical Recall Condition	2/10	6.31 (2.83)	low
Decrease Performance Rating (%)	71.4	29.69 (29.23)	low
<i>Episodic Memory</i>			
• Verbal memory test			
Cued episodic memory Test (Buschke 48)			
Direct recall	26	39.33 (4.54)	Impaired
Cued Recall	3	27.11 (4.47)	Impaired
Intrusions	6	2.39 (2.81)	Low
• Visual memory test (Baddeley)			
Form test		< percentile 5	Impaired
Doors Test		Percentile 50-75	normal
<i>Attentional and Executive Functioning</i>			
• Trail Making Test			
Part A	38"	60.08 (26.76)	normal
Part B	118"	118.50 (50.67)	normal
• Stroop Task			
Naming Time (sec)	59	68.03 (14.6)	normal
Errors	0	0.82 (1.1)	normal
Reading Time (sec)	46	45.43 (10.05)	normal
Errors	0	0.10 (0.4)	normal
Interference Time (sec)	110	127.76 (32.89)	normal
Errors	4	1.87 (1.78)	low
• Code (Wais-R)	8	10 (3)	normal
<i>Oral Language</i>			
• Naming Battery	53/64	58 (2.90)	normal
• Phonemic Fluency Task	13	25.57 (6.02)	Impaired
• Semantic Fluency task	15	38.71 (9.78)	Impaired
<i>Instrumental Functioning</i>			
• Visuo-spatial abilities - geometric form copy			normal
• Praxies			normal
• Visual perception			normal

events, the current day and month. This scale also revealed a difficulty to learn new information, to locate objects, as well as more comprehension difficulties.

In the Neuropsychiatric Inventory (NPI, Cummings *et al.*, 1994), neither behavioural nor neuropsychiatric problem was shown. No sign of depression was detected with the Geriatric Depression Scale (Sheikh & Yesavage, 1986). A bespoke scale designed to assess the burden resulting from everyday life caring for a AD patient indicated no general burden (Zarit *et al.*, 1980). Although cognitive problems were frequent and disturbing, care giving was not considered as an important burden by the husband. In addition, no significant deficit was observed on scales assessing the patient's autonomy in instrumental (automatic) everyday life activities (Lawton *et al.*, 1969; Teunisse & Derix, 1991).

Rehabilitation contract

A 3-month rehabilitation contract was proposed including two sessions a week. The objective was to reduce the occurrence of memory lapses by promoting the use of an adapted memory notebook. The memory rehabilitation programme consisted in teaching MA to use a notebook in which she had to keep note of her meals and telephone messages. Her husband was asked to take note of appointments, tasks to do and other activities (pick up grand children at school etc.). The intervention of the husband was required because MA used abbreviations that she didn't understand subsequently and her relative anosognosia made it difficult to resolve this problem. The training programme was organised in two steps and was based on a simplified version of rehabilitation described by Sohlberg & Mateer (1989).

Table 2

General evaluation after 6 months of rehabilitation

Initial Assessment	After 3 Months	After 6 Months	Comments	
MMSE	21/30	18/30	20/30	
Mattis Dementia Rating Scale	124/144	123/144	117/144	Decreasing in verbal initiation
Revised Memory and Behavior Checklist				
Frequency	0.60/4	0.42/4	0.28/4	Improvement observed for the next items (decreasing order)
Reaction	2.27/4	1.08/4	0.64/4	
				<ul style="list-style-type: none"> • Forget the day • Repetitive questions • To have difficulties in concentrating on a task • To speak about death • To be tired • To be sad or depressed slight decrease in : memory for recent events (not in the diary) ; felling to be a burden ; to be tired
IQ-Code	3.88/5	2.44/5	2.75/5	<ul style="list-style-type: none"> • Improvement observed for the next items • Recent event memory • Day and month knowledge • Conversation memory • To use electric apparatus • To use intelligence to understand a situation Decrease in : memory for place of things (to remember usual place or to find things in a wrong place)
	Globally slight decrease with regard to before	globally slight improvement since 3 months	globally no change since 3 months	
Neuropsychiatry Inventory				
Objective burden	0/144	0/144	0/144	
Subjective burden	0/60	0/60	0/60	
Instrumental Activity of Daily Living	14/31	14/31	14/31	No change
Burden Assessment	15/88 or 0.68/4	13/88 or 0.59/4	13/88 or 0.59/4	No burden
Teunisse's scale (IDDD)	163/165 or 4.9/5	123/231 or 3.88/7	132/231 or 4/7	Improvement in : Expression (less repetitive questions) ; MA is more active
	5/5 : no problem 0/5 : autonomy lost	4/7 : no change with regard to precedent evaluation 7/7 : marked deterioration 0/7 : marked improvement		Slight decrease in knowing place of things

TRAINING PHASE

Because of the evolutive nature of the disease, the Solhberg & Mateer's original three-step method was reduced to a two-step training.

The first step consisted of an acquisition and an application part : the training aimed at encouraging MA to demonstrate explicit knowledge of the purpose of her agenda. On every session, this familiarisation training was performed through the repetitive administration of 10 questions regarding the agenda's content and specific use ; other questions were asked to assess her spontaneous use of the agenda (see annex 1). MA learned new information by expanded rehearsal technique or "spaced retrieval" (Camp, 1989 ; Camp *et al.*, 1996 ; Camp & Mckitrick, 1992) which prompted recall of information over increasingly longer retention intervals. The patient was given specific information to remember and immediate recall was asked. If the retrieval attempt was successful, the next attempt

involved a longer interval before the presentation of the information and the time of recall. Following a recall failure, the interval was decreased to that of the previous successful trial. This learning was combined with a procedural training in which MA had to carry out appropriate manipulations of the agenda : selection of the correct page of the agenda, adequate note taking and appropriate retrieval of information. To induce agenda use through questions, we first provided a minimal cue ("how could you know this information ?"). If a correct response was not obtained, increasingly more explicit cues were presented until MA produced the correct response or action ("don't you have something to help ?" ; "is it not written somewhere ?" etc.).

Gradually, the patient needed fewer cues to produce correct responses, suggesting an automation of this behaviour. MA showed from the beginning a good knowledge about the practical use of her agenda. After 8 sessions, MA's performance on the questionnaire reached ceiling during five

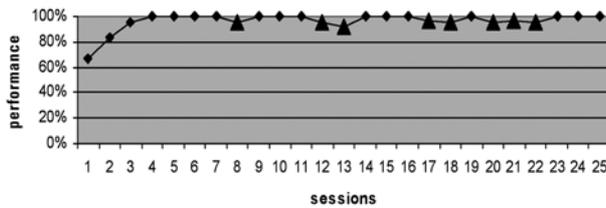


Figure 1 shows results at questions asked to assess knowledge about agenda's use and spontaneous consulting. After 8 sessions, MA reach 100% of performance for 5 consecutive sessions. This rapid learning was followed by performance variability, due to time disorientation.

consecutive trials. The procedural training was initiated, but MA made mistakes when selecting the page in her agenda because she ignored the date (Fig. 1).

TRANSFER PHASE

In the second phase of the programme, patient had to demonstrate her ability to use the agenda in "ecological" situations (relating to daily life activities). This phase of transfer began 4 weeks into the program. It was based on interviews conducted in the training phase, during which the use of the agenda was measured. Because it was not possible to simulate every real life situation in which the use of her agenda was required, MA's use of the agenda was observed during memory group activities. This was possible because our Centre also offers leisure-oriented activities that patients enjoy and during which they socialise (see Camp, 2001 ; Judge, Camp, & Orsulic-Jeras, 2000 ; Romero and Wenz, 2001). The leisure time allows staff to observe the patients' difficulties and detect unsuspected preserved abilities. These group activities were also created in our Memory Centre to replace occupational activities and to propose more ecological situations than desk work tasks to transfer learning. They consisted of a quiz game (on topics such as news, temporal and spatial orientation or the conversion rate of the Euro) in which the questions are adapted for our population of patients. MA's spontaneous use of her agenda was observed in this situation. During the game, MA also had to answer questions about recent personal (episodic) life events and temporal orientation, which required her to check her agenda (e.g., "when did you come here last time ?", "what did you prepare for dinner yesterday ?", "what is the date today ?"). Our observations confirmed that MA could not retrieve the exact page in her agenda because she did not know which date to look for (Fig. 2).

Finally, we gave MA homework to confirm the learning transfer in daily life situations (e.g., to bring specific information for the next visit, to call the Memory Centre from home at a given time).

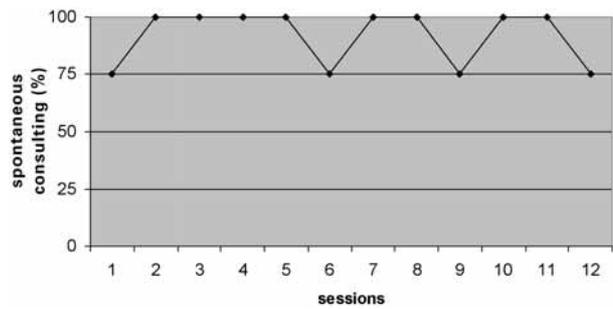


Figure 2 shows spontaneous agenda consulting during memory group activity : fluctuation of performance concerns questions about the day.

MA's husband was provided with some training to help MA to use the external aid. This training consisted in teaching him techniques to encourage MA to use her agenda, as well as role play exercises.

Evaluation after 3 months of rehabilitation

A general evaluation was undertaken after 3 months of intervention, at the end of the contract. With regard to general cognitive functioning, the score on the DRS remained stable (from 124/144 to 123/144) and a slight decrease was observed on the MMSE (from 20/30 to 18/30).

With regard to the Revised Memory and Behavior Checklist, MA's husband identified fewer deficits than in the initial assessment. A significant decrease was also observed in the number of complaints concerning memory losses for recent events, and MA was aware of the date and month. There was improvement in the recall of recent events, in concentrating on a task, in retrieving the date ; fewer repetition of the same questions, less anxiety, and fewer expressions of sadness when thinking about future. The husband's perception of MA's memory deficit for recent events and temporal disorientation problems also decreased on the IQ-Code Scale : improvements were observed for memory about friends, recent events, and the current day and month. However, we observed an increase in the loss of objects. The improvements were mainly observed in situation in which the use of the agenda provided help.

The husband explained that MA did not repeat questions as frequently as before but that most of her questions concerned the location of information in her agenda (she would typically asked her husband's confirmation for page numbers).

Second rehabilitation contract : reducing temporal disorientation

The second contract aimed at reducing the perseveration in asking the same questions about the current day of the week and date by using a digital clock.

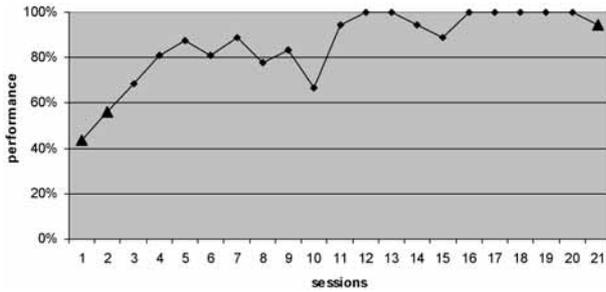


Figure 3 shows improvement of performance at questions regarding clock use and spontaneous consulting. The first data point corresponds to baseline. At sessions 2, labels were stuck on the clock. At the last session (21) performance decreased when labels were removed.

A method similar to that used in the first contract was chosen to promote an automatic use of a digital clock. In fact, MA's husband bought an automatically "set by satellite" clock a few months before (at the beginning of the first intervention) thinking MA would use it to know the day of the week. Despite his repeated explanations, MA thought it was a radio. A baseline observation performed at the onset of this contract emphasised a problem with the recognition of the clock and also with understanding of the data displayed on it (date, day, month).

TRAINING

As described earlier, the first step consisted in an acquisition and application phase: the training was focused on teaching MA to demonstrate explicit knowledge about the purpose of the clock and its use. Other aspects of the training concerned the spontaneous use of the clock (see annex 2).

Early observations showed clear deficits in identifying the date and month among other information displayed on the clock. Since our objective was to automate a quick check of the clock, we decided to stick labels on the clock to facilitate its use and decrease the interference from irrelevant information. These labels were removed in the last training session. At that point we observed MA still had difficulties to report the current month. We therefore decided to reinstate the labels. Figure 3 illustrates the improvement of MA when answering questions about the information available on the clock.

TRANSFER

In the transfer phase, we assessed MA's learning in a more realistic context, that of group memory activities in the Centre. The quiz game was adapted to include specific questions requiring the use of the clock (see Figure 4). One difficulty was to question MA often enough to obtain sufficient data: across the different group activity sessions, the

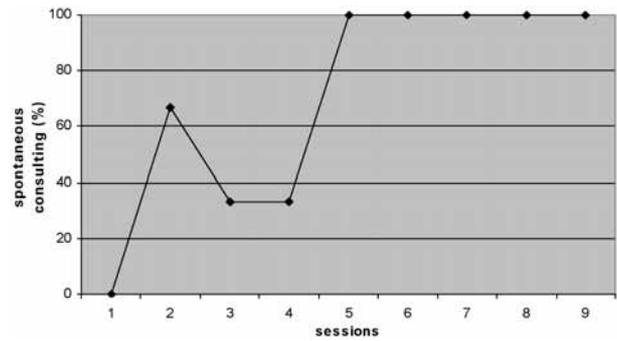


FIG. 4. — Gradual improvement in spontaneous clock consulting in memory group activity.

smallest number of personal questions was three. However we observed that MA checked the clock every time it was necessary in at least five consecutive trials.

Evaluation after 6 months of rehabilitation

A general evaluation was undertaken 6 months after the onset of the intervention, at the end of this contract (see Table 2). With regard to general cognitive functioning, MMSE score remained stable but a decrease was observed on the DRS.

At the Revised Memory and Behavior Checklist, MA's husband identified fewer deficits than in the last assessment. The husband's perception of MA's memory deficits for recent events decreased, as did the repetition of the same questions and the temporal disorientation, measured on the IQ-Code Scale. The improvements mainly related to tasks requiring the use of the clock and the agenda. However, we observed an increase of the loss of objects as well as more attentional difficulties and memory losses for recent events information that was not written down in the agenda.

Conclusions

Early cognitive rehabilitation of individuals with AD can be beneficial in many ways. In spite of important episodic memory impairments, it is possible to increase the daily life autonomy of AD patients using cognitive training, capitalising on preserved abilities and using prosthetic aids. This can lead to a better quality of life for patients and their caregivers.

Camp and collaborators (Camp *et al.*, 1996) demonstrated the usefulness of a spaced retrieval technique but also showed that this method can be incorporated into the natural environment of AD patients. This technique has also been successfully used to teach patients the use of an external aid. However, these initial findings clearly needed to be replicated and generalised.

Several authors (Bourgeois, 1990, 1991, 1993 ; Bourgeois & Masson, 1996 ; Hoerster *et al.*, 2001) have demonstrated that patients with dementia are able to use a memory book to improve the quality of their conversations. This prosthetic aid contains simple sentences, pictures and personal facts to reduce the impact that cognitive deficits may have on everyday activities. After caregivers were given intensive training on the use of this tool, the conversational interaction with the patients significantly improved.

An external memory aid has also been used by Lekeu *et al.* (personal communication) in an AD patient to reduce topographical disorders. The aid contained cards describing routes corresponding to walks and shopping activities familiar to the patient prior to the disease. By procedural training and by automation of the use of cards, the patient showed a substantial increase of spontaneous walks and shopping activities after three months.

The intervention programme designed to minimise the impact of cognitive deficits in our patient constitutes an illustration and a synthesis of these approaches. We demonstrated that teaching a patient with early Alzheimer disease how to use an agenda is possible and useful. The feasibility of training the patient the use of a clock was also demonstrated. An important benefit of the use of the clock was that it helped the patient choose the correct page in her agenda. A calendar was available but the patient did not use it.

While a slight increase in cognitive deficits was observed at DRS across the intervention, the complaints concerning the daily impact of these memory deficits significantly diminished, as did the repetition of the same questions, temporal disorientation, and the husband's level of annoyance relative to these problems. The benefit of the intervention was not limited to the memory for events written down in the agenda ; it generalised to other everyday life activities : MA repeated questions less frequently, took a more active role in conversations and became more active with respect to housework. At a behavioural level, MA was less tired and no longer felt useless. The rehabilitation took place in a multidisciplinary memory centre, which simulated real-life situations to improve the therapy's effectiveness and to facilitate transfer of knowledge to home. Globally, the intervention proposed in the Memory Centre led to a better functioning of the relationship between MA and her husband, and better family and social life. This study also illustrates the necessity to assess impaired and preserved abilities and to pinpoint their repercussions in daily life.

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Annex 1 : Acquisition and application of agenda

	session		
What is the day ? and the date ? (without agenda) ?	No rating		
Spontaneous consulting of agenda	Application		
(If no consulting), how could you know it ?	acquisition		
What is the day ? and the date ? (with agenda)	Application		
How can you be sure to be at the right page ? (yesterday page is crossed out + corner of today's page is removed).	acquisition		
Where is the date on a page of your agenda ?	acquisition		
Where is the month on a page of your agenda ?	acquisition		
When should you look at your agenda ? (in the morning, at lunch Time and dinner time)	acquisition		
What should you do every evening with you agenda to keep it in order ? (cross the day out & remove the corner)	acquisition		
Where should you place our agenda at home ?	acquisition		
What is your agenda to be used for ? (remember the meal, telephonic messages, appointments, remember if we have to look after grand children) ?	acquisition		
What did you eat yesterday (without agenda)	No rating		
Spontaneous consulting of agenda	application		
(If no consulting), how could you know it ?	acquisition		
Correct response with agenda consulting ?	application		
When will be our next appointment ? (without agenda)	No rating		
Spontaneous consulting ?	Application		
(If no consulting), how could you know it ?	acquisition		
When will be our next appointment ? (with agenda)	application		
Total			

Annex 2 : Questions concerning digital clock with agenda's use

	session		
1. How could you know the date of the day (agenda & clock) ?			
2. How can you be sure to be at the right page ? (yesterday page is crossed out + corner of today's page is removed).			
3. If despite agenda consulting, you not sure of the date, how can you check ? (clock consulting)			
4. Where is the clock, at home ? (in the kitchen, on the table)			
5. (without the clock) where is the date on the clock ?			
6. (without the clock) where is the day on the clock ?			
7. (with the clock) today, what is the date ?			
8. (with the clock) today, what is the day ?			
PAUSE			
9. What day is it today ? and the date ? (spontaneous consulting of agenda ?)			
(if no consulting) How could you know it ?			
Right response with agenda ? (day & date)			
12. no asking of confirmation (verbal or no verbal) no = 1, yes = 0			
13. «Are you sure ?» → clock consulting to check ? consulting = 1, no consulting = 0			
14. (if no consulting) How could you check ?			
Total			