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Training early Alzheimer patients to use a mobile phone

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Abstract

The mobile phone may be useful to keep in contact with spatially disoriented and memory impaired patients. In keeping with this idea, this study describes the training program developed to teach two patients with mild Alzheimer's disease (CI and ML) how to use their own mobile phone. Each training session was divided into two parts. In the first part, the spaced-retrieval technique was used to promote the consultation of a card pasted on the back of the phone. The card detailed each stage of phone utilization and which keys had to be pressed to call somebody. In the second part, the patients received repetitive exercises of calling based upon the errorless learning principle. At the end of three-months rehabilitation, the results showed different learning patterns for the patients. ML needed more spaced-retrieval sessions to spontaneously consult the card and to correctly use the phone, compared to CI. However, by the repetition of calling exercises, both patients showed a decrease of instruction card consultation, whereas they were still able to correctly call somebody. This learning ability is hypothesized to be a consequence of a relatively preserved procedural memory in both patients. In conclusion, this study highlights the effectiveness of combined specific learning techniques for improving AD patient's autonomy in daily life activities.

Key words : Cognitive rehabilitation ; Alzheimer's disease, spaced-retrieval ; errorless learning ; daily living activities.

Introduction

A growing number of studies have proved that it is possible to deal efficiently with the cognitive functioning of Alzheimer patients (see for example Butters, Soety, & Beckers, 1997 for a review). In this perspective, there are some cognitive rehabilitation strategies that could be used in the clinical management of cognitive deficits associated with early Alzheimer patients (see Van der Linden, Juillerat, & Adam, 2002 for a review). First, it is possible to facilitate cognitive performance by exploiting optimization factors. For example, in the episodic memory domain, some studies facilitated memory encoding of Alzheimer patients by inducing semantic, or motor, or multimodal processing of the to-be-remembered information (e.g., Bird & Luszcz, 1991 ; Hutton, Sheppard, Rusted, Ratner, 1996 ; Lekeu *et al*., 2002) or by providing the material with positive emotional features (Hamann, Monarch, & Goldstein, 2000 ; Kazui *et al*., 2000).

Second, another kind of intervention in AD consisted in structuring the environment and providing external cognitive supports (e.g., memory book, alarms, diaries, calendar), in order to compensate for impaired cognitive functions. The usefulness of some external cognitive aids in AD has been demonstrated for reducing apathy (Adam, Van der Linden, Juillerat, & Salmon, 2000), for improving conversations (e.g. Hoerster, Hickey, & Bourgeois, 2001) and for rehabilitating topographical disorientation in a familiar environment (Lekeu, Van der Linden, Adam, Laroi, & Salmon, 2002).

Third, it is also possible to teach Alzheimer patients specific knowledge by exploiting their preserved learning abilities. There are three techniques that would rely on spared implicit memory abilities in AD which facilitate learning of information : the spaced-retrieval technique, the vanishing-cues procedure and the errorless learning method.

With the spaced-retrieval technique, the patient has to recall a target-information over extended intervals of time (Landauer and Bjork, 1978). This technique has been applied in AD in order to learn new face-name associations (Camp, 1989 ; Camp and McKitrick, 1992 ; Vanhalle, Van der Linden, Belleville, & Gilbert, 1998), but also to promote the use of an external memory support (e.g., a calendar ; Stevens, O'Hanlon, & Camp, 1993 ; Camp, Foss, O'Hanlon, & Stevens, 1996 ; Lekeu, Chicherio, Van der Linden, & Salmon, 2000) and to enhance prospective memory (McKitrick, Camp, & Black, 1992 ; McKitrick and Camp, 1993 ; Camp, Foss, Stevens, & O'Hanlon, 1996).

The vanishing-cues technique consists in exposing subjects to a cue (a word stem, i.e., MARTI- for MARTIN) which is progressively faded (i.e., MART–– ; MAR––– ; MA–––– ; etc), until subjects find the responses in the absence of partial cues. Although this method has mainly been used in amnesic (non-demented) patients (e.g., Van der Linden, Meulemans, & Lorrain, 1994 ; Van der Linden and Coyette, 1995 ; Glisky, Schacter, & Tulving, 1996), a few studies also proved its efficacy in the acquisition of new facts by Alzheimer patients (e.g., Moffat, 1989 ; Fontaine, 1995).

A third method which could be used in the cognitive rehabilitation of AD is the errorless learning. The principle of this method is to prevent eventual errors by repeatedly exposing the patients with the correct response rather than asking them to explicitly retrieve or to guess it. Using this method, some studies showed that amnesic patients are able to learn new information, for example to re-learn the names of politicians (Parkin, Hunkin, & Squires, 1998), and to learn how to program an electronic memory aid (Wilson, Baddeley, & Evans, 1994). Using this technique (in conjunction with the spaced-retrieval and the vanishing cues methods) in an early Alzheimer patient, Clare *et al.* (1999, 2001) showed that the patient was able to learn the names of 11 members of his social club. Interestingly, they also demonstrated that the acquisition of the persons names remained stable over one year after the end of the rehabilitation program, which highlighted the robustness of its long-term effect. In another study, Clare *et al.* (2000) also demonstrated that Alzheimer patients were able to improve significantly some everyday memory tasks when the training program employed the errorless learning method.

The goal of the present study was to teach two early Alzheimer patients (CI and ML) how to use their own mobile phone in order to call somebody. In response to the patient and caregiver complaints, training to use a mobile phone was of particular importance for everyday life of both patients. Indeed, CI was still driving her car and spent a lot of time away from home (essentially for shopping). Consequently, it was essential for CI to be able to call her husband if any problems arose outside. In the case of ML, the mobile phone training was associated with topographical intervention. Thus, if he got lost during a walk, it was useful for him to be able to warn his family. The cognitive intervention was designed to exploit preserved procedural and implicit memory skills of both patients, by using the spaced-retrieval technique and the errorless learning method.

Method

Participants

CI and ML, two right-handed patients diagnosed with probable Alzheimer's disease (Mc Khann *et al.*, 1984), participated in this study. Both patients frequented the ambulatory cognitive rehabilitation Centre for memory impairment of the University Hospital of Liège. The diagnosis of both patients was based on a general medical and neurological examination and complete neuropsychological testing. At most, the CT scan showed mild atrophy. At the time of testing and rehabilitation program, both patients were free of acetylcholinesterase inhibitor treatment. Overall functioning of AD patients was assessed by the Mini Mental State Examination (Folstein, Folstein, & Mc Hugh, 1975) (Score = 21 for C.I. and 22 for M.L.) and Mattis Dementia Rating Scale (Mattis, 1973) (Score = 122 for C.I. and 118 for M.L.), reflecting a relatively mild dementia stage for both patients. Characteristics and results of the neuropsychological assessment are presented in Table 1. Both patients have completed a bachelor's degree : an economic science degree for CI and a civil engineering degree for ML. Concerning the professional activity, CI was still working as secretary for her husband, and ML was a civil engineering retired since about 10 years. Moreover, we wanted to test the presence of some preserved procedural memory abilities, because the learning methods that would be used in the training program were based upon procedural memory. Consequently, both patients received a mirror-drawing task (see Gabrieli, Corkin, Mickel, & Growdon, 1993), in which they had to trace a circle reflected in a mirror on multiple trials during the same day. Both patients showed a decreased completion time across trials, which reflected some preserved abilities in procedural learning (see Figure 1).

Procedure

Pre-training examination. Before the beginning of the training program, the initial ability of each patient in the use of their own mobile phone was individually tested. This corresponded to the first baseline measure. In this condition, the instruction for each patient was to call the home number (which is the most important call number for daily life of both patients). Performance was scored using an analytical grid of activity, designed by an occupational therapist. An example of the grid is illustrated in Figure 2. The mobile phones of both patients were similar and both required nine stages to be effective. During the baseline, the analytical grid allowed to score *correct responses* (stages correctly realised) and *blockages* (stages for which the patient did not know what to do during a relatively long period of time).

Training sessions. Patients were trained in individual sessions, and were exposed to the rehabilitation program for three months (45 min/day ; one or two days/week). The intervention consisted in pasting on the back of the phone a card describing each stage of its utilisation and illustrating keys that had

Table I

Characteristics and neuropsychological evaluation of both AD patients

	C.I.	M.L.
Sex	F	M
Age	58	82
Education	18	18
MMSE	21	22
MDRS	122	118
GDS	3	3
Working memory		
Digit span forward	5	5
Corsi test (Corsi, 1972)	4	4
Verbal episodic memory		
Free and Cued Selective Reminding Test		
(Grober & Buschke, 1987 ; French adaptation : Coyette *et al.*, 2001)		
Total free recall (48)	13*	2*
Total free + cued recall (48)	23*	14*
Recognition (16)	14*	13*
Visual episodic memory		
Shapes test (Baddeley, Emslie, & Nimmo-Smith, 1994) (36)	20*	13*
Language functions		
Naming battery (64)	56	44
Semantic fluency : Animals (2 min)	21*	24
Phonemic fluency : P (2 min)	11*	16
Attention		
Subtest « Code » WAIS-R	5*	11
Stroop test (Stroop, 1935)		
Naming (s)	85*	96*
Reading (s)	49	51
Interference (s)	178*	261*
TMT		
Part A (s)	35	58
Part B (s)	128	243

Note : MMSE = Mini Mental State Examination (Folstein, Folstein, & McHugh, 1973) ; MDRS = Mattis Dementia Rating Scale (Mattis, 1973) ; GDS = Geriatric Depression Scale (Yesavage, 1986) ; WAIS-R = Wechsler Adult Intelligence Scale-Revised (Wechsler, 1989).

* impaired performance according to the norms (taken into account the patient's age and socio-cultural level).

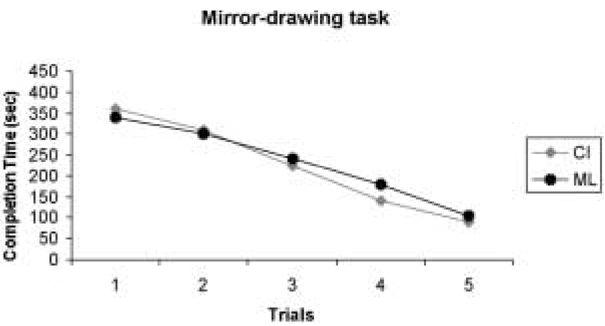

FIG. 1. — Decreased completion time for both patients in the mirror-drawing task.

to be pressed (see Figure 3 for an illustration of one instruction card).

Each session of the rehabilitation program was organized in two stages. First, at the beginning of the sessions, both patients were trained by using the spaced-retrieval method (Camp, 1989) to turn the phone over in order to look at the instruction card. In practical terms, after expanded intervals of time (0, 10, 20, 40, 60, sec., increasing in 30-s intervals until 240 sec.) the experimenter asked the patient : "what are you going to do in order call somebody ?". The patient had to respond : "I'm looking for my instruction card" and he had to turn the phone over (motor encoding). When a recall failure occurred, the intertrial interval was decreased to that of the preceding trial. Second, after the spaced-retrieval training, patients carried out numerous exercises of calling (including calling home) in which errors were minimized (errorless learning). This procedure implied anticipating the patients' errors, so as to inhibit a beginning of an incorrect gesture by exposing the patients to the correct gestures (rather than asking them to guess). This method prevented the memorization of an incorrect gesture. Each exercise was scored step by step by using the analytical grid of activity. With this grid, the experimenter scored *spontaneous use of the card* (number of times the patient consulted spontaneously the card, maximum = 9) and the *cued use of the card* (number of times the patient needed a cue in order to consult the card,

	Correct response	Blockage	Verbal cue	Physical cue	Spontaneous use of card	Cued use of card	Remarks
1. Switch on the mobile phone							
2. PIN code							
3. OK							
4. N° phone + prefix							
5. Start call							
6. Listen to ring							
7. Conversation							
8. Stop communication							
9. Switch off the mobile phone							
TOTAL (%)							

FIG. 2. — Analytical grid of activity : to call somebody with a portable phone

maximum = 9). When the patients did not spontaneously consult the card, two kinds of cues were given : *verbal cues* and/or *physical cues*. The *verbal cues* were provided to the patients when they were blocked and did not spontaneously consult the card to find out what to do. This consisted in giving progressive verbal cues to the patients in order to coax them to consult the card : "how could you find out how to do it ?", "what could you consult in order to know what to do it ?" ; "consult your card". The *physical cues* consisted in showing which key of the phone had to be pressed for inhibiting a patient's spontaneous erroneous gesture.

The success criteria of the training program was to reach 100% correct responses without any cueing during two consecutive sessions.

Post-training examination. At the end of three months rehabilitation, both patients were submitted to conditions identical to those of the first baseline, with the same method for scoring (except that they had the possibility to look at the card). In order to assess the effectiveness of the training sessions, performance during this second baseline was compared to the first baseline.

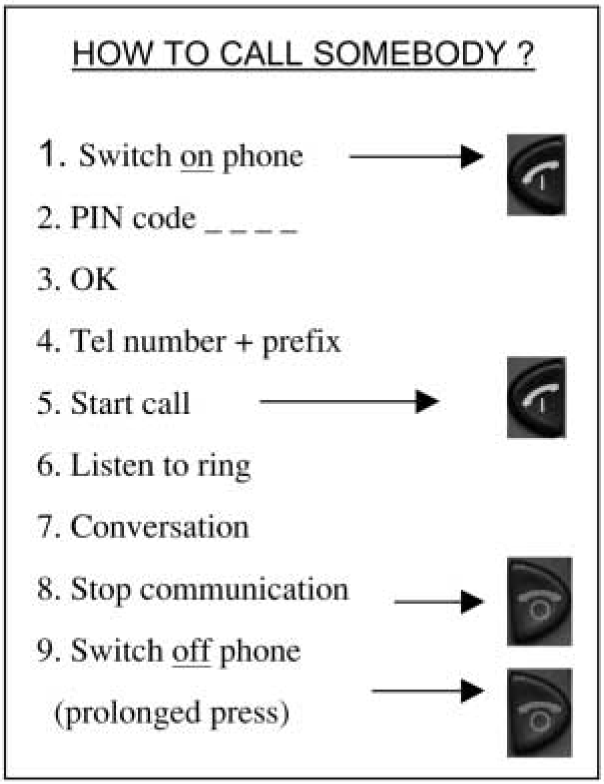

FIG. 3. — An example of instruction card pasted in the back of the phone.

Results

Progression of learning shown by CI and ML is illustrated in Figure 4. For the sake of clarity, the figure is represented in % correct responses and blockages as well as the spontaneous use of the card and the cued use of the card. During baseline 1, the figure showed that both patients were unable to use correctly their mobile phone to call home. Indeed, the percentage of blockages was superior to that of correct responses.

Through all the training sessions (from session 1 to session 13), CI demonstrated a high and consistent number of correct responses (μ = 90.5% correct responses). Moreover, the patient was quickly able to use the card spontaneously in order to know which key had to be pressed. Indeed, in the first eight sessions, the patient spontaneously consulted the card together with minimal cueing (μ = 13.3%). From the ninth session, there was an important decrease in the consultation of the card (both spontaneously and with cueing), with a proportion of correct responses remaining very high until the end of the sessions.

ML demonstrated a different learning pattern. Through out the first eight training sessions, the patient consulted the card mainly after cueing, with a response accuracy tending to increase (maximum

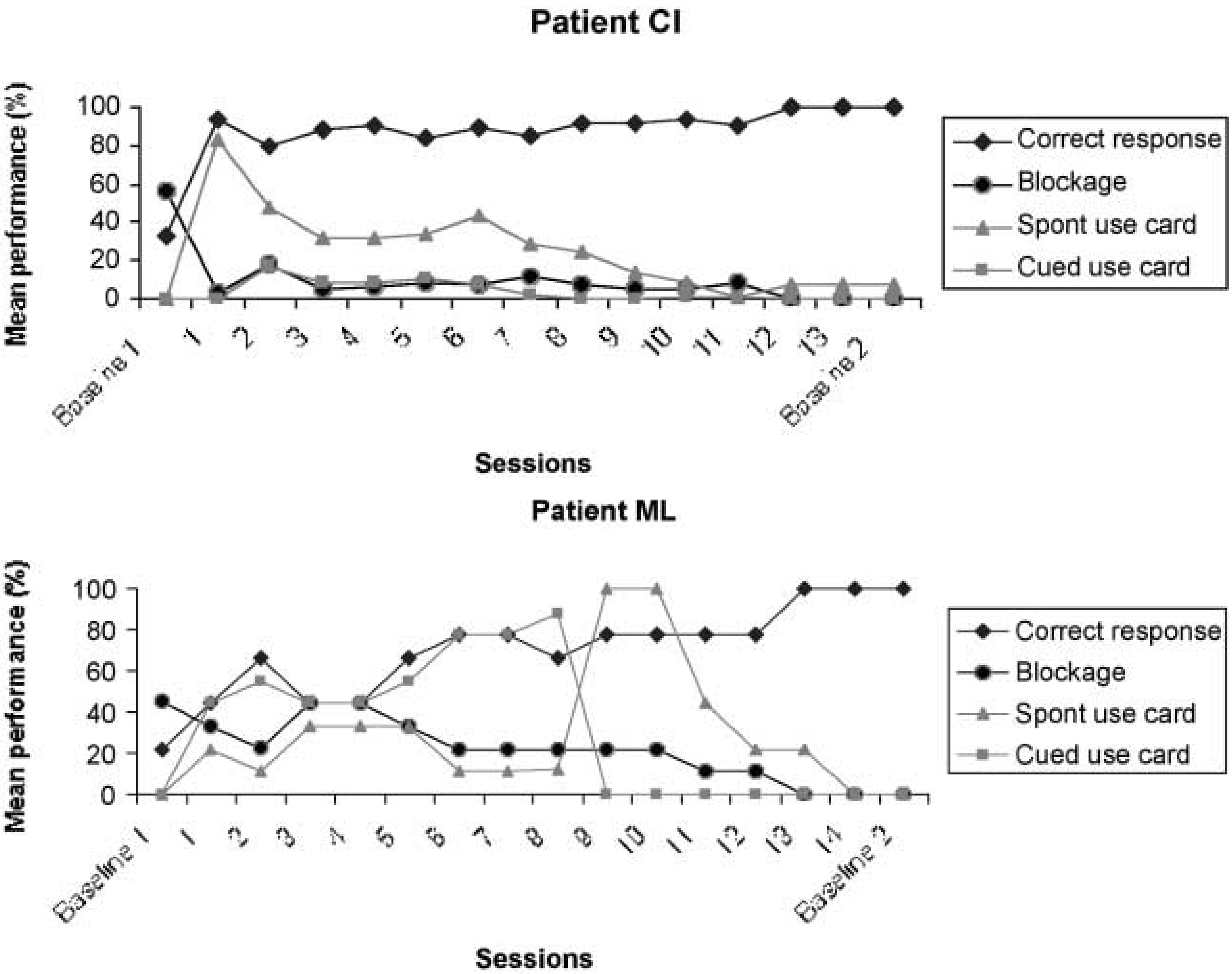

FIG. 4. — Representation of learning patterns by CI and ML through the training sessions

of 77% correct responses). It is only from the ninth session that ML began to use spontaneously the card while maintaining 77% correct responses. Interestingly, from the eleventh session, ML had less and less recourse to the card while improving his performance.

At the end of three months rehabilitation, both patients reached the criteria for success : 100% correct responses without any cueing during two consecutive sessions. The second baseline (in comparison to the first baseline) objectified the progress of both patients following the training sessions. From the first baseline to the second (three months later), the proportion of correct responses of CI was 33% and 100%, and that of ML was 22% and 100%, without any consultation of the card for both patients.

Discussion

This case report combined two learning methods (spaced-retrieval and errorless learning techniques) for teaching two patients with mild Alzheimer's disease how to call somebody with a mobile phone, by promoting the use of an external memory aid.

First, the results of this study, in agreement with previous researches (Stevens, O'Hanson, & Camp, 1993 ; Camp, Foss, O'Hanlon, & Stevens, 1996), demonstrate the usefulness of the spaced-retrieval technique to promote the spontaneous use of an external memory support (an instruction card). However, it is interesting to note the differences between learning patterns of CI and ML. In fact, ML needed more spaced-retrieval sessions than CI to spontaneously use the card during calling exercises. We suggest that this difference could be related to the greater impairment of episodic memory performance in ML compared to CI (see the neuropsychological results in Table 1). It is possible that for CI, learning was based upon some residual explicit as well as implicit memory function, while learning for ML would mainly rely only on implicit memory systems. Above all, this observation highlighted the effectiveness of the spaced-retrieval method even in patients with severe impairment in episodic memory.

Following the repetition of calling exercises, the results show that, by means of errorless learning, both patients were able to use correctly their mobile phone without any aid or consultation of the card. This observation highlighted the possibility to exploit preserved procedural skills in mild Alzheimer patients, not only to improve execution time of a well-known action (Zanetti *et al.*, 2001), but also to learn a new sequence of actions.

In agreement with previous studies, all these results show the importance to combine different learning techniques (spaced-retrieval and errorless learning methods) in AD not only to learn verbal information (Parkin, Hunkin, & Squires, 1998 ; Clare *et al.*, 1999, 200) but also to know how to use a new appliance (e.g. Wilson, Baddeley, & Evans, 1994).

This kind of cognitive rehabilitation is of particular importance, since it targets activities of daily living, for which acquisition or re-acquisition will improve autonomy of Alzheimer patients. Interestingly, the application of the procedure described in this study could be used for teaching or re-teaching different actions that are useful every day : e.g., to heat a dish up in the microwave oven, to use a coffee machine, to use an Euro converter pocket calculator…

However, a follow-up assessment of patients will be necessary in order to test the long-term maintenance of this kind of procedural learning in AD (see Clare *et al.*, 2002 for the long-term effect of some verbal learning).

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