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Effects of Different Learning Methods for Instrumental Activities of Daily Living in Patients With Alzheimer's Dementia: A Pilot Study

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Abstract

We examined whether errorless learning (EL) and learning by modeling (LM) were more advantageous than trial and error learning (TEL) in the acquisition of instrumental activities of daily living (IADL) in Alzheimer's dementia (AD) patients ($n = 14$). Using a counterbalanced within-subject design, participants performed 3 learning conditions. EL consisted of straightforward prompts before any action, LM focused on the modeling of each step of the tasks and standard TEL without cues was used as a control condition. The participants had to (re)learn 3 IADL. Repeated-measure analyses during learning and follow-up assessments were performed 1 and 3 weeks after learning. The LM and the EL procedures resulted in significantly better learning compared to TEL, with effect sizes (partial eta squared) of 0.42 and 0.35, respectively. This is the first controlled study to show that (re)learning of IADL is possible in patients with AD using an error-reduction approach.

Keywords

errorless learning, modeling, trial and error, instrumental activities of daily living, learning and memory, Alzheimer's dementia, neuropsychology

Introduction

While pharmacological interventions are beneficial in the treatment of individual patients with Alzheimer dementia, their effects are typically small and side effects often hamper the clinical applicability. Consequently, an increasing number of studies have examined the effects of nonpharmacological treatment in dementia, with promising results.[1] One type of intervention that may contribute to health-related quality of life in Alzheimer's dementia (AD) is the learning or relearning of potentially useful instrumental activities of daily living (IADL), as it may increase the patients' functional autonomy. Functional autonomy loss is a key feature of AD, affecting the ability to perform IADL, such as managing finances, food preparation, or housekeeping.

Cognitive impairment is a crucial factor in losing autonomy and independence. The magnitude of this loss in time varies, depending on how well an individual patient is able to maintain the performance of everyday tasks or acquire new skills. Normally, skill learning occurs in an unstructured manner,

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which consists of guessing and the occurrence and correction of errors during acquisition (trial and error learning, TEL). In patients with explicit memory deficits, TEL may be disadvantageous, since errors produced during learning may not be corrected and are consolidated by intact implicit memory function.[2] The "errorless learning" (EL) method is described as a teaching technique that prevents people from making mistakes during learning.[3] This contrasts with TEL, in which guessing and errors are not corrected during acquisition. Several studies have examined whether the reduction of errors during learning has beneficial effects in patients with explicit memory deficits, generally showing that EL results in a better memory performance than TEL.[3]

The majority of tasks taught in the EL literature during the last decade have involved relatively discrete, specific behaviors, using laboratory tasks with no relevance to the individual patient, such as recalling words or names,[4,5] which are typically compared to a TEL condition. However, studies that have examined EL of everyday tasks in patients with dementia are scarce and have exclusively adopted a single-case approach without a control group or control condition.[6,7] Thus, to date, no controlled or group study has compared the effectiveness of errorless procedures in teaching IADL. Accordingly, there is to date insufficient evidence from studies involving AD participants to draw firm conclusions about the relevance of EL for such tasks in memory rehabilitation.

Basically, 2 EL approaches can be explored that may be beneficial in IADL relearning. First, a strict verbal approach using forward instructions can be used, in which the patient is instructed what he or she has to do by providing cues before a task sequence is performed, thus minimizing the number of errors (EL).[5,8] Secondly, a learning by modeling (LM) approach can be applied, using a mastery model, with an emphasis on interaction with the patient and imitation learning.[9] The mastery model is a widely used approach in motor learning and rehabilitation training of patients with AD.[10]

It has been suggested that EL approaches may be most successful in patients with severe explicit memory deficits, since these are especially at risk for the implicit consolidation of errors that occur during learning.[2] Indeed, recent findings indicate that EL may be beneficial for patients with more severely impaired explicit memory.[11] It can be hypothesized, therefore, that people with less severe impairments in explicit memory, who retain the ability to monitor and detect errors and to update knowledge of their performance on the basis of feedback, do not require a strict and maximal error-reduction and would also benefit from a modeling approach, in which some errors can be observed. In turn, people with more severe impairments in explicit memory and difficulties in monitoring and detecting performance errors might require a "strict" EL method in order to demonstrate effective learning. This hypothesis is also in agreement with the finding that people with early-stage dementia do not always show an additional advantage from error reduction compared to TEL, since they are generally still able to store some new information into explicit memory.[8,12]

Thus, while most of the available data support the benefits of EL, studies on the efficacy of EL and LM compared to TEL in the acquisition of everyday skills in patients with AD are limited. The main objective of the current study was to observe which of the 3 learning methods (EL, LM, and TEL) will improve most the (re)learning of 3 instrumental skills in different stages of dementia.

Patients and Methods

Design

This study followed a within-subject design in which all participants received all learning methods and practiced 3 individually tailored tasks over a 1-week training. Learning methods were counterbalanced within the 3-week intervention period for each patient. Blind-allocation concealment was used to prevent foreknowledge of the upcoming assignments for the investigators, of whom the recruiter and the assigner were 2 different persons. The assigner had no contact with the patients. The therapists (a total of 6) in The Netherlands and in France were trained by the first author.

When inclusion criteria were met, each patient was randomized via a computer allocation sequence to receive a within-subject crossover sequence to minimize systematic effects of task order, as of course different tasks were used for each participant, and tasks consisted of different numbers of steps. All training sessions and assessments were conducted during face-to-face interaction at the patient care facilities. Approval was obtained from the Institutional Review Boards of the participating nursing homes, and informed consents were obtained in accordance with the declaration of Helsinki. For this pilot study, a convenience sample in France and the Netherlands was used to explore the feasibility and efficacy of EL and LM in AD.

Patients

Participants were screened during individual interviewing. Participants from 2 nursing homes in Nijmegen and Delden, the Netherlands ($n = 4$), and 2 nursing homes in the Bordeaux agglomeration, France ($n = 10$) were recruited. Inclusion criteria for all participants were (1) having a diagnosis of Alzheimer's dementia; (2) aged over 60; (3) having an MMSE score between 10 and 26; and (4) agree to participate and be competent to give informed consent.[13] Participants with severe deficits in alertness, vision, known behavioral disturbances defined by a cut off score of 4 on the Neuropsychiatric Inventory (NPI) Frequency $\times$ Severity score, and known psychiatric comorbidities (eg, major depression) were excluded. Participants' neuropsychiatric diagnoses and comorbidities were retrieved from their medical records, all patients fulfilled the *Diagnostic and Statistical Manual of Mental Disorders* (Fourth Edition, Text Revision; *DSM-IV-TR*) and National Institute of Neurological and Communicative Diseases and Stroke-Alzheimer's Disease and Related Disorders Association (NINCDS-ADRDA) criteria for Alzheimer's dementia type.[14,15]

Autonomy was assessed using a comprehensive face-to-face interview with the patient and the caregiver in charge of the patient's care during which specific questions related to the tasks involved in this study were asked.

Materials

A corpus of 50 instrumental tasks was developed for the purpose of this pilot study (list available from the first author, for example using an umbrella, making tea, or using a mobile phone). Each task was broken into small action sequences. Each of the motor sequences were transformed into verbal instruction. Motor sequences and explicit knowledge were scored using the same assessment procedure which was validated in a multidisciplinary team composed of psychologists and occupational therapists.

Procedure

All therapists followed a standardized 1-week training before the start of the pilot study. This training encompassed real-life training sessions and rating the patients' performance. For each task, patients with AD were visited at their facilities 6 times over a 7-day period (including the weekend) for a total of 6 sessions of 30 minutes (3 hours training per task in total). For each task, a follow-up assessment was performed 1 and 3 weeks after the learning phase.

During each session, the participant learned 1 task using the following schedule: (*a*) session baseline assessment; (*b*) learning phase of 30 minutes; (*c*) end of learning assessment. Each participant received the same number of sessions, the same amount of time and practice for each task in each of the methods.

Task Selection

During the face-to-face interview with the patient and his or her caregiver, the recruiter selected 3 tasks that the patient was not able to perform alone. The tasks were selected according to a tailored procedure. If there was evidence that a given task was already performed (almost) optimally by the patient, the recruiter selected another task from the corpus that was in agreement with the patient's abilities and relevant for his or her daily life. Subsequently, the performance on the selected task was assessed.

Learning Conditions

For each condition, participants received formal information concerning the nature of the task they were involved in, for example, "Here is an electric kettle and some tea bags, I will ask you to make a cup of tea" or "Here is a large pile of mail that needs to be sorted out." These instructions served as shared starting point for each condition. Each session took approximately 45 minutes, with 30 minutes dedicated to the training.

For each step, 2 cue cards were developed, each on an A4 sheet of paper in landscape layout. The written instructions were written in Arial bold font 36. The visuospatial instruction for each step was a picture of this step. The cue cards were only used in the EL training, and for all assessments in all learning conditions. The outline of each learning condition is described briefly here and in more detail in the Appendix A.

Errorless Learning Condition. Participants received the formal introduction information. Subsequently, the therapist gave cues before the completion of the sequence, for example, "you can take a mug (or a cup)" or "you can open the tea bag box." At each step the patient received the verbal instruction before the completion of the action sequence. The patient was told to wait until the instruction was completed, to prevent the occurrence of mistakes. This EL method is practiced for 30 minutes.

Modeling Condition. The same formal introduction information was given to the participant as in the EL condition. In this method, the therapist acts as a model (mastery model). Facing the patient, the therapist shows a single step and verbally accompanies what he or she is doing; that is, "I take the mug" or "I open the tea bag box." In this condition, and for ecological purposes, after the first presentation, the patient is instructed to wait approximately 30 seconds until the therapist asks to repeat the same step. This time interval allowed the therapists to undo what he or the patient has done during the steps, for example, to empty the water tank and put back the tea bags into the tea box. If the step is successfully performed, then another step is added to the sequence, which is then demonstrated by the therapist. Thus, the therapist gradually increases the length of the action sequence that he or she demonstrates, and the participant has to repeat these gradually increasing action sequences. If errors occur, these are corrected after the patient produced them.

Trial and Error Condition. Participants were given the same standard formal instruction related to the tasks. Participants were allowed up to 3 guesses (or a maximum of 25 seconds) before correction, and cues were only provided if the participant was unable to find and complete the next step correctly. The cues were not the same as those on the cue cards in the EL condition. The instructor rather prompted the patient to try finding a solution, using different questions relative to the purpose of the task. No errors were intentionally introduced during the trial.

Neuropsychological Assessment

The Mini-Mental State Examination (MMSE) was used to assess cognitive status and for statistical adjustment purposes only.[16] Severity categories using the MMSE total score were as follows: 21 to 26: mild; 16 to 20: moderate, and 10 to 15: moderately severe.[8] The Trail Making Test (TMT) was administered to test executive functioning.[17] The Visual Association Test (VAT) is a brief episodic memory task (5-15 minutes) based on visual paired-associate learning.[18] The test materials consist of 6 line drawings of pairs of interacting objects or animals (eg, an ape holding an umbrella). The person is asked to name each object and, later, is presented with 1 object from the pair and asked to name the other.

Primary Outcome Measures

At the beginning of each session, the patients were asked to complete the task at hand to assess implicit learning compared to the previous learning session (ie, the procedural performance) and explicit knowledge of the task (using the ordering of the visuospatial and written instruction cue cards). For the implicit performance, the same instruction as for the training was used. For testing the explicit knowledge, the cue cards were placed on a table and the patients had to sort the action sequences into the correct order. The same procedure was used for both visuospatial and written instructions. The assessment procedure remained the same for all patients (in different disease stages) and for the implicit and explicit assessments (written and visuospatial cues). The assessment of each action step was made using 3 categories: (1) competent; (2) questionable/ineffective; (3) deficit using task-specific assessment forms. At each step of a task sequence the patient had performed, the therapist filled in the assessment form. The patient's performance was classified using 3 categories:

Competent. The step or the explicit information is successfully performed or set in the right order.

Questionable/ineffective. This term refers to all actions from the patient that cannot be classified as correct (competent). Questionable steps are indicated by the patient showing hesitation and doubt in performing a step. This category involves: planning problems; the repetition of a step that has already been performed; actions that are unrelated to the task or the use of the materials for other actions; verbal hesitation: asking questions such as "is it correct?" (ie, a patient that performs a correct step but afterward asks the therapist if it was correct is scored as "questionable"). Motor hesitation such as touching the object (or assessment cards) and quickly retrieving the hand, and making small or aimless movements were also classified in this category. Depending on the nature of the task, some steps may be ineffective. For example, pulling out the top drawer of a dish washer (before the lower one) and then putting the right element inside it, is not an ineffective step. However, pulling out the top drawer of a dish washer (before the lower one) and then trying to put the pan or knives or other elements that are normally fitting in the lower drawer onto the top drawer are both ineffective steps.

Deficit. This term designates an absence of answer or reaction. A patient that stops was classified as having a deficit in this specific step.

For each step of the task (ie, folding selected clothes from a basket of laundry took 11 steps, filling a dish washer took 17 steps) cue cards with written instructions and a picture of the step was designed. To assess explicit knowledge of the task, the participant was asked to sort the written instructions and pictures in the right order. The same assessment procedure was used for implicit and explicit performances. The assessment procedure resulted in an overall score for each task sequence. Each task step was assessed following a 3-point scale (ranging from 1 = competent to 3 = deficit).

A competent score is only possible in a sequence of competent steps (ie, taking the bottle and opening the cap), thus ineffective scores are obtained if the step is carried out alone and without a further step toward a complete sequence of actions.

A chaotic order of the task had no effects on the total score. For example, if the task had 6 steps and the patient's sequence was 123654 or 123546, the performance scores were the same, if the specific task allowed this order (ie, with the coffee machine, the reservoir can be filled before a cup is placed or after, which is both correct; if the start button is pressed before the water reservoir is filled, this will be classified as "ineffective"). For the explicit tasks, the same scoring system was applied. That is, a correct "step" often consists of 2 cards in a correct order. Although the participants were instructed to use all cards, unselected cards did occur, which were classified as a "deficit" (as would be an unperformed action in the implicit assessment).

For total score comparisons between tasks, the total scores per task were adjusted to a 100-point scale using the following formula: performance = total score/(number of steps × 3). Thus, a performance of 100% indicating perfect actions and planning. This procedure allowed the comparison of performances in the different tasks which had a different complexity (ie, number of steps varied across tasks).

Statistical Analyses

We performed repeated-measure general linear model (GLM) analyses with trial (8 levels: 6 posttreatment assessments, 1-week follow-up, and 3-week follow-up) and condition (3 levels: EL, LM, and TEL) as within-subject factors. *T* tests were used to compare the performance at the 1- and 3-week follow-up assessments with the baseline scores. Bonferroni correction was applied for all *P* values for post hoc comparisons. All results are presented with their 95% confidence intervals, *F* values, and degrees of freedom. Effect sizes (partial eta squared, η_p^2) were also computed, reflecting the proportion explained variance for a specific factor. All analyses were conducted in an intention-to-treat principle, using all available data and using the maximization likelihood estimation method for missing data. Alpha was set at 0.05 for all analyses.

Results

None of the patients were able to perform any task without errors prior to the training. None of the patients dropped out of the study and no missing data were observed. The mean age of the participants was 86.0 ± 5.7 years (12 women and 2 men)

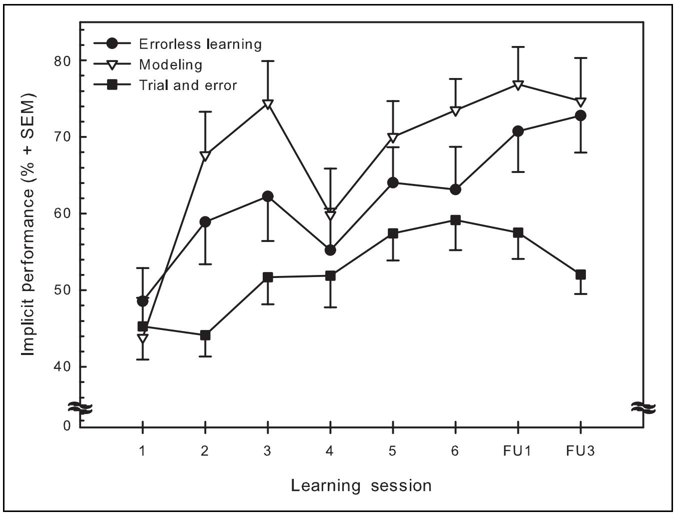

Figure 1. Mean (+SEM) performance at the beginning of each learning session as well as at the follow-up assessments (1 and 3 weeks) for the 3 learning conditions.

in this pilot study. The mean MMSE score was 15.2 with 1 patient in the mild category (21-26), 5 in the moderate stage (16-20), and 8 in the moderately severe stage of dementia (10-15).

The trained tasks in the present pilot study were making tea with an electric kettle, using a CD player, making coffee with a Senseo coffee machine, using a TV remote control, changing the batteries of a remote control, mailing a letter, setting the table for 2 persons, lacing up a shoe, and folding a shirt. Neuropsychological testing showed a mean VAT of 3.6 $\pm$ 3 and a mean TMT-A of 113 $\pm$ 87.5, indicating that all patients had deficits in episodic memory and executive functioning.

Figure 1 shows the results of implicit performance in the 3-task conditions over time. Each data point reflects the performance on the assessment before each training session (or the 1-week and 3-week follow-up assessments) in order to reliably assess the actual learning benefit and not just the immediate learning effect of the 30-minute training session. Repeated-measure analysis showed a learning condition effect ($F(2,26) = 8.3$, $P = .002$, $\eta_p^2 = 0.39$) and a time effect between session ($F(7,91)=15.6$, $P < .001$, $\eta_p^2 = 0.54$). The Time $\times$ Learning Condition effect was also significant ($F(14,182) = 2.8$, $P = .001$, $\eta_p^2 = 0.18$). The LM and EL learning methods were found to improve the most over the 6 sessions at the physical performance. The LM condition showed a baseline to 1-week follow-up improvement of 33.0%, CI95% [6.1-60], $P = .01$ and 30.8%, CI95% [5.8-55.9], $P = .009$ from baseline to 4-week follow-up; The EL condition produced an improvement of 22.2%, CI95% [6.6-37.8], $P = .003$ and 24.2%, CI95% [7.7-40.8], $P = .002$ for the same periods, respectively. The progression over time for LM and EL was significant ($F(7,91)=8.7$, $P < .001$, $\eta_p^2 = 0.42$ and $F(7,91) = 7.0$, $P < .001$, $\eta_p^2 = 0.35$, respectively). The TEL condition was found to improve the patients' performance from baseline to the 1-week follow-up with 12.2%, CI95% [1.7-22.7], $P = .015$ and 6.8% (CI95% [−8-21.5]) at the 3-week follow-up. The TEL condition showed a significant improvement over the training period ($F(7,91) = 5.8$, $P < .001$, $\eta_p^2 = 0.3$).

The Time $\times$ Learning Condition effect was in favor of EL and LM ($F(14,18) = 2.8$, $P = .001$, $\eta_p^2 = 0.17$). The LM and EL procedures yielded better learning performances compared to TEL at the physical performance level (implicit), with a mean difference of 15.2% CI95% [6-24.4], $P = .002$ and 9.6% CI95% [−1.2-20.3], $P = .09$, respectively. The mean difference between EL and LM was of −5.6% CI95% [−16.6-5.3], $P = .55$.

Neither main effects of Time and Learning Condition nor an interaction of Time and Condition were found for the explicit performance with respect to ordering the visuospatial and written instruction cards (all F values < 1.85; see Table 1).

Discussion

This is the first controlled study to examine the (re)learning of IADL in patients with AD, directly comparing 3 learning conditions: EL, LM, and TEL. The results showed that within 6 sessions, it was possible to obtain a consistent improvement of the task performance that remained stable until 4 weeks after the training was completed.

While both LM and EL enhanced implicit performance over the training period, the LM condition showed the largest improvement at the follow-up assessments with 42% of the implicit performance variance explained by the learning condition. Still, the "pure" EL condition was also found to improve implicit performance with more than 35% of variance explained by the learning condition. Although there was a slight improvement after TEL, this improvement was not maintained at 3 weeks follow-up.

To date, no controlled study has been performed showing that several IADL can be relearned by patients with AD using error-reduction principles. In this study, 2 interventions were employed, utilizing errorless principles as a basis for interaction with the patients. The main difference between the 2 learning principles lies in the modeling interaction proposed in the LM stage, while the instructor's approach in the EL condition relied more on the use of strict and straightforward instruction.[8,9] Although the results after both conditions were similar, it can be argued that the LM learning condition improvement in implicit performance was the most consistent even at the 3 weeks follow-up. None of the learning conditions was found to have effects on explicit knowledge of the tasks, as reflected by a lack of improvement in ordering the written and visuospatial cue cards.

Although promising, our findings should be interpreted with caution for several reasons. First, although our results showed large effects in the task performance conditions, these results should be confirmed in a randomized controlled trial (RCT). Second, while the therapists were kept blind for the study outcomes, our results may have been biased to some extent, as the same therapist administered all 3 learning conditions. An alternative would be to use one therapist per condition. Furthermore, evaluation was not blind as this was done by the therapist. A future RCT should also incorporate an external examiner

Table 1. Mean (95% Confidence Intervals) at Baseline and Adjusted Mean Change (95% Confidence Intervals) per Patient in Implicit and Explicit Knowledge of the Tasks at Intervention Termination, and at the 3-Week Follow-Up Assessments

	Baseline			Baseline to 6 Sessions (Intervention Termination)			Baseline to Delayed Assessment (at 3-Week Follow-up; Partial Eta Squared)		
	EL	LM	TEL	EL	LM	TEL	EL	LM	TEL
Implicit performance (%)	48.5 (39.2-58)	43.9 (37.6-50.1)	45.3 (37.2-53.3)	14.6 (−4-33.2)	29.6 (8.6-50.6)[a]	13.9 (4.3-23.5)[b]	24.2 (7.7-40.8), 0.35[a]	30.8 (5.8-55.9), 0.4[a]	6.9 (−7.9-21.5), 0.31[a]
Explicit visuo-spatial (pictures)	51.2 (41.5-61)	55.8 (46.3-65.3)	50.6 (42.7-58.5)	12 (−7.6-31.8)	−5.2 (−31.4-20.9)	3.5 (−8-15)	10.2 (−7.7-28.2), 0.15	3.9 (−12.7-20.6), 0.06	6.6 (−7.3-20.5), 0.17
Explicit written instruction	51.8 (40.3-63.3)	55.4 (48.2-62.5)	51.1 (40.6-61.6)	2.1 (−17.6-21.8)	8.2 (−17.2-33.7)	3.3 (−15-21.6)	13.2 (−10.3-36.4), 0.1	7.9 (−7-22.7), 0.06	6 (−11.4-23.6), 0.1

Abbreviations: errorless learning, EL; learning by modeling, LM; trial and error learning, TEL.
[a] Within-subject adjusted mean change at $P < .01$.
[b] Within-subject adjusted mean change at $P < .05$.

rating the performance. Moreover, as we used a tailored approach by selecting tasks that were adjusted to the patient's performance level, each participant received a different set of tasks that were trained, which also differed in complexity. However, assignment of the individual tasks to a specific training method and order was randomized to avoid a systematic bias. In addition, by calculating a percentage score, we were able to directly compare the performance on tasks of different complexity. Finally, our within-subject design makes it possible that either (beneficial) crossover or (disturbing) interference effects may have occurred across the trained tasks in individual patients. While we would emphasize a tailored approach as this is the most relevant for individual patients, a larger RCT using a between-group design should replicate our findings.

We observed that the learning slopes in the explicit knowledge situation showed limited improvement in comparison with the implicit performance circumstance. This may be in favor of our hypothesis that implicit learning capacities are better preserved than explicit memory in patients with AD. In this pilot study, we tried to extract explicit information regarding the activities. However, the "residual" knowledge of such tasks may need specific training to have any specific effect in comparison with implicit performance, the latter being specifically trained.

Our sample predominantly consisted of patients in the moderate to moderately severe stage of dementia; only 1 patient could be classified as having mild dementia. Although it would be interesting to investigate the effects of EL/LM in subgroups that are in different stages of the dementia, our current sample size does not warrant further subgroup analyses. It could be argued that our effect of EL/LM was attenuated by a relative poor performance of the participants on the TEL condition. Indeed, as we highlighted before, there is evidence that participants with more severe memory deficits may benefit to a greater extent from error reduction during learning. However, there is at least some evidence that even patients with mild cognitive impairment, who may be regarded as very early-stage AD, but who still have residual explicit memory capacity, benefit from an EL approach.[19] Future studies with larger groups and subanalyses using disease severity levels are needed to detect how patients at different severity levels rely or use residual explicit knowledge of the tasks. From an implementation perspective, it can be argued that an error-reducing approach in combination with interactive modeling may be more attractive for patients than receiving straightforward instructions alone as in the strictly errorless condition, although the actual learning benefit did not differ between these 2 conditions. Another practical point is the question of implementation of each condition to the patient's everyday life environment and the training of nursing staff or caregivers.

The population characteristics reported in our study and the large observed effect sizes are likely to be reproducible in other psychogeriatric care settings. However, the described training described in this pilot study may not be easily implemented on a larger scale, as it was an intensive training (6 sessions in 1 week). Moreover, not all patients were successful in that they eventually learned to master the trained tasks to the full extent (ie, a 100% performance). This indicates that an error-reduction approach will not always result in functional autonomy and independence. Still, it is likely that patients who will not be able to perform a task completely independently may require less assistance from others than those who cannot perform the task at all. Future subgroup analyses may also provide more insight into which patients will benefit the most from an EL procedure. Also, a less intensive treatment schedule of 2 to 3 sessions per week should be explored, to enable a comparison with other geriatric training methods that have been found to reliably improve autonomy and quality of life.[8,20]

Appendix A

Description of Each Learning Condition

Learning Condition	Guidance	Instruction and Cueing	Error Correction	Rehearsal of the Step/Task
Errorless learning	Errorless learning refers to the use of feed-forward instruction (ie, how to do) before actions to prevent learners from making mistakes. At each step the patient receives verbal and visual cues (pictures and written cues). After cueing, the cue cards are hidden and the therapist immediately asks to perform the steps.	"Here is "TASK" I will tell you how to do it or use it." Instructions were based on the "written instruction" cue cards. The therapist gives cues before the completion of each step, eg, for coffee machine: "you can take the water tank and fill it with water." The patients are told what he or she has to do. The cueing order is verbal and visual cues (pictures and written instructions) and if necessary physical help.	The therapist allows the participant to find the solution (maximum of 5 seconds), if the answer or action is not immediately given, the participant receives a cue (do the step), and moves to the next step.	When all the steps are completed, the task is rehearsed using the same procedure (step by step)
Modeling	This condition refers to the modeling of the task by the therapist and the rehearsal of the steps at a fixed time interval. Using tailored mastery modeling, the therapist shows the step(s) in front of the patient and prompt the patient to repeat the step(s). The therapist gradually increases the action sequence that is demonstrated if a step is successfully repeated by the patient. There is a special emphasis on adjusting the modeling just above the patients abilities (speed especially).	"Here is a "TASK," I will show you how to use it and you will do it after me." The therapist performs a step (or multiple steps), at the same time he or she uses verbal cues during the performance. The verbal cues are the same as the written instruction; eg, "I take the water tank and fill it with water." Then the therapist asks immediately to the patient to repeat the step(s). After a successful interval of 30 seconds, the therapist adds 1 or more steps to the sequence, and remodels the whole sequence.	The therapist remodels the correct answer and returns to the repetition of the whole sequence. When an error is produced in the middle of a previously learned sequence (eg, the patient is at step 8 and there is a mistake at step 6), the therapist gives a cue (remodeling) for the erroneous step and prompts the participants to continue. If the patient is unable to continue, the therapist shows the correct step (remodeling) and returns to the previously learned interval at which the performace was successful and repeats the sequence again.	After an interval of 30 seconds, the therapist asks: "Can you repeat the actions I showed you since the beginning of the session." Before the patient's performance, the therapist has to undo each of the previous steps that involved a modification of the material (eg, empty the water tank of the coffee machine). During the interval the therapist may engage in informal talking with the patient that is not directly related to the nature of the material used during the session.
Trial and error	Trial and error learning refers to the regular unstructured learning and is considered as control condition.	"Here is a "TASK" I will ask you to try to find how to use it, and I will help you after you have tried."	Erroneous responses are corrected by verbal cues after 3 trials or 25 seconds (approximately). The cues are the same as written instruction starting with "you can . . . ". The patient is encouraged to continue.	No rehearsal after errors. Reduce the frustration by cueing him or her. No physical help, only verbal.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the authorship and/or publication of this article.

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