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Cognitive stimulation of Autobiographic and Emotional Memory in a patient with Alzheimer's Disease

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Abstract: Alzheimer's disease (AD) is the most frequent cause of dementia for people over 65 years of age. AD is characterized by a progressive cognitive decline that generally begins with deficits in the anterograde memory and then evolves to a general cognitive deterioration. The decline of autobiographical memory in AD leads to a loss of knowledge about events that define patients' lives and consequently, causes a degradation of self-knowledge and sense of identity. These difficulties compromise the patient's autonomy, causing a decrease in the quality of life of patients and their caregivers. To promote cognition, independence, and wellbeing in AD's patients medical and pharmacological treatments should be complemented by non -pharmacological interventions. The use of new technologies in non-pharmacological treatments is gaining importance. However; there are few reports on the effectiveness of these strategies. The aim of this study is to evaluate the impact of the use of autobiographical training software (ATS) on autobiographical and emotional memory in an AD's patient. In the case reported, the use of the application stimulated autobiographical remembering, thus serving as a scaffolding toll for the reconstruction of semantic autobiographical memory.

Introduction

Alzheimer's disease (AD) is the most frequent cause of dementia in people over 65 years of age. [1-3] Currently, there are over 36.5 million people in the world who are affected by dementia and the majority of these cases are AD-related [2,4-8]. It is estimated that the number of cases will double in the next 20 years [9].AD is a progressive neurodegenerative disease that usually begins after age 65. AD is characterized by increasing decrements in recent memory, language, visuospatial and executive functions [10,3]. The progressive cognitive decline in AD usually begins with deficits in the anterograde memory and culminates with global cognitive deterioration [11]. These difficulties compromise the patient's autonomy, causing a decrease in their quality of life and that of their caregivers [12]. The etiology of AD remains unknown, although it is considered a disease of multifactorial causes, where the main non-modifiable risk factor is age [13,14]. While the hallmark symptom of AD is the decline in episodic memory, as the disease progresses, other memory systems - including autobiographical memory - are also typically affected. Autobiographical memory is defined as the memory of personal experiences and the facts which allow individuals to define themselves, build their life stories [15] and attribute meaning to their lives. It has been proposed that autobiographical memory has a semantic and an episodic component [16]. While the semantic component is made up of the general representations of life (cover long lifetime periods and general events referring to thematic events that occur repeatedly) [17], the episodic component is involved specific experiences that are identifiable in time and in normal aging, autobiographical episodic memory is negatively affected, while autobiographical semantic memory is usually preserved [18].

The decline of autobiographical memory in AD leads to a loss of knowledge about events that define patient's lives and consequently, causes a degradation of self-knowledge and sense of identity. As autobiographical memory declines, it affects the activities of daily life, causing a negative impact on the patient's quality of life [19]. Consistent with what is observed in normal ageing and with the decline of episodic memory; patients with AD reconstruct less autobiographical episodic memories and have over-dependence on autobiographical semantic memory [15]. It has been proposed that since autobiographical semantic memory is the features of memory that is best preserved over time, it can be used as a scaffolding to support the person sense of identity, accompanied by other cognitive strategies [20]. It is important to mention that emotions trigger anterograde memory [16]. As mentioned above, while the decline of episodic memory is the hallmark of AD disease, emotional processing and emotional memory are relatively preserved in the early stages of the disease [21].Previous studies demonstrated in patients with amnesia that emotions can persist regardless of the episodic memory that caused the emotion itself [22]. Thus, AD patients can report emotional states while experiencing difficulties in the evocation of the episodic memory of initially triggered such emotion [23]. In other words, emotions persist even when the memory linked to that emotion has disappeared, a phenomenon that has been labeled by some authors as "emotions without memory" [24]. International guidelines suggest that in patients with AD, medical and pharmacological treatments should be complemented by non-pharmacological interventions [25]. Among such intervention multidisciplinary treatments that include caregivers have been reported to have a good level of effectiveness in patients with AD [25]. Approaches aimed at improving cognition such as cognitive training and stimulation activities of daily living (ADL) have reported high levels of effectiveness in mood and quality of life [26]. Along these lines, controlled and randomized research shows that training is not only effective when it is carried out individually, but also when the family is part of that process [27,28]. To endorse cognition, independence and wellbeing in AD' patient the recommendations of the UK's National Institute for Health and Care Excellence (NICE) offer a range of activities tailored to the individual preferences of those living with dementia and offer group cognitive stimulation therapy [29].

Other non- pharmacological treatments include the use of modern technology. Mobile phones, smartphones and tablets provide exceptional means for the application of mobile health to AD patients. In fact, most of the applications available -both in the literature and commercially- have been developed for the treatment of AD and other type dementia [30]. These instruments include stimulation games used in a preventive manner, applications to emotionally support patients and their caregivers, as well as applications to check the progress of dementia. Other applications fall under the category of serious games, that is specialized digital applications that aim at education, information, communication and stimulation of different cognitive domains [31]. To our knowledge, serious games that have as an objective the stimulation of autobiographical memory or the use of the emotions to trigger anterograde memory, specifically in patients with AD have not been previously studied. In this study we designed and implement Autobiographic Training Software (ATS) on a patient with AD. The purpose of this software is to stimulate autobiographical memory through the patient's own life material (photos, videos and music) and is specifically designed to be used by patient with cognitive impairment. One of the advantages of this software is that can be adapted to the patient need and performance.

Material & Methods

Case study: Our patient, RT, is a 72-year-old male with a presumptive diagnosis of AD, documented both in neuropsychological evaluations and imaging studies (hippocampal atrophy- Figure 1). RT completed his

graduate studies as a public accountant and worked for more than 20 years at an international pharmaceutical company. His job required him to travel worldwide and learn different languages. Important aspects in his life are his love for his grandchildren, traveling, photography, listening to music and playing billiards. The first symptoms of dementia, according to both RT and his family, appeared at 66 years old and included episodes of confusion, temporary disorientation, attentional failures and a tendency to repeat the same comments and questions. Although at the beginning the clinical picture was consistent with a mood disorder, after an abrupt and unexpected retirement, it evolved into one more consistent with dementia, AD was diagnosed 5 years later. Nowadays, RT's wife report to lack of initiative and frequent episodes of spatial disorientation, together with important alterations in episodic and autobiographical memory (particularly related to the most recent decades of his life). RT's wife gave her signed informed consent for her husband's participation in the study. The consent was obtained according to the terms of the Declaration of Helsinki. At the beginning of this research study, RT was evaluated at

a general cognitive level with the Addenbrooke's Cognitive Examination III, [32,33] which showed a general cognitive decline, particularly in episodic memory and verbal fluency tasks. RT obtains a score of 60, which is 26 points below the suggested cut-off point, denoting an important cognitive compromise. He was also evaluated with the Ineco Frontal Screening [34] also showing executive dysfunction. RT obtains a score of 16, which is 9 points below the suggested cut-off point, denoting an important compromise in executive functions (Table 1).

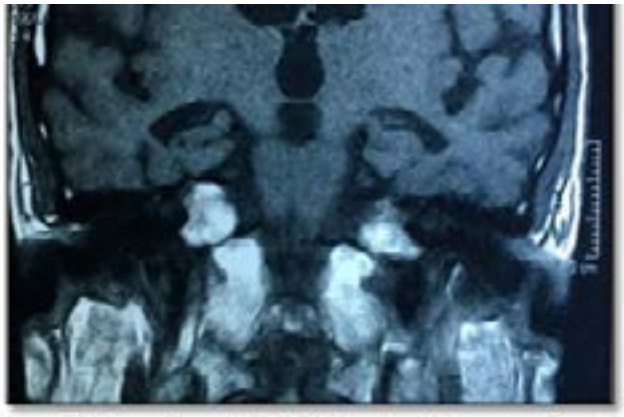

Figure 1. Images from RT's MRI showing hippocampal atrophy.

Table 1. Performance of Mr. RT in ACE III and IFS.

Addenbrooke's Cognitive Examination III (ACE - III)	
Attention	13/18
Memory	7/26
Verbal fluency	2/14
Language	24/26
Visuospatial function	14/16
Total	60/100
Ineco frontal screening (IFS)	
Motor programing	0/3
Conflicting instructions	0/3
Go-No go	2/3
Backwards digit span	4/6
Verbal working memory	1/2
Spatial working memory	1/4
Proverb interpretation	2/3
Verbal inhibitory control	6/6
Total	16/30

Neuropsychological assessment

In order to evaluate the effect of the ATS on autobiographical memory, RT was assessed before and after the intervention with two different scales: The Modified Screening of Autobiographical Memory and the Autobiographical Memory Test. The Modified Screening of Autobiographical Memory [18] consists of the recording of autobiographical memories segmented in periods of the patient's life. The memories are categorized according to their episodic content, taking into account the time, space, thoughts and emotions connected of each memory. The results obtained by RT in this test can be seen in Table 2.

Table 2. Performance of Mr. RT in the Modified Screening of Autobiographical Memory.

Decade		Before	After
Decade 0-9		7	3
Decade 10-19		7	4
Decade 20-29	episode 1	5	7
	episode 2	4	10
Decade 30-39	episode 1	4	9
	episode 2	7	3
Decade 40-49	episode 1	6	6
	episode 2	6	5
Decade 50-59	episode 1	5	4
	episode 2	4	8
Decade 60-69	episode 1	5	0
	episode 2	1	3
Total		61	62

The Autobiographical Memory Test [35] is made up of 15 words that present positive, negative or neutral valence. The test requires the patient to evoke memories connected to words previously read. This memories are divided into 5 categories a) specific memories (events occurred at a specific time and place), b) extended memories: covering relatively periods of time (weeks, moth), c) categorical memory: repetitive events, d) memory of semantic association: when a specific event is not mentioned, but there is an association with a target word and e) omissions:when the patient that's not react to the stimuli or repeats an answer. The results obtained by RT in this test can be seen inTable 3.

Table 3. Performance of Mr. RT in the Autobiographical Memory Test.

	Before	After
Specific Memory	2	1
Categorical Memory	2	5
Extended Memory	3	2
Semantic Association	1	1
Did no remember	2	1

In the following stage of this study, the patient was provided with a tablet containing the ATS developed by the research team. Two additional visual analogue scales were applied in order to in order to assess the ease of use of the instrument and overall user's satisfaction, respectively. The first scale measures eleven aspects with a liker response scale that ranges from 0 (bad) to 10 (excellent). The second scale explores measures nine elements in a similar response format, from 0 (nothing) to 10 (a lot). Both, the patient and his wife, were asked to report both scales. The results can be seen in Tables 4 and 5.

Table 4. Performance of Mr. RT in the visoanalogical scale of use of the tablet.

	Before	After
How much initiative do you have to use the tablet?	2.5	0.6
How important is the tablet to your family?	1.5	4.5
How much time of your day do you use the tablet?	1.5	4.5
How often do you use the tablet as training?	1.5	6.5
How often do you use the tablet to see your email?	1	0
How well do you use the tablet?	3.5	4.5
How well do you turn on the tablet?	3.5	5.2
How easily do you remember the different passwords?	3.5	5.5
How easy is to manage the touch system of the tablet?	8.5	5.6
How easy is it to find the icons on the screen?	7.5	5.6
How easy is it to turn off the tablet?	3.5	4
Total	38	46.5

Table 5. Performance of Mr. RT in the visoanalogical scale of Global Satisfaction Level.

	Before	After
Do activities that are of interest to you	4	10
Presents initiative to perform different activities	1	10
Is involved in recreational activities	4	10
Maintains his hobbies and intellectual interests as before	0.5	9
Carry out your daily routine with enthusiasm	2	2.5
Feel interest in the use of the tablet	2	6
Show motivation to see photos	4.5	8.5
Enjoy listening to music	2.5	10
Maintains an adequate balance between the different occupational activities	3.5	0
Total	24	57

Results: After 6 months of training, improvements were observed both in the autobiographical memory tests and in the visual analogue scale. In the Modified Screening Test of Autobiographic Memory, no significant differences were observed between the scores obtained before and after stimulation with the ATS application,respectively (Table 2). However, the patient recalled more memories for the age range 20-29. In the Autobiographic Memory Test (Table 3) we observed similar results between pre- and post-training performances. However, while specific and extended memory worsened, categorical memory improved after the 6 months of training. The latter was related to the semantic component of autobiographical memory.Qualitatively, it was observed that after the training both words of negative (eg. illness) and positive valence (eg. friendship) generated emotional reactions which accompanied the recall. In the visual analogue scale of Tablet Management (Table 4) RT showed some improvements. The patient also reported increasingly extended period of time using the tablet and higher frequency of use of the device. In the visual analogue scale of satisfaction level (Table 5), RT reported greater satisfaction in relation to music, more interest in the use of the tablet and greater motivation to look at photos of his family and to perform recreational activities.

Discussion

The deterioration of autobiographical memory has a very important impact on the daily life of patients and their families. Previous studies have shown that episodic autobiographical memories begin to deteriorate in normal aging, leading to a dependence on semantic autobiographical memories. Therefore, it has been proposed that semantic autobiographical memory can be used as scaffolding to improve the patient's identity, accompanied with other cognitive strategies [16]. In AD, this phenomenon is observed to a greater extent.

In the present study, we investigated the effect of ATS as a serious game to stimulate autobiographical and emotional memory for a period of 6 months in a patient of 72 years with a presumptive diagnosis of AD. From the results described, the application seemed to stimulate the autobiographical memory, serving as scaffolding for the semantic autobiographical memory and improving the recall of emotional contents. Although there was no greater recall of memories, more semantic-type memories were observed, accompanied by a higher emotional content in the memories recalled (memories accompanied by laughter and crying, unlike the evaluations made prior to training). It is inferred from this, that the training in the use of ATS and the constant contact of the patient with significant information from the present and past may have had an impact on the subject's emotional memory. In the case of RT, the use of the application allowed to favor its autobiographic memory based on semantic aspects, even if does not maintain episodic memories. This was made possible by the use of own audiovisual material during the exercise, that produce a high impact at the level of personal and emotional identity. Additionally, the quality of life of RT and his family was favored, an important aspect to consider when working with patients with Alzheimer's dementia.

Conclusion

This study allowed us to present ATS as a useful tool for stimulating autobiographical and emotional memory in patients with AD and strengthening semantic autobiographical memories. It is important to mention some limitations inherent to the study; the first is that it is a unique case, so the results cannot be generalized. The second one that was not applied a pre-post-classic classic neuropsychological battery, only screening tests and specific autobiographical memory tests were administered, this limited the possible analyzes. Further research is necessary to evaluate the impact of ATS in other patients with AD and other pathologies that involve autobiographical episodic memory, as well as to assess the effects of ATS over longer periods of time.

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