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Neurodegenerative diseases



## **COGNITIVE TRAINING BASED ON DIGITAL MEMORIES FOR MILD COGNITIVE DETERIORATION (RE-MEMORY)**

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## 1. Summary of the project

### **PRESENTATION AND JUSTIFICATION**

Re-Memory ([www.rememory.cat](http://www.rememory.cat)) is a cognitive training program for people diagnosed with amnesic mild cognitive impairment (aMCI) that is based on recording the person's daily life to stimulate autobiographical memories and delay the evolution of symptoms towards dementia.

People diagnosed with aMCI are people who present subjective complaints of memory problems, which are also confirmed through standardized tests, but the rest of the cognitive domains are preserved and without repercussion at a functional level. The Re-Memory has been specifically addressed to this group given the evidence that these people constitute a population with a high risk of developing an Alzheimer-type dementia. It is for this reason that the intervention in this phase represents a critical period to alter the trajectory of the cognitive and functional decline of these patients.

### **GENERAL OBJECTIVE**

The main objective of Re-Memory was to create a new non-pharmacological intervention tool for people with aMCI based on the re-experiencing of the autobiographical episodes. All this with the aim of providing a powerful cognitive and emotional stimulation and contributing to slow down the progression of the cognitive impairment and change the natural course of the disease for this group.

### **SPECIFIC OBJECTIVES**

The specific objectives of Re-Memory have been the following:

1. Develop a personalized program to stimulate recent memory, including personal material based on the autobiographical episodes of each subject, given that the use of individual stimuli facilitates memory improvement.
2. Create a computer vision application that allows management of large collection of images that will be obtained through portable digital cameras, which will be responsible

for developing algorithms to organize images and define and extract significant events. These images will be used for re-experiencing the episode in the therapeutic context of the cognitive training program.

3. To evaluate the effectiveness of the intervention program, to improve not only the memory of patients with aMCI, but also other cognitive functions, such as emotional well-being and functional performance.
4. Explore the use and applicability of biomarkers to quantify the improvement in memory derived from this intervention program.

## **PARTICIPANTS**

The inclusion criteria for the participating subjects were the following:

1. 65-90 years of age;
2. Being diagnosed with aMCI;
3. Having a reliable caregiver or informant who could supervise the patient's daily activities
4. Receiving cognitive stimulation treatment in a day center or hospital for three months or more;
5. Written informed consent to participate in the study.

The exclusion criteria for the participating subjects were the following:

1. Unstable medical conditions
2. Presence or history of severe psychiatric disorder (schizophrenia, bipolar disorder, delusional disorder, severe depressive disorder), stroke or history of some other neurological pathology or history of alcoholism
3. Relevant and uncorrected auditory, visual, motor or language deficits
4. Less than 4 years of formal education
5. Lack of correct command of the Spanish or Catalan languages

## **METHODOLOGY**

The design of the study was a quasi-experimental design, pre-test, post-test and follow-up, in which 30 people diagnosed with aMCI were sequentially assigned to one of 2 conditions: intervention group or control group.

The intervention consisted of the following 3 phases:

*I. Phase of capture / collection of images.* All participants carried a wearable digital camera for two weeks, while they carried out their daily activities. The camera model used was the Narrative Clip2©. It is a small camera that is worn around the neck like a pendant, and it takes pictures automatically every 30 seconds. The user, who carries the camera, is free to decide when he wants photographs to be captured or not.

*II. Processing phase of the images.* All the captured images were later processed by computer vision program, which created algorithms to organize and extract the significant episodes of all the images, were later transformed into films of 3 minutes duration each, which collected the most significant autobiographical episodes. The resulting images and films were the material that was included in the treatment program applied to each subject.

*III. Application phase of the intervention program.* The intervention program consisted of 16 individual sessions, of approximately one hour each session. They were held twice a week (on Monday and Wednesday) over a period of 2 months. The intervention was carried out individually with each patient and one therapist. The images and autobiographical films were presented on a tablet, with which the subject had to interact.

## **MEASURES**

The evaluations were made: a) Baseline phase; b) End of treatment phase; c) Follow-up phase at 3 months.

The measurements of the results collected were:

- Cognitive measures: cognitive tests that evaluate the following domains: attention, memory, language, executive functions, processing speed
- Functional measures: tests, questionnaires and self-report scales that evaluate the level of autonomy of the subject in the different daily life activities.
- Emotional, behavioral and quality of life measures: questionnaires and inventories that evaluate the presence of symptoms of anxiety, depression, happiness, social support and perceived quality of life.
- Biological measures: BDNF serum levels and cortisol hormone levels
- Measures applied to the caregiver: questionnaires that assess the presence of behavioral disorders in the patient, level of social support of the caregiver and emotional state and emotional burden to the caregiver.

## 2. Results

- It is shown that subjects with aMCI can and do accept to use digital lifelogging cameras to capture significant autobiographical episodes of their life. Also, the amount of images that they can capture is adequate to be used later in specific programs to stimulate cognitive functions.
- It is also shown that it is possible to create multimodal programs for the stimulation of cognitive and emotional functions through the review of one's own episodes, and that the systematic application of this program generates changes in cognitive functions in patients with mild cognitive impairment, during a subjective improvement in the perception of emotional well-being and satisfaction. And, moreover, it has been shown that the changes achieved at the end of the treatment are maintained after 3 months.
- A new methodology based on Computer Vision has been available, that allows the acquisition of records of significant biographic episodes of one's life. With these results it will be possible to replicate this study with other groups or parallel investigations.

### 3. Relevance and possible future implications

- The practical application of these results is very broad, given that this project has allowed us to carry out this preliminary study, which was developed with a small sample. Given the positive results of the study, it opens the doors to replicate it with larger samples, to be tested in other groups of people with cognitive disorders, and also to be part of other treatment programs.
- In conclusion, these results open the doors to the use of Re-Memory as a multimodal intervention tool based on the re-experience of the lived episodes.

### 4. Literature generated

- Mariella Dimiccoli, Marc Bolaños, Estefanía Talavera, Maedeh Aghaei, Stavri G. Nikolov, Petia Radeva: SR-clustering: Semantic regularized clustering for egocentric photo streams segmentation. Computer Vision and Image Understanding 155: 55-69 (2017), cites 25 Web of science (WOS) IF: 2.391 Q2
- Marc Bolaños, Mariella Dimiccoli, Petia Radeva: Towards Storytelling From Visual Lifelogging: An Overview. IEEE Trans. Human-Machine Systems 47(1): 77-90 (2017), cites 55 WOS IF: 2.563 Q2
- Egocentric video description based on temporally-linked sequences. J. Visual Communication and Image Representation 50: 205-216 (2018) WOS 1,836 Q2
- Alejandro Cartas, Juan Marín, Petia Radeva, Mariella Dimiccoli: Batch-based activity recognition from egocentric photo-streams revisited. Pattern Anal. Appl. 21(4): 953-965 (2018) WOS IF: 1.281 Q3
- Lidon, A., Bolaños, M., Dimiccoli, M., Radeva, P., Garolera, M., & Giro-i-Nieto, X. (2017, October). Semantic summarization of egocentric photo stream events.

In *Proceedings of the 2nd Workshop on Lifelogging Tools and Applications* (pp. 3-11). ACM.

- Oliveira-Barra, G., Dimiccoli, M., & Radeva, P. (2017, June). Leveraging activity indexing for egocentric image retrieval. In *Iberian Conference on Pattern Recognition and Image Analysis*(pp. 295-303). Springer, Cham.
- Oliveira-Barra, G., Bolaños, M., Talavera, E., Duenas, A., Gelonch, O., & Garolera, M. (2017, September). Serious Games Application for Memory Training Using Egocentric Images. In *International Conference on Image Analysis and Processing* (pp. 120-130). Springer, Cham.
- de Oliveira Barra, G., Cartas Ayala, A., Bolaños, M., Dimiccoli, M., Giró Nieto, X., & Radeva, P. (2016). Lemore: a lifelog engine for moments retrieval at the NTCIR-lifelog LSAT task. In *Proceedings of the 12th NTCIR Conference on Evaluation of Information Access Technologies*.
- Alejandro Cartas, Mariella Dimiccoli, Petia Radeva: Detecting Hands in Egocentric Videos: Towards Action Recognition. EUROCAST (2) 2017: 330-338, cited by 2 Cartas, A., Dimiccoli, M., & Radeva, P. (2017, February). Detecting hands in egocentric videos: Towards action recognition. In *International Conference on Computer Aided Systems Theory* (pp. 330-338). Springer, Cham.
- Eduardo Aguilar, Marc Bolaños, Petia Radeva: Food Recognition Using Fusion of Classifiers Based on CNNs. ICIAP (2) 2017: 213-224, cited by 10 Aguilar, E., Bolaños, M., & Radeva, P. (2017, September). Food recognition using fusion of classifiers based on cnns. In *International Conference on Image Analysis and Processing* (pp. 213-224). Springer, Cham.
- Alejandro Cartas, Juan Marín, Petia Radeva, Mariella Dimiccoli: Recognizing Activities of Daily Living from Egocentric Images. IbPRIA 2017: 87-95, cited by 9. Cartas, A., Marín, J., Radeva, P., & Dimiccoli, M. (2017, June). Recognizing activities of daily living

from egocentric images. In *Iberian Conference on Pattern Recognition and Image Analysis*(pp. 87-95). Springer, Cham.

- Estefanía Talavera, Nicola Strisciuglio, Nicolai Petkov, Petia Radeva: Sentiment Recognition in Egocentric Photostreams. CoRR abs/1703.09933 (2017), cited by 4 Talavera, E., Strisciuglio, N., Petkov, N., & Radeva, P. (2017, June). Sentiment recognition in egocentric photostreams. In *Iberian Conference on Pattern Recognition and Image Analysis*(pp. 471-479). Springer, Cham.
- Gabriel de Oliveira Barra, Alejandro Cartas Ayala, Marc Bolaños, Mariella Dimiccoli, Xavier Giró i Nieto, Petia Radeva: LEMoRe: A Lifelog Engine for Moments Retrieval at the NTCIR-Lifelog LSAT Task. NTCIR 2016, cited by 9 de Oliveira Barra, G., Cartas Ayala, A., Bolaños, M., Dimiccoli, M., Giró Nieto, X., & Radeva, P. (2016). Lemore: a lifelog engine for moments retrieval at the NTCIR-lifelog LSAT task. In *Proceedings of the 12th NTCIR Conference on Evaluation of Information Access Technologies*.

#### PAPERS DELIVERED PENDING ACCEPTANCE:

- Gelonch, O., Ribera, M., Codern-Bové, N., Ramos, S., Quintana, M., Chico, G., Cerulla, C., Lafarga, P., Rdeva, P., Garolera, M. *Acceptability of a Lifelogging wearable camera in Mild Cognitive Impairment: A mixed-method study*. BMC Geriatrics
- Codern-Bové, N., Ribera, M., Gelonch, O., Ramos, S., Bolaños, M., Radeva, P. & Garolera, M. *Are middle-aged and old people with memory complaints able and willing to use wearable cameras?* International Journal of Medical Informatics
- Gelonch, O., Cano, N., Vancells, M., Bolaños, M., Re-Memory Group & Garolera, M. *The effects of exposure to recent autobiographical events in amnesic Mild Cognitive Impairment*. International Journal of Clinical and Health Psychology

#### POSTERS PRESENTED TO CONGRESSES OF NEUROPSYCHOLOGY, NATIONAL AND INTERNATIONAL

- III Congreso Nacional de Psicología, July 2017, Oviedo, Spain

Title: Acceptability of portable cameras in people with mild cognitive impairment: balance between the right to privacy and improved memory

Mar Peretó, Paula Lafarga, Natalia Cuenca, Sílvia Ramos, Noemí Cerulla, Nuria Codern, Mireia Ribera, Marc Bolaños, Olga Gelonch, Maite Garolera

- 6th Scientific Meeting of the Federation of the European Societies of Neuropsychology | September 2017, Maastricht, Holland

Title: Assessing competency in using wearable cameras in older adults with mild cognitive impairment.

Olga Gelonch, Mar Peretó, Paula Lafarga, Natalia Cuenca, Silvia Ramos, Gloria Chico, Nuria Codern, Mireia Ribera, Marc Bolaños, Maite Garolera.

- X Congreso Nacional de neuropsicología FANPSE, March 2018, Valencia, Spain

Title: Does exposure to autobiographical episodes captured with a portable lifelogging camera influence the perception of self-efficacy and subjective well-being in people with Mild Cognitive Impairment?

O. Gelonch, M. Vancells, N. Cano, J. Ginestà, G. de Oliveira, P. Radeva, Grupo ReMemory, M. Garolera.

- 72<sup>a</sup> Jornada de la Societat Catalana de Neuropsicologia. Cognició i neurociències, June 2018, Barcelona, Spain

Title: Are the years of schooling associated with a greater benefit on recall in amnesic-MCI patients?

Olga Gelonch, Marta Vancells, Neus Cano, Kristina Likhmanova, Eva Rubio, Gabriel de Oliveira, Petia Radeva & Maite Garolera

\* This communication received the prize for the best communication and was presented as a stellar communication during the day

- 7th Scientific Meeting of the Federation of the European Societies of Neuropsychology, September, 2018, Prague, Czech Republic

Title: Could the stimulation of autobiographical memory modify the perception of self-efficacy and subjective well-being in people with Mild Cognitive Impairment (MCI)?

O. Gelonch, M. Vancells, N. Cano, J. Ginestà, G. de Oliveira, P. Radeva, ReMemory Group, M. Garolera.

- Jornades R+D+I TIC Salut i Social 2018. Tecnologia i humanisme: Teràpies digitals, September 2018, Vic, Spain

Title: Exploratory study of the use of lifelogging digital cameras in the elderly

Olga Gelonch, Mireia Ribera, Marc Bolaños, Petia Radeva, Marta Vancells, Neus Cano, Sílvia Ramos, Núria Codern, Maite Garolera

- Alzheimer Europe Conference Barcelona, October 2018, Spain

Title: Effects on subjective well-being and self-efficacy in Amnesic MCI people to one session exposure to recent autobiographical information.

O. Gelonch, M. Vancells, N. Cano, K. Likhmanova, E. Rubio, G. de Oliveira, P. Radeva, ReMemory Group & M. Garolera.

- International Neuropsychological Society 2019 Annual Meeting, February 2019, New York City

Title: Autobiographical Event Exposure Training: a Promising Intervention for Amnesic MCI?

Olga Gelonch, Marta Vancells, Neus Cano, Kristina Likhmanova, Silvia Ramos, Gabriel de Oliveira, Petia Radeva, ReMemory Group & Maite Garolera

#### PRESENTATION OF THE REMEMORY PROJECT IN INTERNATIONAL CONGRESSES

- HEALTHIO Congress. Developed in Barcelona on October 18, 2018.
  - o Dr. Garolera presented the Re-Memory project
- CRASH Day, held in Boston on October 9, 2018
  - o Dr. Garolera presented the Re-Memory project

#### SELECTION OF APPEARANCES ON PRESS AND TELEVISION

- Channel 9TV showed an interview with Dr. Garolera about the Re-Memory on 09/28/2018 <https://el9tv.alacarta.cat/7-dies/tall/maite-garolera>

- The newspaper "ARA" published the news about the project in its digital and paper versions on 06/13/2017: [http://www.ara.cat/societat/fotografia-trenta-segons-ajudar-records\\_0\\_1813618638.html](http://www.ara.cat/societat/fotografia-trenta-segons-ajudar-records_0_1813618638.html)
- The newspaper "Món Terrassa" published a news about the Re-Memory on 10/17/2018. It can be accessed through the following link:  
<https://elmon.cat/monterrassa/societat/projecte-pacients-dalzheimer-fet-al-cs-terrassa-al-salo-healthio-salut>