Computer-based cognitive training for dementia

Results from a randomized controlled trial on MCI, mild AD and healthy ageing

Chiara Zaccarelli, Neuropsychologist
chiara.zaccarelli@maggioli.it
Psycho-social interventions for people living with dementia

- Limited efficacy of pharmacological treatments for dementia
- Need to delay disease progression and functional decline
- Plasticity of the human brain

Non-pharmacological interventions for dementia
Psycho-social interventions for people living with dementia

Psycho-social interventions:

- improve cognitive abilities (cognitive stimulation, cognitive training)
- enhance emotional well-being (reminiscence therapy, activity planning)
- reduce behavioral symptoms (aromatherapy, music therapy, pet therapy)
- promote everyday functioning (occupational therapy)
- complement the treatment of patients by supporting family caregivers (educational groups, support programs)

Improve the quality of life of persons with dementia and their caregivers
Non pharmacological interventions in early cognitive decline

- **General** cognitive stimulation/individualized rehabilitation protocols: spread benefits but small transfer effects (Lustig et al., 2009)

- **Cognitive training** (CT): repeated practice on standardized tasks relying on specific domains
  - *strategy based* (sb-CT): learning and practicing memory strategies (large benefits but limited transfer effects)
  - *process based* (pb-CT): repetitive cognitive exercises without explicit strategies (large benefits and larger transfer effects)

- **Reminiscence Therapy** (RT): non specific stimulation activity consisting in recalling personal past events supported by memory triggers
**SOCIABLE Project**

- **SOCIABLE** is a European B project supported by the **Europe’s Information Society: ICT Policy Support Programme, Objective 1.4: ICT for healthy aging**
- **Objective**: to integrate, develop and pilot a novel ICT-based approach for assessment, monitoring, and reinforcement of the cognitive status of elderly people in the early stages of dementia as well as boosting their social interaction
- **Duration**: 36 months (2009-2012)

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**Technological Partners**

| Singular Logic | Athens |
| CEDAF | Forli |
| LabHuman | Valencia |
| AIJU | Alicante |

**Pilot Sites**

| Trondheim Kommune | Trondheim |
| D.T.C.A hygeia | Athens |
| Comune di Forli | Forli |
| Azienda Unita Sanitaria Locale di Forli | Forli |
| Fondazione Santa Lucia | Rome |
| Prev | Valencia |
SOCIABLE Objectives

- pilot and evaluate a radically new ICT-based approach to the cognitive training and social activation of elderly people at the early stage of dementia
- activate and increase the number and quality of social interactions of elderly people
- provide an automated tool for supporting the assessment and managing of the elderly data by medical experts
Clinical Trial: METHODS

STUDY POPULATION:
- **Target Group A**: healthy elderly aged 65+ (HE)
- **Target Group B**: subjects aged 65+ with Mild Cognitive Impairment (MCI)
- **Target Group C**: subjects aged 65+ with Mild Alzheimer’s Disease (mAD)

SAMPLE:
Total of 348 subjects recruited in four countries

• **STUDY DESIGN**: multi-center, randomized controlled study.
• Subjects were randomly assigned to two arms of a crossover design: in arm A participants underwent 3 months of training (pb-CT + RT) followed by 3 months of rest; arm B started with the rest period followed by training
• All participants were followed for 6 months, with assessments at baseline, 3 months, and 6 months
Clinical Trial: STUDY DESIGN

ASSESSMENT

Week

0 12 24

T0 T1 T2

Arm A

Treatment

No treatment

Arm B

No treatment

Treatment
Clinical Trial: METHODS

• TRAINING PROGRAM:
  ◦ **Training frequency**: two sessions per week, 60 min per session (30 min of multi-component pb-CT + 30 min of RT) for twelve weeks (24 sessions)
  ◦ **Training**: 12 weeks
  ◦ **Sessions**: individual or group (2-3 users)

• ASSESSMENT: at baseline (T0), at 3 months (T1), at 6 months (T2) through:
  ◦ **Neuropsychological Assessment**
  ◦ **Affective Assessment**
  ◦ **Functional Assessment**
  ◦ **Social Assessment**

• The training was delivered through **Sociable** system operating on a touch screen computer (Tablet or Surface PCs). The software included exercises for cognitive training and an electronic book «Book of Life» for the RT.
SOCIABLE Procedure

**COGNITION**
- Orientation: Mini Mental State Examination
- Abstract reasoning: Clock Drawing Test
- Verbal memory (long term): Rey’s Auditory Verbal Learning Test
- Constructional praxis: Rey’s Complex Figure (copy)
- Visuo-spatial memory: Rey’s Complex Figure (delayed recall)
- Verbal memory (short term): Digit Span
- Executive functions: Phonological Verbal Fluency
- Attention: Trail Making Test (parts A and B)
- Language: Naming Test (specific for each country)

**AFFECTION**
- Geriatric Depression Scale –GDS (short form)

**FUNCTIONAL ABILITIES**
- ADL, IADL

**SEVERITY OF DEMENTIA**
- Clinical Dementia Rating

**SOCIAL INTERACTION**
- LSNS-18; Social Preferences Questionnaire

**EXPERTISE IN ICT**
- Questionnaire of LEVEL EXPERTISE in ICT (pre-post training)

2 sessions/week = 24 sessions

### DIAGNOSIS

**INFORMED CONSENT**
- COGNITIVE-AFFECTIVE-FUNCTIONAL ASSESSMENT
- SOCIAL ASSESSMENT

**IMPACT ASSESSMENT - SATISFACTION QUESTIONNAIRE**

<table>
<thead>
<tr>
<th>Week 0</th>
<th>Week 1-12</th>
<th>Week 16</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Warm-up”</td>
<td>T0 - T1 - T2</td>
<td>“Follow-up”</td>
</tr>
</tbody>
</table>

2 November 2016

26th Alzheimer Europe Conference, Copenhagen
SOCIABLE Applications:

25 exercises for the pb-CT designed to reinforce the main cognitive skills:
• MEMORY
• ATTENTION
• EXECUTIVE FUNCTIONS
• ABSTRACT REASONING
• LANGUAGE
• CONSTRUCTIONAL PRAXIS

“Book of life”: electronic book, created with the ICT support, for reminiscence therapy (RT)

Back Office: application for management and programming of customized training and patient data storage/assessment
SOCIA BLE Devices

SURFACE: multi-touch surface computing platform, that responds to natural hand gestures and real world objects, for the training of groups of patients in hospitals/social centers

TABLET PCs: touch screen devices for the individual training at home/social-health centers with the caregiver’s support
Medical experts -> Technological Partners -> Games development -> Testing
Sociable Process: where

PLACES OF THE CLINICAL TRIAL:

• *Medical Centers* (public and private hospitals- memory clinics)
• *Social Centers/Aggregation Centers* for elderly people
• *Volunteers Associations/Alzheimer Cafes*
• *Users’ homes*
Clinical Trial: OUTCOMES

• **Study outcomes:**
  
  ◦ **Primary outcome:** effect of the training compared with the rest on neuropsychological test scores and duration at follow-up
  
  ◦ **Secondary outcome:** effect of the training compared with the rest on functional abilities assessed with the Instrumental Activities of Daily Living (IADL, Lawton and Brody, 1969)

• **Statistical Analysis:**
  
  ◦ The interaction arm x time was analyzed with a mixed analysis of variance (ANOVA) with arms (A and B) as between-subjects factor and time of assessment (baseline, month 3, and month 6) as within-subjects factor.
Clinical Trial: RESULTS

- Significant positive effect during the training for episodic memory in all three groups
- Maintained effect during the 3-months of post-training rest
- mAD and MCI showed a positive effect on global cognition (MMSE)
- mAD showed a positive effect on functional abilities (IADL)
## RESULTS: GENERAL OVERVIEW

<table>
<thead>
<tr>
<th>COGNITIVE ABILITIES</th>
<th>TEST</th>
<th>ALL</th>
<th>HE (A)</th>
<th>MCI (B)</th>
<th>mAD (C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GLOBAL COGNITION</td>
<td>MMSE</td>
<td>&lt;.001</td>
<td>0.113</td>
<td>0.002</td>
<td>0.004</td>
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<tr>
<td>REASONING</td>
<td>Clock Drawing Test</td>
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<td>ns</td>
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<tr>
<td>MEMORY-VERBAL-SHORT</td>
<td>Digit Span forward</td>
<td>0.041</td>
<td>0.062</td>
<td>0.024</td>
<td>ns</td>
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<tr>
<td>MEMORY-VERBAL</td>
<td>Rey Auditory Verbal Learning Test (RAVL) – immediate</td>
<td>0.003</td>
<td>0.138</td>
<td>0.060</td>
<td>0.002</td>
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<tr>
<td>MEMORY-VERBAL-LONG</td>
<td>Rey Auditory Verbal Learning test (RAVL) – delayed</td>
<td>&lt;.001</td>
<td>0.001</td>
<td>0.012</td>
<td>0.001</td>
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<tr>
<td>MEMORY-VISUOSP-LONG</td>
<td>Rey’s Complex figure – recall</td>
<td>0.154</td>
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<tr>
<td>PRAXIS</td>
<td>Rey’s Complex figure – copy</td>
<td>0.025</td>
<td>0.003</td>
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<tr>
<td>EXECUTIVE FUNCTIONS</td>
<td>Phonological Verbal Fluency</td>
<td>0.004</td>
<td>0.008</td>
<td>0.012</td>
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<tr>
<td>EXECUTIVE FUNCTIONS</td>
<td>Trial Making Test B</td>
<td>0.111</td>
<td>0.092</td>
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<td>ns</td>
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<tr>
<td>EXECUTIVE FUNCTIONS</td>
<td>Digit Span backward</td>
<td>0.002</td>
<td>0.061</td>
<td>ns</td>
<td>0.014</td>
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<td>ATTENTION</td>
<td>Trial Making Test A</td>
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<td>0.158</td>
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<td>0.057</td>
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<tr>
<td>LANGUAGE</td>
<td>Naming Test</td>
<td>0.012</td>
<td>0.03</td>
<td>ns</td>
<td>ns</td>
</tr>
</tbody>
</table>
SIGNIFICANT EFFECT on
- GLOBAL COGNITION (MMSE)
- MEMORY
- EXECUTIVE FUNCTIONS
Sociable Results

- Increase of mood
- Improvement of cognitive status
- Reduction of isolation
- Increase in daily functioning (ADL, IADL)
- Positive impact with ICT
- High level of satisfaction
The platform was well accepted from the users

User-friendly interface, easy to use and get acquainted with

The training program was interesting for most of users

Most of users experienced an improvement in their mood after the sessions

Group sessions were better accepted than individual ones - due to socialization-cooperation

Most of users expressed willing to repeat the program.
Satisfaction and social impact

SATISFACTION QUESTIONNAIRE

Users
- Users: 90
  - Medical experts: 10

Caregivers
- Caregivers: 79
  - Medical experts: 21

PIADS (Psychosocial Impact of Assistive Devices)

- Ability: +3
- Adaptability: +3
- Self Esteem: +3

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26th Alzheimer Europe Conference, Copenhagen
Main Conclusions

- effectiveness of SOCIABLE CT as an intervention for early cognitive decline (MCI and Mild Alzheimer’s disease)
- effectiveness of SOCIABLE CT as a preventive tool for cognitively intact elderly
- high level of satisfaction and acceptability expressed by the elderly for SOCIABLE platform and applications
- increased confidence and acceptance of ICT devices by the elderly
Added values of Sociable treatment

- for the ELDERLY USERS:
  - personalization of Cognitive Training
  - interaction with other users and with high level ICT devices
  - innovative treatment, interactive and stimulating

- for the CAREGIVERS:
  - satisfaction of results
  - decrease level of stress connected with positive effect of the training
  - educational effect

- for the HEALTH PROFESSIONAL/MEDICAL EXPERTS:
  - overcome the traditional paper-pencil approach in the field of cognitive rehabilitation
  - collect and storage data, always available
  - computerized assessment, with automated recording and scoring
Research Article

Protecting cognition from aging and Alzheimer's disease: a computerized cognitive training combined with reminiscence therapy

Francesco Barban¹, Roberta Annicchiarico¹, Stelios Pantelopoulos², Alessia Federici¹, Roberta Perri¹, Lucia Fadda¹, Giovanni Augusto Carlesimo¹,³, Claudia Ricci¹, Simone Giuliani¹, Francesco Scalici¹, Chiara Stella Turchetta¹, Fulvia Adriano¹, Maria Giovanna Lombardi¹, Chiara Zaccarelli⁴, Giulio Cirillo⁴, Simone Passutì⁵, Paolo Mattarelli⁵, Olga Lymeropoulou⁶, Paraskevi Sakka⁶, Eva Ntanasi⁶, Reyes Moliner⁷, Azucena Garcia-Palacios⁸ and Carlo Caltagirone¹,³

1 Clinical and Behavioral Neurology Laboratory, IRCCS Santa Lucia Foundation, Rome, Italy
2 SingularLogic, Athens, Greece
3 Department of System Medicine, University of Rome “Tor Vergata”, Rome, Italy
4 Azienda Unità Sanitaria Locale, Forlì, Italy
5 Maggioli, Forlì, Italy
6 Hygeia Diagnostic and Therapeutic Center, Athens, Greece
7 Psicología y Realidad Virtual, Valencia, Spain
8 Jaume I University of Castellón, Castellón de la Plana, Spain

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