Using computer-based cognitive training games to assess the evolution of cognitive capacity in people at high risk of Alzheimer's disease

- *A study published in iScience, spearheaded by the Hospital del Mar Research Institute and the Barcelonaβeta Brain Research Centre, part of the Pasqual Maragall Foundation, validates these tools for monitoring potential sufferers*
- *Data was analysed from 56 volunteers who participated in the PENSA study, designed to determine whether it is possible to slow cognitive decline in stages prior to the onset of dementia through a combination of a lifestyle intervention programme and the consumption of a preparation based on a green tea component*
- *It was possible to monitor the evolution of the cognitive functions of these people much more closely and continuously than with standard tests. This paves the way for the adaptation, practically in real time, of treatments that can be adjusted to changes in cognitive decline*

Barcelona, 15 June, 2023. – Simple **computer games** may make it possible to improve how we **monitor the evolution of cognitive capacity** in people in the early stages of Alzheimer's, where there is subjective cognitive decline, an early clinical marker that can indicate the progression of this pathology. This approach not only makes it possible to continuously monitor people's cognition but also, based on the results, to personalise treatments and follow-up. This has been established in a study published in *iScience*, in which the Integrated Pharmacology and Systems Neuroscience Research Group at the Hospital del Mar Medical Research Institute and the Barcelona Beta Brain Research Centre (part of the Pasqual Maragall Foundation), as well as the CIBER on the Physiopathology of Obesity and Nutrition (CIBEROBN) collaborated.

The study validated these tools based on data from 56 people who took part in the **PENSA Study**, which evaluated how effective an intervention based on lifestyle habits, diet, physical activity, cognitive stimulation and cognitive training was in preventing cognitive decline over a 12-month period. In the cognitive training component, participants played a panel of 36 games designed by the company NeuronUP, which were distributed over a month in three 30-minute sessions per week. For twelve months, the participants played the same games, but the degree of difficulty varied according to each participant's performance. Data from six computer-based cognitive stimulation games that trained executive abilities, including planning capacity, working memory, mental flexibility, attention and inhibition, was analysed. Based on this data, it was possible to monitor the evolution of their cognitive performance in a very accurate and precise way. Unlike the traditional approach, which limits the waiting time between cognitive assessments to a minimum of 6 months, with this new tool cognition can be assessed on a monthly basis without the learning effects observed in standard testing. In addition, these tools are **twice as sensitive** as traditional tests in terms of measuring changes in cognitive ability in the stages prior to the onset of Alzheimer's disease.

Innovative tool
This is the first time such a tool has been validated for monitoring people at risk of dementia or Alzheimer's. "***It is a very innovative way of continuously assessing cognition in people***" explains Dr. Rafael de la Torre, researcher at the IMIM-Hospital del Mar and CIBEROBN, and principal investigator of the PENSA study. ***"Its major advantage is that we avoid the***

learning effect that occurs with other assessment systems and we solve one of the challenges of how to monitor cognitive ability in real time", adds Natàlia Soldevila, first author of the publication and a researcher at the Hospital del Mar Medical Research Institute.

Normally, participants in a study of this type are evaluated at three specific points in time. At the beginning, to determine their initial state, in the middle, to assess their evolution, and at the end, to establish what effect the evaluated interventions have had. Using computer-based cognitive stimulation games greatly improves follow-up capacity. They also provide other advantages, as Dr. Laura Forcano, a researcher at the Hospital del Mar Medical Research Institute and CIBEROBN and author of the study explains: **"In traditional tests there are no levels, the difficulty is always the same. In these games, the degree of difficulty is adjusted to the individual's baseline performance. Once the person has reached their maximum level, we can accurately measure cognitive changes."** Moreover, the fact that they play at home, in a familiar environment, also eliminates the stress factor of standard tests, which must be carried out in a clinical or research environment.

That is why the use of a tool like this **"not only allows us to see how the cognition of our participants has evolved overall, but also permits us to offer personalised medicine according to who responds and who does not respond to the intervention. Acquiring so many repeated measurements allows us to trace trajectories and see who has a better trajectory and who does not, and we can also explore the reasons for this"**, adds Natàlia Soldevila. If applied to a patient or participant in a study, it should be possible to tailor the treatment to their response without having to wait until the end of the investigation. In this study, this was verified in four of the participants, in whom no improvement in cognitive ability was observed.

From a clinical point of view, **"NeuronUP (NUP) is a cognitive stimulation and rehabilitation tool that has been validated for the first time for evaluating cognition, specifically executive functions, in a longitudinal manner to detect subtle changes. Having this type of tool is key for assessing the effectiveness of interventions to prevent cognitive impairment"**, says Dr. Oriol Grau, neurologist and coordinator of the Clinical Research Group and Risk Factors for Neurodegenerative Diseases at the Hospital del Mar Medical Research Institute, as well as head of the Clinical Research Group and Risk Factors for Degenerative Diseases at the Barcelonaβeta Brain Research Centre.

All the participants in the PENSA study were physically fit people between 60 and 80 years of age. To be included, they had to have detected some memory problems that they had not noticed for some time and be carriers of the *APOE4* allele. A total of 129 volunteers took part in the project and were offered a personalised action plan based on lifestyle habits and health indicators. The project received a grant of 1 million dollars from the United States *Alzheimer's Association* and 150,000 euros from the ISCIII, and is part of the *World Wide FINGERS* global project on the primary prevention of Alzheimer's disease.

Reference article

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Further information