

SENSATIONAL

Use of a spatial navigation video game for the early and personalised diagnosis of Alzheimer's disease

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CONTEXT

Alzheimer's disease (AD) is the most common major neurodegenerative dementia type. There are around 50 million people worldwide living with dementia, and this number will double every 20 years, amplifying the burden on older adults, caregivers, healthcare systems, and society as a whole. Early and precise diagnosis is essential because it offers an opportunity to intervene in the initial stages, prior to significant neuronal loss. Current state-of-the-art diagnostic measures of AD are invasive, expensive and time-consuming, resulting in limited accessibility. By contrast, cognitive fingerprints for incipient AD and digital biomarkers are widely overlooked, yet highly valuable as they would provide inexpensive, non-invasive alternatives. Coupled with emergent blood-based biomarkers, this multimodal approach could provide a light, scalable, and personalized screening process for AD.

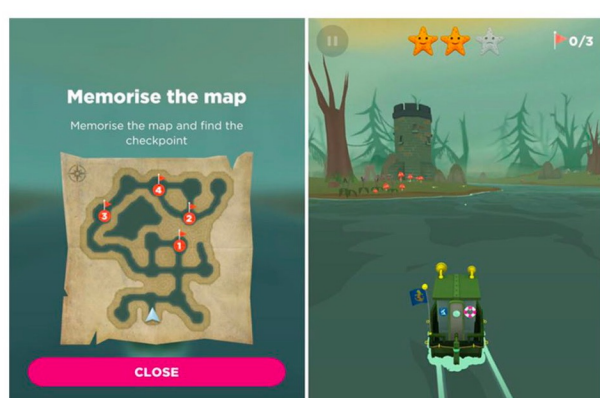
OBJECTIVES AND METHODOLOGY

In this project we propose to:

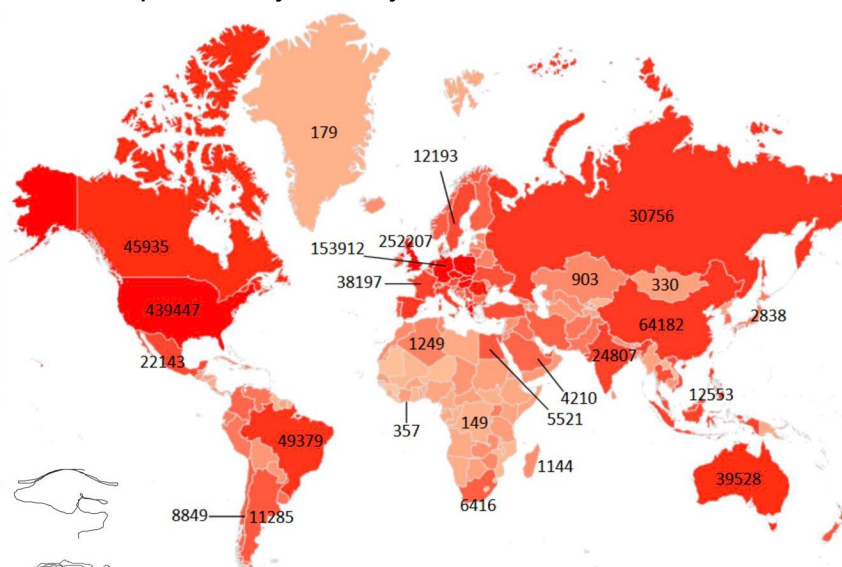
- Jointly record and analyze eye movements and spatial trajectories of controls and patients during a spatial navigation task, as spatial disorientation is an early AD symptom);
- Collect blood samples to identify blood biomarkers of AD (blood level of phosphorylated tau protein) along with cognitive markers;
- Develop new machine learning algorithms to identify relevant spatial manifolds in an existing spatial navigation database of 4 million people from the general population (Sea Hero Quest).

The prospect of predicting chronic disease, or even identifying or screening for AD at pre-clinical stages, raises numerous ethical questions, such as: « What are the human, psychological and ethical impacts of large-scale early detection? ». These questions will be the subject of a specific WP of the project.

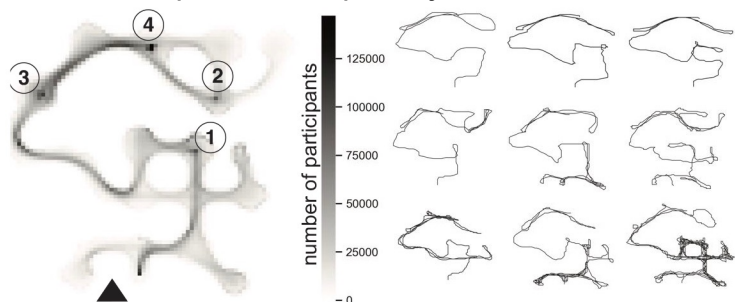
a – Screenshot from Sea Hero Quest



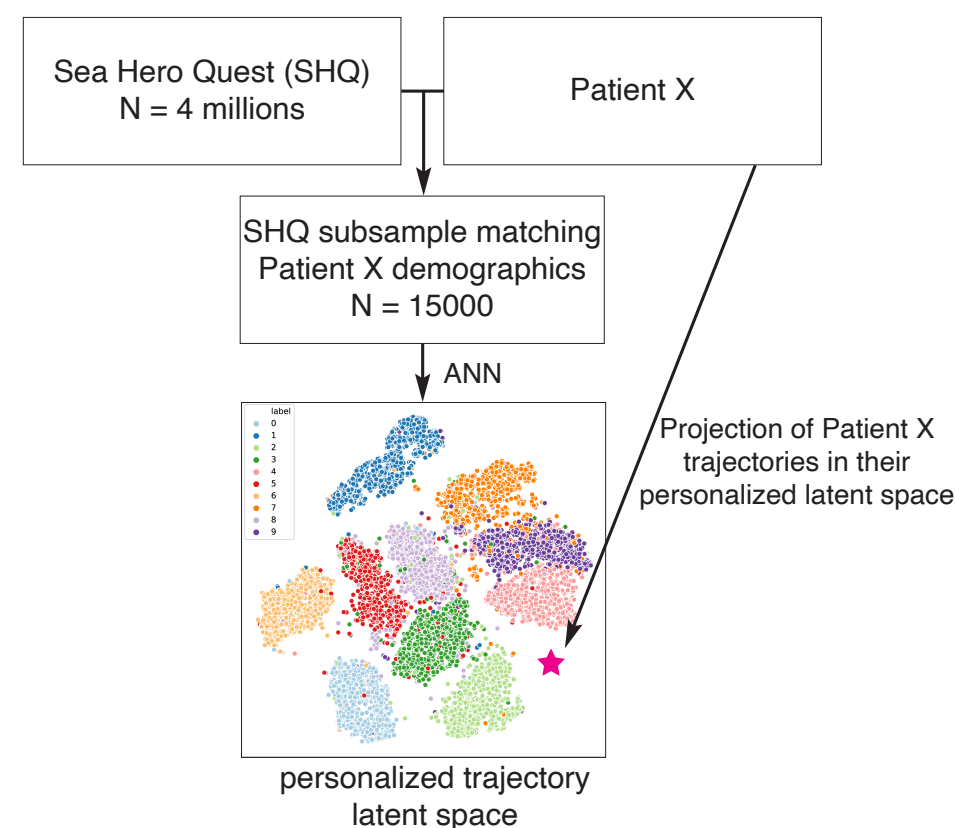
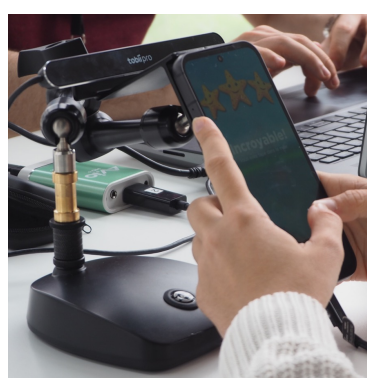
c – Sample size by country



b – Heatmap and example trajectories

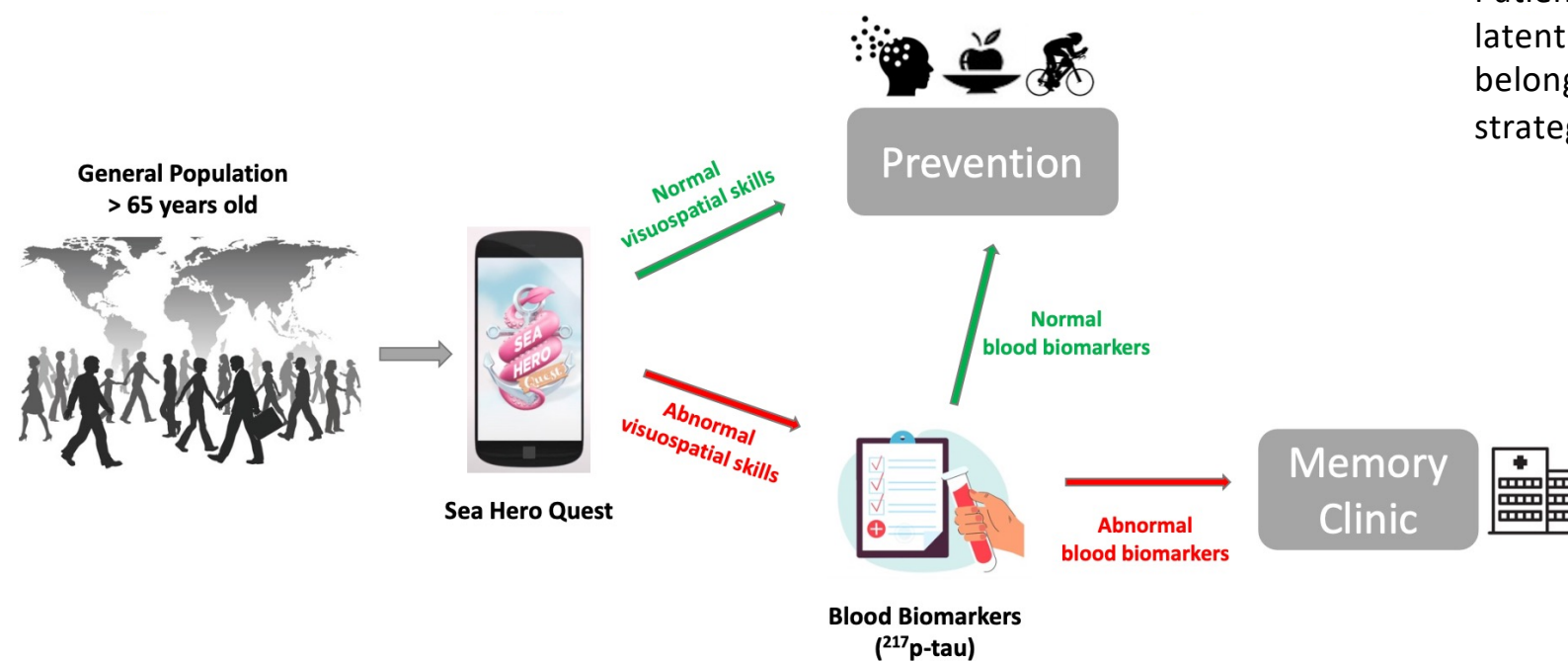


d - Eye-tracking set-up



Data analysis pipeline - A doctor needs to assess Patient X spatial behavior. A subsample of participants from the SHQ big dataset matching Patient X's demographics will be used to train an Artificial Neural Network (ANN). The ANN will identify a latent space where the trajectories of this subsample are clustered. Patient X's trajectories will be projected into their personalized latent space (pink star). The posterior probabilities of Patient X to belong to the identified clusters will inform the doctor on their strategy.

LONG-TERM GOALS



Identification of AD in the general population, with a graded cognitive and biological approach. Sea Hero Quest will help identify subjects at risk of AD, in whom ultra-sensitive plasma biomarker assays will further screen the patients necessitating specialized consultation.

More information on the project:
<https://projet.liris.cnrs.fr/seaheroquest/>

