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## Marqueurs cognitifs de la maladie d'Alzheimer : intégration du profil socio-démographique et des habitudes de vie pour un dépistage précoce

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# La navigation spatiale comme marqueur cognitif précoce de la maladie d'Alzheimer : prise en compte du profil sociodémographique du patient pour un diagnostic personnalisé

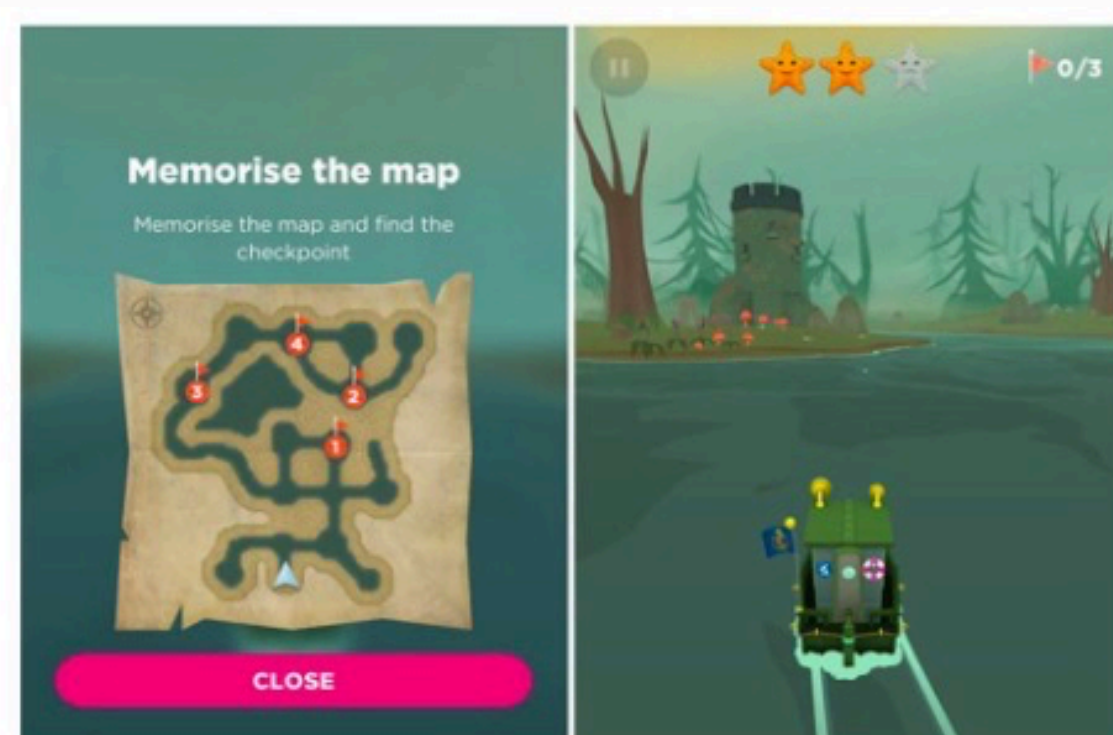
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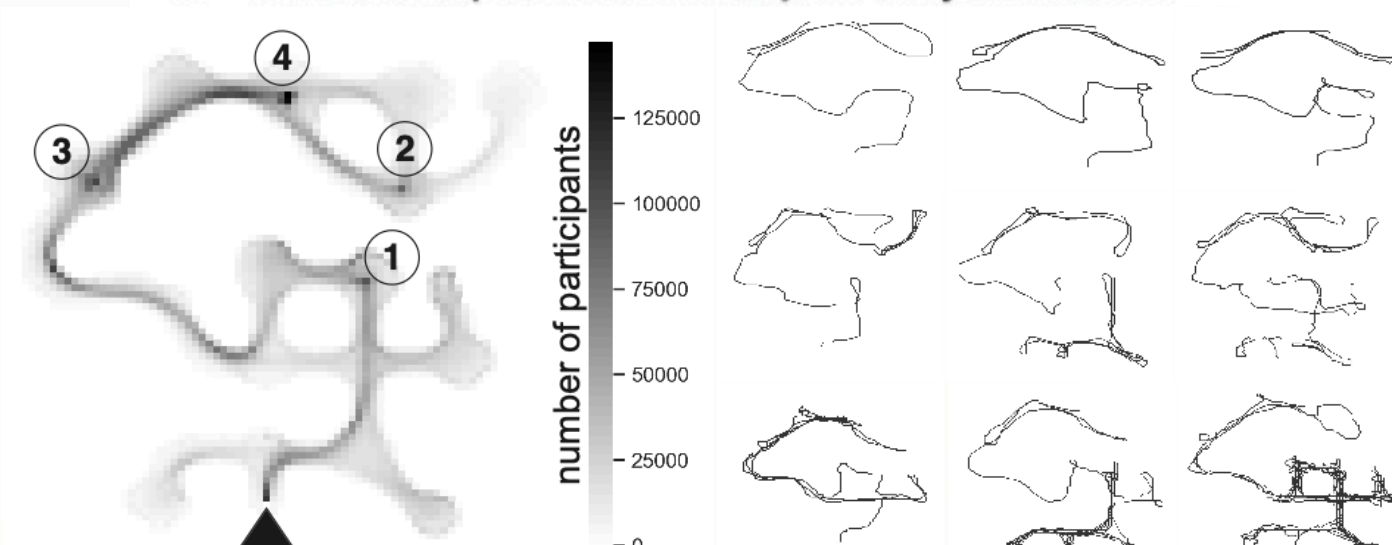
## CONTEXT

Alzheimer's disease (AD) is the most common cause of neurodegenerative dementia. 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.

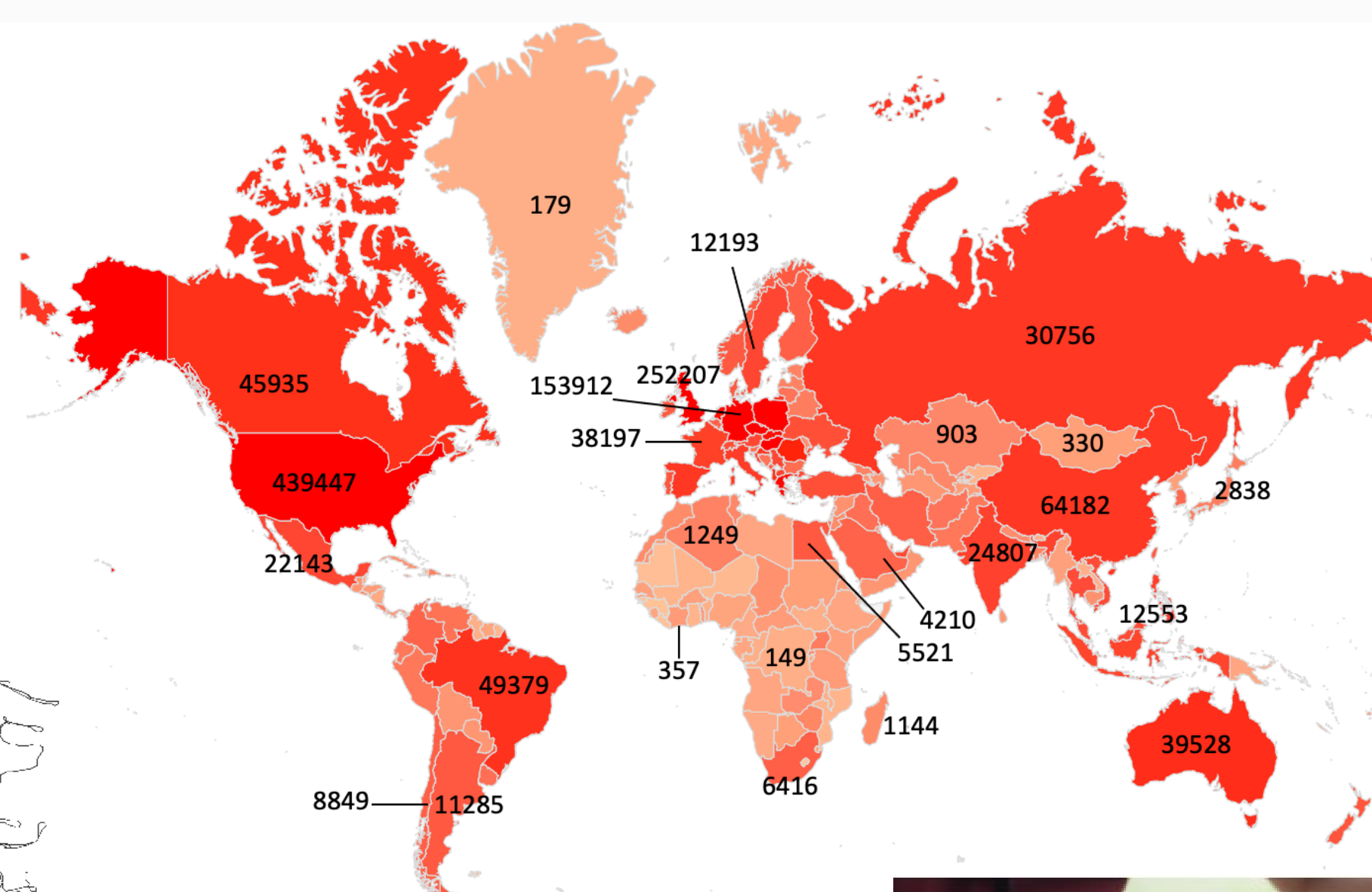
a – Screenshot from Sea Hero Quest



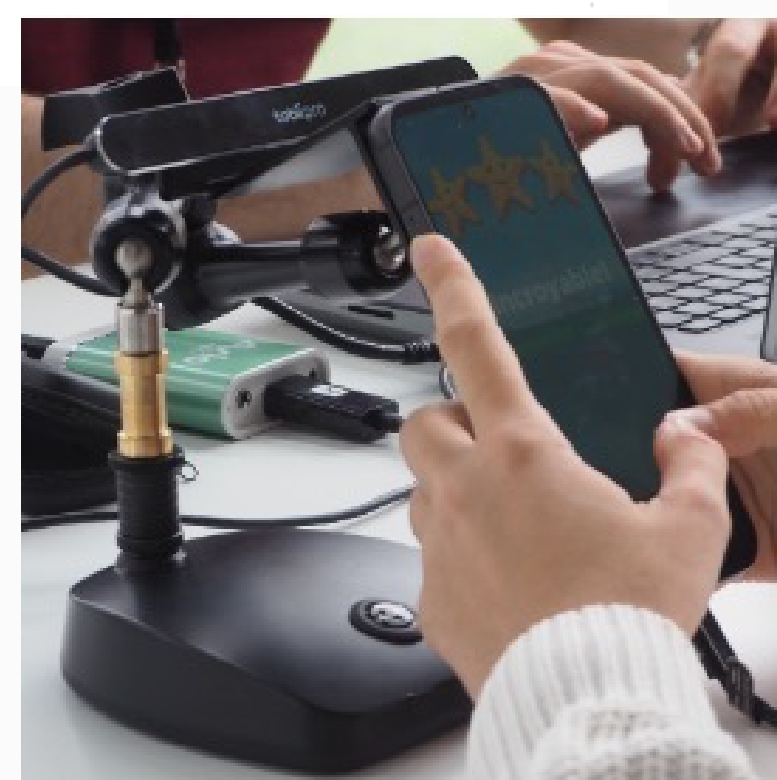
b - Heatmap and example trajectories



c – Sample size by country



d - Eye-tracking set-up



## 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 (the blood level of phosphorylated tau protein, and a genetic risk factor: the APOE genotype) 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).

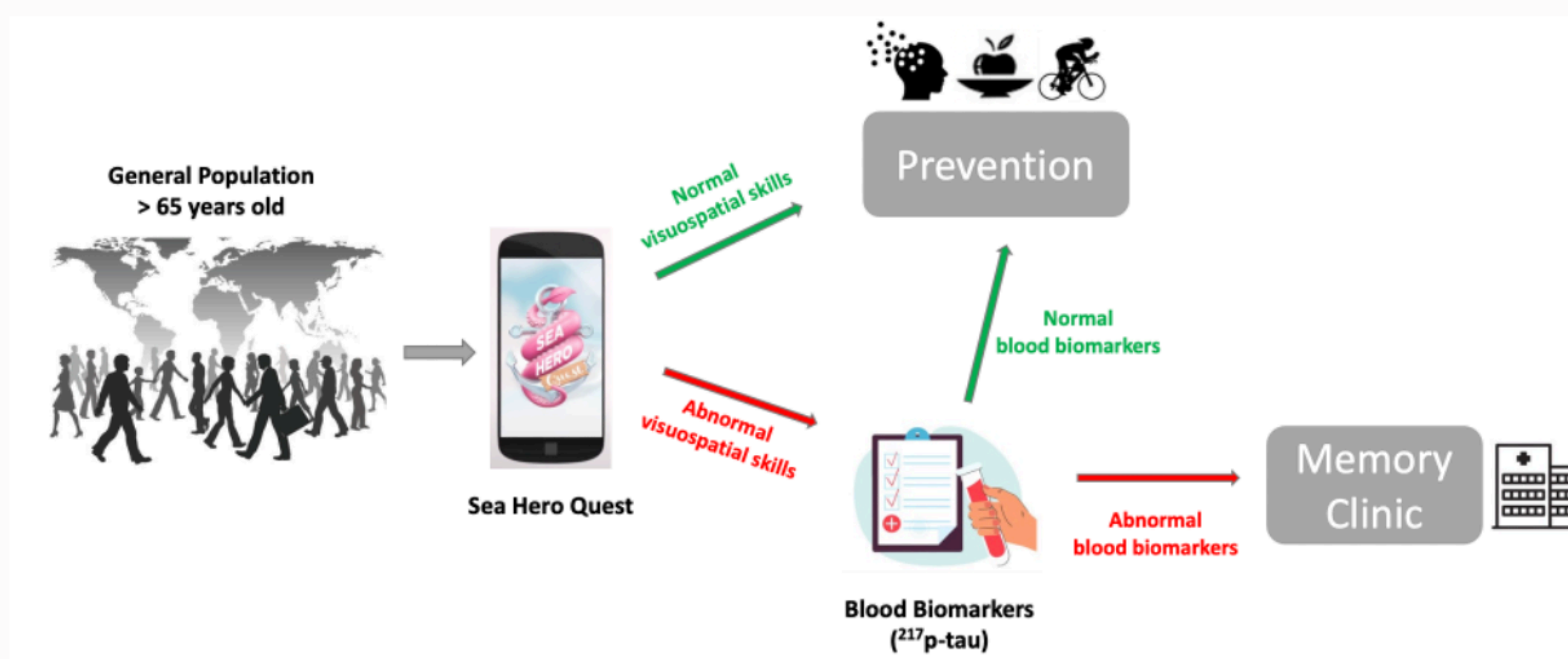
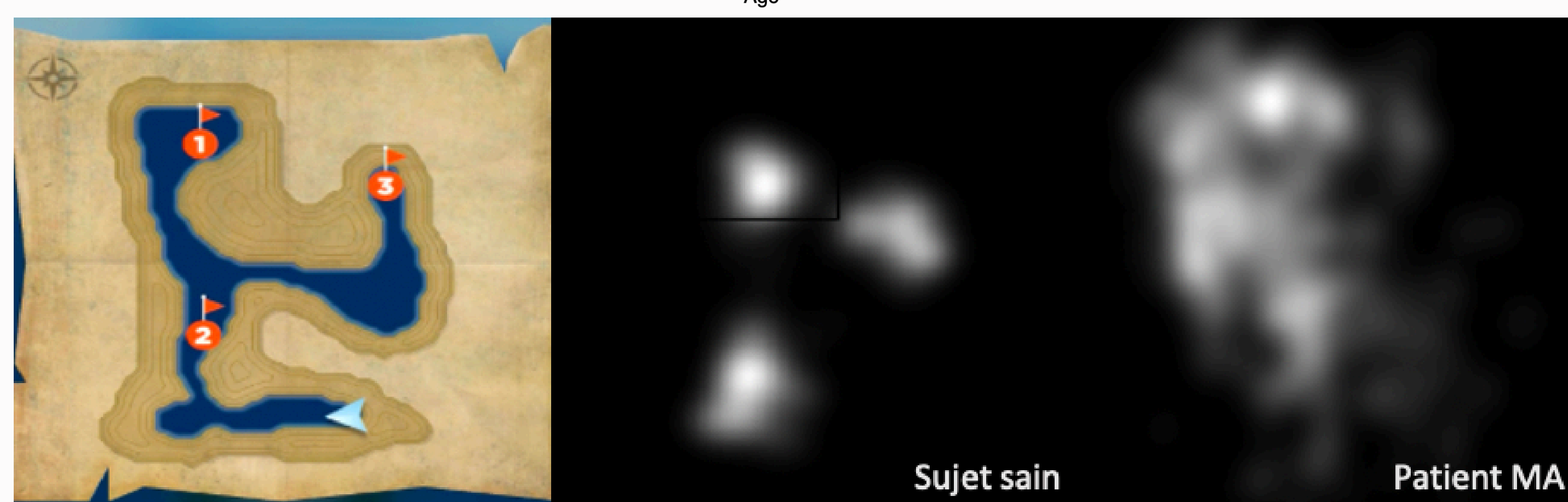
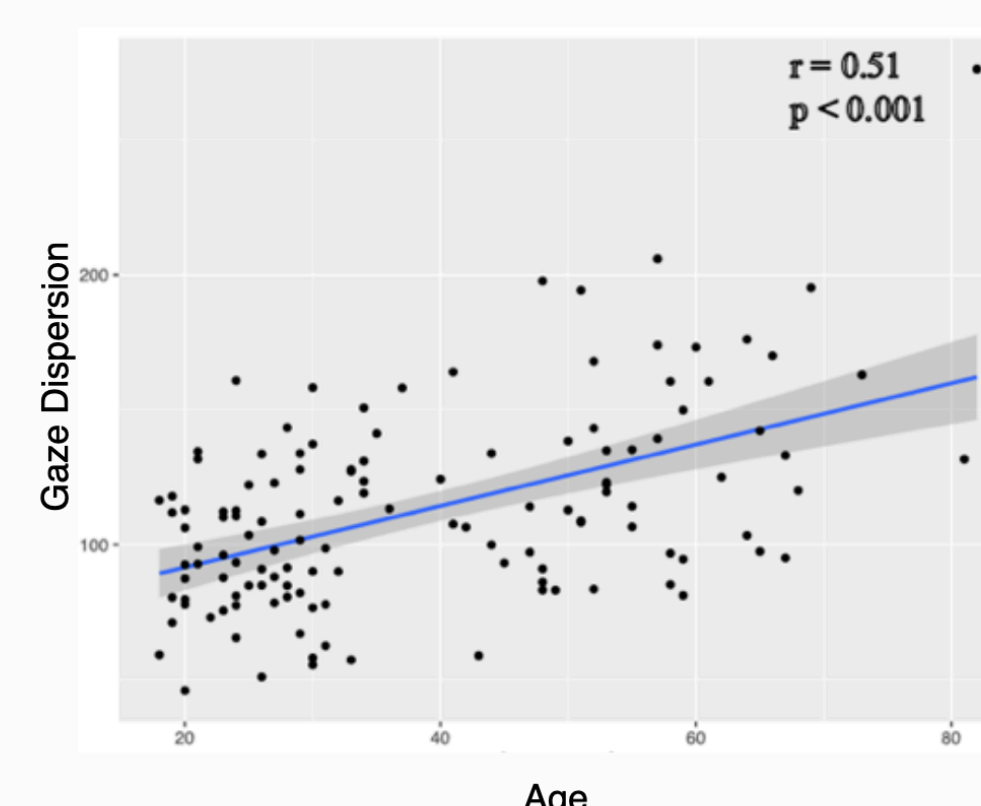
## PRELIMINARY RESULTS

**Objectives.** To assess how demographic factors, cognitive reserve, and visual attention (via eye-tracking) influence spatial navigation during aging.

**Methodology.** Visitors to the Musée des Confluences played Sea Hero Quest (SHQ) while their eye movements were tracked. Demographic and cognitive reserve data were collected.

**Results.** Data from 293 participants (ages 18–85) showed that navigation performance declines with age ( $r=-0.67$ ). Cognitive reserve wasn't linked to navigation, but more books read correlated with lower performance. Older participants took longer to explore maps and had more dispersed eye movements.

Eye-tracking results  
Gaze dispersion increases with age during map encoding



## LONG-TERM GOALS

Assessing AD in the general population through a stepwise cognitive and biological approach. Sea Hero Quest will serve as a tool to detect individuals at risk of AD, followed by ultra-sensitive plasma biomarker assays to further evaluate patients who may require specialized consultation.

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

