Virtual navigation exposes the reality of Alzheimer’s disease onset

Research Objectives
Prof Moussavi’s work aims to find new methods for early diagnosis and treatment of Alzheimer’s disease.

References

Detail
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Bio
Dr Zahra Moussavi is a professor, a Canada-Research-Chair and the founder and director of the Biomedical Engineering Program at University of Manitoba. She has received several awards including the “Canada’s Most Powerful Women: Top 100 Award”. With over 240 peer-reviewed publications, one of her research focuses is Alzheimer’s onset detection and treatment.

Funding
NSERC
Virtual navigation exposes the reality of Alzheimer’s disease onset

Prof Zahra Moussavi from the Faculty of Engineering at the University of Manitoba in Canada has developed a novel method of assessing patients for Alzheimer’s disease. Using a virtual reality environment to measure spatial awareness, she has shown key differences between control and patient groups, leading to pilot studies for effective early treatment.

When a person navigates from point A to point B, spatial and temporal processing is at play to identify the most efficient route. There are two main types of spatial processing: allocentric and egocentric. In allocentric spatial processing, external landmarks or cues are used to navigate through space; in an environment lacking these cues, such as an unfamiliar location, egocentric spatial cognition orients the individual in relation to their own body (i.e. forward, back, left, right).

CONSTRUCTING A VIRTUAL WORLD

Using a virtual reality (VR) environment, either with or without landmarks, Prof Moussavi has shown that egocentric spatial processing in particular is impaired in Alzheimer’s patients compared to healthy controls. Moreover, the results can highlight those participants on the borderline between healthy results and those with probable Alzheimer’s. Those participants identified with probable Alzheimer’s by her test can be targeted for further assessment and an intervention treatment if deemed suitable.

In a landmark study, Prof Moussavi showed that her designed VR experiment is able to discriminate between age-related decline and known cognitive status in comparison with traditional pen and pencil questionnaire scoring methods. Following up with sub-groups of the participants six and 12 months later identified both the effects of age-related decline and a similarly significant and identifiable correlation with cognitive status. Unlike classical measures of spatial cognition, her VR experience revealed significant predictors of cognitive score and has been shown to be reliable, age-specific and valid for cognitive assessment.

The test consists of participants navigating in an immersive virtual environment using a headset (from VR company Oculus Rift) connected to a computer and a customised wheelchair. In a simple but inspired substitution, the wheelchair replaces a joystick to enable movement in the VR world; real world motion is captured by the wheelchair and transferred to the computer simulation. Moving in VR using common tools such as a joystick, causes significant motion sickness in older adults, especially in immersive VR because of the mismatch between visual and vestibular (inner ear) information. However, the novel design of the customised wheelchair enables the participant to closely match their physical movements to their movement in the VR world, significantly reducing the motion sickness side effect. Performed in a large open space, this approach has produced fantastic results, as well as being an enjoyable challenge for the participants.

A STIMULATING ENVIRONMENT

In a single-patient trial, the use of VR for training of egocentric orientation has also shown potential benefits to Alzheimer’s patients as a treatment. It has long been known that a large cognitive reserve, the amount of ‘spare’ capacity in the brain for decision making, prevents significant cognitive decline even in patients with physical manifestations of Alzheimer’s such as amyloid plaques and neurofibrillary tangles (pathological protein accumulations associated with Alzheimer’s). Learning new tasks which challenge cognitive abilities, such as that of Alzheimer’s, offers a fantastic results, as well as being an enjoyable challenge for the participants.

Prof Moussavi was convinced that it must be possible to develop a test to detect Alzheimer’s at its onset.
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