# STELLARX®

University of Manitoba

Virtual Neurocognitive Recovery Treatment

VR is becoming an essential tool in modern medicine. Commonly-used applications are in pain control, surgical training, and rehabilitation. In this last field, VR's immersive and interactive simulations fit like a glove for neurocognitive recovery.

As such, under the Active at Home program, The University of Manitoba partnered up with OVA's team to develop a VR rehabilitation program.
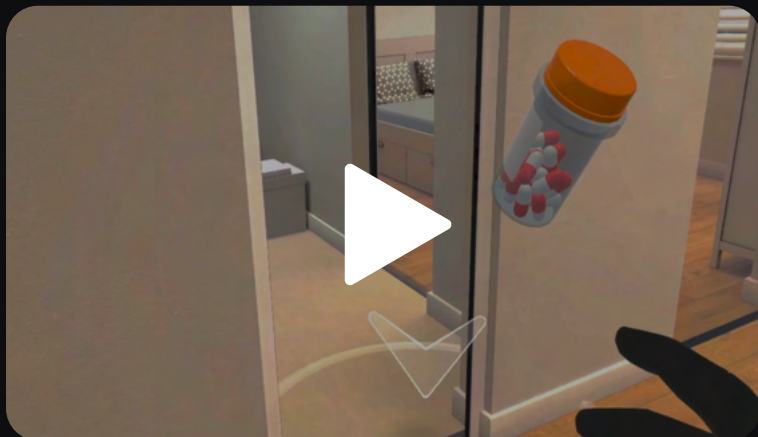
University of Manitoba

Industry

Healthcare 🛡️

Investigator

Amine Choukou, PHD (Associate Professor)

Technologies

Virtual Reality

Overall Goals

- **Be able to determine whether an undesired action is human-related or technologically tricky.**

- **Integrate an incremental training strategy.**

- **Lead the participant to develop autonomy through the sessions, both in the desired interactions and technological ease.**

A Remote Solution

Telerehabilitation (TR) is an alternative to conventional rehabilitation for the motor, cognitive, and affective domains. The used technology varies, but can include smartphones, computers, tablets, video conferencing, and immersive technologies.

Immersive technologies are becoming an essential tool in **modern medicine**. Commonly-used applications are in **pain control**, **surgical training**, and **rehabilitation**. For the latter, immersive and interactive Virtual Reality simulations fit like a glove for neurocognitive recovery.

As such, the University of Manitoba partnered up with the StellarX team to develop a Virtual Reality rehabilitation program. This "Active at Home Post-Stroke Program" (or Home PSP), developed in collaboration with Dr. Amine Choukou, combines VR-enabled cognitive training with tablet-led physical activity. It consists of 48 sessions (half VR, half tablet) to be completed over a 12-week period, and is conducted remotely in a semi-supervised way. Since VR hardware mildly limits the participant's movements, it isn't exactly accurate to perform and register complex physical movements; so, it is used here to cover cognitive skills, while a tablet is used alternatively for motor skills. First, an interactive mobile app, installed on a mobile tablet, enables a virtual coach to deliver a follow-along exercise program including resistance training, balance training, and stretching; then, a simulated VR environment provides activities for participants to complete, resembling scenarios they would encounter on the daily inside their home. The end goals of Home PSP are to guide stroke survivors toward regaining increased levels of physical and cognitive abilities following a stroke.

Physical training program
(Tablet)

Neurocognitive training program
(VR)
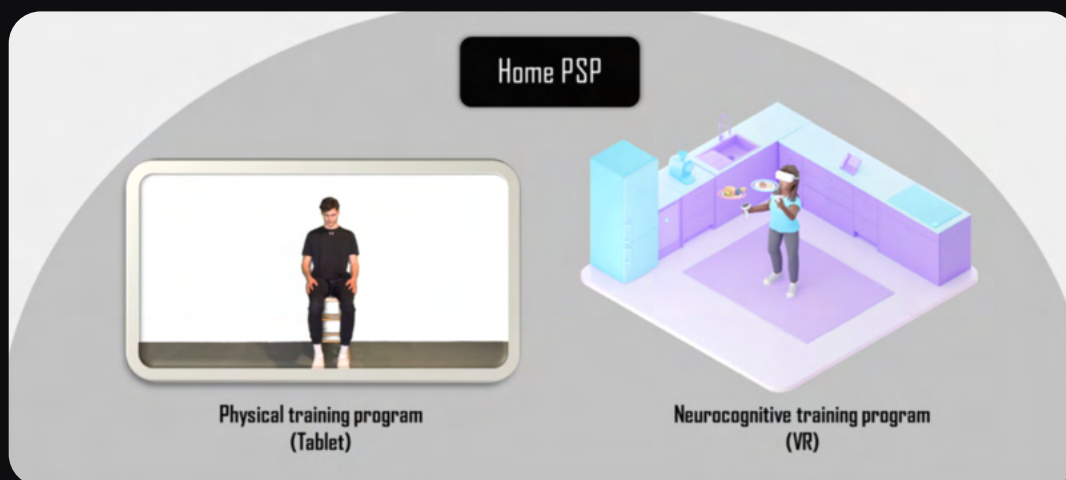
VR Simulation

The VR program was put together using our sandbox software StellarX. The setup of the participant for this study consisted of a HTC Vive Pro headset, two hand-held controllers, and two base stations on a tripod.

⟶ **We designed the environment and the cognitive activities based on a virtual apartment that replicates a newly developed ambient assisted living facility.**

The activities resemble scenarios one would encounter daily, and are based on tools used to allocate autonomy assistance, which cover two main categories of activities: activities of daily living (ADL), and domestic activities (DA). ADLs concern basic personal care, while DAs encompass more elaborate actions one must perform independently. Each session included several tasks, requiring the participant to move around the virtual home using the controllers to interact with spaces and objects. As the sessions progressed, the complexity of each session gradually increased, along with the total number of tasks to perform.

The VR program was divided in a total of five total training modules:

Module 1   **Familiarity with the Environment and Technology**

The first module aims to instruct the user on how to use VR in an incremental way. The activities involve adjusting the helmet, learning basic commands, and getting comfortable moving around.

Module 2   **Task Management and Prioritization**

The second module focuses on task management and prioritization of actions. The goal is to manage tasks, identify priorities, and sometimes even interrupt a task in progress to meet an immediate need.

Module 3   **Financial Management**

The third module aims to enhance budget awareness and money-management abilities. Throughout each session, the user will be required to make financial judgements while staying under a set budget of CAD 100, and then explain their reasoning at the end of the module.

Module 4   **Tasks and Financial Management**

The fourth module resembles the previous modules, but attempts to provide the client more autonomy. The sessions are more sophisticated, combining interpersonal and financial issues, and aim to increase task learning and retention.

Module 5   **Full Day**

The fifth module aims to move closer to the reality of daily activities. The user is expected to apply everything they've learned up until now, to deal with unexpected everyday life situations and financial situations for an entire day.

Results

$\longrightarrow$ Overall, the objectives of this project were to evaluate the feasibility and safety of introducing virtual rehabilitation into the home of a stroke survivor, to evaluate the participant's satisfaction with the technology, and to note any marked improvements in physical function, self-reported quality of life, and motivation.

For the study, the participant was a 55-year-old woman who experienced a stroke in March of 2021. She lives in a community of fewer than 15,000 inhabitants, where the main city is a 1.5-2h drive away. The stroke affected her right upper and lower extremities, as well as her speech, which resulted in aphasia. At the time of the study, the participant was already attending in-person stroke rehabilitation with a physiotherapist, an occupational therapist, a speech and language pathologist, and a personal trainer; so, for the purpose of this study, the remote program was here considered as adjunctive therapy to conventional rehabilitation services.

Overall, the participant completed 16 VR home training sessions within 6 weeks, and 10 tablet training sessions within 12 weeks. Several factors were to blame for this lack of assiduity, namely a two-week illness, a lack of motivation, as well as the ergonomics of the VR equipment. Indeed, the participant was unable to press certain buttons on the controller because of the high tone in their right hand, which prevented them from performing VR sessions without continuous help from their caregiver. Due to those circumstances, the participant did the best they could, but were not able to complete the recommended two sessions a week for each program; therefore, the numeric outcomes of the study were obviously affected. Despite the participant not partaking in the entirety of the program, preliminary results still show that it can effectively engage patients in telerehabilitation, and is a safe virtual space for stroke survivors to regain neurocognitive skills. The value of combined cognitive and physical training has already been proven; cognitive training results in neural network reconfiguration and improved executive processing, while physical exercise enhances neuroplasticity and improves cognitive functioning. Plus, home-based interventions allow participants to initiate and complete exercises when it is most suitable for them, which is a big asset. Despite the lack of comfort and technical limitations, the VR program was still well received by the participant, which only highlights the need for immersive devices that are adapted for people with neurologic conditions to increase the program's feasibility. Improvements on feedback and exercise progression could also be considered to boost user motivation and hold them accountable. Now that we have gathered preliminary data on the program's feasibility, safety, and efficacy, further research should evaluate the telerehabilitation program as a standalone intervention.

Testimonials

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