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Virtual Reality for Cognitive Rehabilitation: A Beginner's Guide for Clinicians

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Why Should I Know about Virtual Reality for Cognitive Rehabilitation?

Despite the promising benefits of virtual reality (VR) cognitive rehabilitation^{1–6} and the affordable VR systems currently on the market, few VR tools have found their way into the clinic. The purpose of this Information and Education page (I/EP) is to assist clinicians in deciding which VR systems are useful for cognitive rehabilitation.

What Is VR?

VR employs computer technology to project the user into an artificial environment. This allows the client to interact with that environment by smartphones, screens, or head-mounted devices (Figure 1).

What Are My VR Options?

Devices	Smartphone	Console	PC	Standalone
About	Smartphone is placed into handheld viewer or HMD	Gaming console connects to one or more TV screens	Powerful gaming computer connected to one or more TV screens or HMD	HMD that does not require the use of pre-existing equipment and is run from the hardware

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Devices	Smartphone	Console	PC	Standalone
				and software built into the HMD
Best For	Clinicians who want a taste of VR. Smartphone VR does not require a computer or gaming console	Clinicians who like to play games on a gaming console	Clinicians who are looking for high-end immersive graphics and interaction	Clinicians who want to immerse themselves in top-of-the-line VR experiences with portable devices
Product Examples	Google Cardboard Samsung Gear VR Nintendo Labo™ VR	PlayStation VR	HTC Vive Valve Index	Oculus Quest Oculus Go
Price (US Dollars)*	\$	\$\$	\$\$ to \$\$\$	\$\$
Examples of Games	Project Ocarina Proton Pulse	Tetris Effect Wii Fit	Cubism	A Fisherman's Tale

Abbreviations: HMD, head-mounted device; HTC, Hight Tech Computer; TV, television; VR, virtual reality

*

\$ 1 – 149 US Dollars; \$\$ 150 – 999 US Dollars; \$\$\$ 1000 US Dollars and above

Cognitive Rehabilitation: Practical Tips

1. Choosing Devices

- Choose VR that will add to your clinical practice and enhance your clinical goals
- Make sure you understand the type and intent of the VR tools (e.g., commercial vs. research grade VR)
- Make sure the VR hardware and software align with your technical skills and comfort level so that you can troubleshoot if needed

2. Choosing VR Tasks/Games

- Compare the cognitive requirements of the VR with the cognitive capabilities of your clients
- Choose the VR game based on your clients' needs/goals/enjoyment
 - If the goal is to improve everyday activities or functions, focus on games that mirror real-life activities in a VR environment
 - If the goal is to improve cognition, select games that incorporate cognitive exercises
 - Identify if a multiplayer mode of VR will increase client satisfaction
- Choose VR that:
 - Adapts its difficulty levels to the cognitive capabilities of your clients
 - Provides feedback and reward mechanisms
 - Enables you to determine the clients' progress and end goals

3. Client Considerations

- Tailor VR hardware (e.g., choice of controller) to your clients' physical needs
- Identify the optimal screen size and resolution
- Have instructions tailored to your clients
- Consider VR games available in multiple languages for non-English-speaking clients
- Consider VR games in respect to clients' gender, time since onset of injury, comorbidities, and cognitive reserve

How Can Persons With Cognitive Challenges Benefit From VR Training?

The pooled evidence of clinical trials shows that certain cognitive domains can be trained using VR.¹⁻⁶ This was found to be true among diverse populations with cognitive challenges, from children to older adults (see Table below). VR may create engaging, motivating, fun, and realistic training experiences. These experiences foster reactivation and improvements in brain areas which improve cognition.⁸

How Can I Use VR In Cognitive Rehabilitation?

Clients who experience cognitive changes benefit from VR cognitive rehabilitation. This intervention may enhance treatment outcomes, when serving as an adjunct to clinician guided treatment. In particular, clients with lower baseline functioning stand to gain more from the intervention than those with higher functioning (i.e., ceiling effect).⁸ Similar to cognitive training, improvements in attention, working memory, and mood are observed in VR cognitive rehabilitation. Below is a non-exhaustive list of effective VR programs for diverse populations.¹⁻⁷

Examples of VR	Cognitive Domains Trained	Training Parameters	Population Best Served
Wii, Wii Fit, Reh@City, Reh@Task, IREX, RAPAEI smart glove, RAPAEI smart board, RehabMaster, Xbox Kinect, customized software	Overall cognition, orientation, perception, visual motor functions, thinking, attention, processing speed, visual search	Duration: 2 – 6 weeks Frequency: 2 – 5/week Intensity: 30 – 90 min/session	Stroke
Xbox Kinect, CAREN, VMall, AIVTS	Executive skills, working memory, processing speed, attention	Duration: 4 – 8 weeks Frequency: 2 – 3/week Intensity: 25 – 60 min/session	Brain injury
Xbox Kinect, Job simulator, Neuro-VR	Overall cognition, processing speed, attention, working memory	Duration: 3 – 12 weeks Frequency: 2 – 3/week Intensity: 30 – 100 min/session	Schizophrenia; Attention Deficit Disorder
Xbox Kinect, Job simulator	Executive function, short-term memory, long-term memory	Duration: 3 – 25 weeks Frequency: 2 – 3/week Intensity: 15 – 45 min/session	Mild neurocognitive disorder

What Are The Pros And Cons Of Using VR In My Clinic?

Pros	Cons
Safe simulation of real-world activities/past memories, experiences: cooking, baking, driving	Side effects (motion sickness, dizziness, nausea, eye strain, headache, and others)
Motivating, fun, enjoyable, engaging	Headset discomfort
Convenient and safe with opportunity for telerehabilitation	May require supervision
Affordable	May require technology support/training
Competition/group training	May require internet connection (additional data cost)
Improves brain function	Commercial games may not be adapted for people with cognitive challenges
Feedback on performance	Cost associated with acquiring equipment and subscription to software
Increase time spent in therapy	Limits direct or personal connection with the clinician
May improve compliance and adherence to therapy	Individual factors such as lack of acceptance of technology could affect the adherence to VR

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A. Client with PlayStation, controller, and screen	B. Client with HMD, controllers, and screen

Figure 1:
Two examples (A & B) of client interacting with VR displayed on screen or head mounted device (HMD).