Non-Immersive Virtual Reality as a Safer Alternative for Cognitive Training in Older Adults: Investigating the Effect of Age on Cybersickness

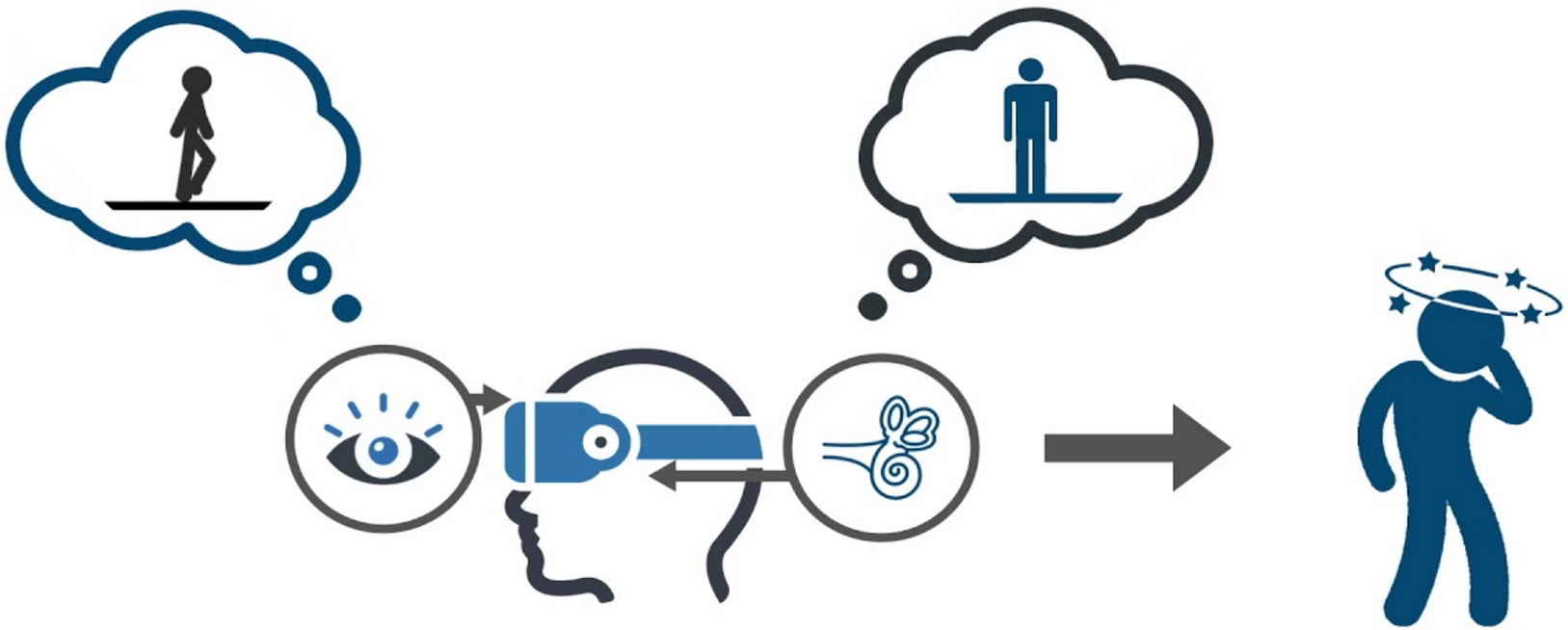
Zahra Moussavi
Rashmita Chatterjee

Department of Biomedical Engineering
University of Manitoba
Winnipeg, MB, Canada

AIVR 2025
April 06, 2025 to April 10, 2025 - Valencia, Spain

University of Manitoba

What is Cybersickness?



Source of the data- Serious games

Serious game is any game that has a primary educational purpose before the secondary purpose of leisure and entertainment.

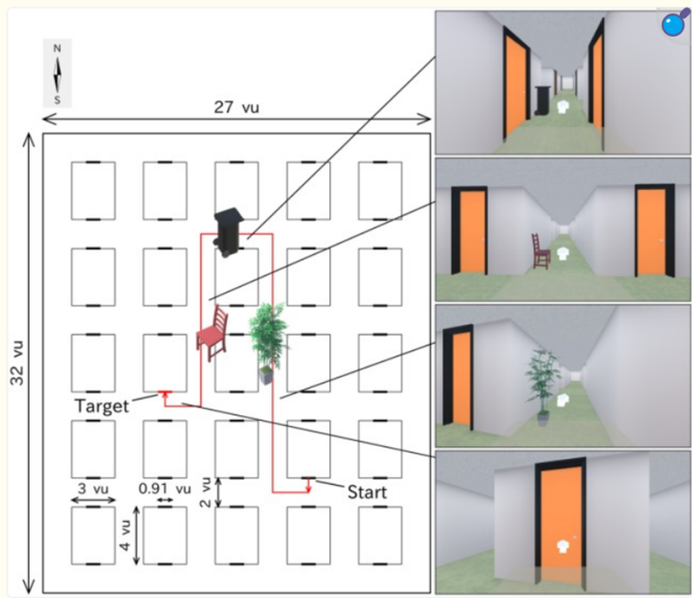
Our team has been developing and testing spatial serious games for over a decade.

Research Gap

Lack of largescale studies and datasets in cybersickness.

Serious games used

VRNHouse



Virtual Hallway

Barn Ruins

All consisted of maze-like route-finding tasks.

Virtual reality technology used

	Immersive	Non-immersive
	179	450
	43 (24%)/ 136	31 (6.9%)/ 419
	109/ 70	291/ 159

How was cybersickness measured?

Simulator Sickness Questionnaire (SSQ)

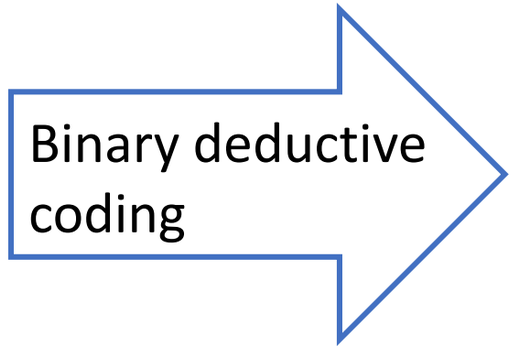
1. General discomfort
2. Fatigue
3. Headache
4. Eyestrain
5. Difficulty focusing
6. Increased salivation
7. Sweating
8. Nausea
9. Difficulty concentrating
10. Fullness of head
11. Blurred vision
12. Dizziness (eyes open)
13. Dizziness (eyes closed)
14. Vertigo*
15. Stomach awareness**
16. Burping

Participants were verbally asked if they felt any of the symptoms given in the SSQ.

Assessors made notes of all the symptoms the participant mentioned. These notes are qualitative data.

Converting qualitative to quantitative data

Verbal qualitative data were written assessor notes.



Verbal quantitative data is 0 or 1 as present or absent for each symptom of cybersickness.

Binary coding: A team of 3 coders read through the notes and put present or absent for each of the themes. More coders allows for more scientific rigor.

Converting qualitative to quantitative data

Qualitative assessor note

“On trial 6 I had to show her the house since being in the third floor she forgot where the target was (she remembered before entering the house), for the other trials she remembered where were the target before entering the house. We skipped trial 8 since she explored more than 3 rooms and she was very tired. She said that by the end she felt tired and she was not relaxed and giving up. During all the test she seemed stressed every time she ended a trial she breath deeply and clean the sweat of her hands. I always told her that she had to be relaxed, sometimes she needed a little bit of assistance to locate herself (like asking: which side are you facing now? remember how you entered to the house and which side of the house you were facing.)”

Quantitative data- cybersickness (present/ absent)

General Discomfort	Fatigue	Headache	Eye strain	Difficulty focusing	Increased salivation	Sweating	Nausea	Difficulty concentrating	Fullness of head	Blurred vision	Dizzy (eyes open)	Dizzy (eyes closed)	Vertigo	Stomach awareness	Burping	**Cybersickness (present/ absent)**
	1					1										**1**

Research Questions

Are older adults at higher risk of susceptibility to cybersickness in immersive or non-immersive virtual reality?

Results: Impact of age and sex on cybersickness susceptibility in immersive environment

Characteristic	OR[1]	95% CI[1]	p-value
Sex			
F	—	—	
M	0.17	0.06, 0.41	<0.001*
Age (per 10 years increase)	1.28	1.04, 1.61	0.024*
[1] **OR = Odds Ratio, CI = Confidence Interval**			

Both age and sex affected the likelihood of experiencing cybersickness in an immersive environment.

Results: Impact of age and sex on cybersickness susceptibility in non-immersive environment

Characteristic	OR[1]	95% CI[1]	p-value
Sex			
F	—	—	
M	0.72	0.31, 1.57	0.4
Age (per 10 years increase)	0.97	0.80, 1.20	0.8

[1] **OR = Odds Ratio, CI = Confidence Interval**

Neither age nor sex affected the likelihood of experiencing cybersickness in a non-immersive environment.

Key Takeaways

- Every 10-year increase in age, the odds of experiencing cybersickness increased by 1.28 times in immersive environment.
- Females are more susceptible to cybersickness than males.
- Cybersickness is felt more in immersive (24%) than non-immersive environments (6.9%).
- Older adults face a higher risk of cybersickness in immersive VR environments in comparison to non-immersive VR.
- This increased risk could limit their ability to comfortably engage with immersive VR-based cognitive training programs and hence non-immersive is preferred.

THANK YOU

University of Manitoba

Riverview Health Centre Foundation

Mitacs Accelerate