Opening Keynote Presentation
2023 BIAMD Annual Conference

Virtual Reality, Mindfulness, and TBI Rehabilitation

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- <u>Acknowledgements</u>:
  - This presentation contains modified portions of a presentation for the 2022 Mind Your Brain Conference at the University of Pennsylvania, in coordination with Dr. Gillian Murray, and information from a submitted research paper, 'Virtual Reality Immerses You In Your Mind' (*Murray & Shmidheiser, In Press*)

Disclaimer

- Workshop goal is educational only
  - No guarantee is made regarding the accuracy or sufficiency of the info contained herein for your specific circumstance (Maheu, 2017)

Overview & Introduction

- **Mindfulness**
  - Mindfulness and TBI Rehabilitation
- **Virtual Reality (VR)**
  - Brief History
  - VR and TBI Rehabilitation
- **Combining Mindfulness & VR in TBI Rehabilitation**: A Research Study
  - No studies of mindfulness interventions with a VR platform in a TBI population…
  - Pilot Study Results!!
- **Future Directions** for VR, Mindfulness and TBI Rehabilitation

- **FIRST… a few questions**
  - How many of you have tried a *mindfulness* activity?
    - Was it helpful?
  - How many of you have used a *virtual reality* device?
    - Any unpleasant symptoms?
  - How many of you have tried a mindfulness activity *on* a virtual reality device?
    - Was it helpful?
    - Any symptoms?

Mindfulness:

paying attention
to the present moment
without judgment

(Kabat-Zinn, 2015)

Credit: JoyofMindfulness.com

Benefits of Mindfulness

Mindfulness increases:

- Empathy, patience, gratitude, open-mindedness
- Awareness
- Attention
- Relaxation

Mindfulness decreases:

- Stress
- Anxiety and depression

(Bostock et al, 2019; Kabat-Zinn, 2015, Schuman-Oliver et al., 2020; Seigel, 2007)

Benefits of Mindfulness

Mindfulness improves:

- Emotional regulation
- Sleep
- Mental health and wellbeing
- Mood

Mindfulness is also helpful to those with substance use disorders, eating disorders, smoking cessation, and chronic illness/pain.

(Bostock et al, 2019; Kabat-Zinn, 2015, Schuman-Oliver et al., 2020; Seigel, 2007)

Mindfulness for Individuals with TBI

- "Mindfulness-based interventions for individuals with TBI is **feasible and effective**"
  - Significant reductions in *chronic stress*, *depressive and general symptoms*
    - ...for mindfulness group compared to control group (Bay & Chan, 2019)

- Mindfulness helpful in improving various **psychological symptoms**, including *fatigue*, and specific **neurological symptoms**
  - Significant benefits for objective **cognitive outcomes** as well as *self-reported cognitive function* (Smart et al., 2022)

Mindfulness for Individuals with TBI

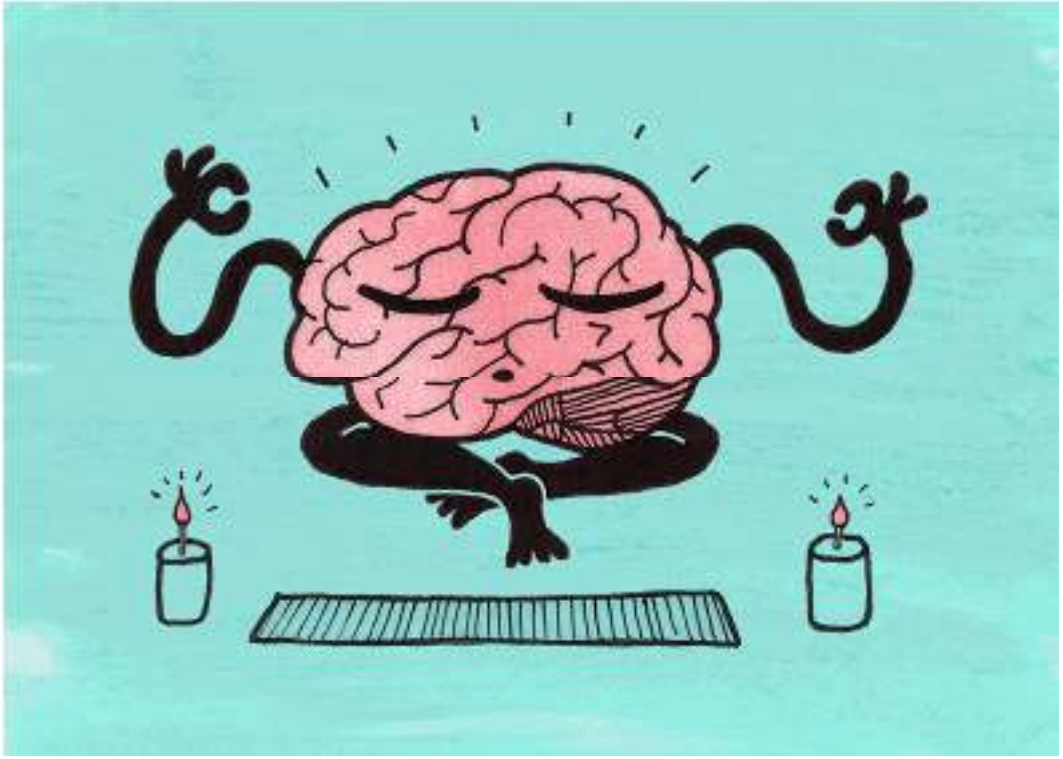
- Mindfulness beneficial in **coping with emotional and cognitive consequences** of ABI (Niraj, 2017)
- Mindfulness interventions may improve the **quality of life** and/or **depression symptoms** of individuals with TBI (Stojav, 2018)
- Mindfulness interventions shows promise for improving **cognition, self-monitoring, and mood** after ABI (Trumbauer et al., 2018)

Mindfulness for Individuals with TBI

- **Systematic review** of multiple research studies:
  - 75% of outcomes found **significant and/or positive results** (Kenuk and Porter, 2017)

- **Meta-analysis** on mindfulness for chronic mild TBI symptoms:
  - **Significant improvement** of overall symptoms compared to controls
    - ...in **mental health**, **physical health**, **cognitive performance**, **quality of life**, & **self-related processing**
  - Greatest improvement: **fatigue** and **depression** (Acabchuk et al., 2020)

Activity: Guided Mindfulness Meditation



Credit: Christine Fleming

Virtual Reality: Definitions

- **<u>Virtual Reality:</u>** “a computer-generated environment that can be experienced and interacted with as if real” (Brassel et al., 2021)

- **VR Types:**
  - Immersive
  - Semi-Immersive
  - Non-Immersive

    - Virtual Reality **vs.** Augmented Reality

VR: Brief History

1987 – Virtual Reality: birth of the name

-Jaron Lanier coined/popularized the term "*virtual reality*";

-He had the first company to sell Virtual Reality goggles

-EyePhone HRX: $49,000

https://www.vrs.org.uk/virtual-reality/history.html

1989 – NASA Gets Into VR

-VR used to train astronauts

VR: Brief History

1991 – Virtuality Group Arcade Machines

-Public can access VR devices

-Not yet for home use

1992 – *The Lawnmower Man*

-VR idea presented to wide audience

-VR therapy first used on a patient

1993 – SEGA's new VR glasses!

...BUT, technical development difficulties; never released

https://www.vrs.org.uk/virtual-reality/history.html

VR: Brief History

1997 – Landmark VR PTSD Treatment

-VR for treatment of PTSD in war veterans

2014 – VR is suddenly a ***very*** hot topic for consumers!

-Launch of Google Cardboard

- Launch of Samsung Gear VR

-Facebook Buys Oculus

-Sony Announces VR Project

https://www.vrs.org.uk/virtual-reality/history.html

VR: Brief History

2016–2017 – VR ready for *primetime*

https://www.vrs.org.uk/virtual-reality/history.html

-Oculus Rift and HTC Vive lead the way

2018 – *Standalone* VR Rises, Mobile VR Dies

-Oculus Go & Oculus Quest

-need no computer or phone to work
-becoming very affordable

2019 – VR cost dropping *dramatically*

-Oculus Quest released

2020 – Oculus Quest 2 released; **commercially successful & fully immersive VR**

Application of VR in TBI Rehabilitation

- VR significantly improved:
  - Cognitive functioning, mood, cognitive flexibility, and selective attention (De Luca et al., 2019)
  - Memory, executive function, and attention in patients with TBI after VR training (Alashram et al., 2019)

- Literature review (11 studies): improvement with the use of VR, most frequently used to address **gait** or **cognitive deficits** after TBI (Aida et al., 2018)

- Systematic review (10 of 13 studies) VR use related to significant improvements in **cognitive** performance (Manivannan et al., 2019)

Application of VR in TBI Rehabilitation

- VR has potential to provide effective TBI rehab for cognitive & behavioral impairments (Maggio et al., 2019; Banville et al., 2019)
    - ***How??***
- VR creates a **positive, motivating** and **enjoyable** learning experience (Maggio et al., 2019a; Maggio et al., 2019b)
- VR mimics **everyday contexts**, which increases the possibility of improving cognitive function that is **generalizable to real life** (Banville et al., 2019; Manivannan et al., 2019)

- VR **and** mindfulness?
  - Only examined in persons ***without*** TBI…
    - Seabrook et al. (2022) found that VR can support mindfulness practice by:
      - **inducing positive affect**
        - *and*
      - **enhancing mindful presence**

Let's Review:

- In sum, there are indications of **significant benefit for persons with TBI** in:
  - Utilizing mindfulness exercises
    - and
  - In receiving VR interventions

- **However…**
  - *No* studies have examined mindfulness interventions on a VR platform **in persons with TBI**!

Questions?

Virtual Reality Immerses You in Your Mind:

A Mixed-Methods Study on the

Experience and Stress Reduction Benefits of VR Mindfulness Modules

in Persons with TBI

Murray & Shmidheiser *(In Press)*

Objective: To test the feasibility, experience, and stress reduction effectiveness of a one-time VR mindfulness module (VRMM) in individuals with mild to moderate TBI

Background

- MYBF awarded a grant from Merck to develop VR modules for persons with TBI
- Developed two VR mindfulness modules that aimed to be both relaxing and well-tolerated among individuals with TBI

Welcome to MYBF's Mindful Moment

Welcome to MYBF's Blissful Beach

Participants:

-Thirty-eight adults with mild to moderate TBI

Research Design:

-Stress levels (0-10) were collected pretest and posttest

-Participants engaged in a brief 4-question posttest qualitative interview

Qualitative Findings: Three Themes Emerged

- (1) Emotional experience
- (2) VR ‘immerses you in your mind’
- (3) Considerations for future use

Qualitative Findings:
Emotional Experience

- 34 participants endorsed that VRMM provoked **relaxation** and **tranquility**
  - it “made you open your eyes and feel the quietness and feel how peaceful it was.”
  - Participants shared that VRMM allowed them to “get away” and to “not be here”.
  - “It made me stop thinking about the other stressors - all the stress building up over the years - they went away for a bit.”

Qualitative Findings:
“VR Immerses Your Mind”

- 35 participants described VRMM as an **immersive experience**, and felt as though they were **transported to another reality**
  - “I felt like I was sitting at the beach watching the waves ...”
  - “it felt like I was really standing in front of a mountain.”
    - “It’s crazy how life like this is!”
  - Interestingly, some participants noted that VRMM provided opportunities for new experiences:
    - “If I’d never been to the mountains, which I haven't, it gives me the closest reality of being near the mountains.”

Qualitative Findings:
“VR Immerses Your Mind”

- Participants commented 77 times about admiring the scenery:
  - “beautiful,” “breathtaking,” and “gorgeous”
  - “You don’t often get to go to an environment like that!”
  - “the detail shocked me - even the grains of the sand,”
  - Participants found the virtual environment sounds to be integral to the realism

Qualitative Findings:
“VR Immerses Your Mind”

- Thirty-two participants spoke about benefits of having an immersive environment with both audio and visual elements
  - “You use more of your senses. You get more out of it… it wouldn’t be as good without the visuals.”
  - Numerous participants commented that the fully immersive experience made the mindfulness activity more effective and enjoyable; and because of this, they were better able to relax:
    - “I’ve done [mindfulness] **without visuals** before and **it wasn’t as relaxing.**”
    - VRMM was “way better ‘cause you **get to see the atmosphere** – it takes you from visualizing it to actually being able to look around … **way better than just picturing**.”
    - “This was by far the best [mindfulness experience] – you had **something to watch while you were doing mindfulness**. You weren’t staring in the room – you had **something actively to do and participating**. You weren’t just told to close your eyes and imagine things. … Thank you. It’s **so much better than someone just talking and talking**.”

Qualitative Findings:
“VR Immerses Your Mind”

- Some participants shared that, post-TBI, it was difficult to conjure up mental imagery, and they expressed gratitude that virtual imagery provided:
  - “Sometimes people who have brain injuries **can’t use their imagination as well** as other people.”
  - “It gives you the visual of what you’re hearing instead of using your imagination. **When you see it, you can imagine it a little more.**”

Qualitative Findings:
"VR Immerses Your Mind"

- Twenty-seven participants found that it was easier for them to focus in the VRMM compared to audio-only mindfulness activities
- They emphasized the VRMM increased attention 68 times
  - "This is 100x better - because it **sustained my focus**."
  - "It **immerses you in your mind**... [in] mindfulness you have… a difficult time focusing and clearing my head- this **easily cleared my head**."
  - "This would **keep your attention** a lot more than just listening. Someone like me, *if I'm sitting listening to something and someone is talking over there,* ***that's no good to me***."

Qualitative Findings:
“VR Immerses Your Mind”

- Participants addressed how VR immersion eliminated distractions and anchored their focus, and how this *contrasts with the typical disruptions* of practicing mindfulness in their day programs:
  - “People talk all the time during the mindfulness and they kind of mess it up for other people... [VRMM] would help if you just had that on and it [was] blocking out them.”
  - “I feel like I'm alone in my own room [with VRMM], and without it everyone is still talking and taking your mind off what you're supposed to do.”
  - ***The elimination of background noises and full immersion made it easier to focus***
    - ***Hence, participants were fully engaged in- and benefitted from- the VR mindfulness activity***

Qualitative Findings:
Considerations for Future Use

- Thirty-six participants endorsed interest in future VRMM use, and most provided only positive feedback
  - A few had constructive feedback:
    - e.g., regarding **different expectations** (of a more interactive experience, or of how mountains should be depicted)
      - being disturbed by not **seeing one's hands**
      - **distractions** during the experience (i.e., a visible gap at the bottom of the device, etc.).
    - A few participants shared that the **headset felt heavy**, and one found that the device's weight was distracting

Qualitative Findings:
Considerations for Future Use

- Suggestions to better develop the technology for persons with TBI
  - Most common request was a larger selection of environments:
    - "Other [persons with] TBI might have a **different preference for what is relaxing** for them."
    - The four commonly suggested relaxing environments were
      - Mountains
      - Ocean/beach
      - Forest/cabin
      - Open field/park
  - Some requested a more physically interactive experience in the VR environment

Other Key Results:

-Post-VRMM, two-thirds (24) of participants had a **statistically significant decrease** in stress levels

-**No adverse side effects** reported, indicating that well-designed VRMMs (that minimize motion-induced adverse effects) can be well tolerated in persons with TBI

Discussion

- Key qualitative finding: '**immersiveness**' and **realism** of VR environments helpful in **compensating for cognitive deficits** resulting from TBI
    - e.g., by limiting distractions and promoting attention
  - Participants cited how **these factors enhanced focus** and **engaged them in the mindfulness activity**
    - In turn, this **may have increased** the **effectiveness of the stress reduction activity**
  - Participants also mentioned that a mindfulness activity- incorporating both **visual and audio** elements- was **more effective** compared to common audio-only mindfulness activities.
    - Participants found this helpful, as several commented that persons with TBI often have a **hard time following guided imagery** due to **post-injury issues with visual imagination.**

Discussion

- Our findings suggest that **VR may address challenges of mindfulness practice-** especially exacerbated by cognitive issues in persons with TBI (e.g., diminished concentration, increased distractibility, etc.), by:
  - creating a **'sense of presence'** within a TBI-friendly tailored virtual environment
  - allowing users to attend to **visual/auditory anchors** of their choice
  - **diminishing mind-wandering** due to extraneous stimuli.[16]

Conclusion & Future Directions

- In sum, **VR environments have potential to harness guided mindfulness practice, which participants felt enhanced concentration in the present moment**

- **Future interventions** should continue to leverage & utilize VR, since it was reported to be:
  - Desirable and well-tolerated in persons with TBI
  - Beneficial for anchoring attention (visually and/or auditorily) and eliminating ambient distractions

Conclusion & Future Directions

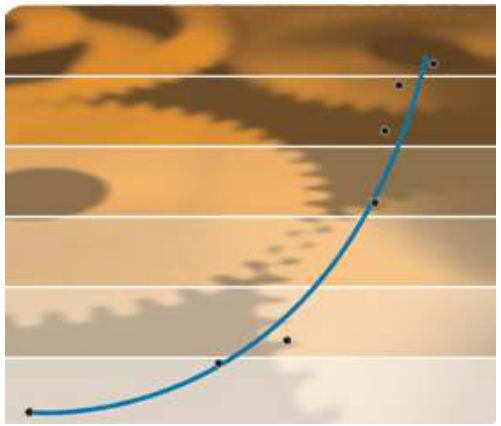
- **Future research** should further examine the potential benefits and efficacy of mindfulness utilizing a VR platform in persons with TBI
    - E.g., examine if those with **TBI experience greater benefit from visual *and* auditory VR environments, especially compared to a non-TBI group**
        - could use a non-TBI control group, as well as a TBI comparison group receiving a non-VR (audio-only) mindfulness intervention…

- **More generally**, further application of **VR in TBI rehabilitation is promising** and warrants future research to **harness the benefit** of VR in improving rehabilitation outcomes

Other Future Directions

Consider: Exponential Growth of Technology

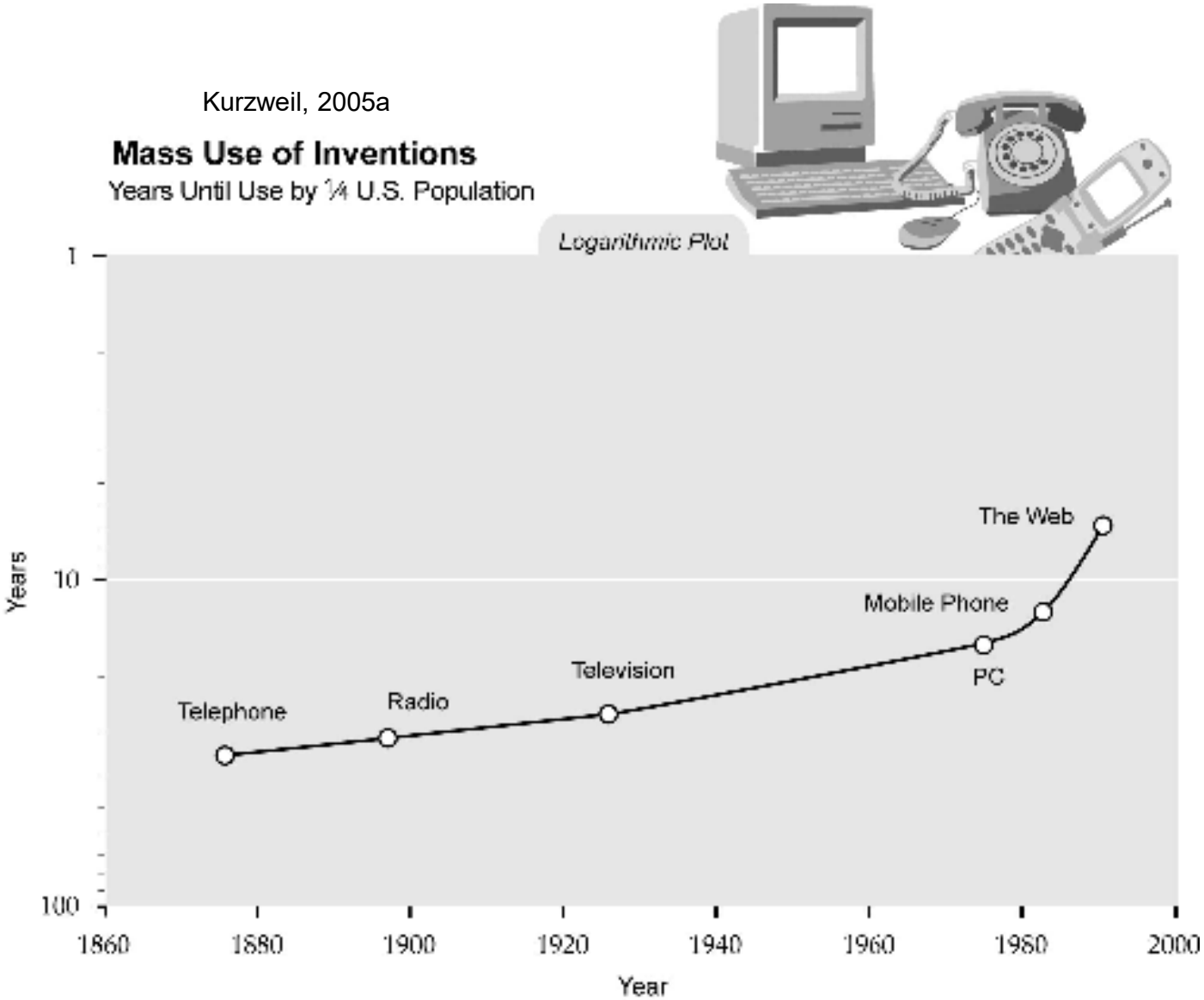
- "We're doubling the power of information technologies, as measured by price-performance, bandwidth, capacity & many other types of measures, about every year. That's a factor of a thousand in ten years..." (Kurzweil, 2005)



Exponential Growth of Information Technologies

- Technology is *rapidly* developing
- Various technology platforms are *increasingly* used in rehabilitation settings
  - **This trend is expected to grow in coming years**

Kurzweil, 2005a



<u>2007</u>: Steve Jobs introduced the iPhone

<u>2010</u>: ¼ of Americans had a smartphone

Virtual Reality for Neuropsychological Assessments

- Assessments can be built into VR environments so measures appear virtually, or simulate useful real-world conditions, to elicit multiple real-world functional abilities and measure complex sets of skills in real-time (Matheis et at., 2007 as cited in Luxton, Pruitt & Osenbach, 2014)

Benefits of VR Environment-Based Neuropsychological Assessments

- Stimulation customizability
- Safety & efficiency
- Applicable to wide range of impairments
- User-friendly interfaces
- Data capture
- Real-time analyses of performance
  - (Parsons, 2016)

Questions or referrals?

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- **Questions?**

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