Do Brain Exercises Improve Cognitive Function in People with Dementia?

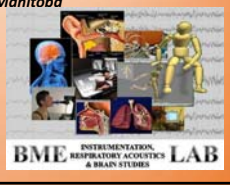
Zahra Moussavi, Ph.D. P.Eng.
Professor & Canada Research Chair in Biomedical Engineering
University of Manitoba, Winnipeg, Manitoba

UNIVERSITY OF MANITOBA FACULTY OF ENGINEERING

UNIVERSITY OF MANITOBA

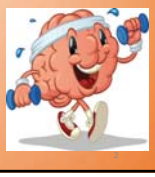
RIVERVIEW HEALTH CENTRE FOUNDATION

EVestG



How to age with a healthy brain?

- **Use it or lose it! Exercise your Brain regularly (daily).**
  Fiction or Fact?!
- **A recent study** [Stojanoski B, et al, 2018] **says there is no benefit of doing brain exercises in general.**
  Fiction or Fact?!



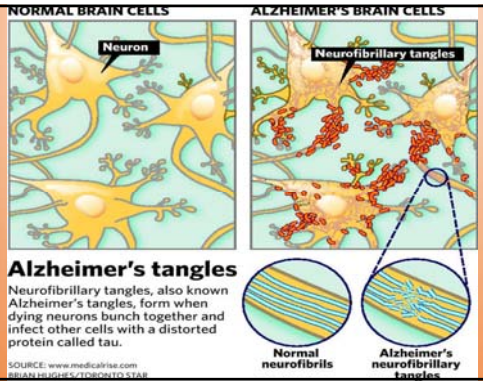
Why happens in the Brain of a person with Alzheimer's?

Alzheimer's brain

- The cortex shrivels up, damaging areas involved in thinking, planning and remembering.
- Shrinkage is especially severe in the hippocampus, an area that plays a key role in formation of new memories.
- Ventricles (fluid-filled spaces within the brain) grow larger.

Alzheimer's brain

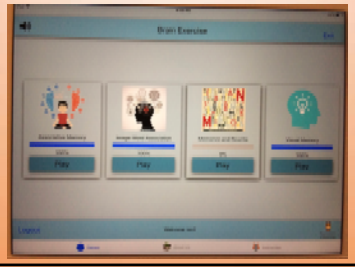
- many fewer nerve cells and synapses
- Plaques, abnormal clusters of protein fragments, build up between nerve cells.
- Dead and dying nerve cells contain *tangles,* which are made up of twisted strands of another protein.



- The Tau protein accumulation in the brain causes neurofibrillary tangles and thus, profound synapse degeneration.
- Synapses are the channels of communication between the neurons.
- The abnormalities in terms of β-amyloid plaques and neurofibrillary tangles disrupts the fronto-parietal function connectivity.
- Cholinesterase inhibitor medications try to suppress the Tau protein but not very effectively.
- Brain Exercises, on the other hand, try to use brain plasticity.

We developed a new series of Brain Exercises

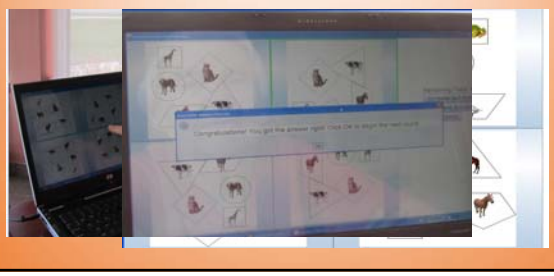
- **7 different types of exercises**



We developed a new series of Brain Exercises

- **7 different types of exercises**
- **Focusing on Spatial Memory, Visual Memory, Delayed Recall, Categorization and Left-Right Brain Connectivity,**

Focusing on Visual Memory, Delayed Recall, Left-Right Connectivity



Focusing on connectivity between visual and verbal cognition

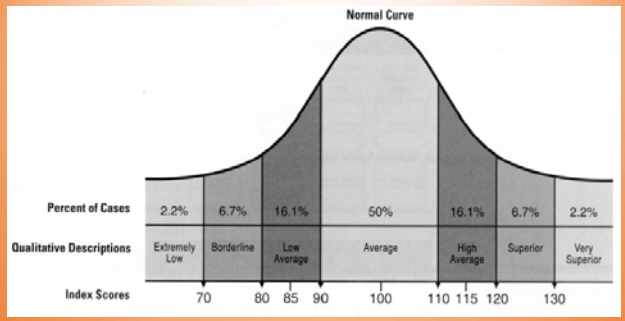
Video of our Brain Exercises

Protocol of the Study

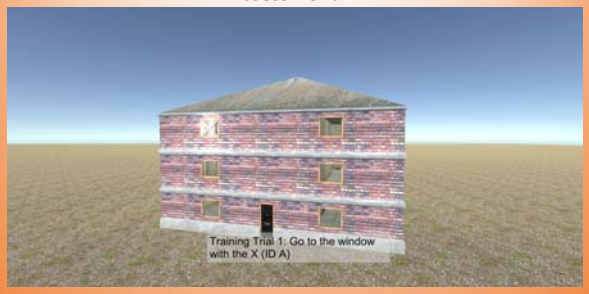
- **4 Weeks of using brain exercises everyday (5 days/week) twice/day, each 30 minutes (one hour apart).**
- **Two Modes of Operation:**
  - **At home at their own pace**
  - **At our center with a tutor (trainer)**
- **Assessments at Baseline, Post-Intervention and Follow up (a month after)**
- **Assessments: MoCA (only at baseline), WMS-IV, Spatial Orientation**
- **Participants:**
  - **23 cognitively healthy individuals (69.8±5.9 years) – all used the App on their own.**
  - **16 individuals with Mild Cognitive Impairment (MCI) or early stage Alzheimer's (68.9±8.2 years) – 11 of them used the App with a tutor at our center (4 with tACS).**

Primary Outcome Measure: Wechsler Memory Scale (WMS-IV)

- Individually administered battery of learning, memory, and working memory measures.
- Composed of 11 subtests in 4 major categories:
  - Auditory Memory
  - Visual Memory
  - Immediate Memory
  - Delayed Memory
- Aside from raw scores it also provides qualitative grouping, i.e. low, average, high, etc. based on a large cohort study of seniors.



Secondary Outcome Measure: Virtual Reality Navigational (VRN) Assessment

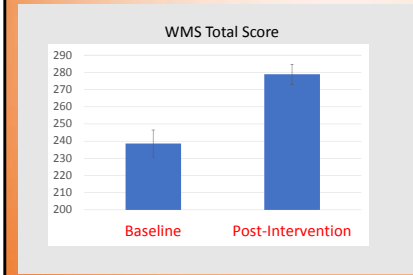


Secondary Outcome Measure: Virtual Reality Navigational (VRN) Assessment

Secondary Outcome Measure: Virtual Reality Navigational (VRN) Assessment

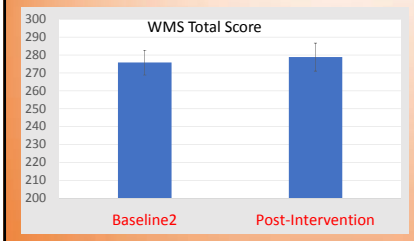
Secondary Outcome Measure: Virtual Reality Navigational (VRN) Assessment

Results – Healthy Group, exercising at home at their own pace – Memory Test with WMS



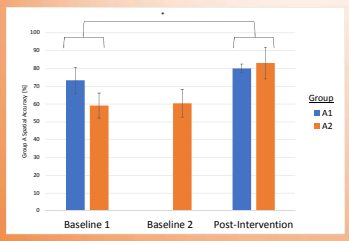
Significant improvement but is there any practice effect of WMS after 4 weeks?

Results – Healthy Group, exercising at home at their own pace – Memory Test with WMS



No significant improvement when considering practice effect of WMS!

Results – Healthy Group, exercising at home at their own pace – Spatial Test with VRN building



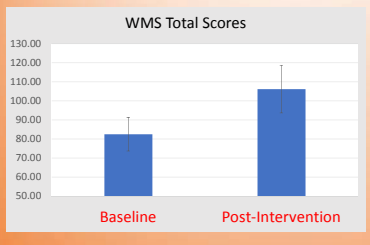
- No practice effect
- Noticeable improvement post-intervention

Summary of the Results - Healthy Group Exercising at Home

- ❖showed memory improvement after the intervention but most likely due to practice effect of WMS than the brain exercises.
- ❖However, some of them who were very keen in doing the exercises improved much beyond the practice effect.
- ❖Many healthy individuals had a ceiling effect at baseline 2 → WMS could not measure the plausible improvement.
- ❖However, they did improve in spatial orientation beyond the practice effect of the assessment.

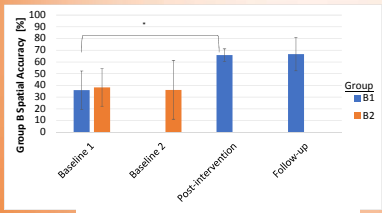
23

Results – MCI/Alzheimer's Group, exercising at our center with a tutor – Memory Assessment (WMS)



- ➢ Significant Improvement
- ➢ No Practice Effects in this group

Results – MCI/Alzheimer's Group– Spatial Assessment with VRN building



- Significant Improvement
- No Practice Effects in this group

- **B1: Tutored group, n=11**
- **B2: Controls – non-exercising, n=5**

Summary of Results – MCI/Alzheimer's Group

❖9 out of 11 individuals with MCI/Alzheimer's, who received tutored daily sessions of brain exercises, improved significantly; the other two remained almost the same.

❖The MCI/Alzheimer's individuals practicing at home (not regularly) did not show much improvement (remained almost the same → no practice effect of the assessments either).

Brain Cognitive Training + Transcranial Alternative Current Stimulation (tACS)

- **Protocol:** The same Brain Exercises protocol but simultaneously with tACS at 40 Hz was applied to 4 mild Alzheimer's patients.
- **Results:** These 4 people improved similarly to those without tACS after the end of trial but kept improving even a month after the end of Trial.

Main Conclusion

❖**The Key for Brain Exercises to be effective and helpful in cognitive function can be its delivery.**

❖**FACT: Use it or lose it! Exercise your Brain regularly (daily).**

- The key point is to keep a **dynamic and challenging** choice of exercises and challenge yourself for higher scores.

Thanks to my team and volunteers!

Thank you for your attention!

Questions?