



40 Hz Gamma Sensory Stimulation Effects on Memory Performance in Cognitively Healthy Older Adults

Katie Davis, Jyotleen DeWal, Megan Kemp, Ashley Salen
Dr. Thackery Brown & Dr. Qiliang He

Introduction

Recent studies have demonstrated that a gamma sensory stimulation, light and sound flickering at 40 Hz, decreased Alzheimer's symptoms and pathology in mice (Laccarino et al., 2018; Singer et al., 2018). Subsequent human trials demonstrated its safety and showed similar results (Martorell et al., 2019). Flickering light and sound for 1 hour a day over 8 weeks demonstrated preliminary improvements in memory performance in adults with mild cognitive impairment (He et al., 2021). Here we examine preliminary behavioral effects of a study in which cognitively healthy older adults use either the flicker or a control intervention for 1 hour per day for 8 weeks. It is hypothesized that there will be greater improvements in memory performance for those using the flicker.

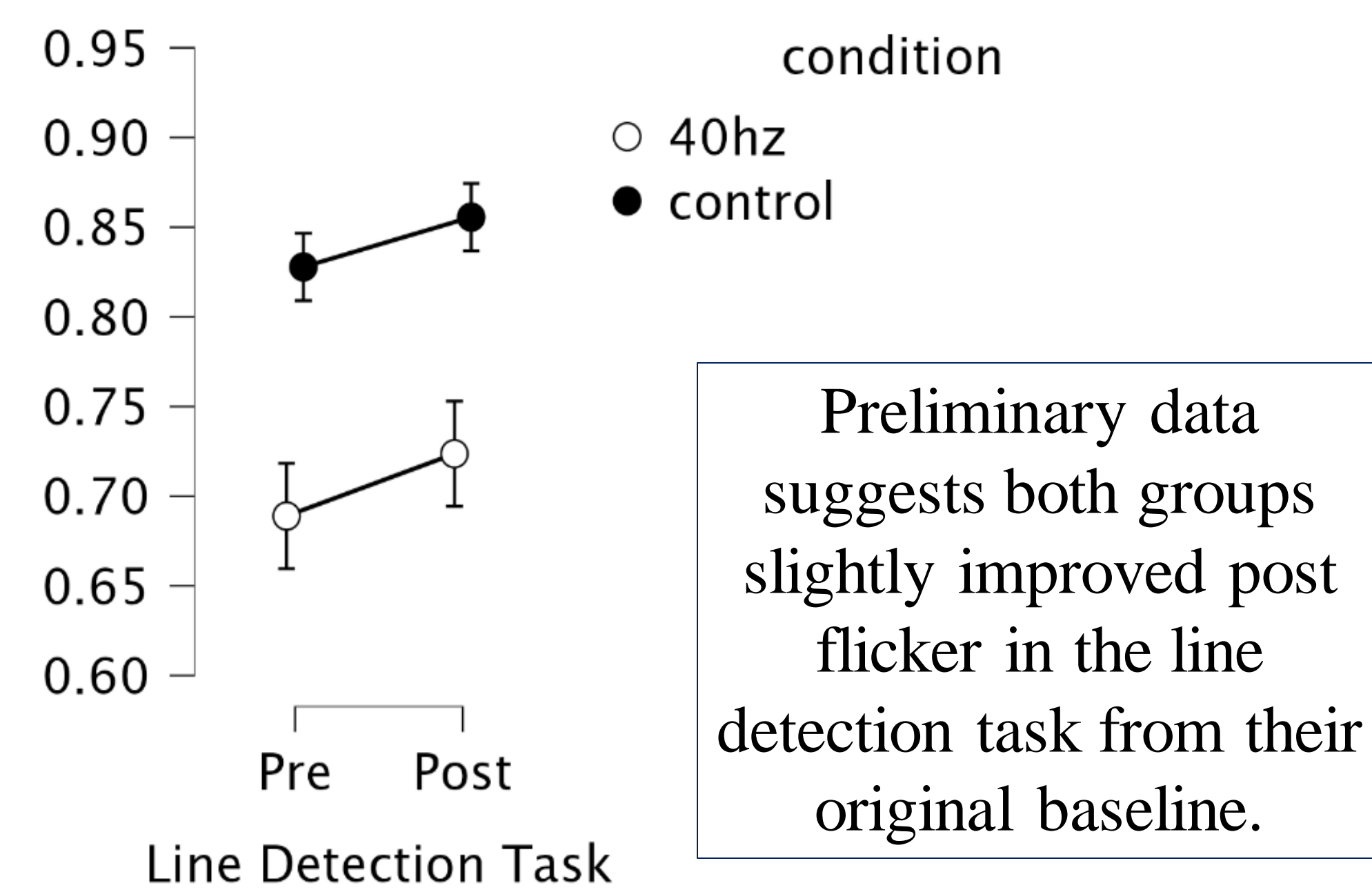
Methods & Materials

- N = 11 cognitively healthy older adults
 - Total will be 48 by May 2023
- 1 hour of auditory and visual sensory stimulation per day for 8 weeks
 - 40 Hz gamma sensory stimulation or constant light and sound stimulation
- Memory tests before and after 8 week intervention:
 - Face-name-occupation delayed recall - long-term memory
 - Spatial navigation using VR - spatial memory
 - Line detection - perceptual discrimination
- Repeated-measures ANOVA using JASP software

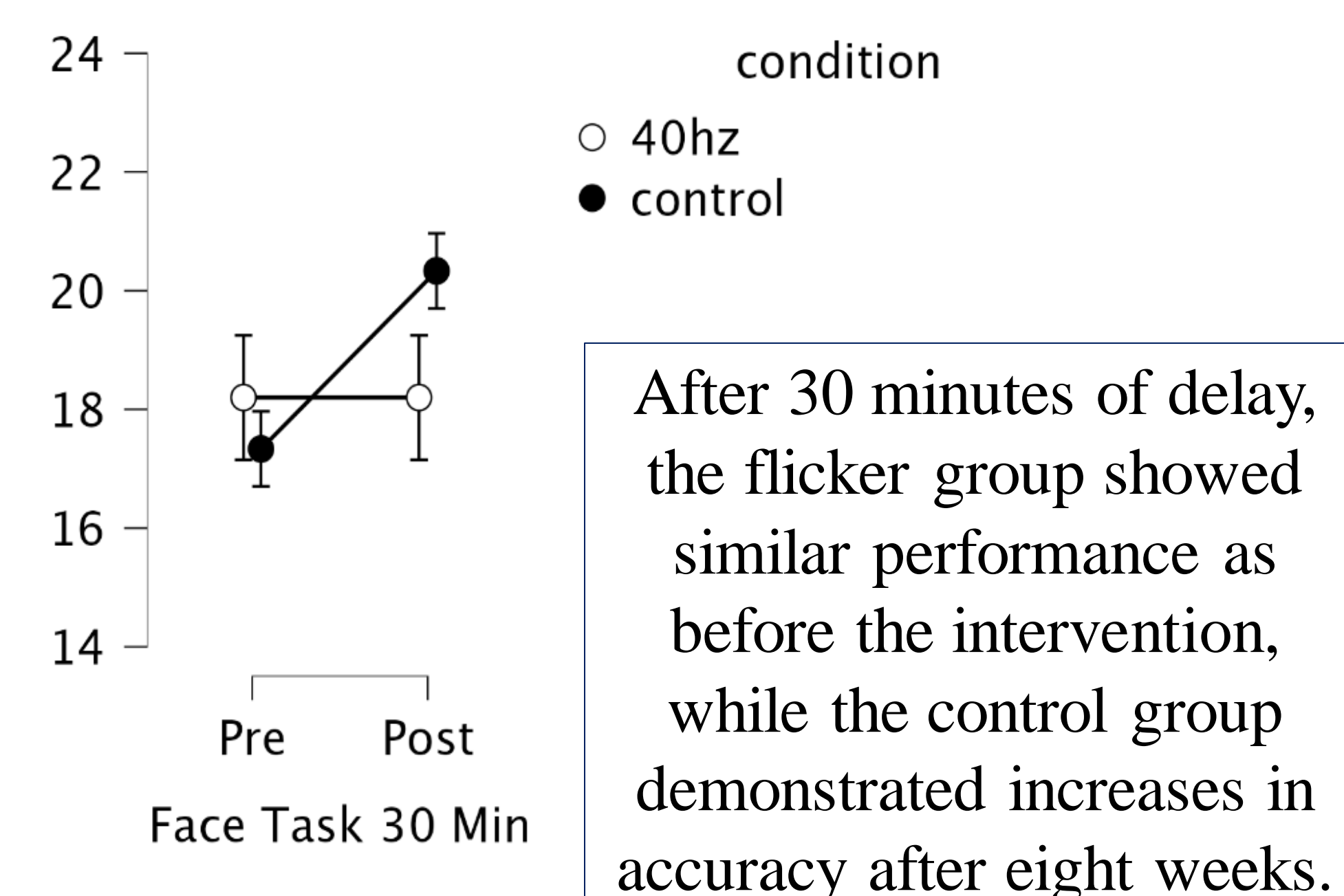
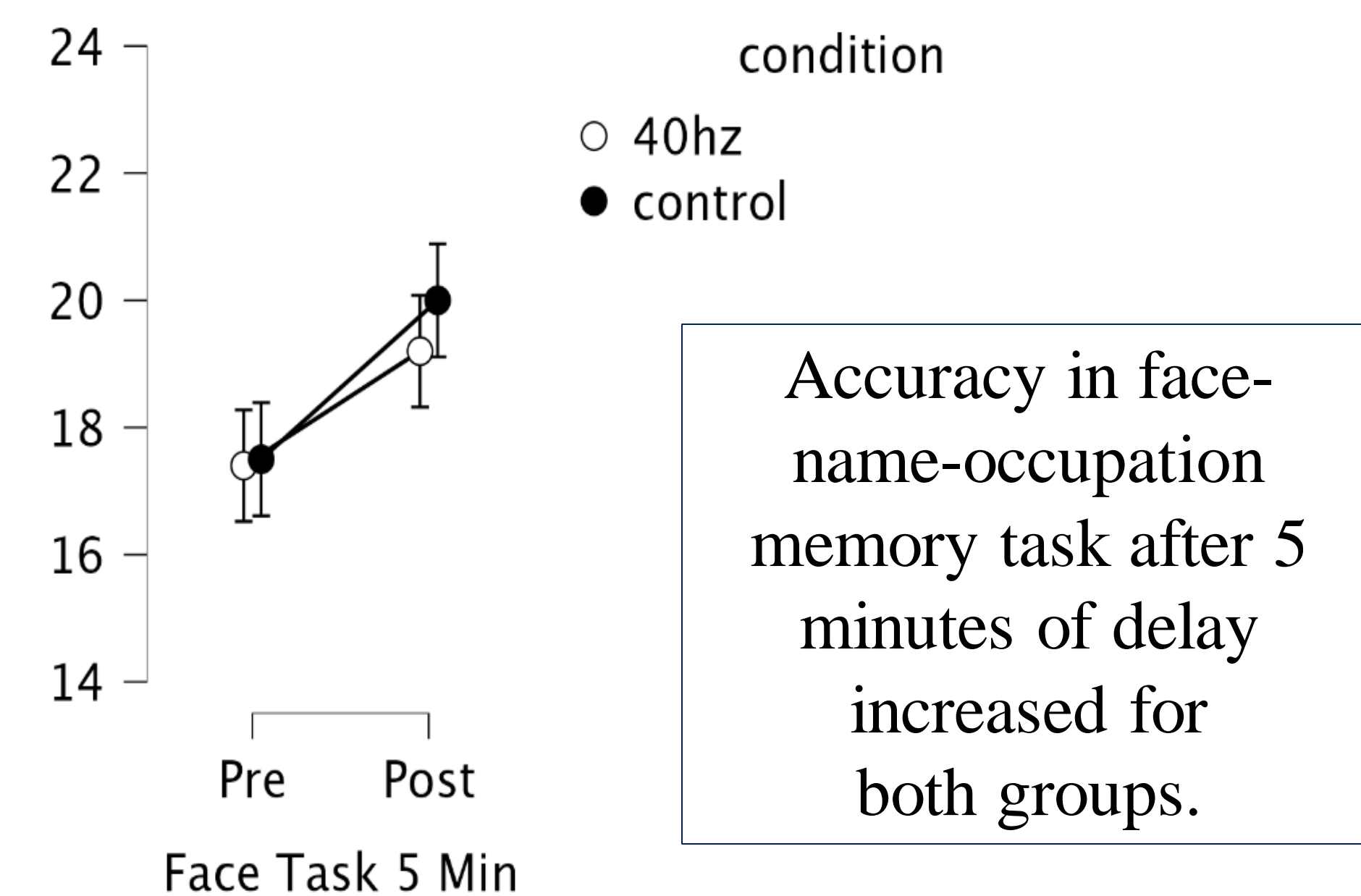
Materials:

- VIVE Pro headset
- Mind Alive David Light Therapy Sound Machine with Tru Vu Viewhole eye set

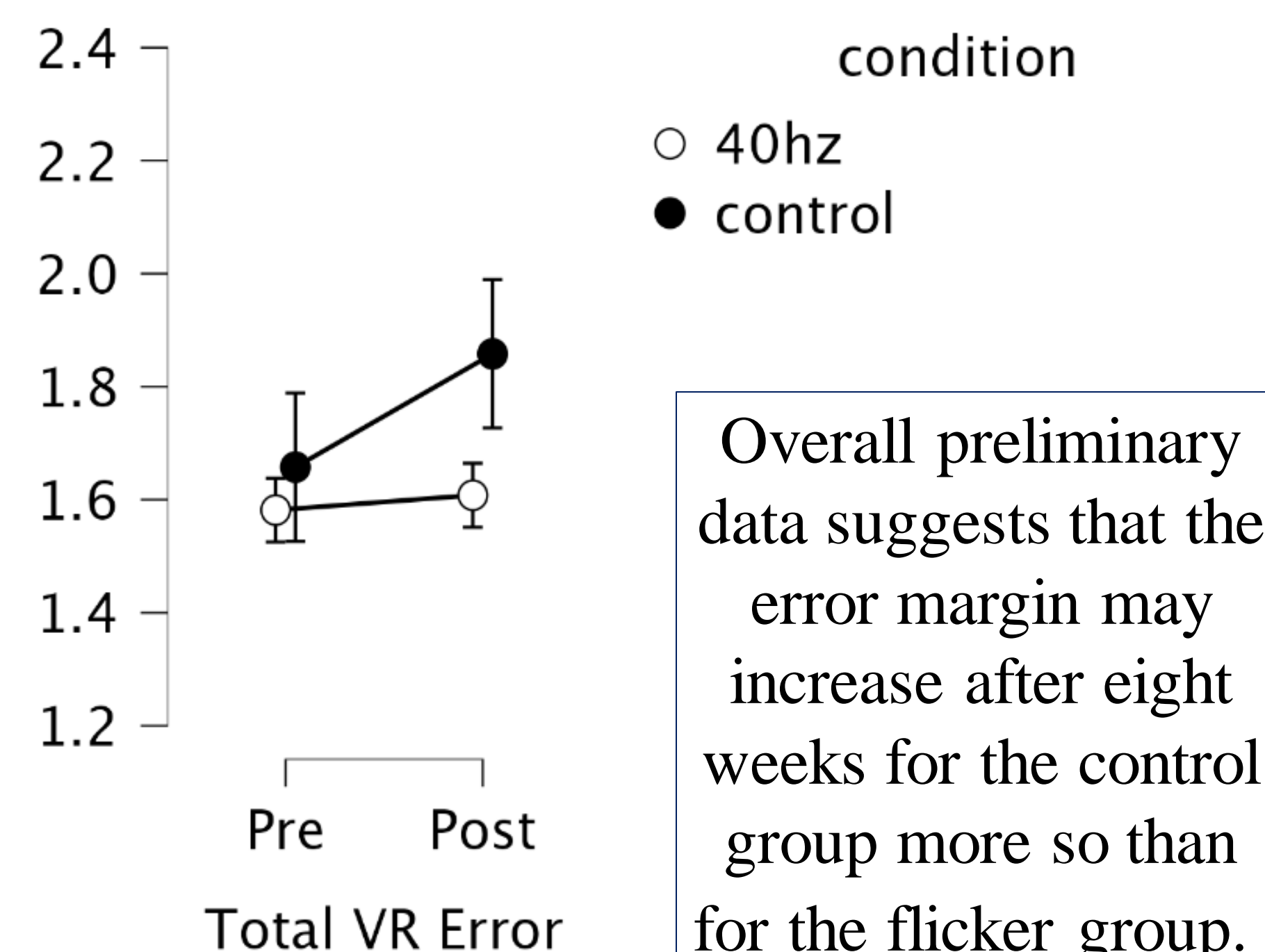
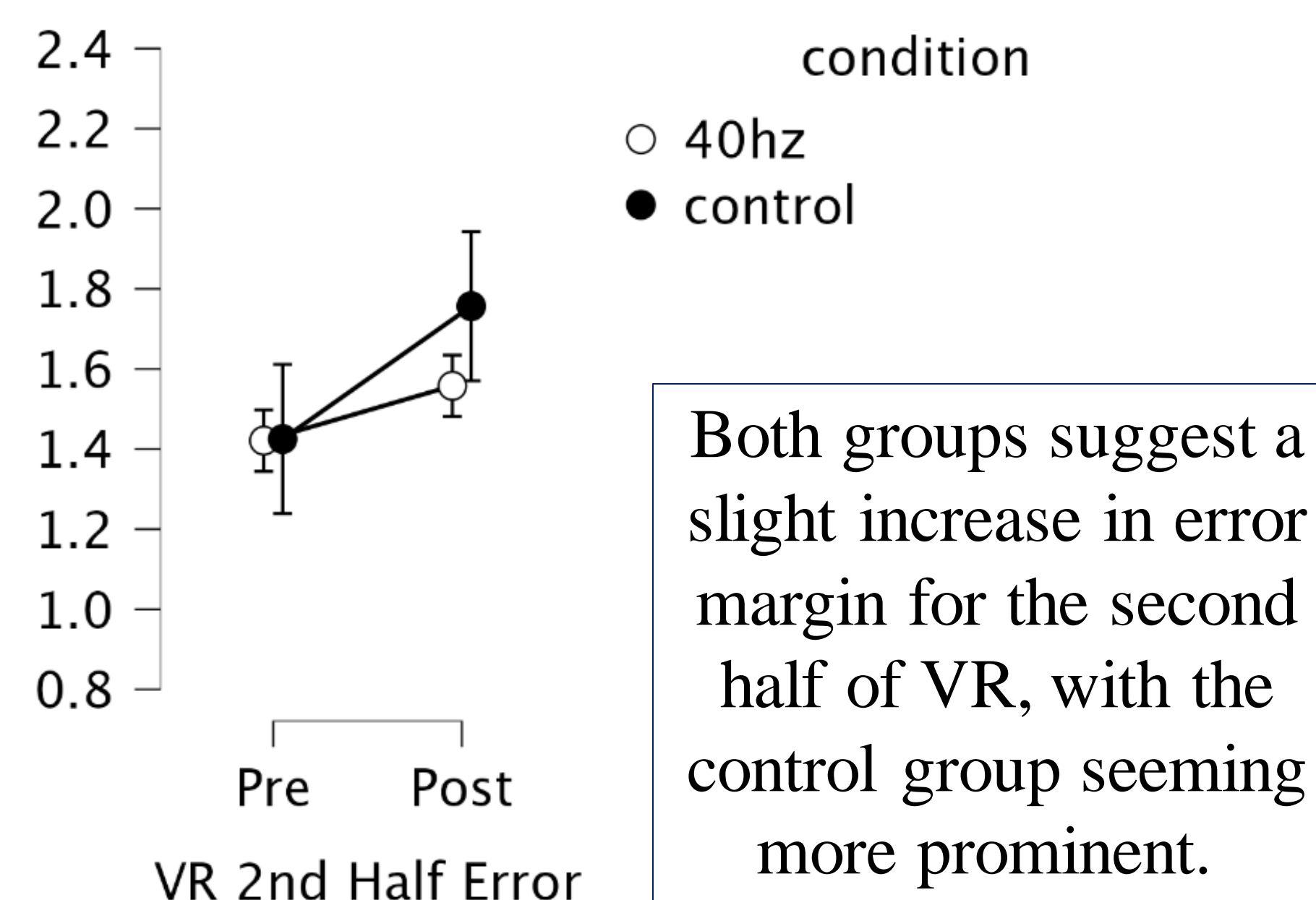
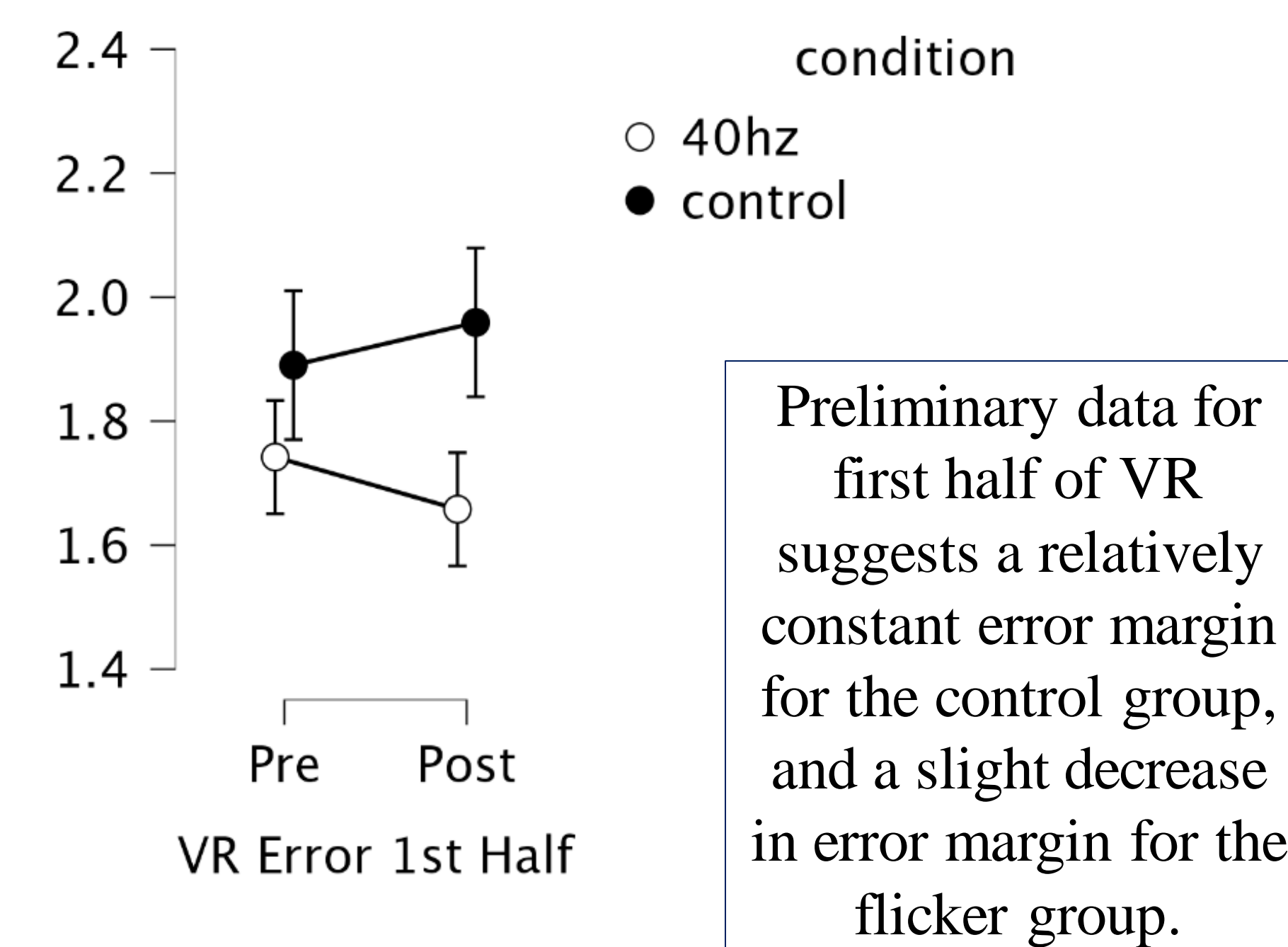
Perceptual Discrimination Test



Long-term Memory Test



Spatial Memory Test



Preliminary Results

- No statistical significance in current data analysis (N = 11)
- Both groups may have higher accuracy in perceptual discrimination after 8 weeks, likely due to learning effects for specific task
- Flicker group may have similar error margin error after 8 weeks in spatial navigation task, while control group may have increased error margin
- Flicker group may have similar long-term memory performance after 8 weeks, while those in the control group had seemingly improved memory performance

Interim Conclusion

Based on current preliminary results, it is predicted that the flicker group will have fewer spatial memory deficits, as shown by error margin from VR task, but may have more long-term memory retrieval errors, as shown by accuracy in face-name-occupation task. These results are based off a very small sample size and may not reflect the pattern that will be found later, which could give further insight into the effectiveness of 40 Hz gamma sensory stimulation in pre-clinical cognitively healthy older adults.

Sources

He, Q., Colon-Motas, K., Pybus, A., Piendel, L., Seppa, J., Walker, M., Manzanares, C., Qui, D., Miodinovic, S., Wood, L., Levey, A., Lah, J., & Singer, A. (2021, May 13). A feasibility trial of gamma sensory flicker for patients with prodromal Alzheimer's disease. *Alzheimer's association*. Retrieved April 19, 2021 from <https://alz-journals.onlinelibrary.wiley.com/doi/full/10.1002/trc2.12178>.

Laccarino, H., Singer, A., Martorell, A., Rudenko, A., Gao, F., Gillingham, T., Mathys, H., Seo, J., Kritskiy, O., Abdurrob, F., Adaikkan, C., Canter, R., Rueda, R., Brown, E., Boyden, E., & Tsai, L. (2018, July 25). Gamma frequency entrainment attenuates amyloid load and modifies microglia. *Nature* 540, 230-235. Retrieved April 19, 2022 from <https://www.nature.com/articles/nature20587>.

Martorell, A. J., Paulson, A. L., Suk, H. J., Abdurrob, F., Drummond, G. T., Guan, W., Young, J. Z., Kim, D. N., Kritskiy, O., Barker, S. J., Mangena, V., Prince, S. M., Brown, E. N., Chung, K., Boyden, E. S., Singer, A. C., & Tsai, L. H. (2019). Multi-sensory Gamma Stimulation Ameliorates Alzheimer's-Associated Pathology and Improves Cognition. *Cell*, 177(2), 256-271.e22. <https://doi.org/10.1016/j.cell.2019.02.014>

"Mind Alive Inc - Tru-Vu Eyesets." *Mind Alive Inc.*, <https://mindalive.com/collections/eyesets>

"Vive Pro Full Kit: Vive United States." *VIVE Pro Full Kit | VIVE United States*, <https://www.vive.com/us/product/vive-pro-full-kit/>

Singer, A. C., Martorell, A. J., Douglas, J. M., Abdurrob, F., Attokaren, M. K., Tipton, J., Mathys, H., Adaikkan, C., & Tsai, L. H. (2018). Noninvasive 40-Hz light flicker to recruit microglia and reduce amyloid beta load. *Nature protocols*, 13(8), 1850-1868. <https://doi.org/10.1038/s41596-018-0021-x>.