The Impact of Mindfulness Training on Declarative Memory Performance and Microstructural Integrity of Major White Matter Tracts Associated with the Hippocampus

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Overview

Following an 8-Week intervention (Mindfulness Training or Cognitive Fitness Training), participants showed significant increases in declarative memory performance. We hypothesize that differences in modifications to white matter microstuctrual integrity might underlie these differences in declarative memory performance.

Background

- Alterations in hippocampal structure and function, associated with healthy aging, have been hypothesized to underlie decreases in cognitive performance, including declarative memory performance (DMP).
- Several computer-based interventions have been designed to preserve DMP in aging adults. Investigations into the efficacy of these interventions have produced mixed results.
- Growing evidence suggests that mindfulness-based interventions (MBI) may reduce normal age-related cognitive declines and thus, may be an alternative method to promote DMP.

Study Design

- 96 cognitively normal older adults aged 65-80.
- Mindfulness Training (MT, n=47), based on MBSR
- Cognitive Fitness (n=49) matched for time, prescribed daily crossword puzzles and sudoku.
- RCT with 6, 12, and 24-month follow-up
- Declarative memory performance (DMP) measured with lure discrimination index (LDI) from Mnemonic similarity task (MST).
- Freesurfer TRACULA (v7.2.0) (Figure 1).

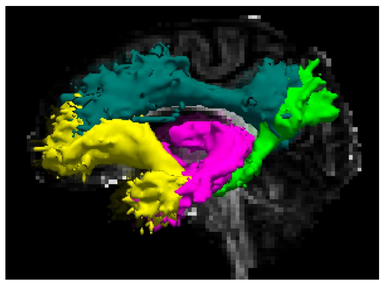

Figure 1: Visualized Reconstructed WM Pathways. *A left sagittal view of pathways reconstructed automatically with TRACULA: fornix (magenta), uncinate fasciculus (UF) (yellow), dorsal portion of cingulum bundle (CBD) (teal), ventral portion of cingulum bundle (CBV). The distribution of each pathway is displayed as an isosurface over the T1 image of a randomly selected control participant.*

Results: *Group x Time Differences In Diffusion Metrics*

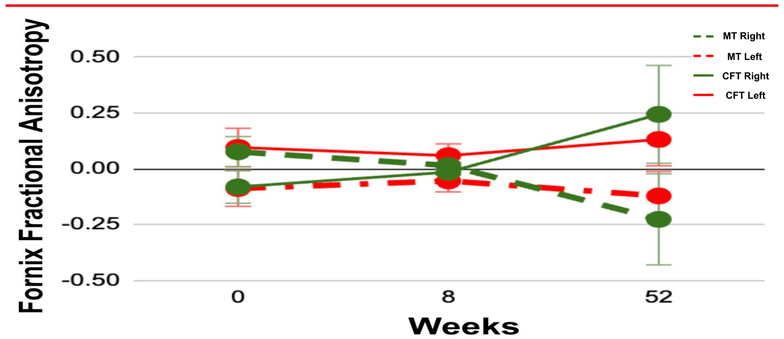

Figure 1: Fornix FA Over Time. *Scaled and Centered Fornix FA Values in the MT group (dashed line) and CFT controls (solid line). LMMs revealed significant GxT differences in the Left (red; p=0.014, F=0.07) and Right (green; p=0.025, F=3.2) Fornix.*

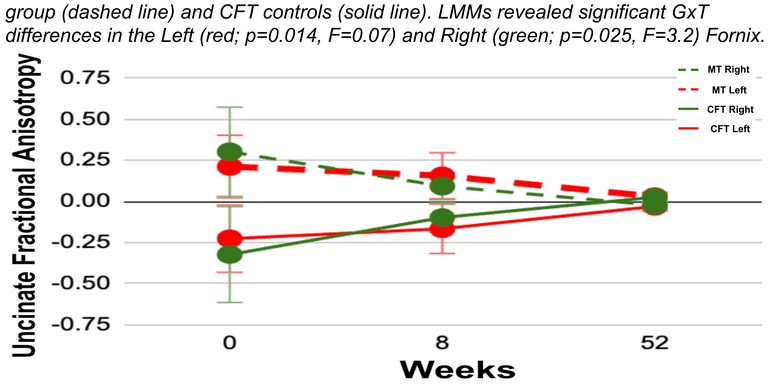

Figure 2: Uncinate Fasciculus FA Over Time. *Scaled and Centered Uncinate Fasciculus FA Values in the MT group (dashed line) and CFT controls (solid line). LMMs revealed significant GxT differences in the Left (red; p=0.019, F=1.4) and Right (green; p=0.02, F=3.6) Uncinate Fasciculus.*

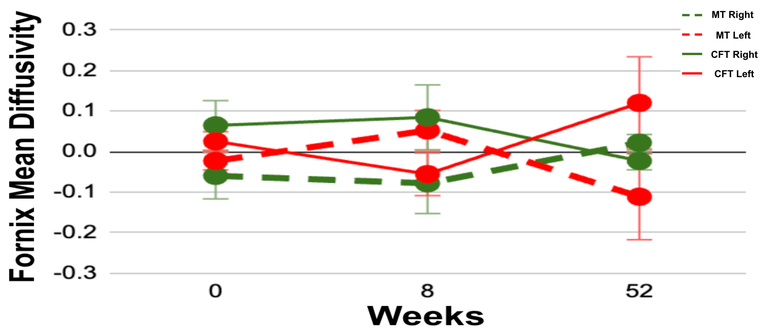

Figure 3: Fornix MD Over Time. *Scaled and Centered Fornix MD Values in the MT group (dashed line) and CFT controls (solid line). LMMs revealed significant GxT differences in the Left (red; p=0.017, F=4.2) and Right (green; p=0.0092, F=3.6) Uncinate Fasciculus.*

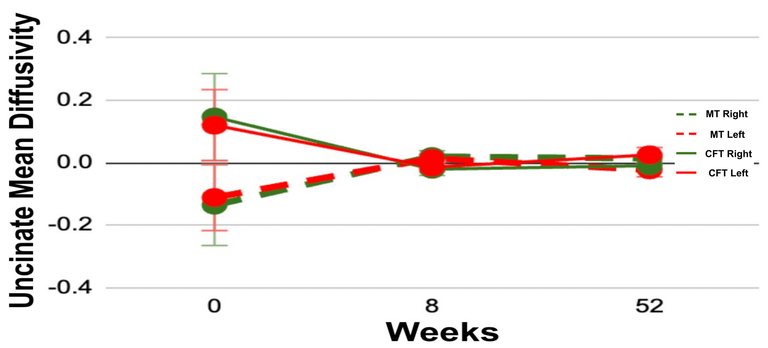

Figure 4: Uncinate Fasciculus MD Over Time. *Scaled and Centered Uncinate MD Values in the MT group (dashed line) and CFT controls (solid line). LMMs revealed significant GxT differences in the Left (red; p=0.00096, F=6.7) and Right (green; p=0.025, F=2.4) Fornix.*

Results: *LDI scores over time*

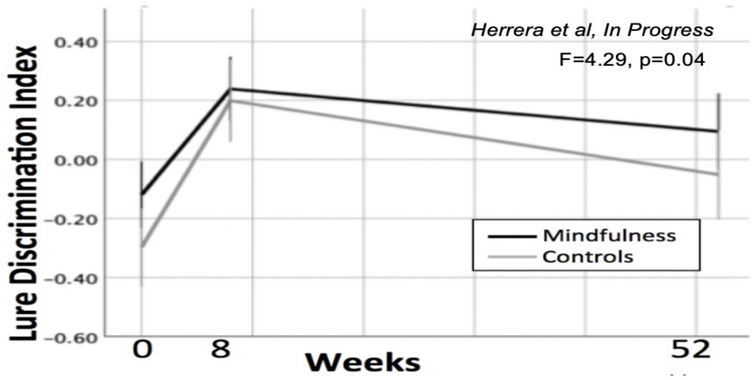

Figure 5: LDI Scores Over Time. *Changes in LDI scores over time in the MT group and CFT controls. Both groups showed a statistically significant increase in LDI scores pre- versus post-intervention, while only the control group showed a statistically significant decrease in LDI scores at the one-year follow-up.*

Conclusion

- Hippocampal WM Tracts are modified by MT.
- Memory improvements in each group are associated with different diffusion metrics
- Mindfulness-related changes in both the fornix and uncinate fasciculus contribute to enhanced declarative memory
- Other neuroimaging modalities are needed to clarify cellular level changes contributing to FA, i.e. crossing fibers vs. pruning, etc.

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