Introduction
• Short-term memory has long been assumed to reside in the hippocampus, with replay (on the scale of months or years) solidifying the memory into the neocortex.
• An imaging method called diffusion-weighted MRI has been recently introduced to the field of cognitive neuroscience as a measure of microstructural plasticity, which allows tracking of a physical, dormant memory trace in the brain (rather than relying on functional data/active memory).

Memory formation and memory loss: Investigating Alzheimer’s Disease through MRI

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Areas of Analysis
• Please note that the below describe anticipated analysis/results as data collection is ongoing.

1. How quickly does a memory trace become hippocampal-independent?
• New evidence that under certain conditions, the hippocampus can rapidly disengage, involving neocortical areas such as the PPC in memory engram representation.
• Our goal: show an enduring memory trace in neocortical areas within 60-90 minutes after a learning task (much faster temporal dynamics than original model!)
• This would also mean that the hippocampus may be only a partial contributor to short-term memory storage, and the neocortex may play a more important role than previously assumed.

2. Is memory information coded in neocortical diffusivity changes?
• Importantly, we must show that measured neocortical changes reflect learning of specific material and are not tangential to memory formation.
• Using representational similarity analysis, we will try to show that diffusivity changes are predictive of the category of naturalistic stimuli learned (airport or restaurant).
• We will also look at the functional changes (increased blood flow to a brain area) during encoding to correlate activity with lasting dormant traces.

3. How do these results shed light on Alzheimer’s disease?
• There has been inordinate focus in AD research on hippocampal degradation while neglecting the contribution of early neocortical decay to memory symptoms.
• If the neocortex (PPC) is implicated in early memory formation, this could be an avenue for a) earlier detection of AD and b) better targeting of treatments to all brain areas involved in short-term episodic memory.
• In addition to the experimental study, my thesis will also look at long-term standard of care for patients with AD, bridging neuroscience and global health.
• Specifically, I will look at ‘dementia villages’ in Canada, Denmark and the Netherlands, and their potential to increase independence and quality of life for our aging population.

Discussion
• Our aging population will be more and more in need of research both on the neuroscience of memory/memory loss and the ways to provide a high standard of care for individuals with dementia.
• Early detection before symptoms progress can allow more long-term autonomy.

Questions
• What are ethical ways to research patients with Alzheimer’s disease more directly (rather than drawing conclusions from healthy participants)?
• How can we improve the quality of care for patients with AD when they may not be able to communicate their needs?

Conclusion
• Data collection and analysis will be ongoing as my senior thesis project. No conclusions can be drawn as of yet.

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