Identifying Patterns of Brain Volume Loss in Alzheimer's Disease at NIRAL

Gil Internship Fall 2020

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About the Neuro Image Research and Analysis Lab

- NIRAL is a lab within the Department of Psychiatry within the UNC School of Medicine that uses neuroimaging to study neurological and genetic conditions
- Dr. Styner is the director of the Structural and DTI analysis team, as well as a professor of Computer Science
- Includes graduate students from Computer Science, Neuroscience, and Biology-related fields and research reflects this diversity
- Involved in the creation of SlicerSALT, which we used in this project

The Project & My Contribution

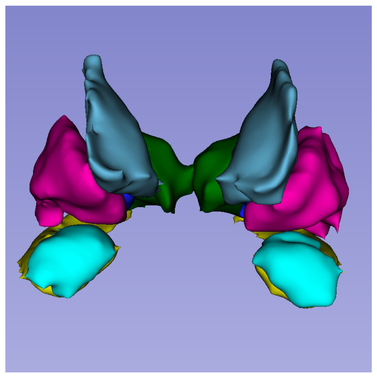
- Alzheimer's Disease is a neurodegenerative disease that affects more than 5 million Americans, which is why it necessitates so much research
- A hallmark indication of Alzheimer's is a significant and rapid loss of brain volume, which is particularly prevalent in structures like the hippocampus

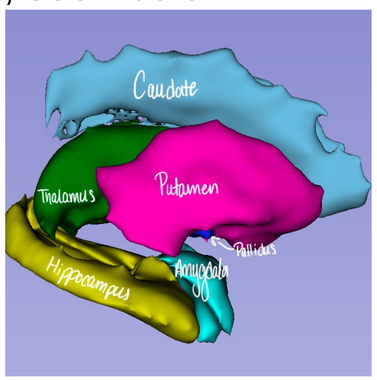
Since Alzheimer's is characterized by loss of brain volume, can we identify patterns specific to AD that can be used for diagnosis or prediction?

- We used the shape analysis software SlicerSALT to compare brain volume loss between control and AD brains
- I have been responsible for creating the 3D representations, determining the parameters for the official test, and calculating the difference in brain volume for the initial trial subjects

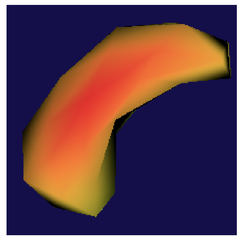
Creating 3D Representations

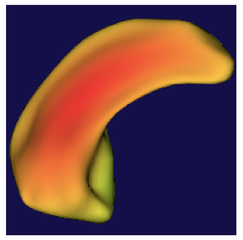
- The MRI scans for each participant were used to build a 3D representation of the structures of interest, seen below



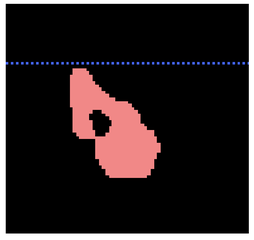


- One of my main responsibilities has been testing out different parameters to use for creating the 3D representations
- One such parameter is the subdivision level, an increase in which results in a smoother render

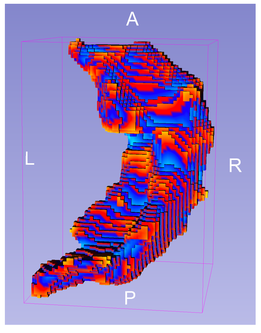




- One goal was to create representations that did not have errors in them, as seen on the right; in the testing phase, I used ITK-SNAP to correct these



- I then used model-to-model comparisons to ensure that the renders created by the different parameters were not too different from each other
- The lighter sections (close to white) indicate a bigger difference, meaning that the parameters change the render significantly



Shape Analysis and Significance Testing

- Once we have finalized the parameters for creating the 3D representations, we will run the full data set and then use covariate significance testing to compare the brain volumes of subjects with and without Alzheimer's Disease
- The left and right hippocampi are our main targets, but we will also examine the caudate, putamen, pallidus, and thalamus
- Each participant has several MRI scans over several years, so we will compare how brain volume changes over time
- Our analysis will need to hold 3 variables constant: age (as neurodegeneration naturally occurs with aging), gender, and brain cavity volume

What I've Learned

- Gained a deeper understanding of Alzheimer's Disease, neuroanatomy, and neuroimaging
- Learned how to use tools such as SlicerSALT and ITK-SNAP
- Improved organization and planning skills by working with large data sets
- Explored a more neuroscience and computer science-based side of cognitive psychology, which I had not experienced before

Acknowledgements and References

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Facts and Figures. (n.d.). Retrieved November 02, 2020, from https://www.alz.org/alzheimers-dementia/facts-figures

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