Are Age-Related Changes in Hippocampal Granularity in Older Adults Associated with Verbal Episodic Memory

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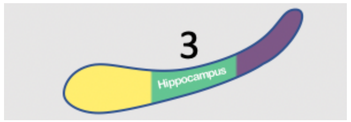
Introduction

The hippocampus, which plays a major role in learning and memory, can be represented as a gradient in the direction of the longitudinal axis. Brunec et al. (2018) found that the anterior hippocampus has a greater intervoxel similarity compared to the posterior hippocampus, which means that the anterior hippocampus is can be characterized as "more global", while the posterior hippocampus has a "finer granularity".

Fig. 1. Hippocampus Diagram



Why do we care? My poster rests on the assumption that this hippocampal gradient is advantageous for multiscale coding. Eliav et al. (2021) ran a full decoding analysis and found that this kind of granularity hierarchy is advantageous because 1) it requires fewer neurons and 2) it leads to fewer errors.

My research was inspired by the Stark et al. (2020) paper, which was interested in age related changes along the longitudinal axis of the hippocampus. The study found that in both hemispheres, younger adults showed a pattern where intervoxel similarity decreases as we move from the anterior to the posterior of the hippocampus as expected, while older adults have a reverse effect..

Hypothesis -- In older adults, if the changes in hippocampal granularity found in Stark et al. (2020) are valid, we should be able to replicate the result in our sample. If changes in aging are compensatory, then it should be positively correlated with RAVLT performance. But, if changes in aging are a deficit, then it should be negatively correlated with RAVLT performance.

Methods

Participants were collected by the Nathan Kline Institute for the Cross-Sectional Lifespan Connectomics Study, and range in age from 6 - 85. Our analyses will be performed on a 5 minute scan with a 2500 msec TR and 3 x 3 x 3.5 mm voxels. We will compare the inter-voxel similarity over the course of each resting state scan within each segmented hippocampal region between subjects.

We split our participants into two groups: young (18-35) and old (65-85).

We ran a linear model to see if hippocampal granularity in anterior, middle, posterior subregions changed in older adults. This model has fixed effects for subregion, age group, and their interaction, as well as covariates of number of voxels and mean frame displacement.

Results

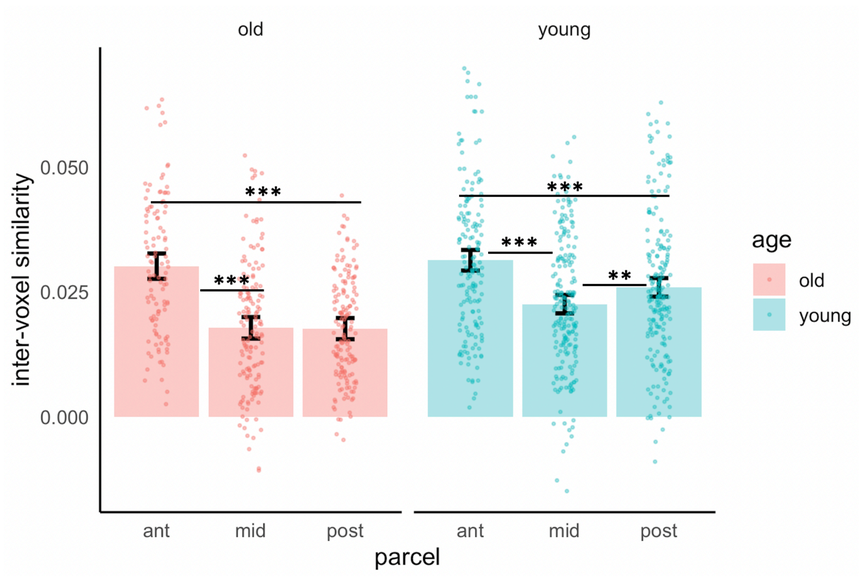


Fig. 2. Anterior, Mid, and Posterior Parcels in the Hippocampus

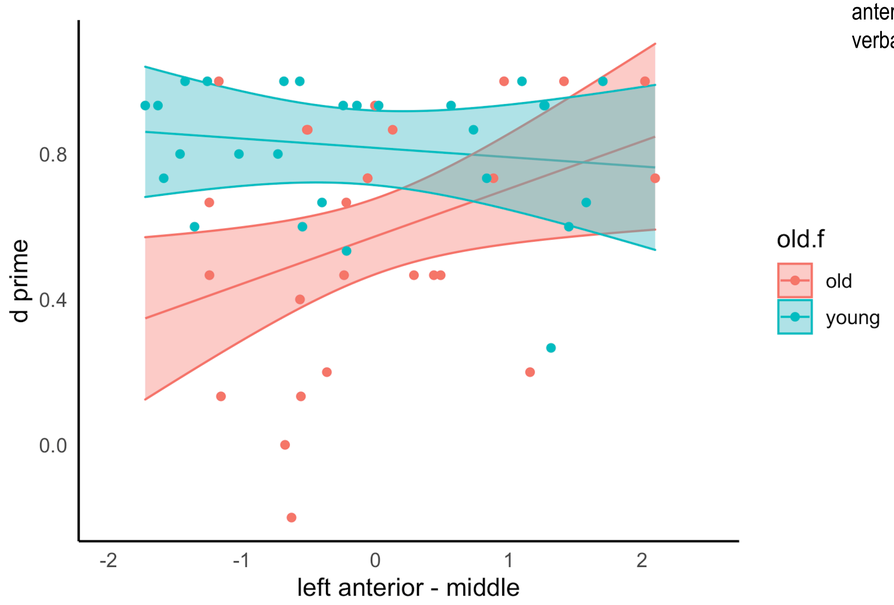


Fig. 3. How IVS difference between anterior and mid hippocampus affects verbal recognition in RAVLT test

Discussion and Conclusions

In Fig 2., we are comparing intervoxel similarity across anterior, middle, and posterior from young and old people. The results we found are different than what Stark et al. found. We attribute this to the fact that we split the hippocampus in three parcels, while in their model they split it up into six. In addition, studies in the past have often split the hippocampus by anterior-mid and mid-post. We found a substantial difference between middle and posterior segments that we wanted to investigate.

We then ran models - comparing IVS to different RALVT measures (immediate learning, delay recall, and verbal recognition. None of the models we ran were predictive of behavior except when using the measure of verbal recognition. We were surprised by the results because the studies mentioned talked about the IVS difference between the anterior and posterior hippocampus, but when looking at the gradient the middle parcel has often been left unconsidered. This leads us to the conclusion that the difference between the anterior and middle sections should be studied more in depth.

In Fig 3., while the IVS difference between anterior and mid hippocampus did not have an affect in younger adults, in older adults, with a more global anterior and more granular posterior had an increased rate of corrected recognition. When the gradient in the hippocampus does reverse (to a pattern seen in young children, Callaghan et al. (2021)), the older adults performed worse on the cognitive test. This leads us to believe that when a older adults brain maintains the gradient of a younger adult's brain instead of reversing, verbal memory remains more in tact.

References

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