

Opportunities for defining brain structural changes in the oldest old

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There are a lot of ways to look at brain structure with MRI

- Standing up
- Sitting down
- Head to the side
- Glasses on the face
- Glasses on top of the head



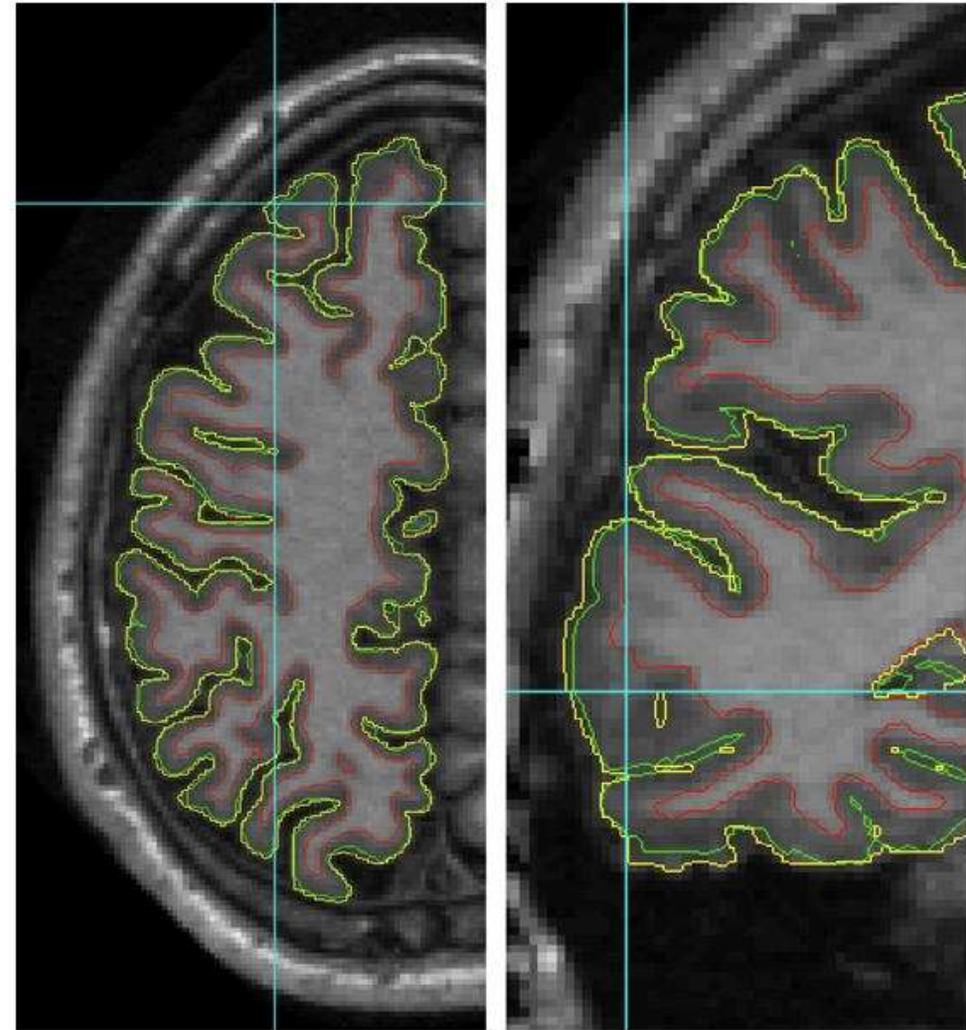
Cortical Thickness



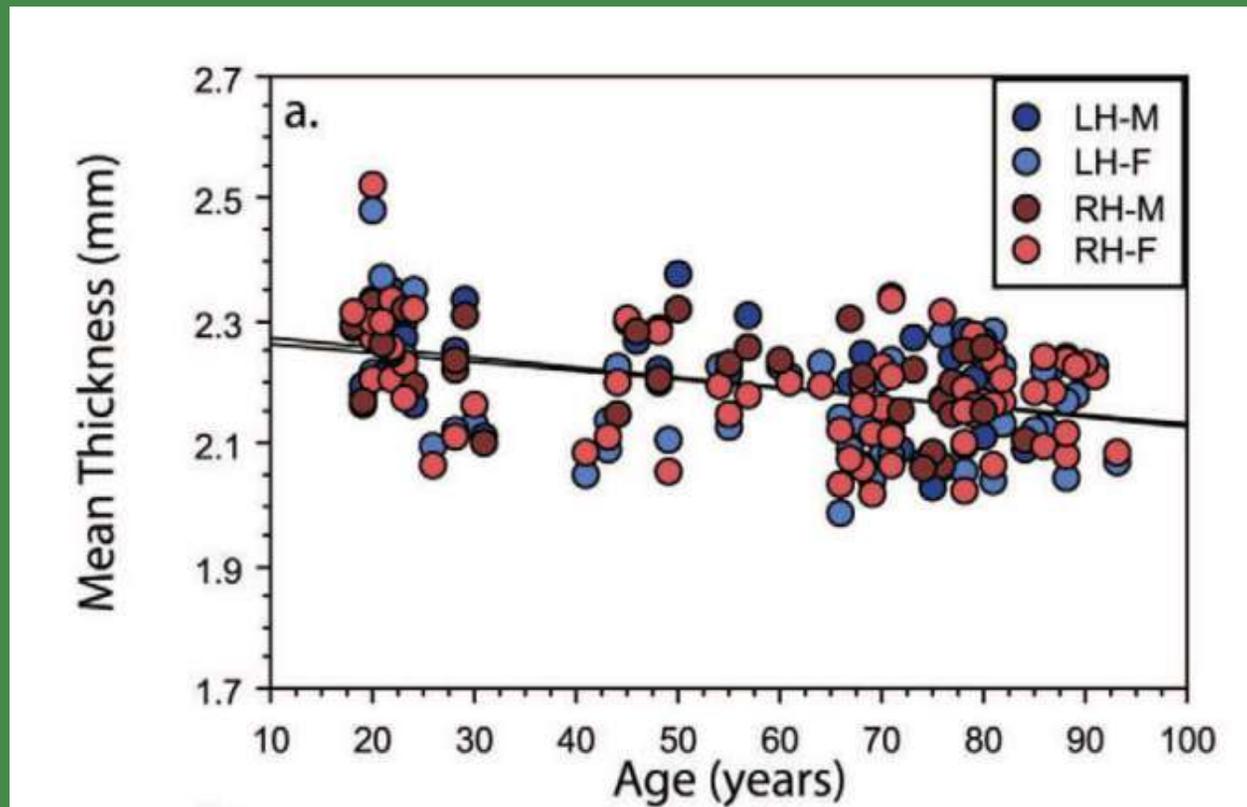
- Cortical thickness
- ~ 2 mm thick
- Variable thickness

Methods

- High-resolution anatomical scan
 - T1-weighted
- Freesurfer
 - Pial surface
 - white matter boundary

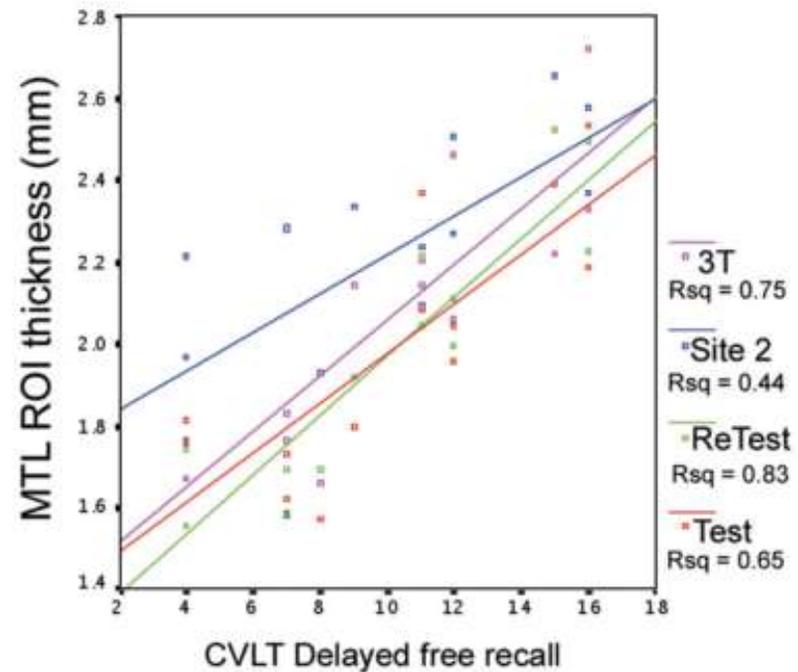
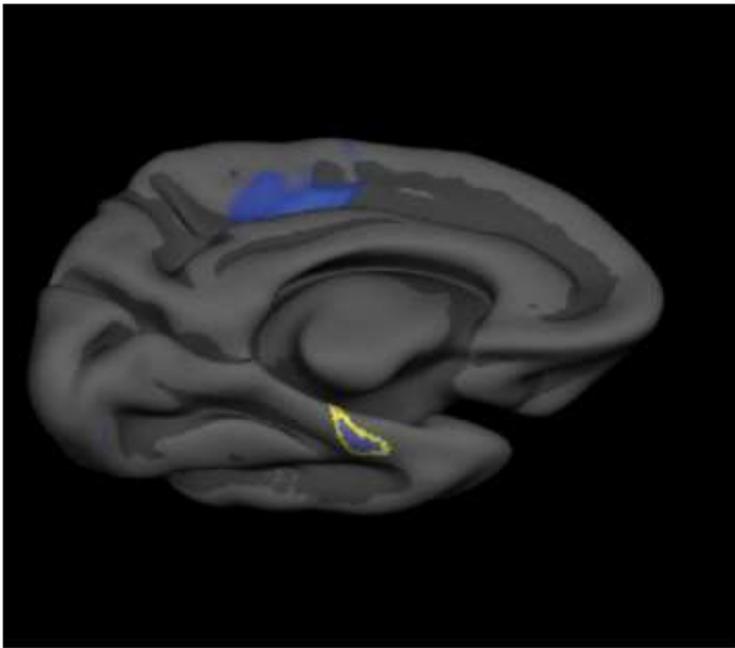


Cortical thinning occurs with aging



Salat et al, 2004, Cerebral Cortex

Thickness of cortex can relate to behavior

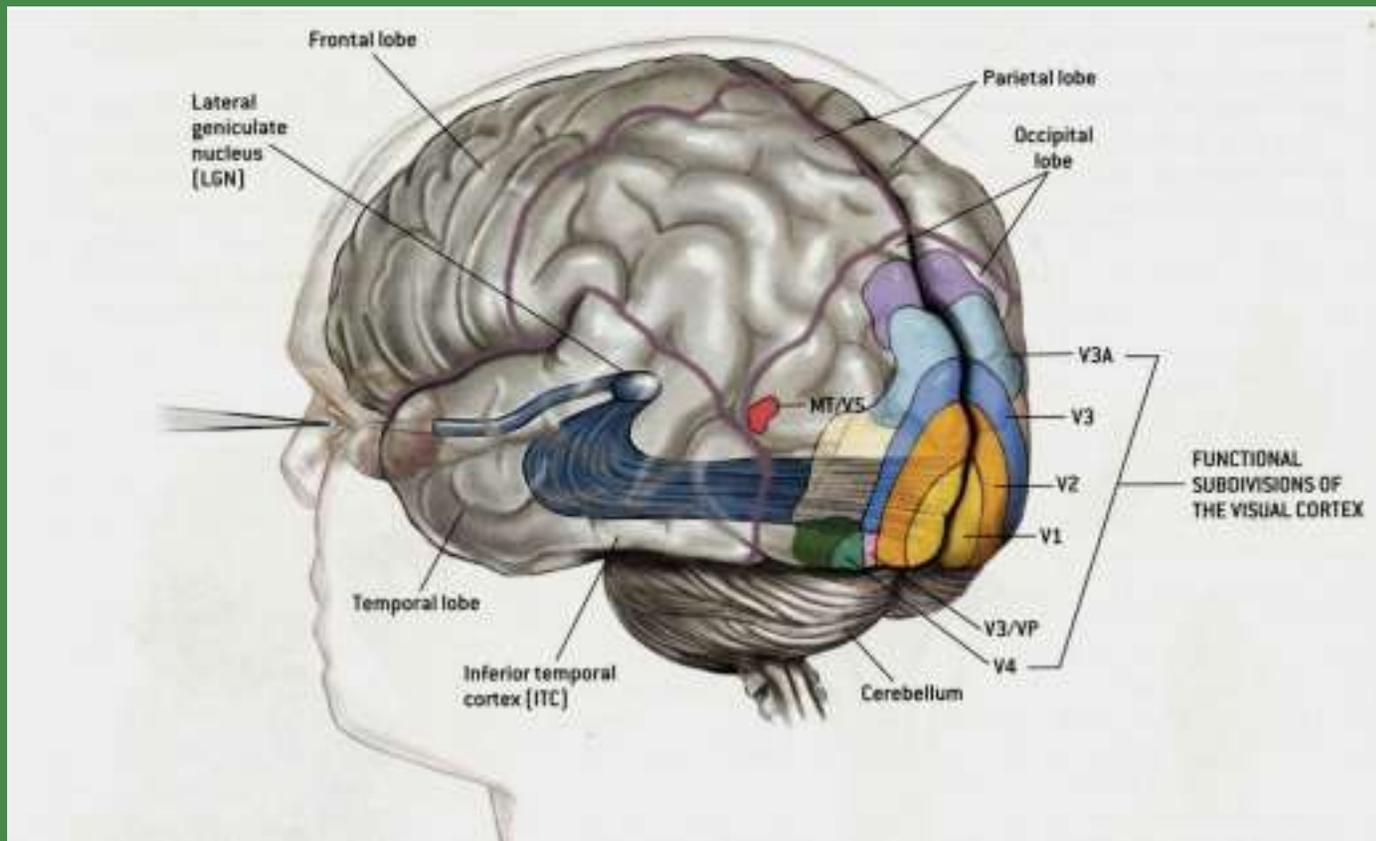


Cortical thickness in Medial Temporal Lobe relates to Memory performance.

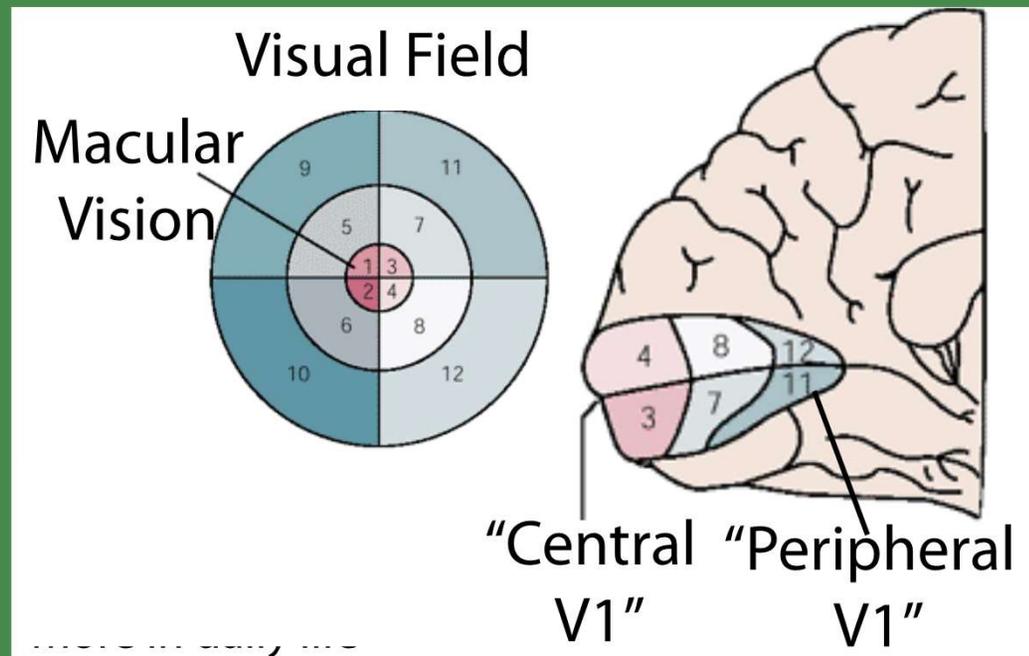
e.g., Dickerson et al., 2008, Neuroimage:

- Cortical thickness
- Example: cortical thickness in the visual cortex
 - Relationship to function
 - Relationship to aging
 - Plasticity of cortical thickness in adulthood

Early Visual processing areas



Central vision is processed in different part of V1 than peripheral vision



Central vision is different than peripheral vision

- Central vision has higher acuity than peripheral vision.

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- Central vision has higher acuity than peripheral vision.
- Central vision is attended more often than peripheral vision

Central vision is different than peripheral vision

- Central vision has higher acuity than peripheral vision.
- Central vision is attended more often than peripheral vision
 - Typically when you pay attention to an object you direct central vision there
 - Use central vision for reading, manipulating tools, tasks requiring moment-to-moment control
 - Use peripheral vision for tasks requiring vigilance, e.g. detecting threats

Central vision is different than peripheral vision

- Central vision has higher acuity than peripheral vision.
- Central vision is attended more often than peripheral vision

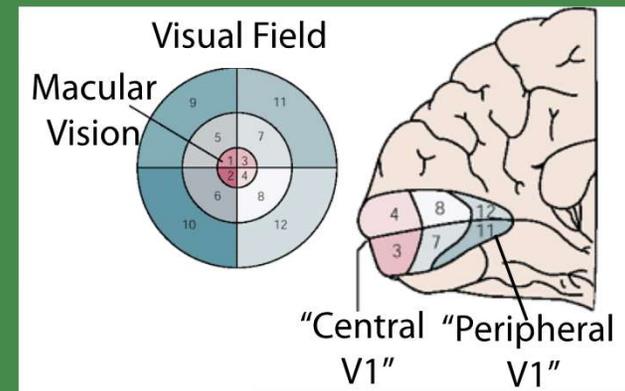
Central vision is different than peripheral vision

- Central vision has higher acuity than peripheral vision.
- Central vision is attended more often than peripheral vision
- Central vision distractors are more effectively ignored (e.g., Chen and Triesman, 2008)

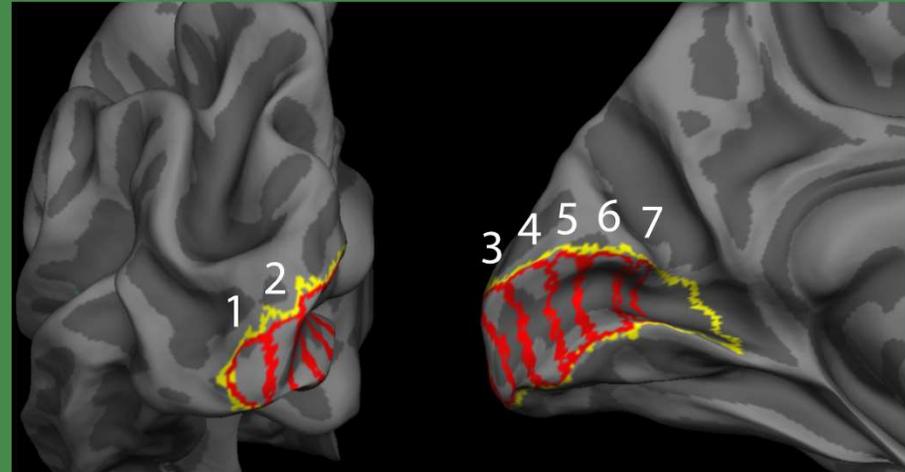
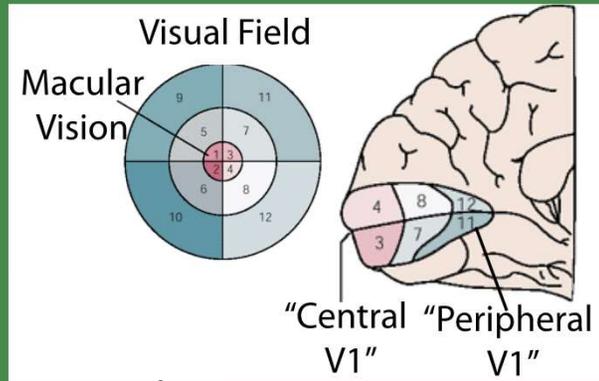
Central vision is different from
peripheral vision in cortex

Central vision is different from peripheral vision in cortex

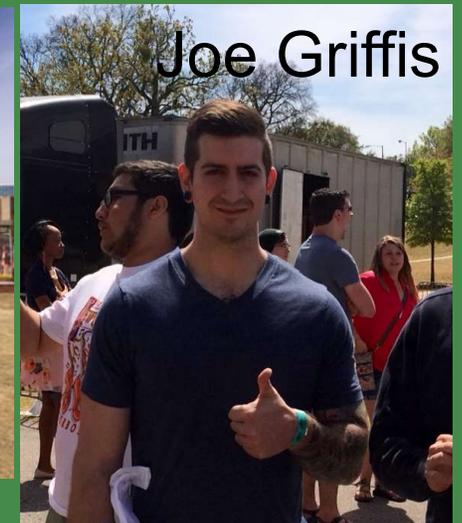
- Noninvasive methods like functional imaging can distinguish central from peripheral visual cortex
- How does the *structure* of peripheral cortex differ from central cortex?



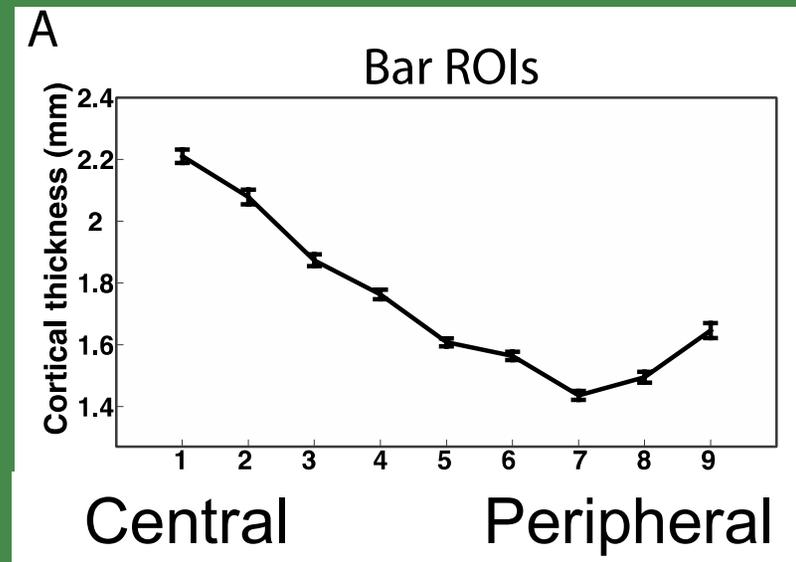
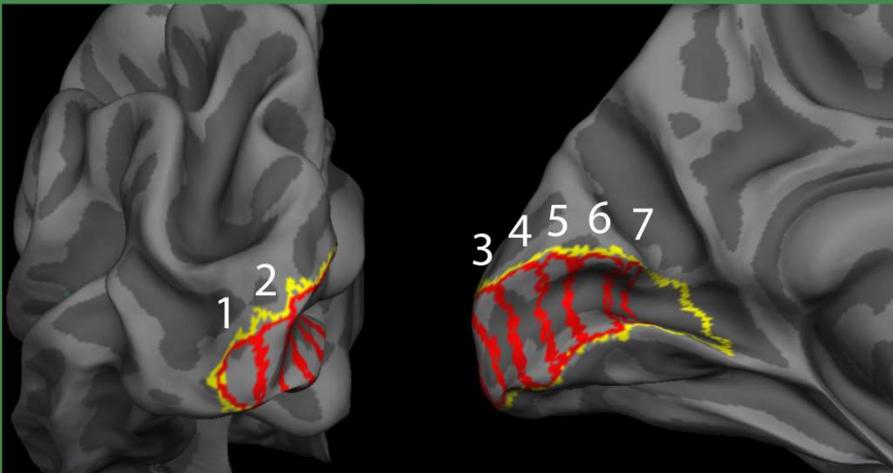
Segment V1 by eccentricity



Measure cortical thickness as a function of eccentricity



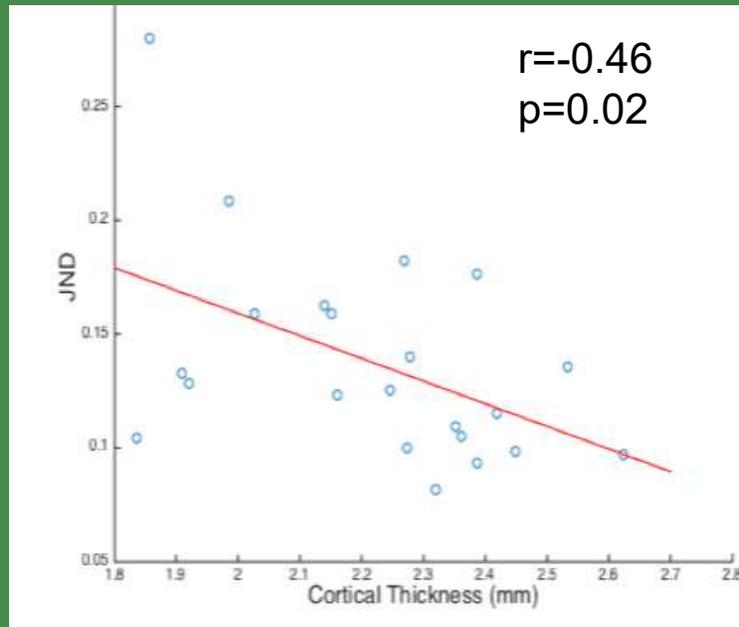
Central cortex is thicker than peripheral cortex



Younger adults

Cortical thickness in central V1 relates to behavioral performance

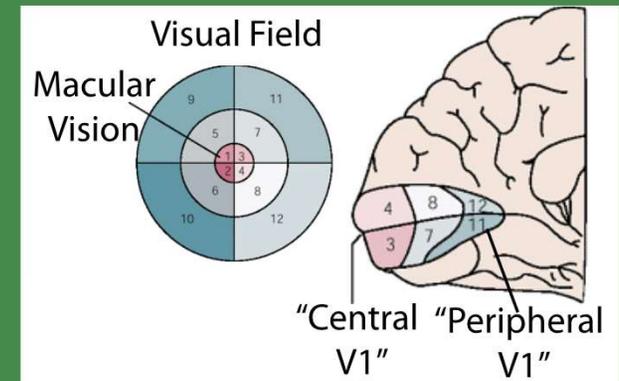
- Visual task
 - (Gabor discrimination for a central stimulus)



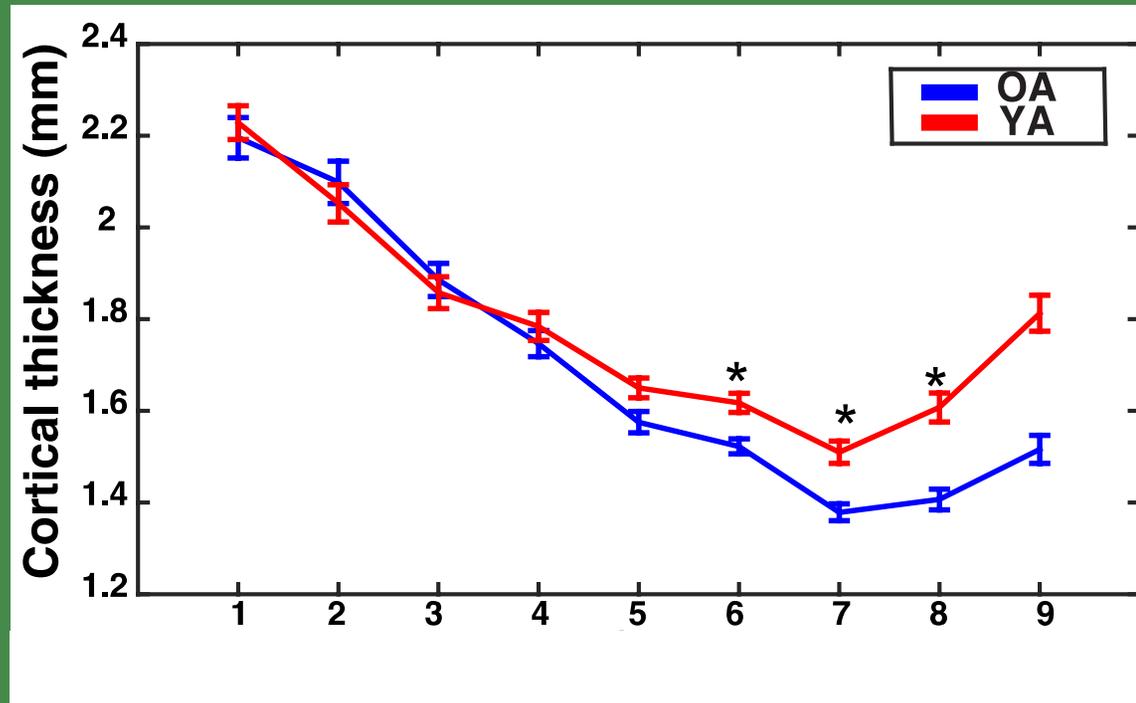
David Lee, Neuroscience Undergraduate program

What would this predict for Older vs. younger adults?

- Central vision is attended more often than peripheral vision throughout the lifespan
- Some studies show that functional use of peripheral vision declines with age
 - (e.g., Drance et al., 1967; Haas et al., 1986; Ball et al., 1990)



Age-related thinning selective to Peripheral V1



Suggests that thinner cortex relates to decreased functional use of peripheral vision.

Are such age-related changes permanent? Or can they be affected by experience?

Age-related macular degeneration



Effects of visual deprivation

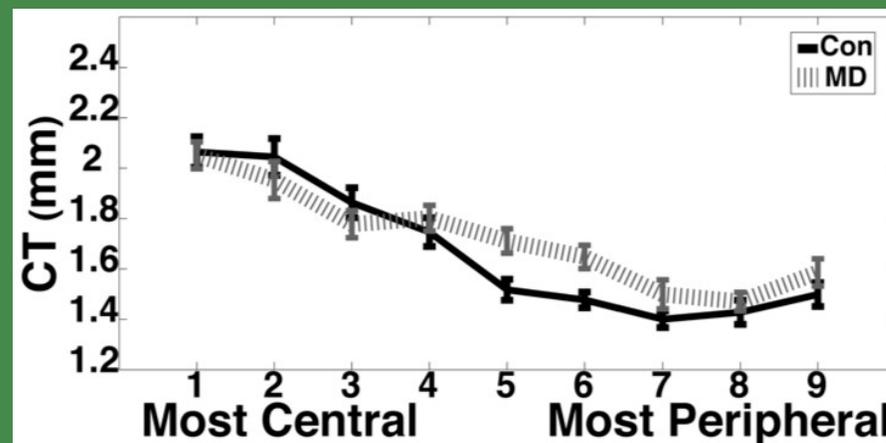


- In healthy vision
 - Central vision is attended more often than peripheral vision
 - Use central vision for reading, manipulating tools, tasks requiring moment-to-moment control



- After Macular Degeneration
 - Central vision is attended **less** often than peripheral vision
 - Use **peripheral** vision for reading, manipulating tools, tasks requiring moment-to-moment control

Patients with macular degeneration have thicker cortex devoted to processing peripheral inputs



Suggests that experience relying on peripheral vision *as an adult* leads to thicker primary visual cortex.

Summary

- Using vision as a model for defining and characterizing brain structure:
- Cortical thickness relates to behavior:
 - In healthy young people, central visual representations are thicker than peripheral representations, consistent with respective functions.
- Selective cortical thinning with aging:
 - Selective thinning of peripheral visual cortex, consistent with age-related functional loss in peripheral vision
- Adult cortical plasticity:
 - Peripheral representations are thicker following long-term central vision loss, and increased use of peripheral vision.

Future Directions

McKnight Neuroimaging Core & Brain Aging Registry

- Enrolling oldest old (85+) cohort of 200 participants
- Within this oldest old cohort, how does cortical thickness relate to behavior?
 - We already know cortical thickness declines with age overall, but which aspects relate to which functions?
- Relate to different modalities of data
 - Does perfusion moderate these effects?
 - Do connection patterns moderate the effects?
 - Relate cortical thickness data to genetic and epigenetic data from this sample.

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