U13 Bedside-to-Bench Conference Series
Sensory Impairment and Cognitive Decline

Supported by National Institute on Aging and American Geriatrics Society
Additional support provided by American Academy of Audiology Foundation, Cochlear, EyeSight Foundation of Alabama, Lighthouse Guild, National Eye Institute, MED-EL, Research to Prevent Blindness, and The Retirement Research Foundation

October 2 – 3, 2017
Bethesda North Marriott Hotel and Conference Center
White Oak A & B

Animal models of hearing loss and brain changes

Gregg H. Recanzone
Department of Neurobiology, Physiology, & Behavior
and Center for Neuroscience
University of California at Davis
Davis, CA

ghrecanzone@ucdavis.edu

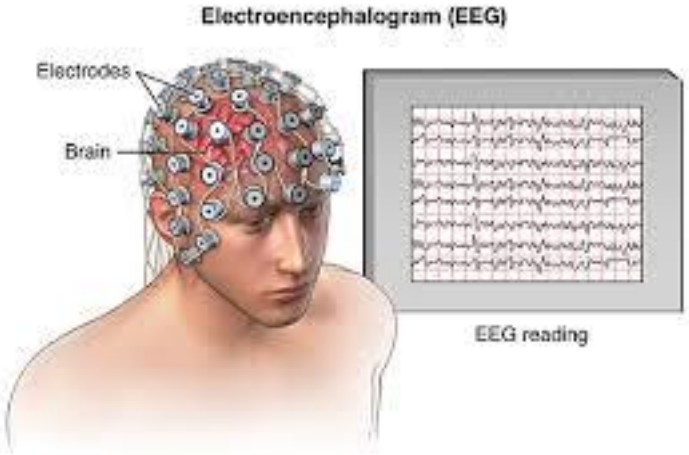
Disclosure:

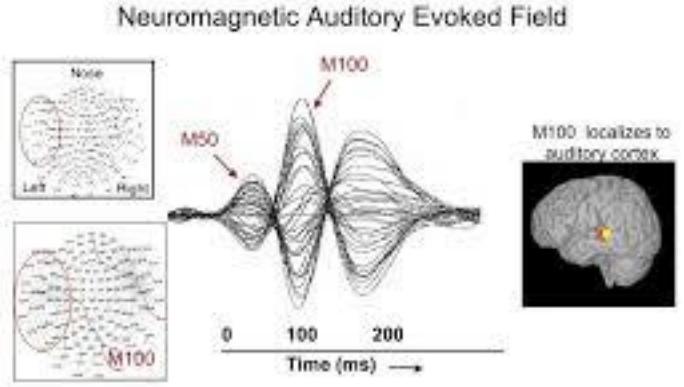
Current funding: R21AG024372

R01DC015232

Other financial relationships: None

Conflicts of Interest: None



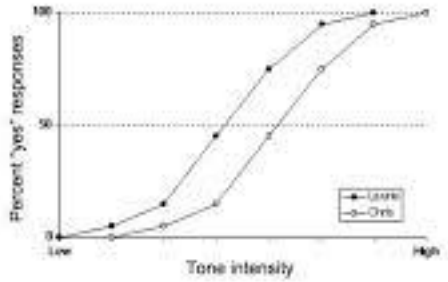


A prototype auditory evoked neuromagnetic field detected by MEG; 37 channels with y-scale representing evoked response magnitude in units of femtotesla (fT) are shown collapsed on the same horizontal time axis.

A. Auditory task response relative to rest

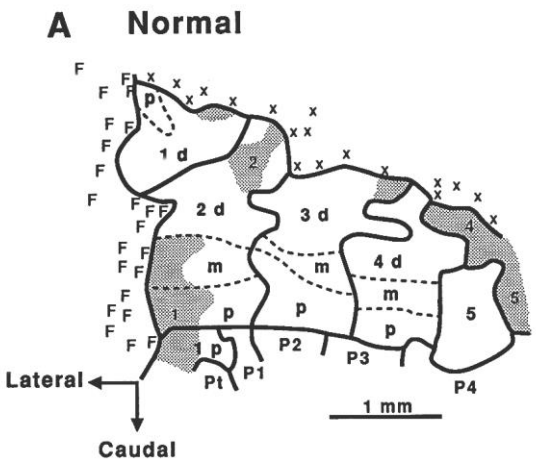
B. Visual task response relative to rest

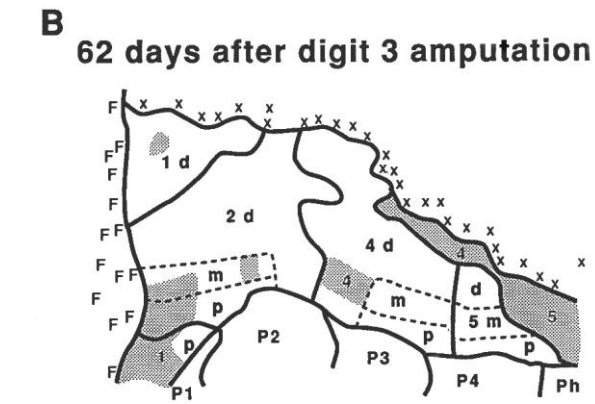
Yes/no method of constant stimuli



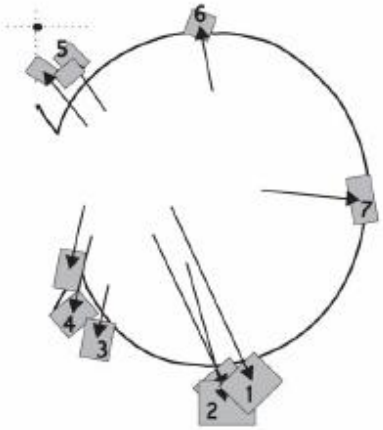
Do these data indicate that Laurie's threshold is lower than Chris's threshold?

Sensory Deprivation in Adults leads to Cortical Map Changes

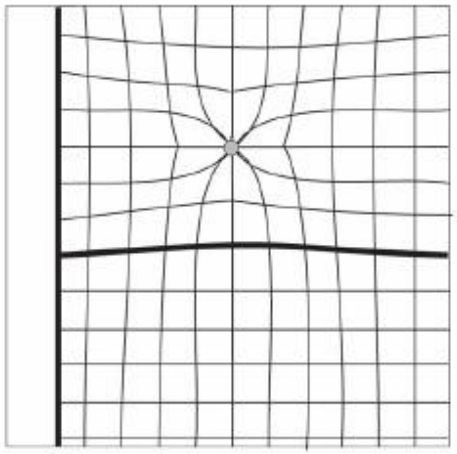




Merzenich et al. (1984) *J. Comp. Neurol.*224:591-605

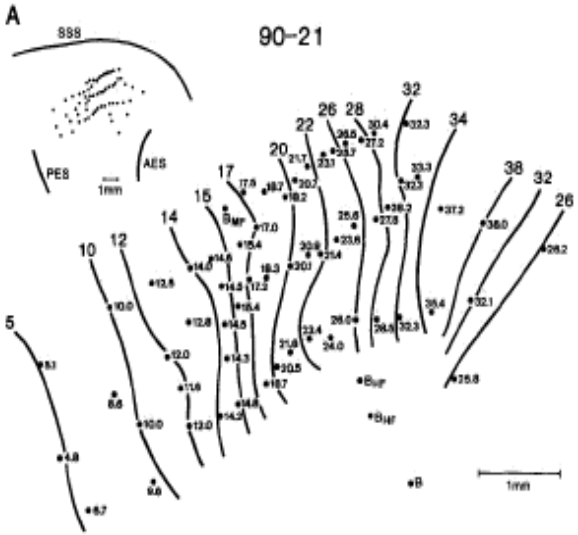


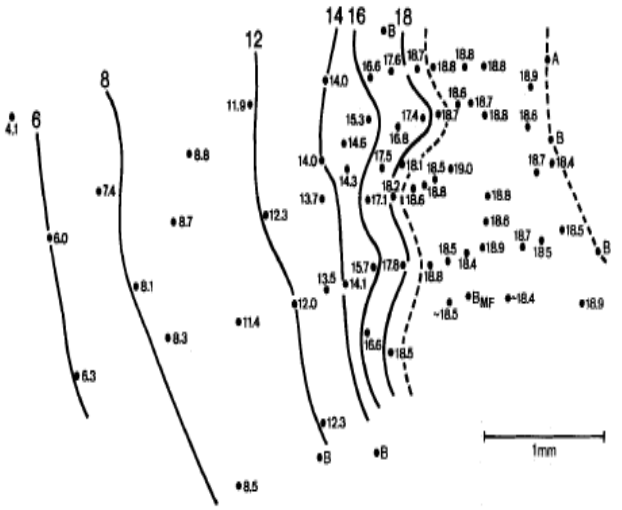
26 weeks post-lesion



Cortex -- 2 months

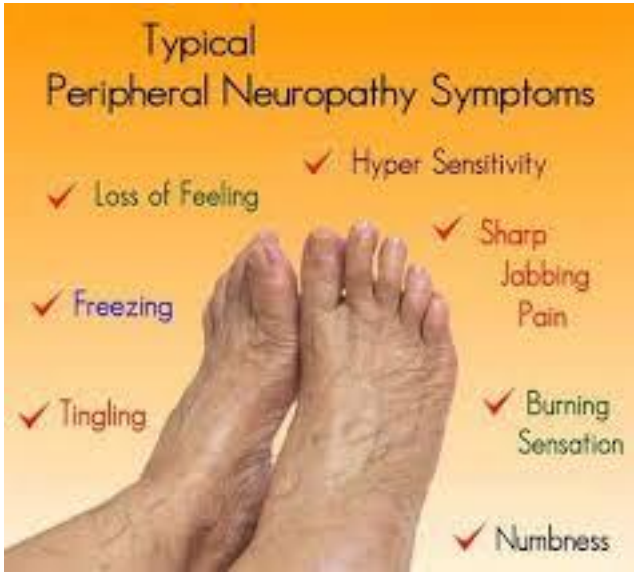
Gilbert and Li (2012) *Neuron* 75:250-264

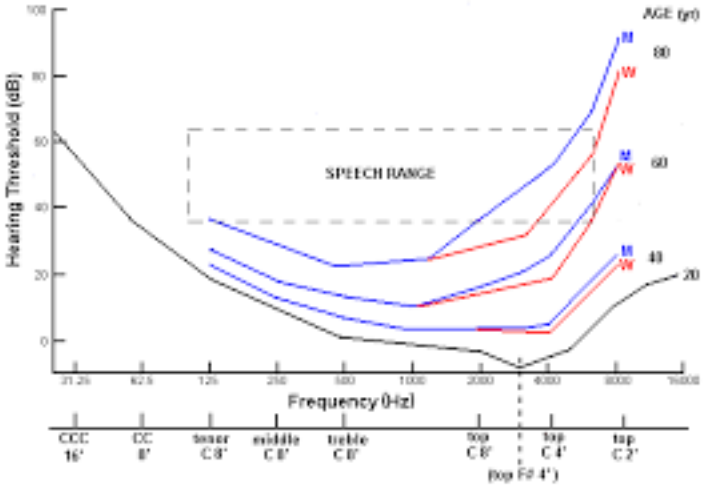




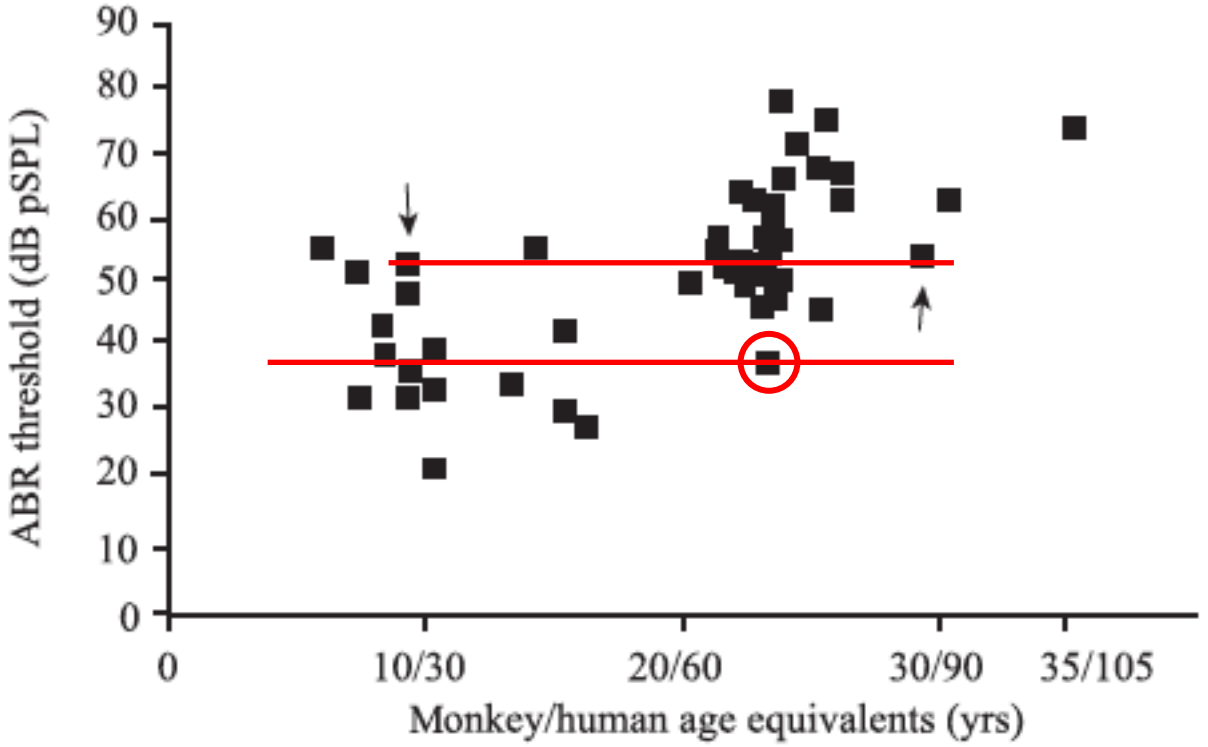
Rajan et al. (1993) *J Comp Neurol* 338:17-49

Normal aging often leads to sensory deficits from the periphery





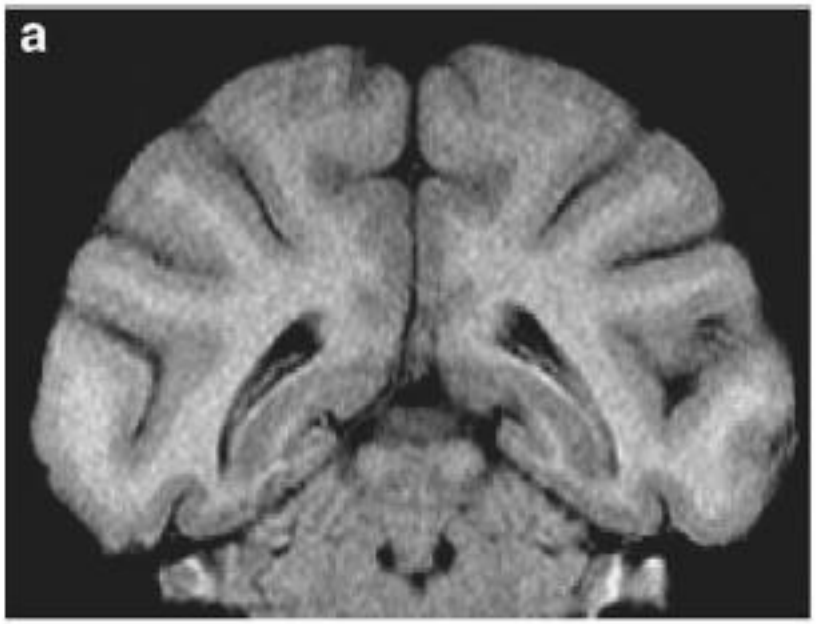
Normal aging often leads to sensory deficits from the periphery
BUT NOT ALWAYS!



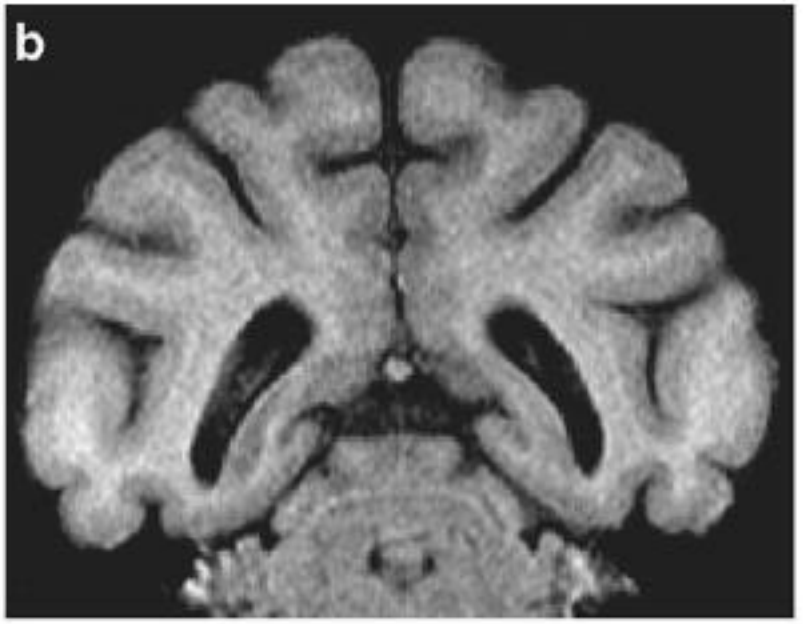
Gray and Recanzone (2017) *Evolution of Nervous Systems* J.H. Kaas (Ed.)

Normal aging does lead to changes in the central nervous system even in the absence of peripheral deficits

6 year old (~18 human)

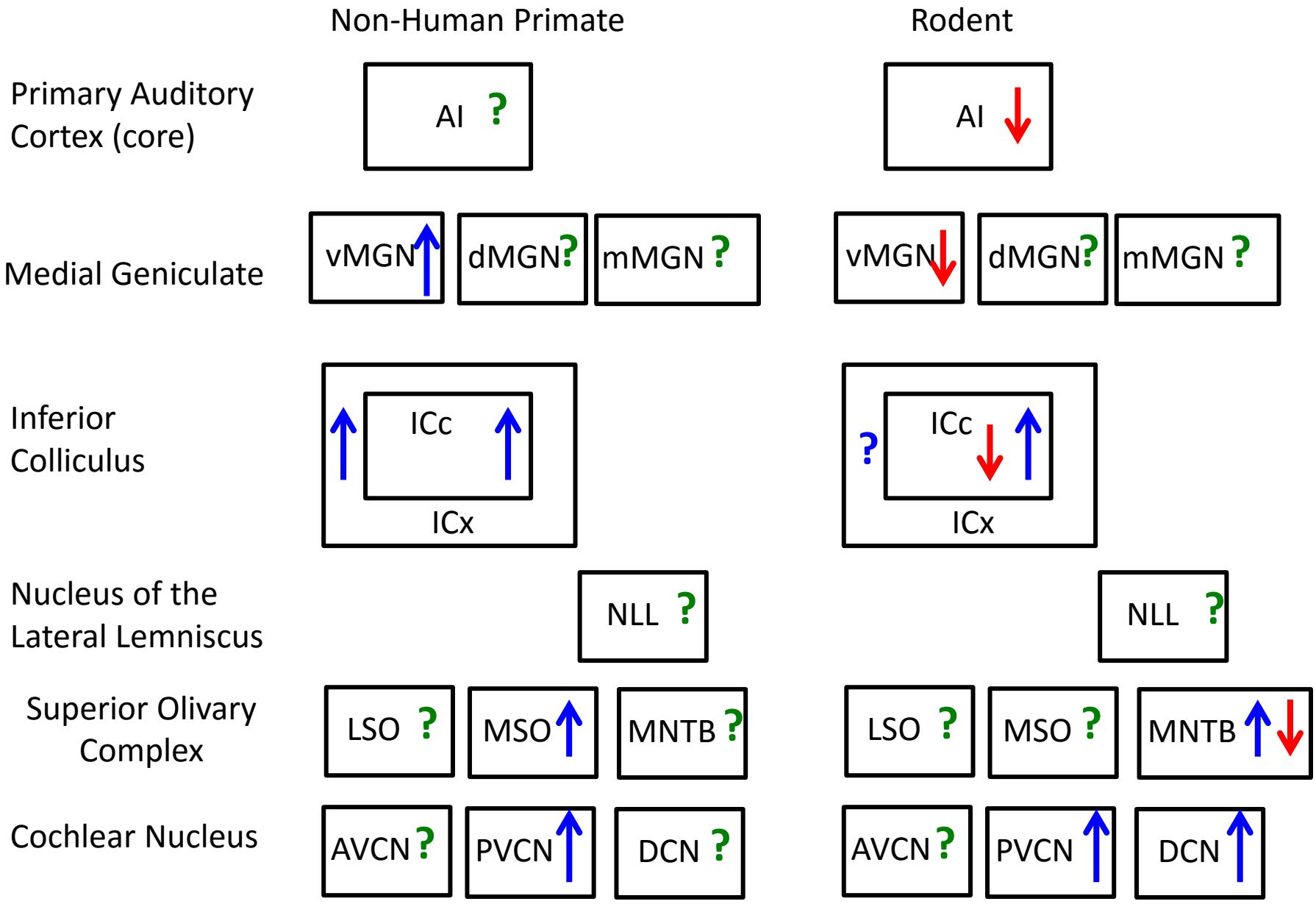


24 year old (~72 human)



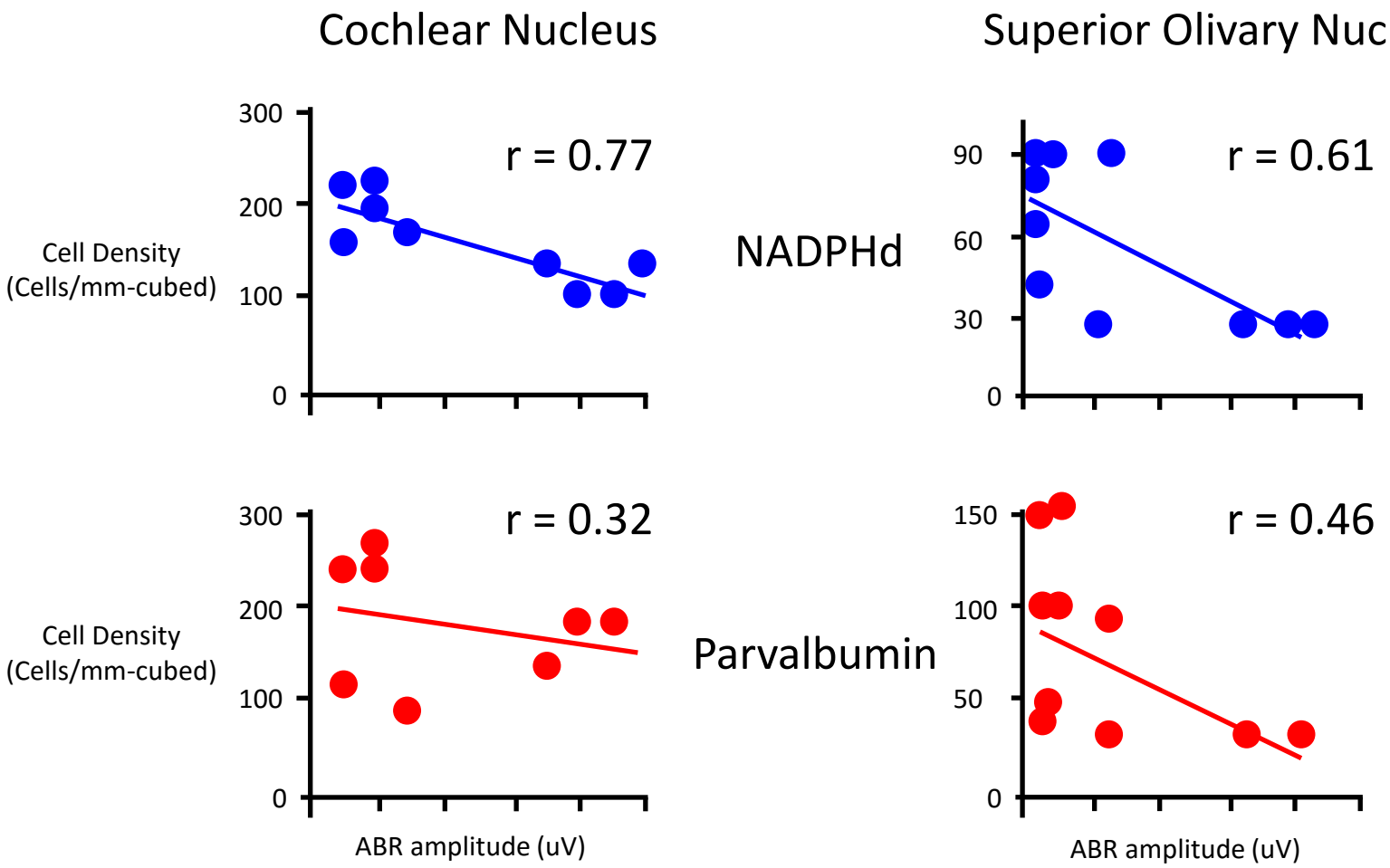
Kohama et al. 2012. *Age (Dordr)*. 34(5): 1093–1110.

Neurochemical changes occur throughout the ascending auditory system with age



Adapted from Gray and Recanzone (2017) *Evolution of Nervous Systems* J.H. Kaas (Ed.)

Neurochemical changes are not always tightly correlated with ABR thresholds



Adapted from Gray et al. (2014) *J Comp Neurol* 522:1527-1541.

Adapted from Gray et al. (2014) *J Comp Neurol* 522:573-591.

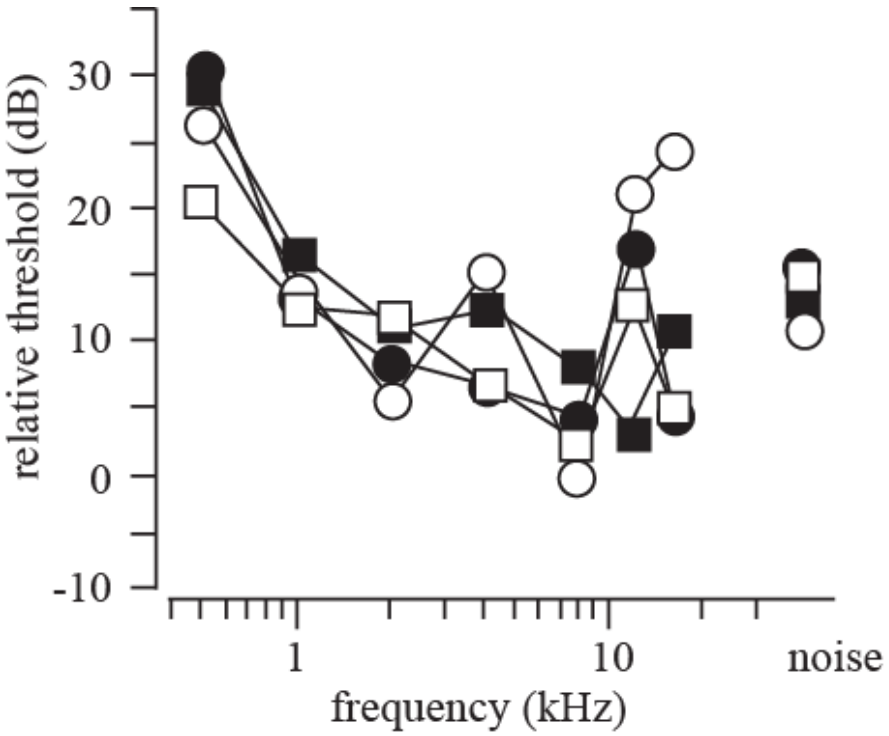
There are varying degrees of sensory loss between individuals with aging

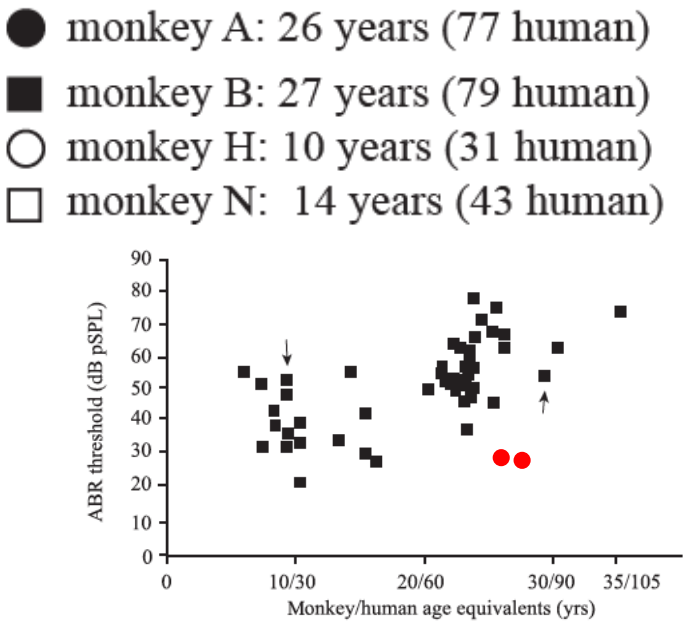
The aging brain shows both morphological and neurochemical changes at least partially independently of sensory loss

Both sensory loss and aging need to be taken into account when studying central changes

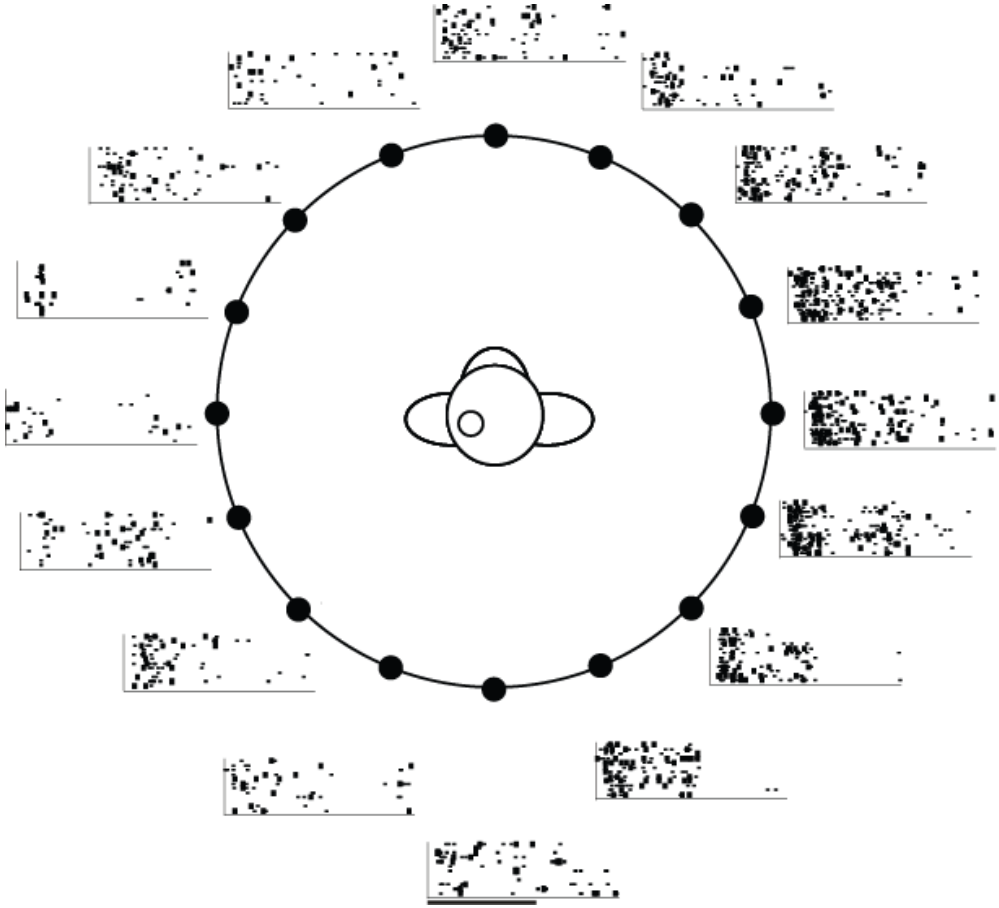
How much does the brain change just with aging?

Comparisons Between Young and Geriatric Monkeys

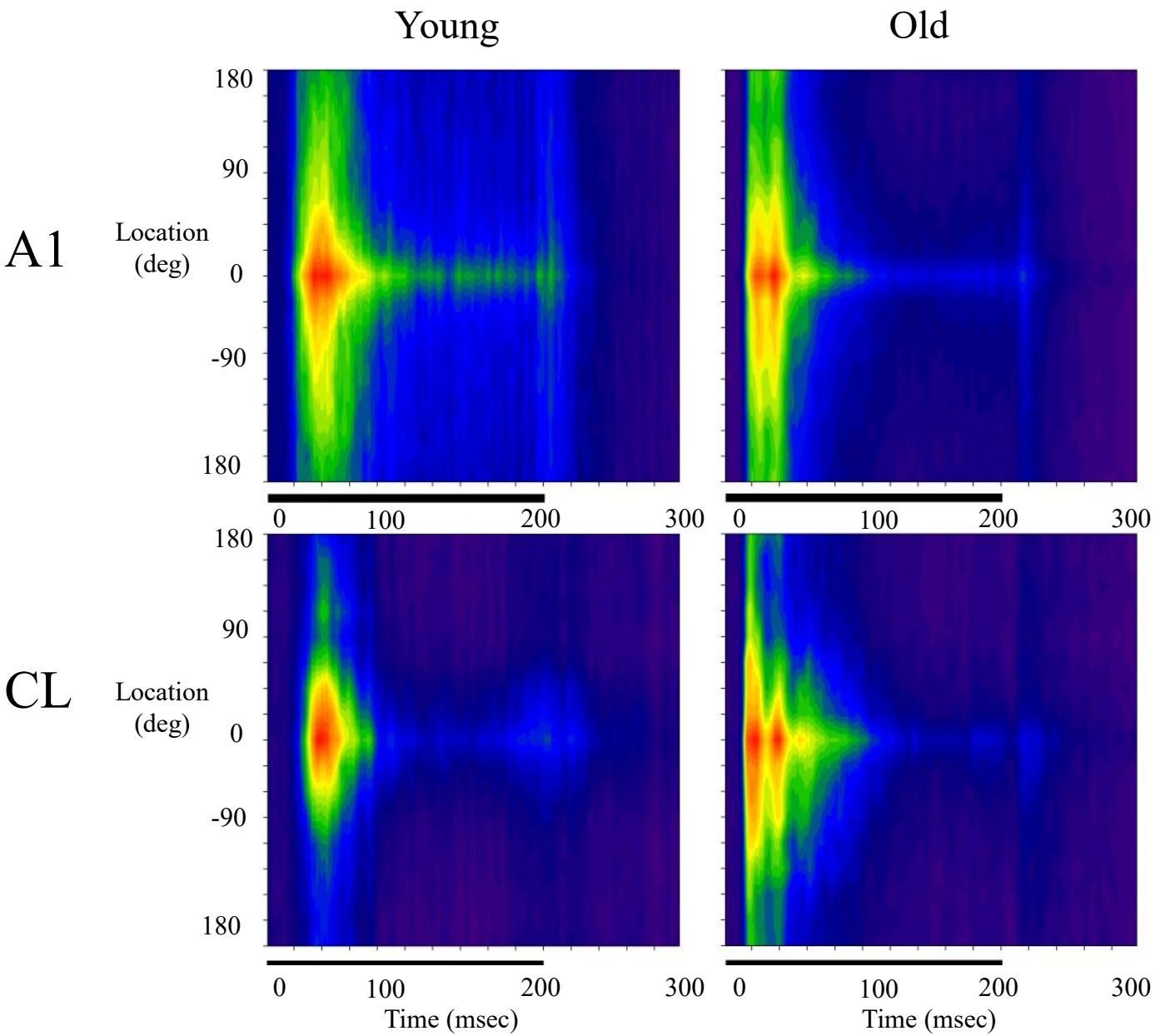




Salinas-Juarez et al. (2010) *J Neurosci* 30:14795-14804

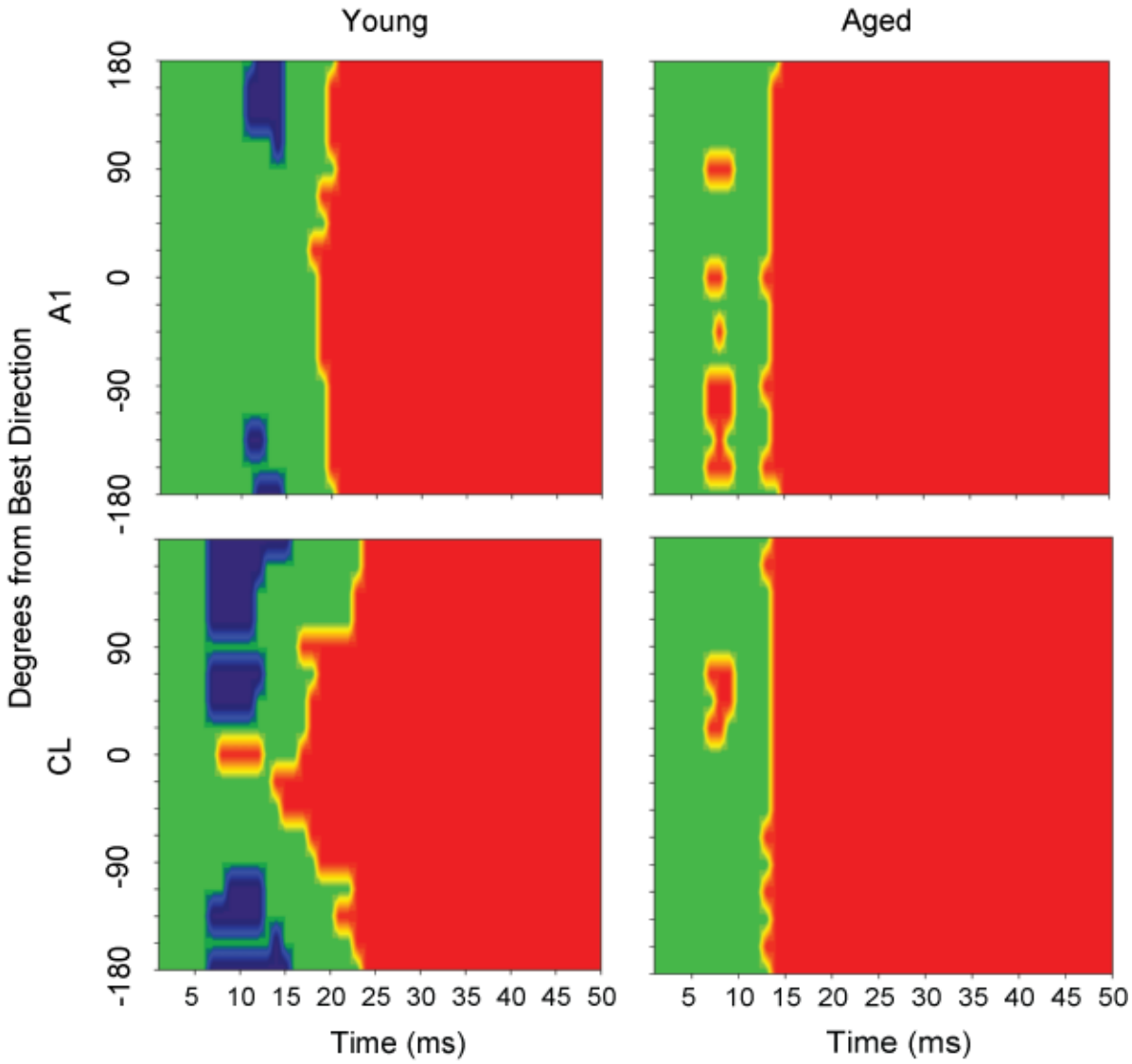


Spatial tuning of the population of neurons



Engle and Recanzone (2013) *Front Aging Neurosci* doi: 10.3389

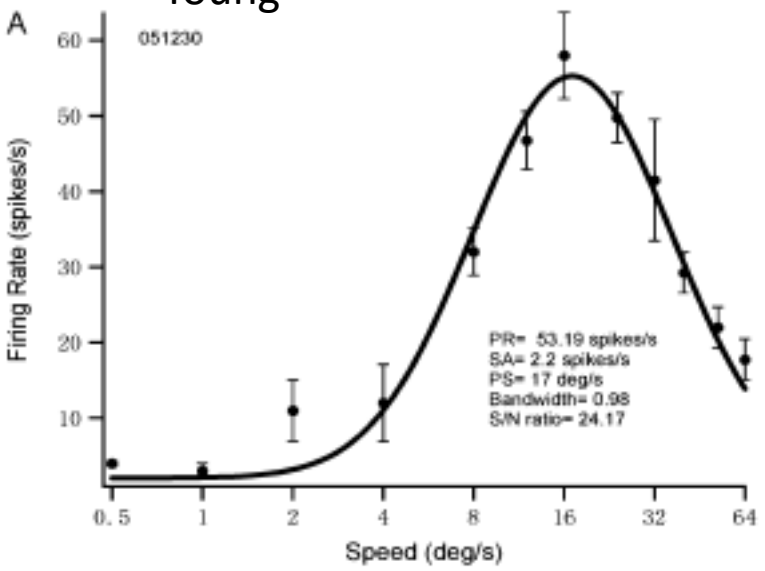
There is also less spatial inhibition in aged vs. young cortical neurons



Engle and Recanzone (2013) *Front Aging Neurosci* doi: 10.3389

Speed tuning in MT is broader in aged monkeys

Young



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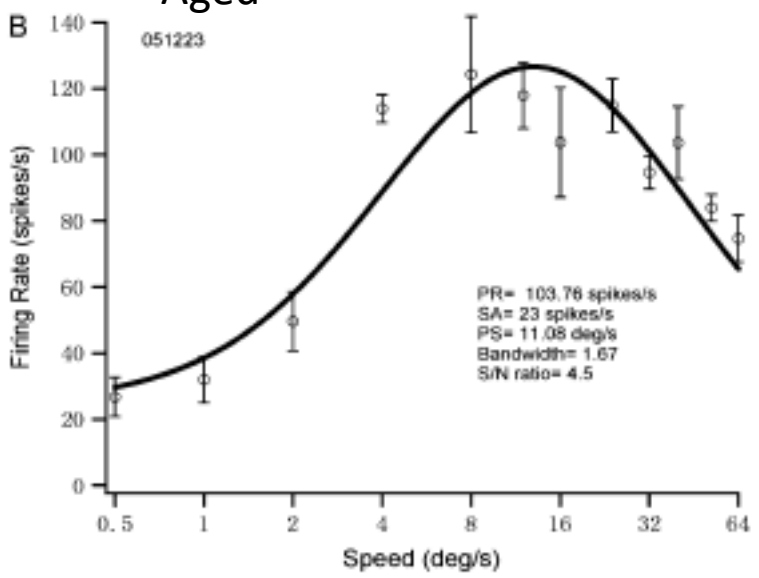
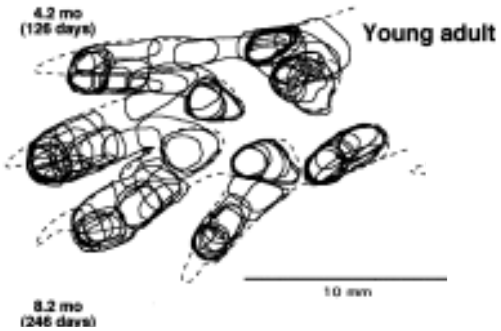


Yang et al (2009) *Cereb Cortex* 19:1957-1967

Receptive fields in S1 are larger in aged rats

Young



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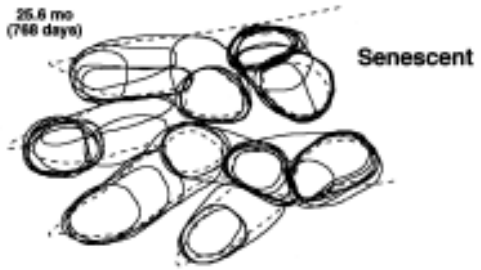

Coz and Xerri (2001) *Neuroscience* 104:705-715

Caveats: 1) why are neurons in some animals older than others?

2) Are the sensory/cognitive functions similar and/or subserved by the same neural machinery?

2 years old
mouse = 90+ years

3 years old
Rat = 90+ years

30ish years old
Monkey = 90+ years

Studying perception in aged animals or people needs to take into account that the brain is aging with or without sensory loss

Animal studies using invasive techniques is a compliment to non-invasive human techniques and vice versa. Both are necessary to understand the aging brain

Gaps:

1) How much is sensory loss and how much is aging?
2) How can we ameliorate one, the other, or (preferably) both?

Thanks To:

James Engle
Daniel Gray
Jackie Overton
Heather Turner
Dina Juarez-Salinas
Xochi Navarro

National Institute of Aging

National Institute of Deafness and Communication Disorders