Changes in the human brain with hearing loss

Anu Sharma, Ph.D.
University of Colorado, Boulder

Current funding:

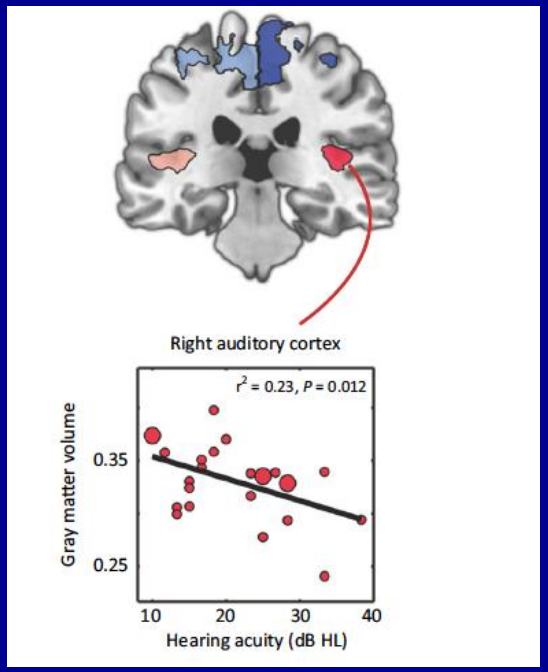
-National Institutes of Health
NIDCD U01DC013529 and
NIDCD R01DC016346

-Hearing Industry Research Consortium

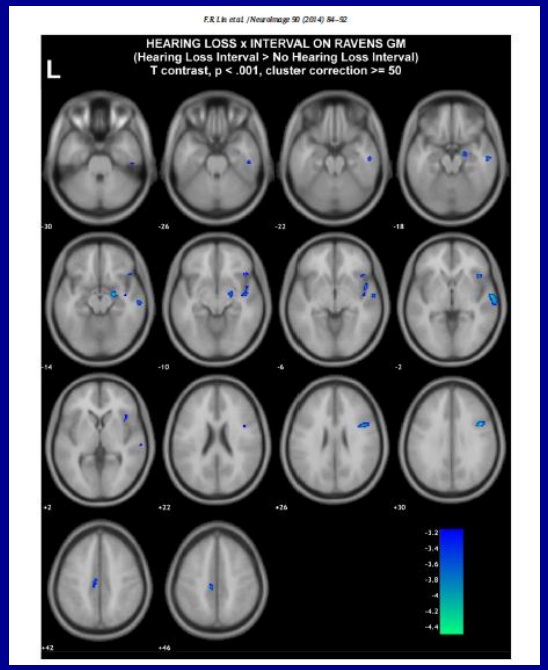
- Other financial relationships: None
- Conflicts of interest: None

Neuroplasticity of Age-Related Hearing Loss (AHRL)

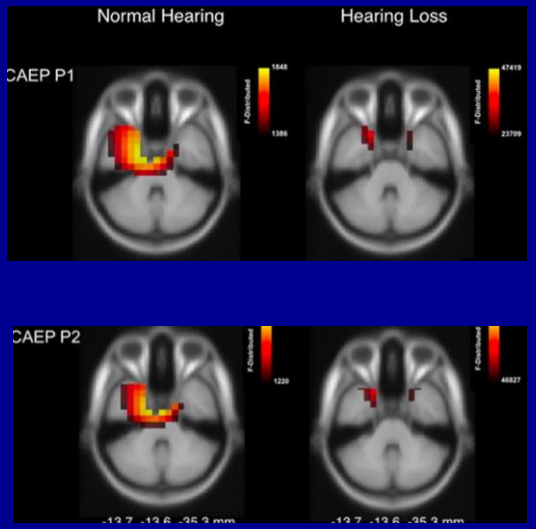
- Structural changes in auditory cortex



Peelle and Wingfield, TINS 2016



Lin et al., 2014

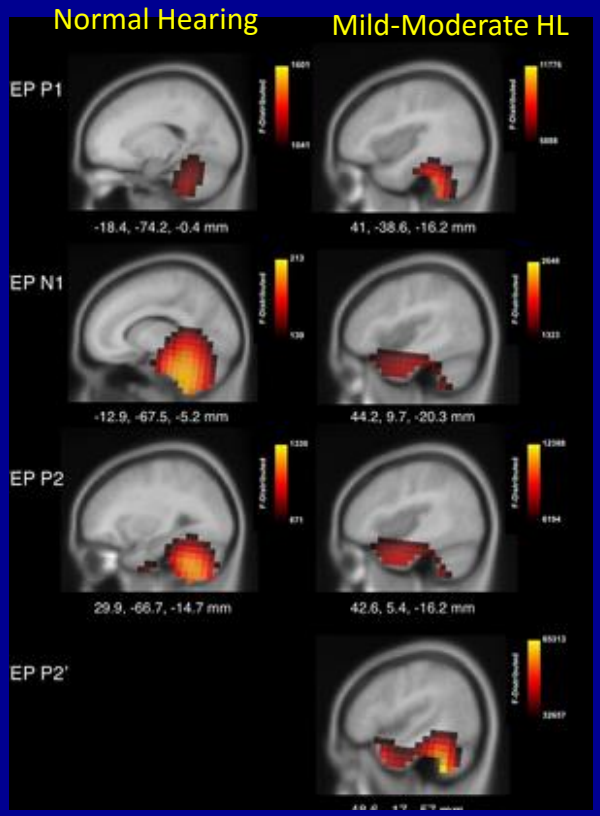


Campbell and Sharma, 2013

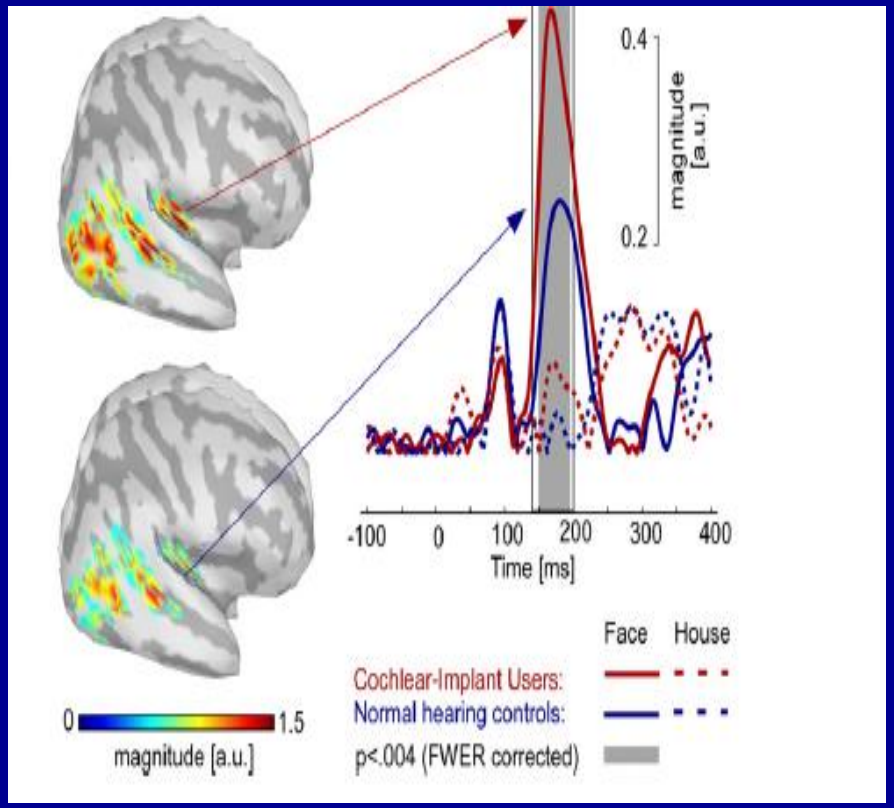
Gray matter volume decreases in right auditory cortex as a function of hearing loss.

Simulation of degraded listening.

Compensatory Cross-Modal Plasticity



Campbell and Sharma, 2014

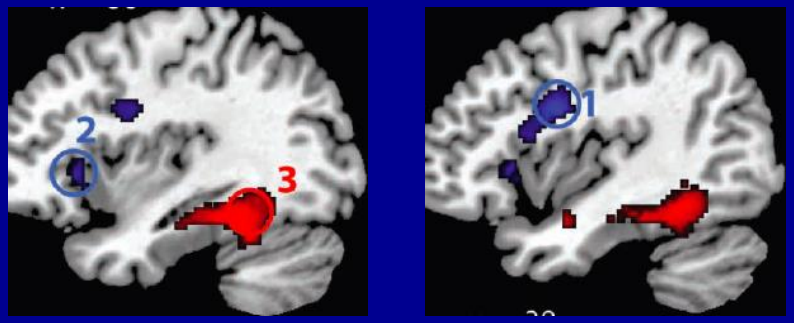


Stropahl et al., 2015; Stropahl and Debener, 2017

Listeners with hearing loss depend more on visual cues. Vision recruits and re-purposes auditory areas for visual processing.

Activation of additional networks to optimize perception of degraded input

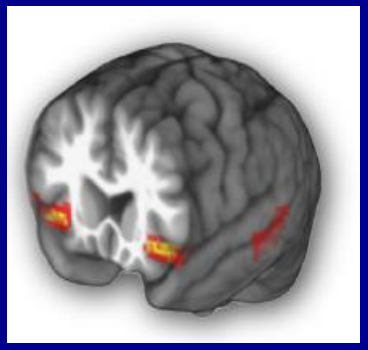
Noise-Vocoded Words



Effort network

Hervais-Adelman et al., 2012

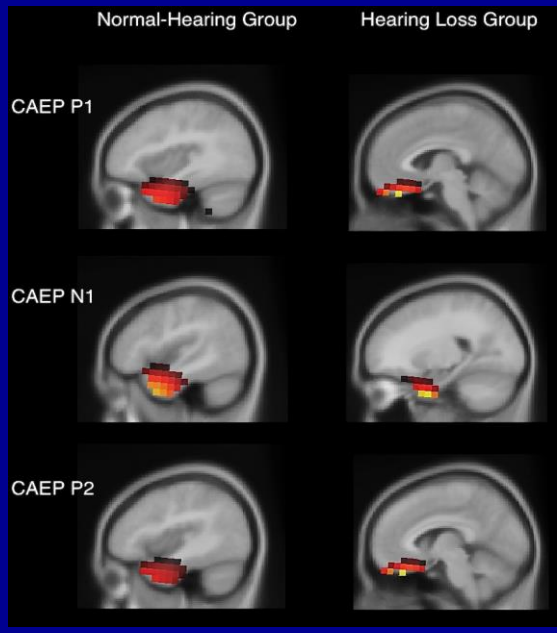
Words in Noise



Cingulo-opercular network

Vaden et al., 2013; 2017

Passive Listening



Compensatory frontal areas are active during everyday listening.

Campbell and Sharma, 2013

Knowledge Gaps and Research Opportunities

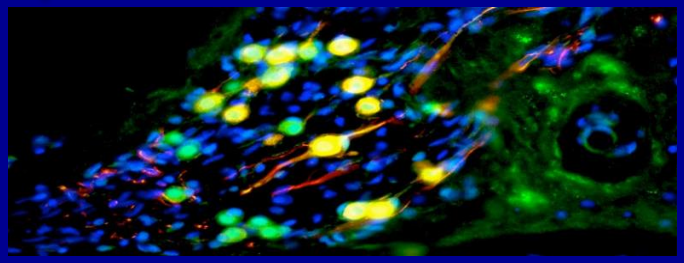
- Causality between structural /functional changes and cognitive decline needs to be established.
- Better understand common etiological causes like inflammation, genetics, cardiovascular.
- Other compensatory mechanisms like the efferent system which may modulate the bottom up signal.
- Hearing loss needs to be better defined and assessed.
  - Getting beyond the audiogram
  - 'Hidden' hearing loss

- Can cortical re-organization be reversed by appropriately fitted hearing aids and cochlear implants and does this lead to improvements in cognition?

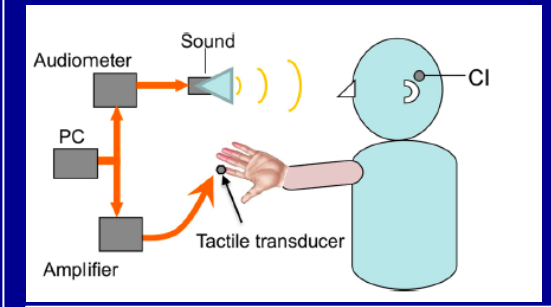
  - -*Earlier intervention* with hearing aids and cochlear implants.
  - Need clinical neurophysiologic markers of when to intervene (EEG, fNIRS, pupilometry)

- When intelligibility is poor—how can we use re-organization to achieve better real world outcomes?

Training paradigms which take advantage of better auditory-visual integration? Or training working memory or executive function so cognitive spare capacity can be distributed more efficiently?



Enhancing neuroplasticity in combination with intervention using pharmacology or stem cells?



Tactile Aid was applied to the index finger which converted fundamental frequency to vibrations. *Huang et al., 2017*