

Aging and Clinical Electrophysiology



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Acknowledge and Thank

ARC Planning Committee

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Aging

Older adults, with and without peripheral hearing loss, frequently complain...

"I can hear you but I can't understand you."



Hearing Impairment



Memory?

Attention?

Depression?

Confusion?

Hair cell damage?

GABA?

Stria ?

Genetics?



Hair cell damage?

GABA?

Stria ?

Genetics?



Memory?

Attention?

Depression?

Confusion?

Hearing Impairment

Frequently hypothesized

- Impaired perception results from age-related factors affecting neural synchrony.

(Frisina & Frisina, 1997; Schneider & Pichora-Fuller, 2001; Tremblay et al. 2003; Ison, Tremblay, Allen 2009)



Behavioral Detection Studies

- Gap detection
- Duration Discrimination
- Rate
- Interaural timing codes
- Voice onset time (VOT)

*Caveats that come with testing older adults using behavioral tests.

Hair cell damage?

GABA?

Stria ?

Genetics?



Memory?

Attention?

Depression?

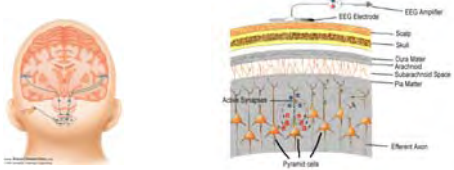
Confusion?

Physiological Detection Studies

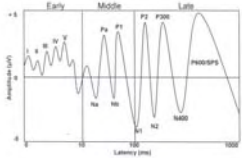

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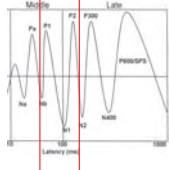
Tools: MEG and EEG



EEG


MEG



Physiological Detection Studies

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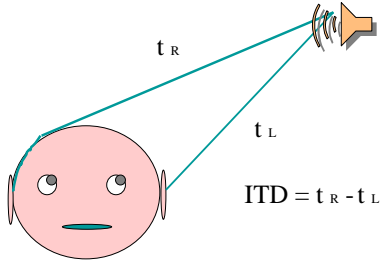
Binaural Hearing



Important for: Signal to noise ratio
Speech perception in noise
Sound localization

Ross, Tremblay, Picton (2007) Journal of Neuroscience

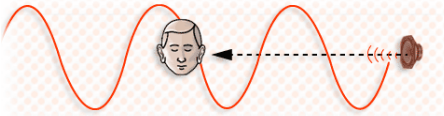
Interaural time-difference - ITD



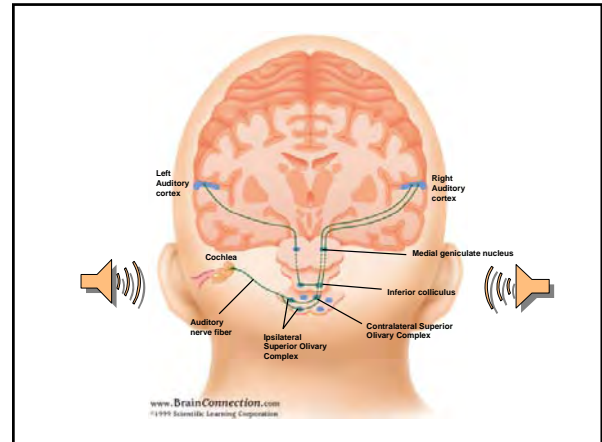
$ITD = t_R - t_L$

www.biol.susx.ac.uk/home/Chris_Darwin/Perception/Lectures/3.ppt

Interaural *phase-difference* - IPD



www.biols.susx.ac.uk/home/Chris_Darwin/Perception/Lectures/3.ppt



Purpose

- 1) To determine if the physiological detection of *interaural phase changes* could be measured in humans.
- 2) To determine if *aging affects* the physiological detection of interaural phase changes.

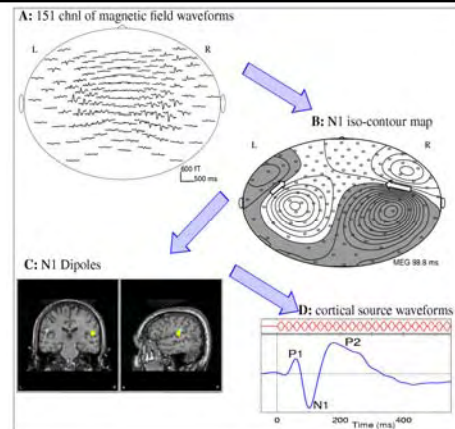
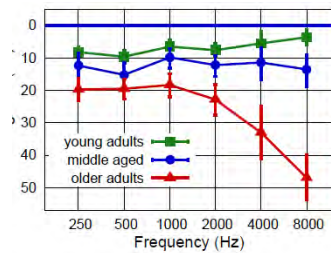


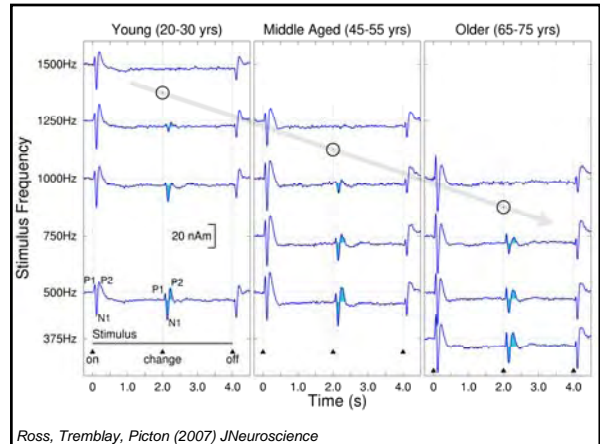
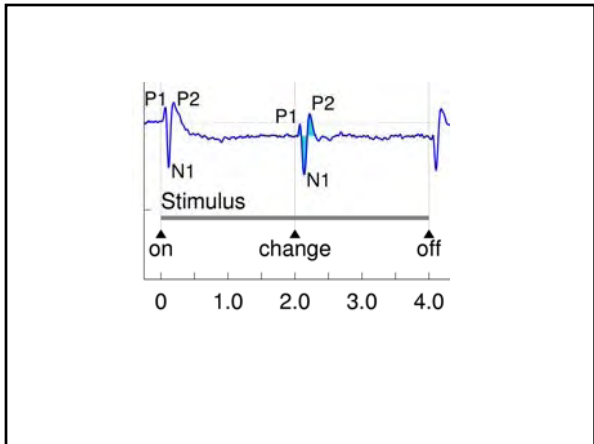
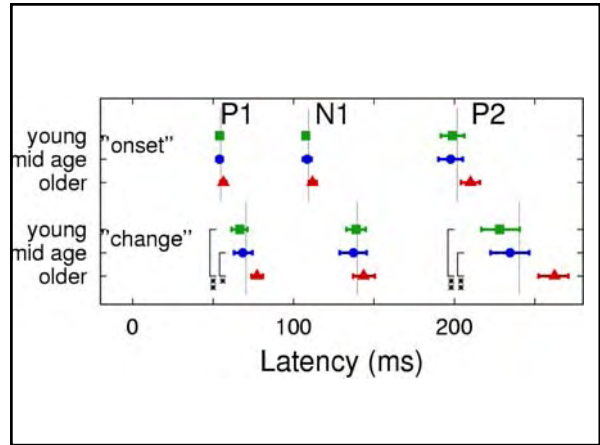
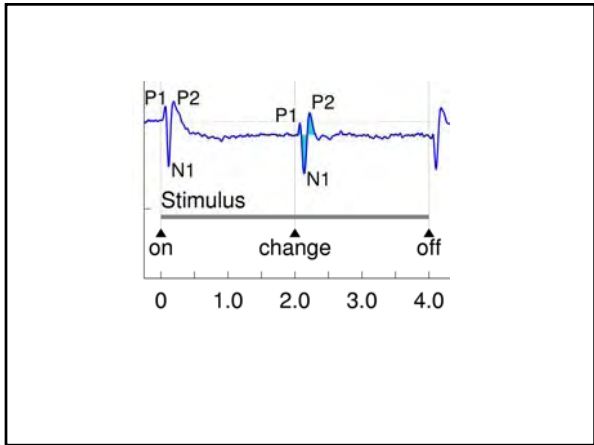
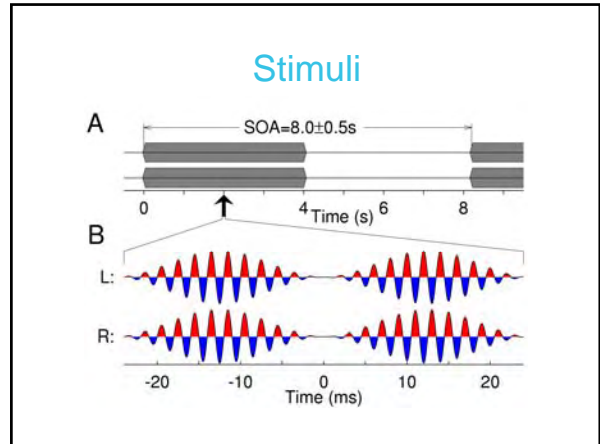
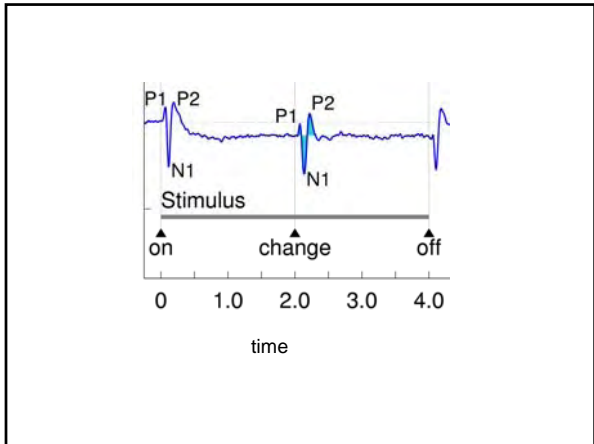
Ross, Tremblay, Picton (2007) *Journal of Neuroscience*



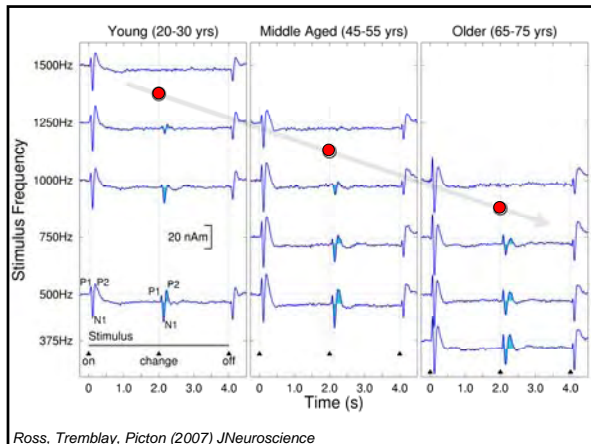
45 Subjects = age range 19-74 years

Audiometric Thresholds





Ross, Tremblay, Picton (2007) JNeuroscience



Results

Physiological IPD thresholds closely approximate *behavioral* thresholds.

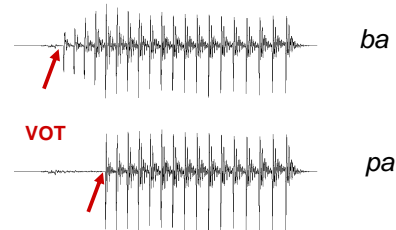
Physiological and perceptual detection of IPD is negatively affected by increasing *age*.

Detection Studies

- Gap detection
- Duration Discrimination
- Rate
- Interaural timing codes
- Voice onset time (VOT)

Speech - VOT

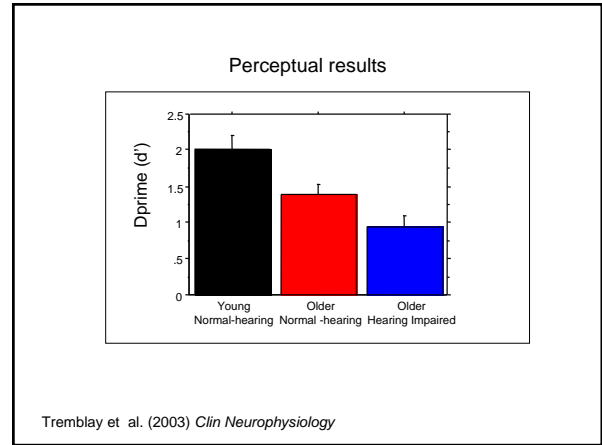
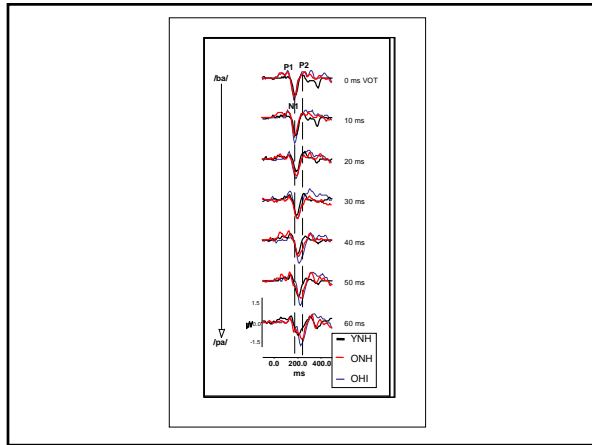
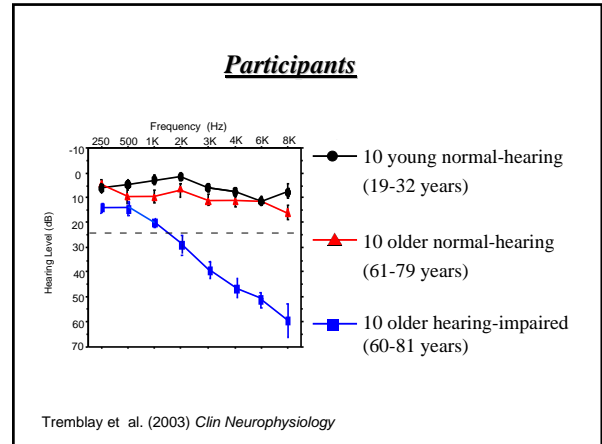
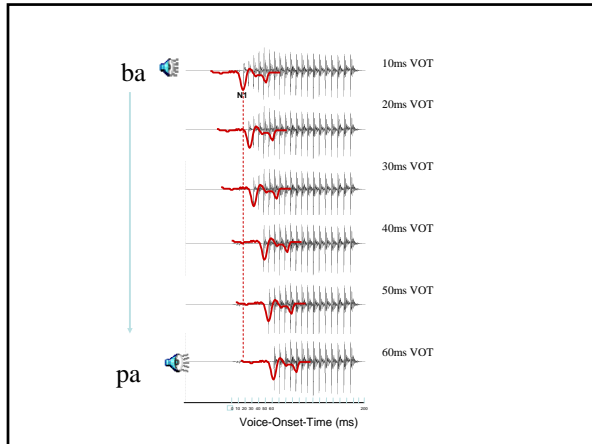
- Contains time-varying acoustic cues



Did you get the bill?

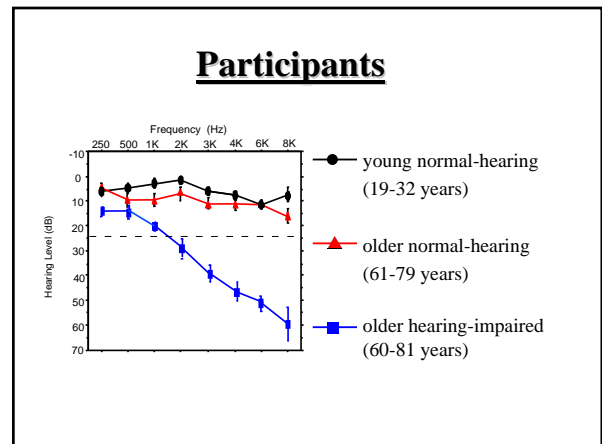
Did you get the pill?

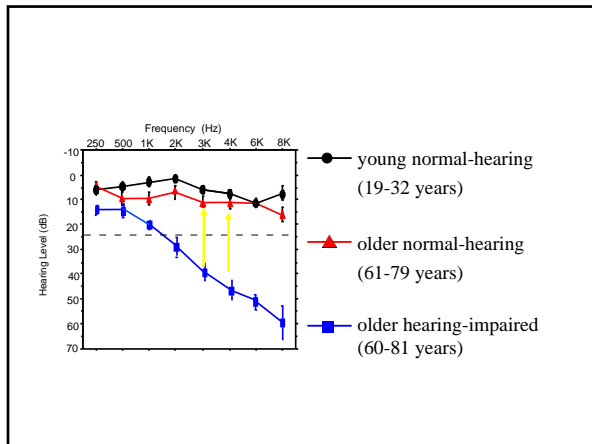
- Older adults, compared with younger adults, had more difficulty discriminating small VOT durations along a /ba-/pa/ continuum. (Strouse et al. 1998)
- Numerous single and multiple unit studies have shown VOT is faithfully represented in the temporal firing patterns of neurons. (Eggermont, 1995; Steinschneider, et al. 1995; 1999)



Conclusion

- Some of the perceptual difficulties expressed by older adults are related to impaired temporal precision.
- This might also explain why older adults frequently complain that hearing aids make sounds louder, but not clearer.





The Good news:
 Numerous studies have shown that temporal perception can be improved with training exercises.

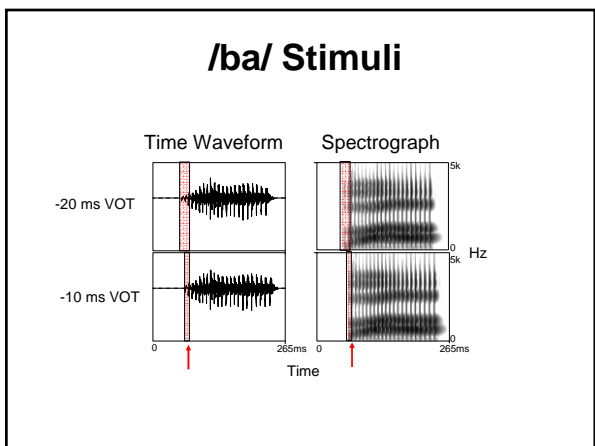
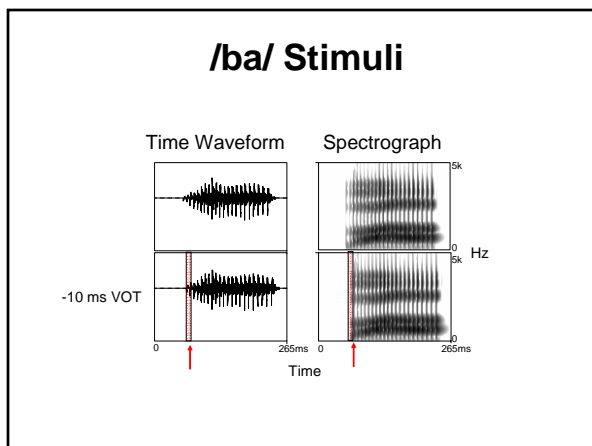
But:
 Most of the training studies have been done in people who are young, and most people who are hearing impaired are older.

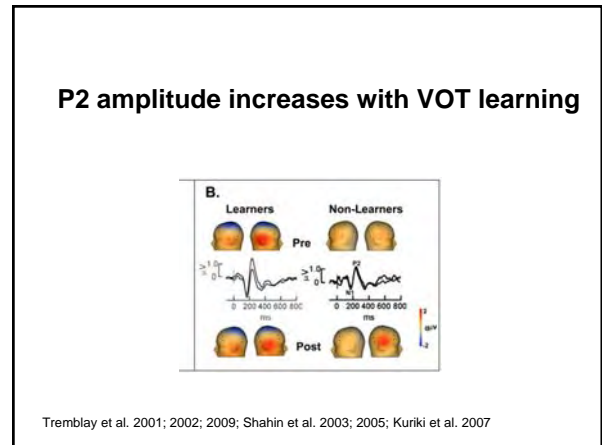
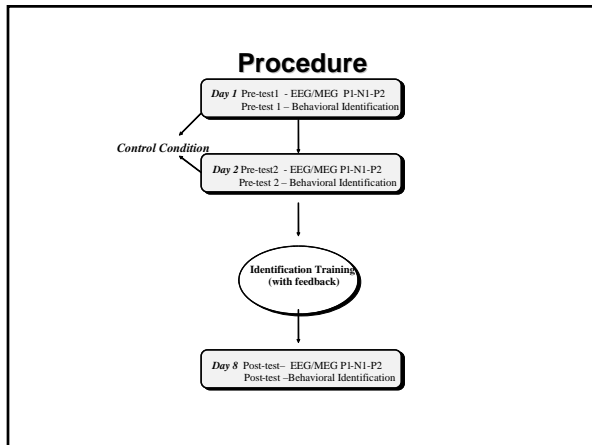
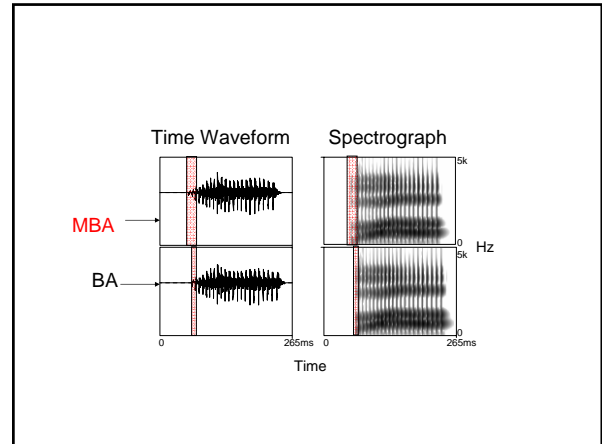
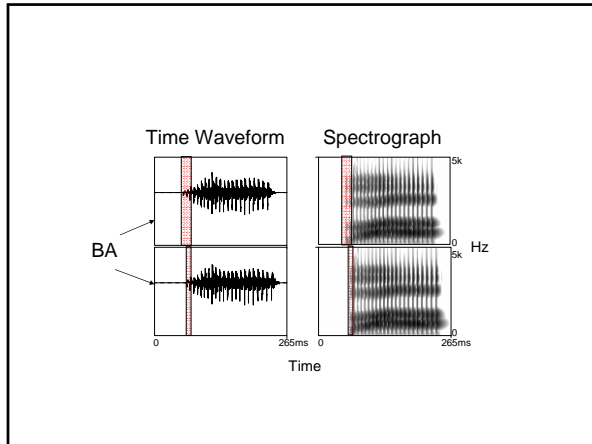
Baycrest
 Rotman Research Institute
 AGING BRAIN: We're all the best minds working on it.

VOT training: Age effects.

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¹ University of Washington, Seattle, WA, USA
² Rotman Research Institute, Toronto, Canada

Can older adults improve their perception of a 10 ms VOT contrast?





Conclusion

There are age-related biological changes that take place in the human auditory system (peripheral/central) that affect the way timing cues are represented.

The perception and physiological representation of temporal cues can be altered with training.

Thank you!