

Top-down restoration of speech: Hearing impairment and age can influence it in unexpected ways



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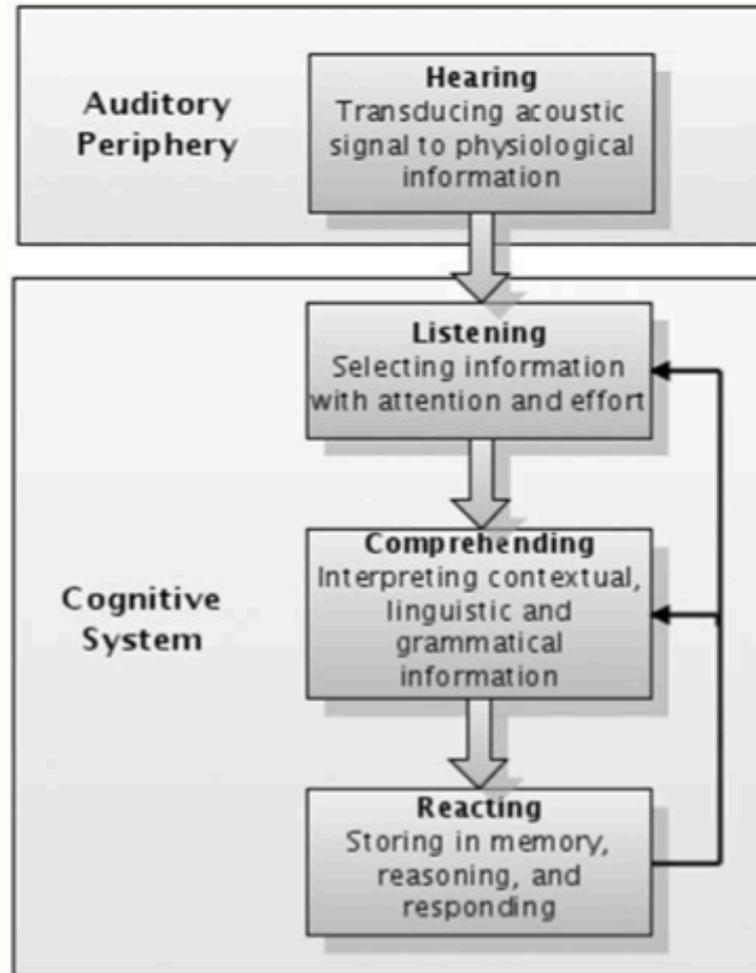


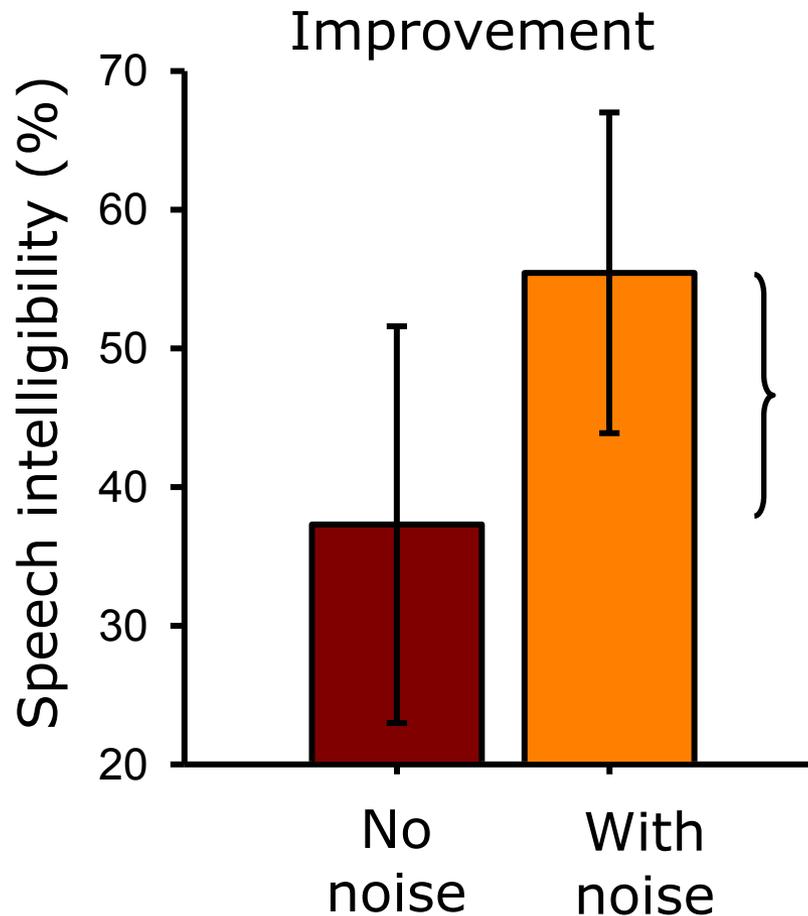
Figure 2. Components of communication. Adapted from Sweetow and Henderson-Sabes. The case for LACE (Listening and Communication Enhancement). *Hear J.* 2004;57:32-38.⁴⁷

Top-down restoration of speech

Turns out when a guy says
"my girlfriend died of terminal
cancer" it sounds exactly like
"my girlfriend was a topless
dancer" in a bar... worst high
five ever

Yesterday, 19:19

Top-down restoration of speech



Warren, Science 1970

Miller and Licklider, JASA 1950

Powers and Wilcox, JASA 1977

Verschuure and Brocaar, P&P 1983

Bashford et al, P&P 1992

Başkent et al, JASA 2009

Başkent, JASA Lett, 2010

Başkent et al., Hear Res 2010

Başkent and Chatterjee, Hear Res 2010

Başkent, JARO 2012

Benard and Başkent, PLOS ONE 2013

Saija et al, JARO 2014

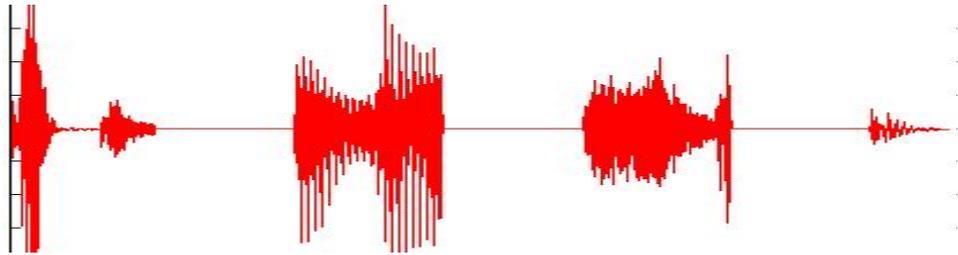
Bhargava et al, Hear Res 2014

Benard et al, JASA Lett, in press

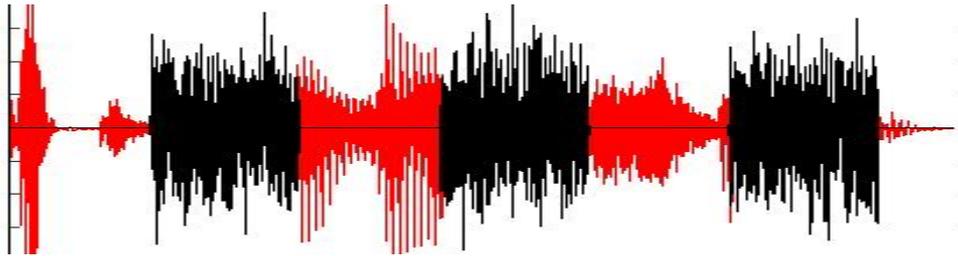
Clarke et al, HearRes, submitted

Top-down restoration of speech

Interrupted
speech



Gaps filled
with noise

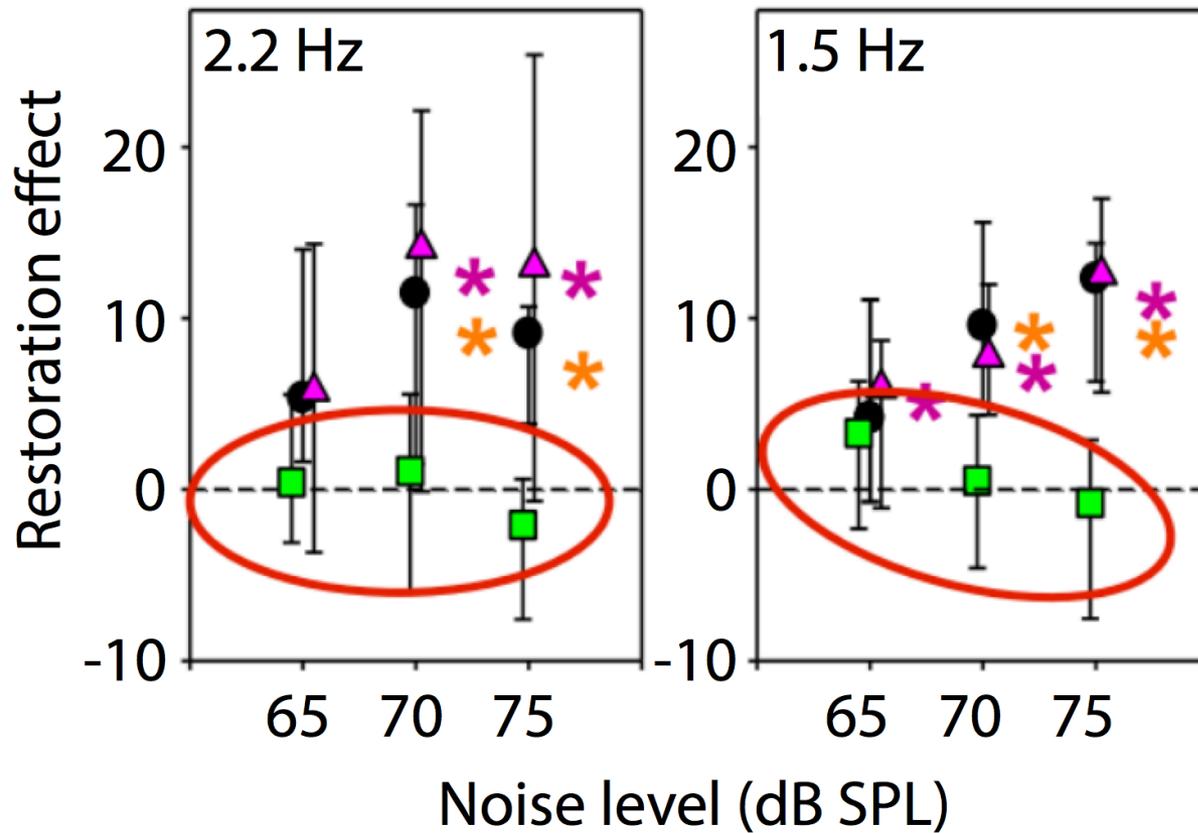


Top-down restoration of speech

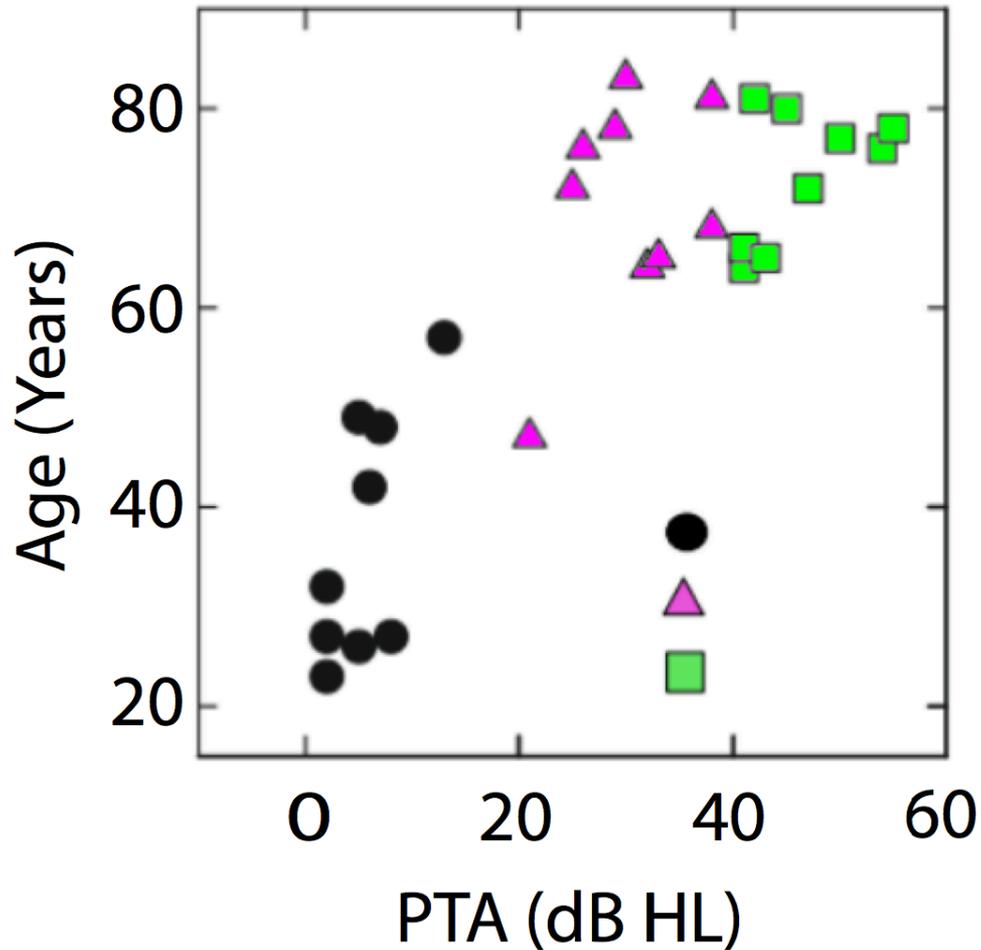
Activation of best lexical candidates

- Speech features from the audible parts
- Filler noise increases ambiguity
- Resolve ambiguity
 - Linguistic knowledge
 - Context
 - Expectations

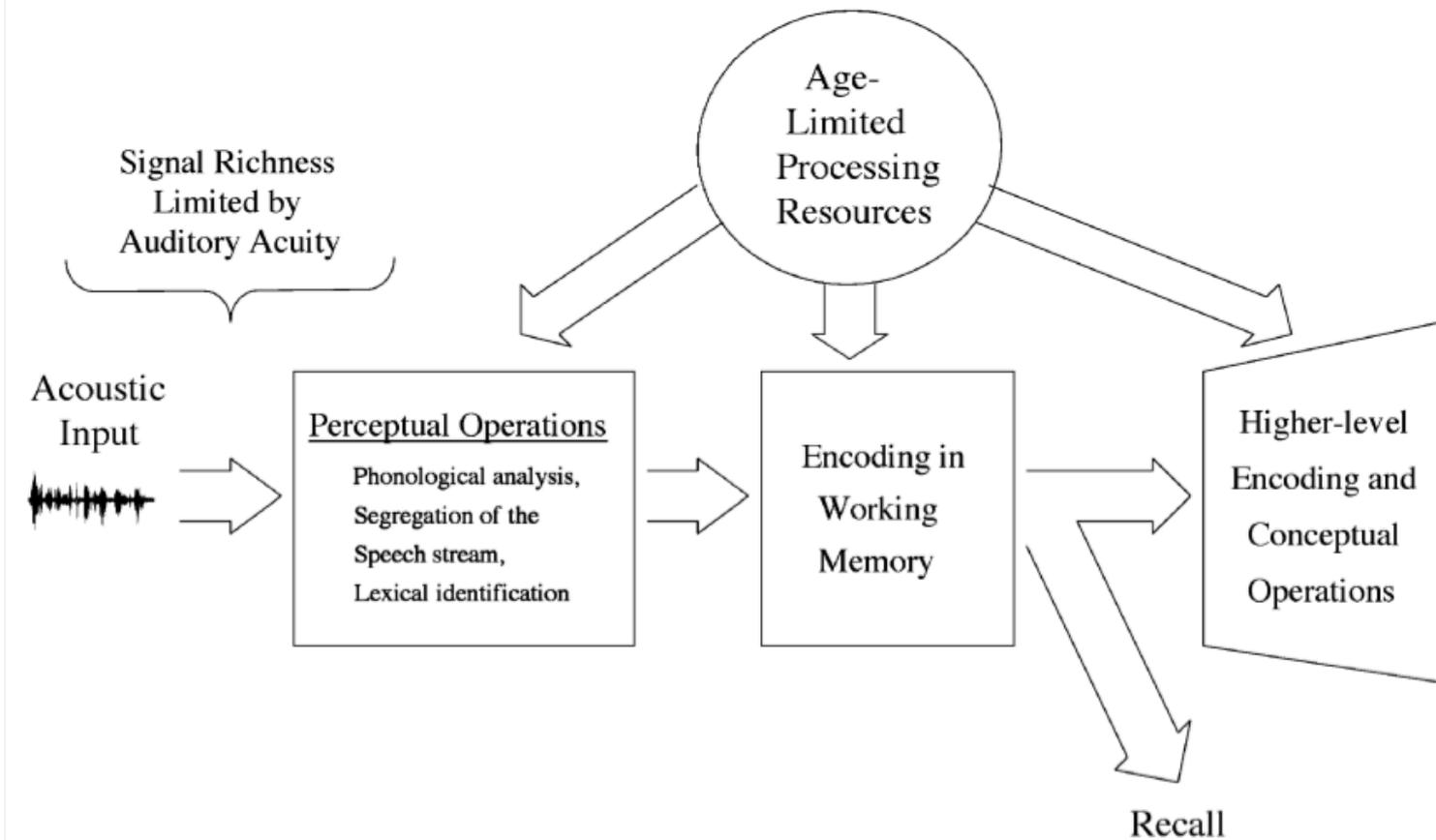
Hearing impairment



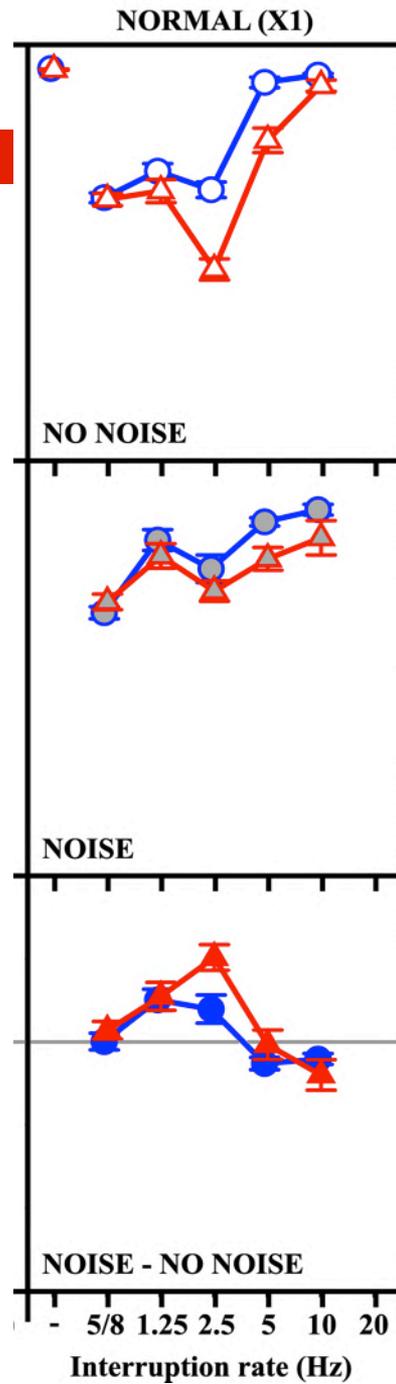
Hearing impairment



Age effect



Age effect

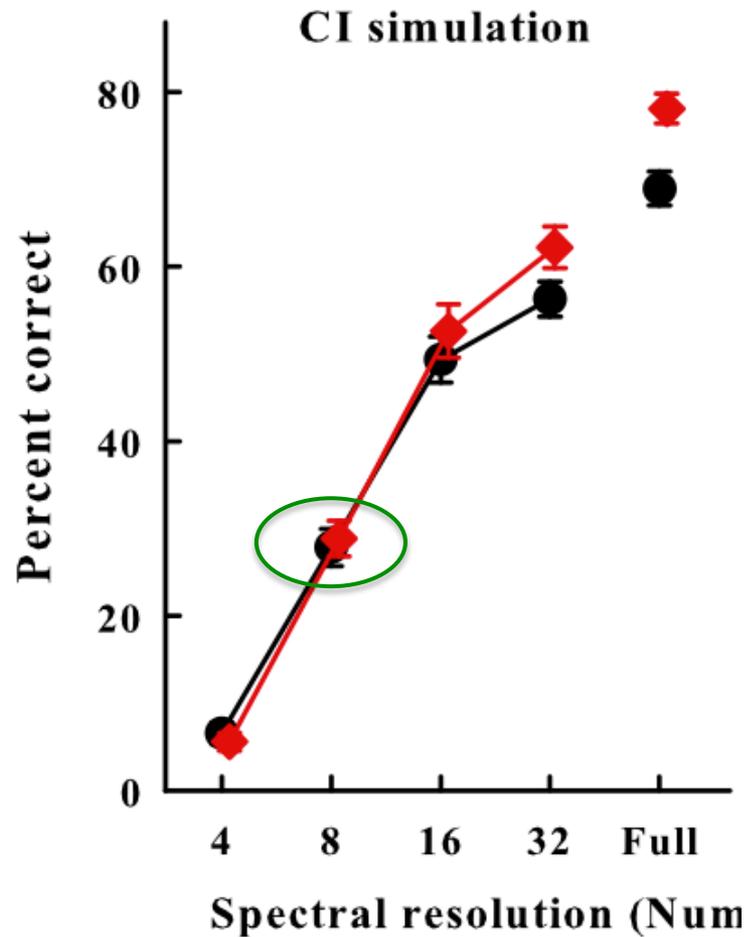


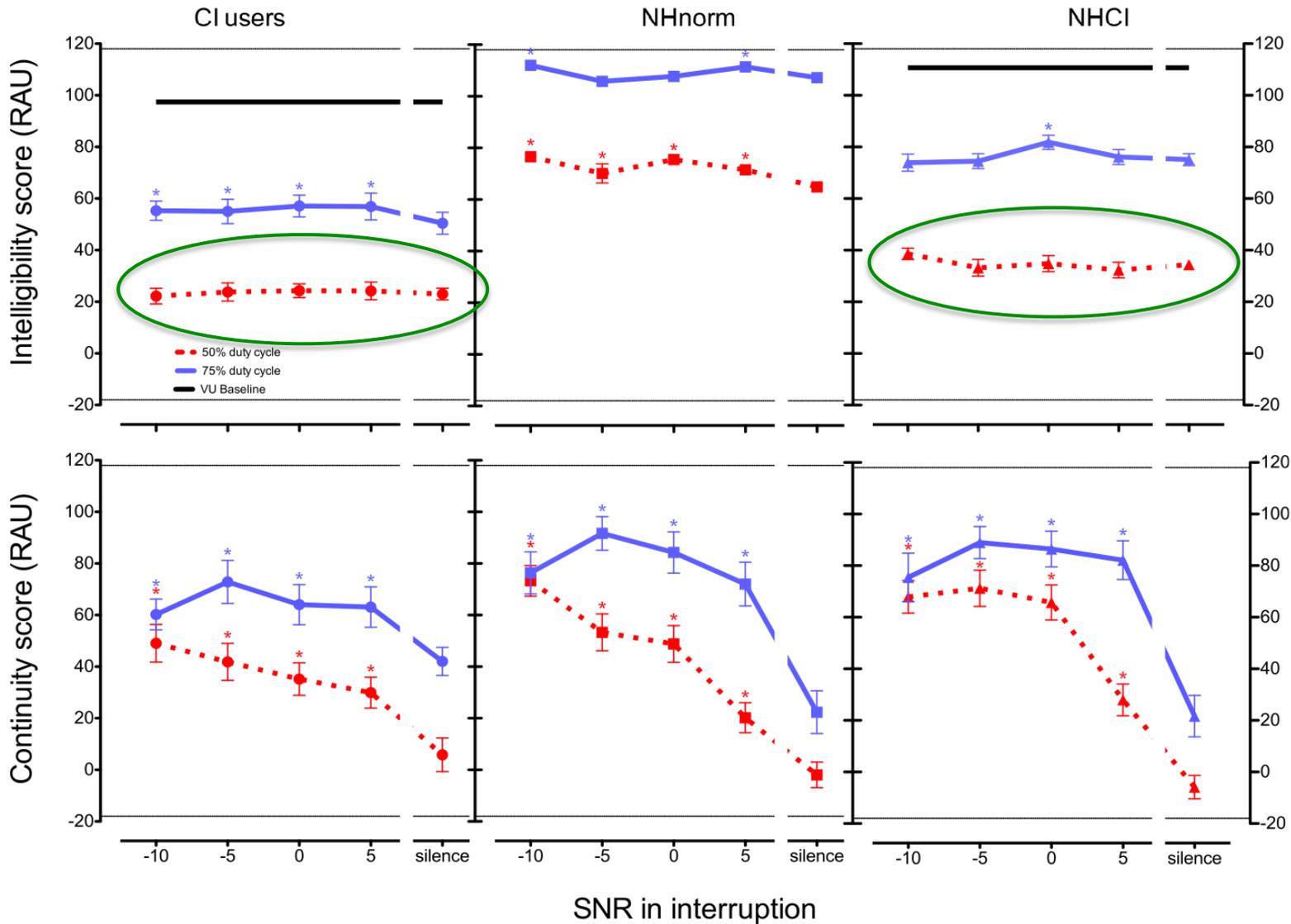
Benefit from
phonemic restoration

Saija et al, JARO 2014
Saija et al, SPIN 2014, poster

Cochlear implants

Başkent, JARO 2012

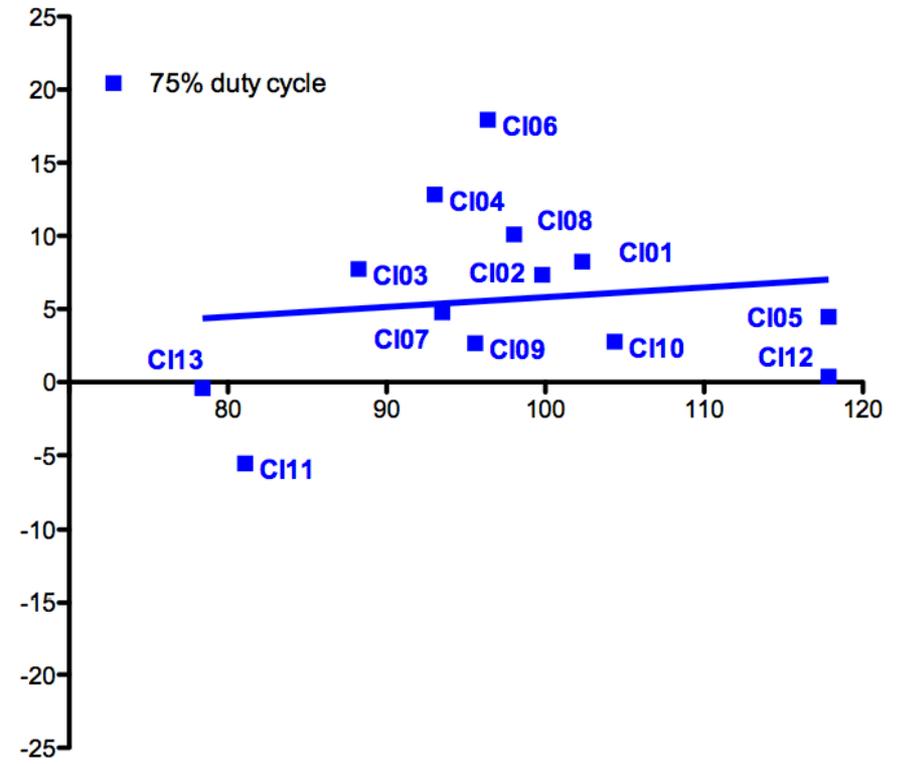
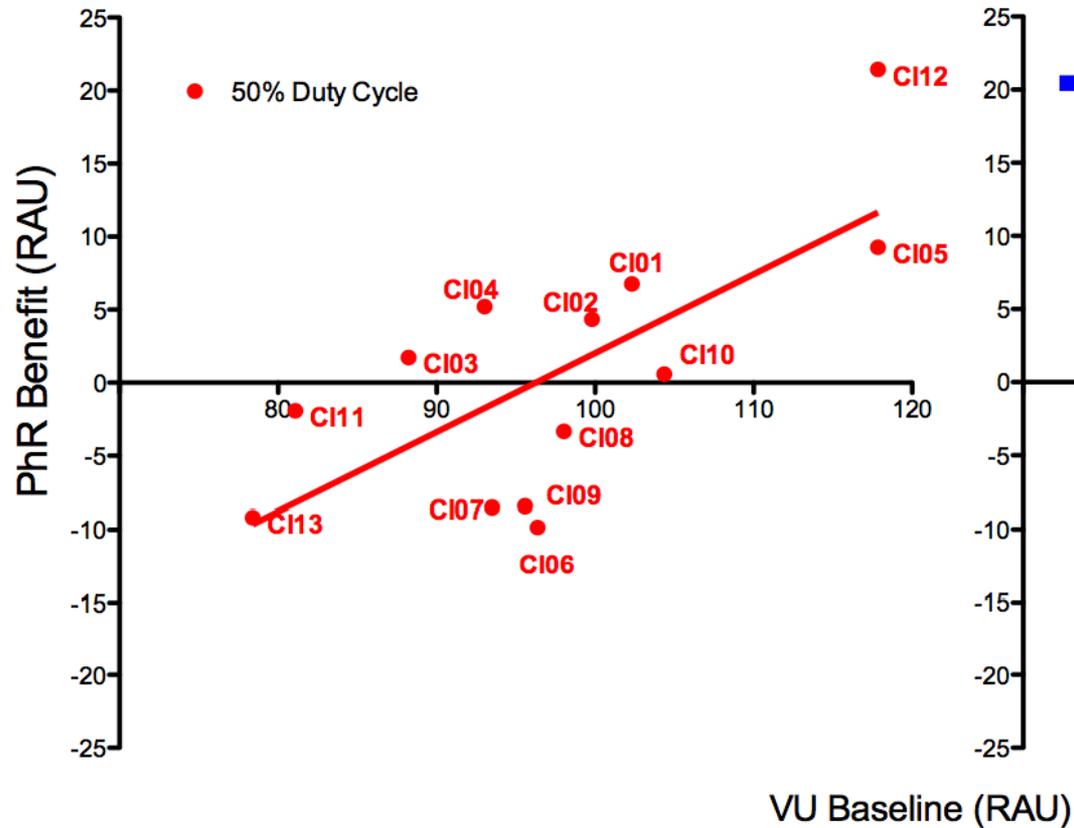




Bhargava et al,
Hear Res 2014

Cochlear implants

Bhargava et al,
Hear Res 2014



Conclusions

- In the presence of additional degradations (hearing impairment, hearing device), and without a cognitive degradation, top-down compensation may reduce.
- Changes in top-down speech restoration could be a contributing factor to speech in noise problems in hearing impairment.

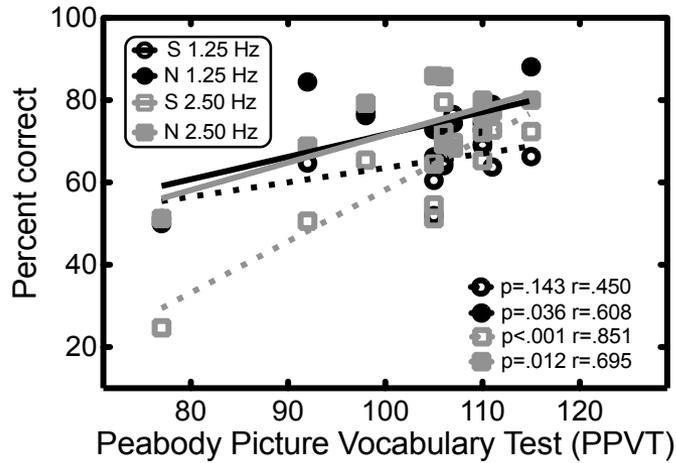
Conclusions

- Fine balance between speech degradation vs. its top-down enhancement
 - Hearing impairment, CIs
 - What speech cues available?
 - Phonetic cues
 - Acoustic cues for segregation/forming speech stream
 - Ambiguity

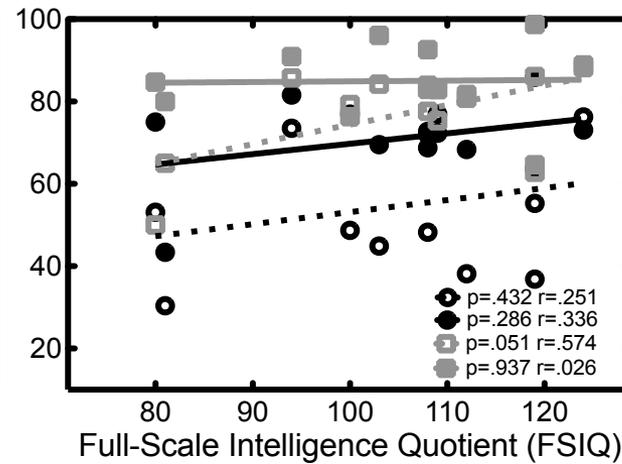
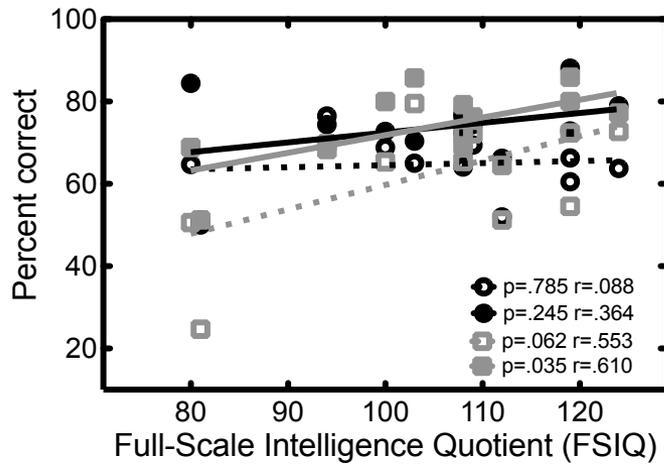
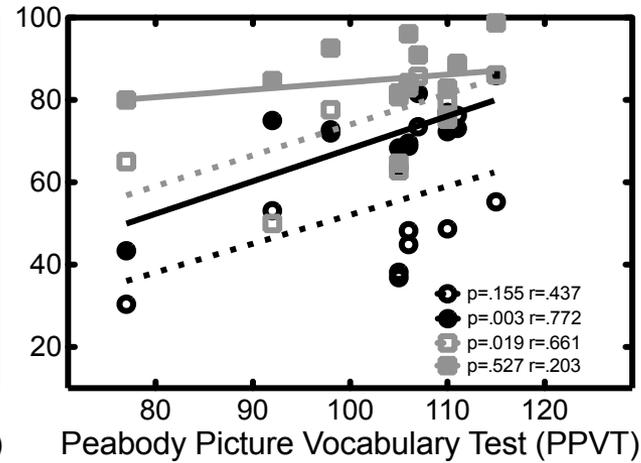
Conclusions

- Mildly hearing impaired and good CI performers seem to be able to compensate.
- In the lack of additional degradations, elderly can also compensate.
 - Despite the age-related changes in cognitive functioning
 - Perhaps with help from lifelong language experience

Normal speech



Slow speech

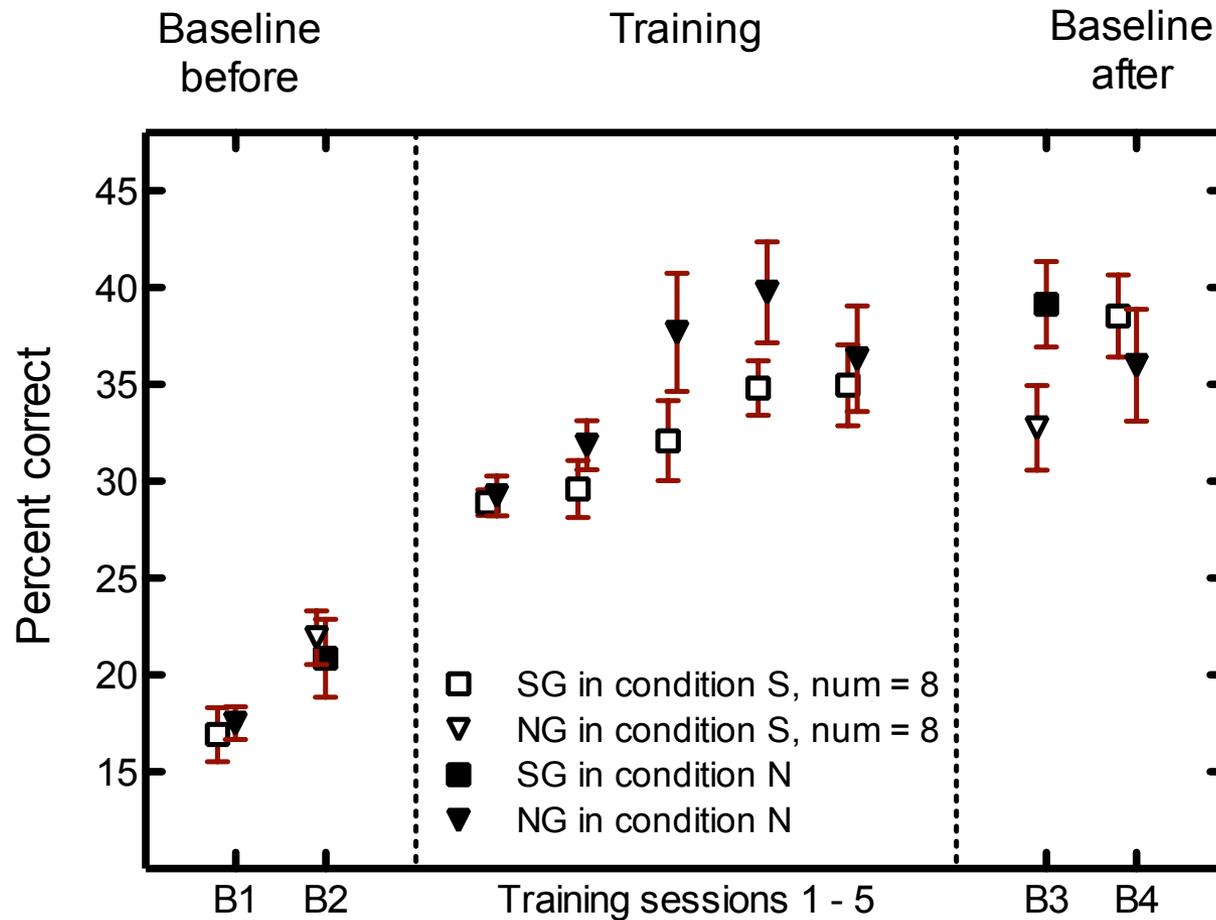


Conclusions

- Mildly hearing impaired and good CI performers seem to be able to compensate.
- In the lack of additional degradations, elderly can also compensate.
- Training can help.

Perceptual learning

Benard and Başkent, PLOS ONE 2013
 Benard and Başkent, JASA, in revision



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