

# *Hearing aid features: Do older people need different things?*

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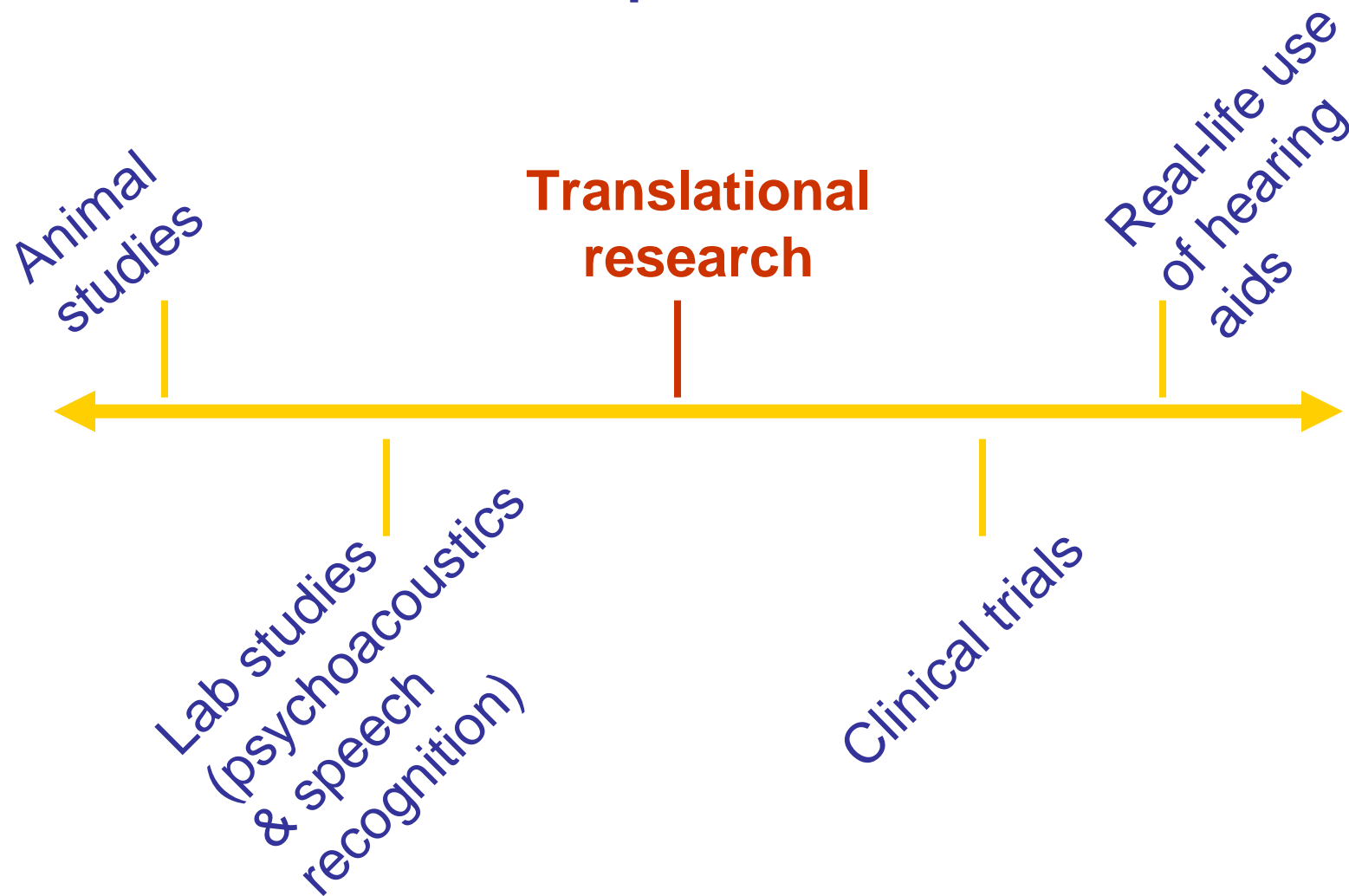
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*Bloedel Hearing Research Center*

Clinical goals: to make the best possible choices for each patient

- Hearing aid vs ALD vs cochlear implant
- Device parameters
- Appropriate AR/training
- Counseling
- Follow-up structure

# Evidence-based practice



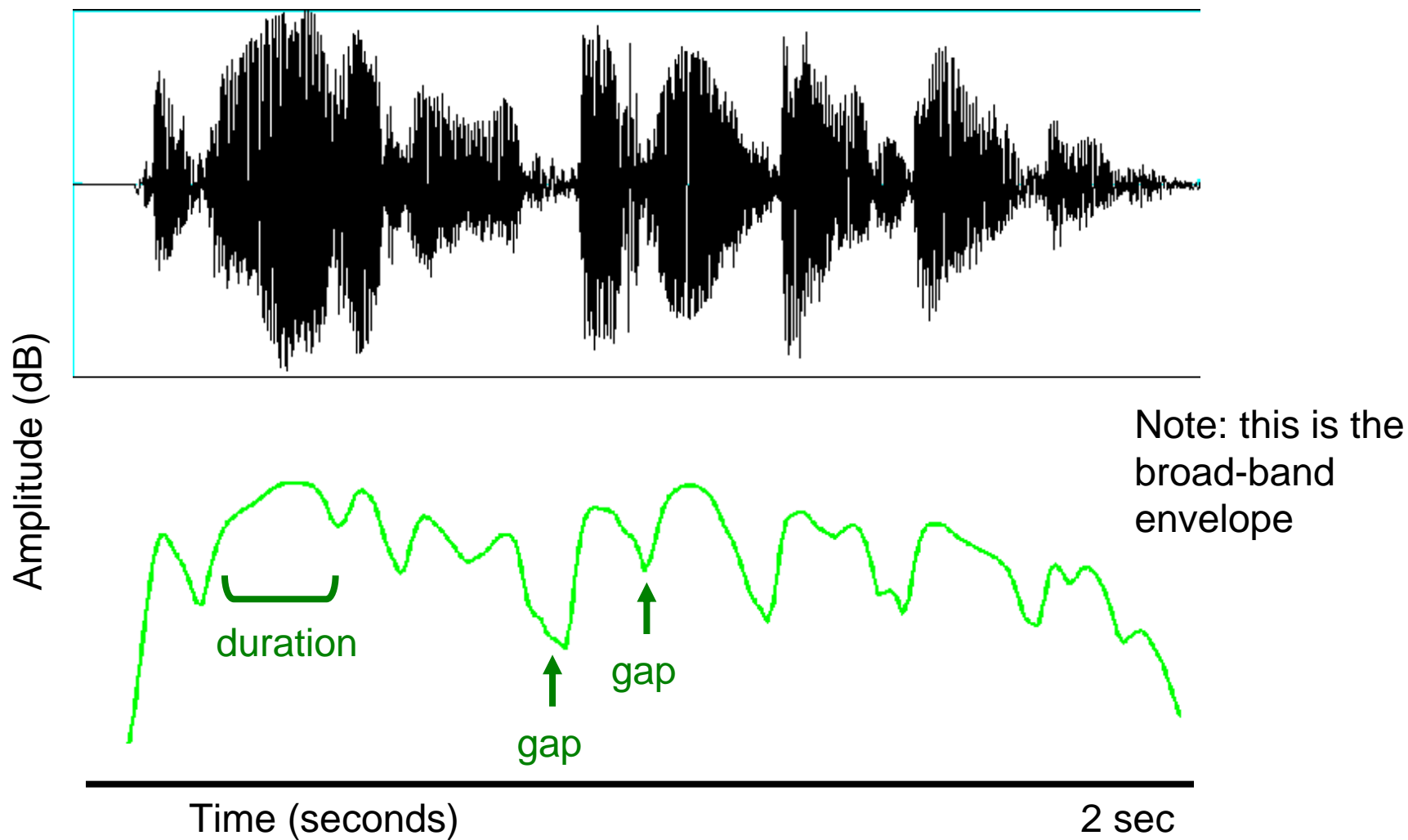
# Part 1: Using multichannel WDRC processing with older listeners

# Speech cues are carried by the temporal variations of the signal

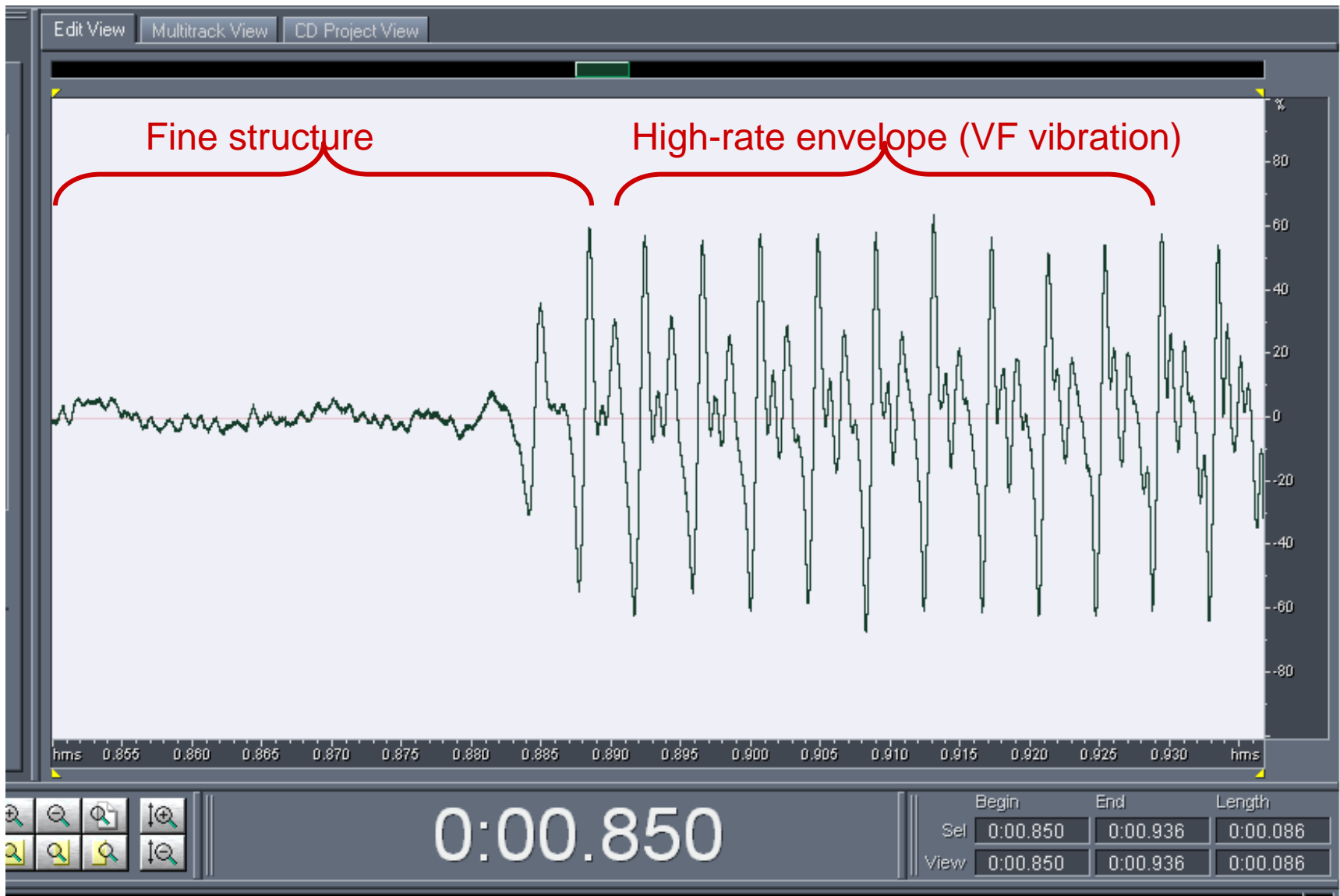
|                           | <i>Modulation rates</i> | <i>Information</i>                  |
|---------------------------|-------------------------|-------------------------------------|
| <b>Low-rate envelope</b>  | 2-50 Hz                 | Voicing, manner, vowel identity     |
| <b>High-rate envelope</b> | 50-500 Hz               | Voicing, manner, stress, intonation |
| <b>Fine structure</b>     | 600 Hz +                | Place of articulation               |

**Low-rate envelope:** slow fluctuations in speech amplitude.

*"the ear is an important sense organ"*



“po” from “important” illustrating **fine structure** and **high-rate envelope (VF vibration)**

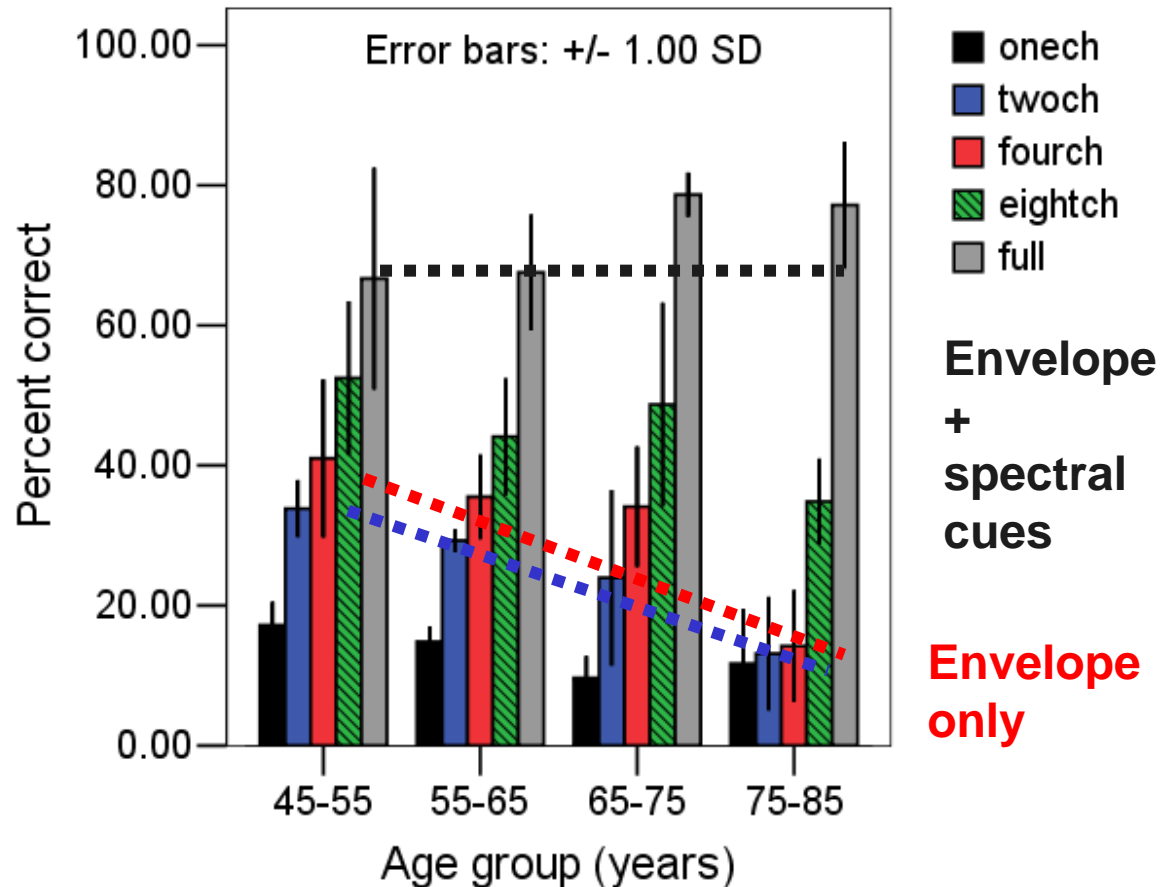


# Why should we be concerned about effects of WDRC on envelope?

- It's important for speech recognition
- Hearing aids (and cochlear implants) compress & distort the envelope
- Some listeners rely on envelope cues (e.g. cochlear implant wearers; listeners with severe loss; and [perhaps] older adults with loss of neural synchrony preventing full use of fine structure)

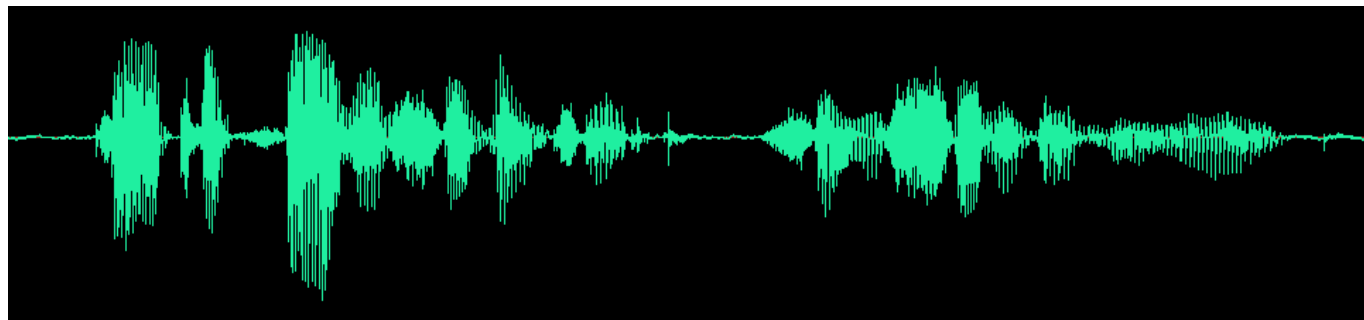


Hearing aids  
aside: we  
know that  
older adults  
have more  
difficulty  
using  
envelope  
cues to  
speech

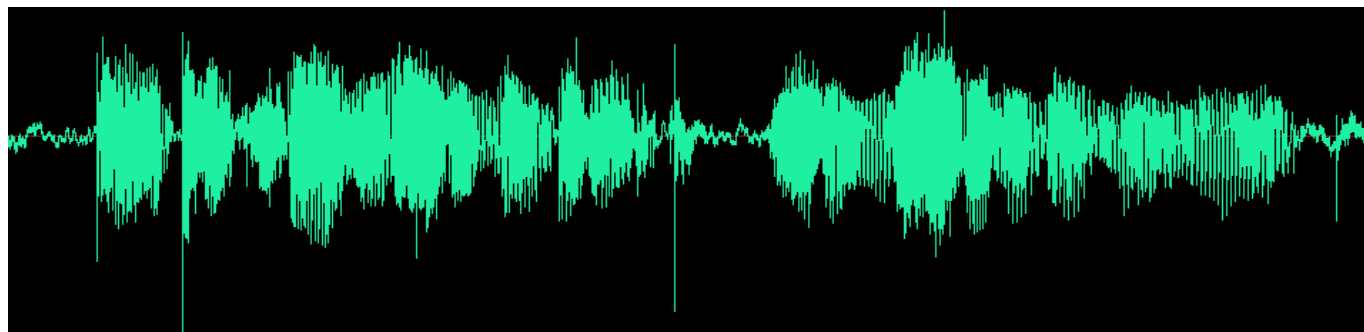


# What does a hearing aid do to the speech envelope?

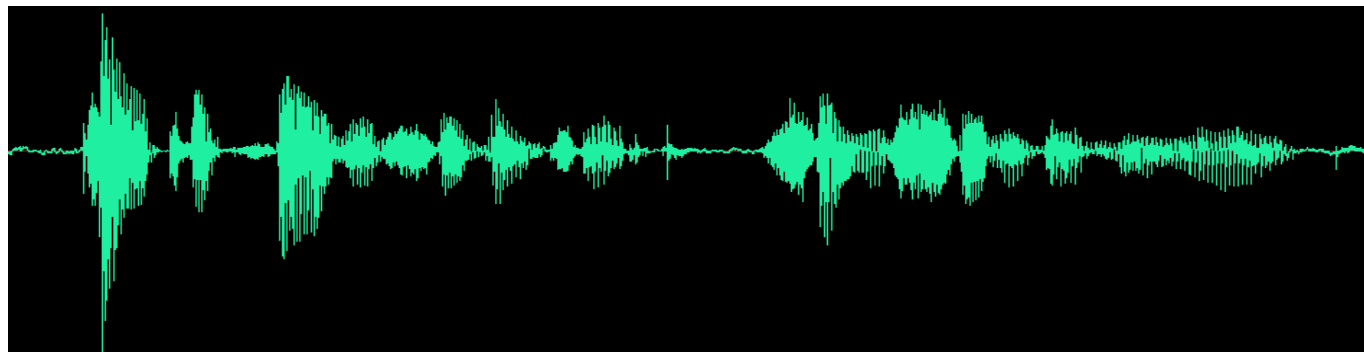
Unprocessed



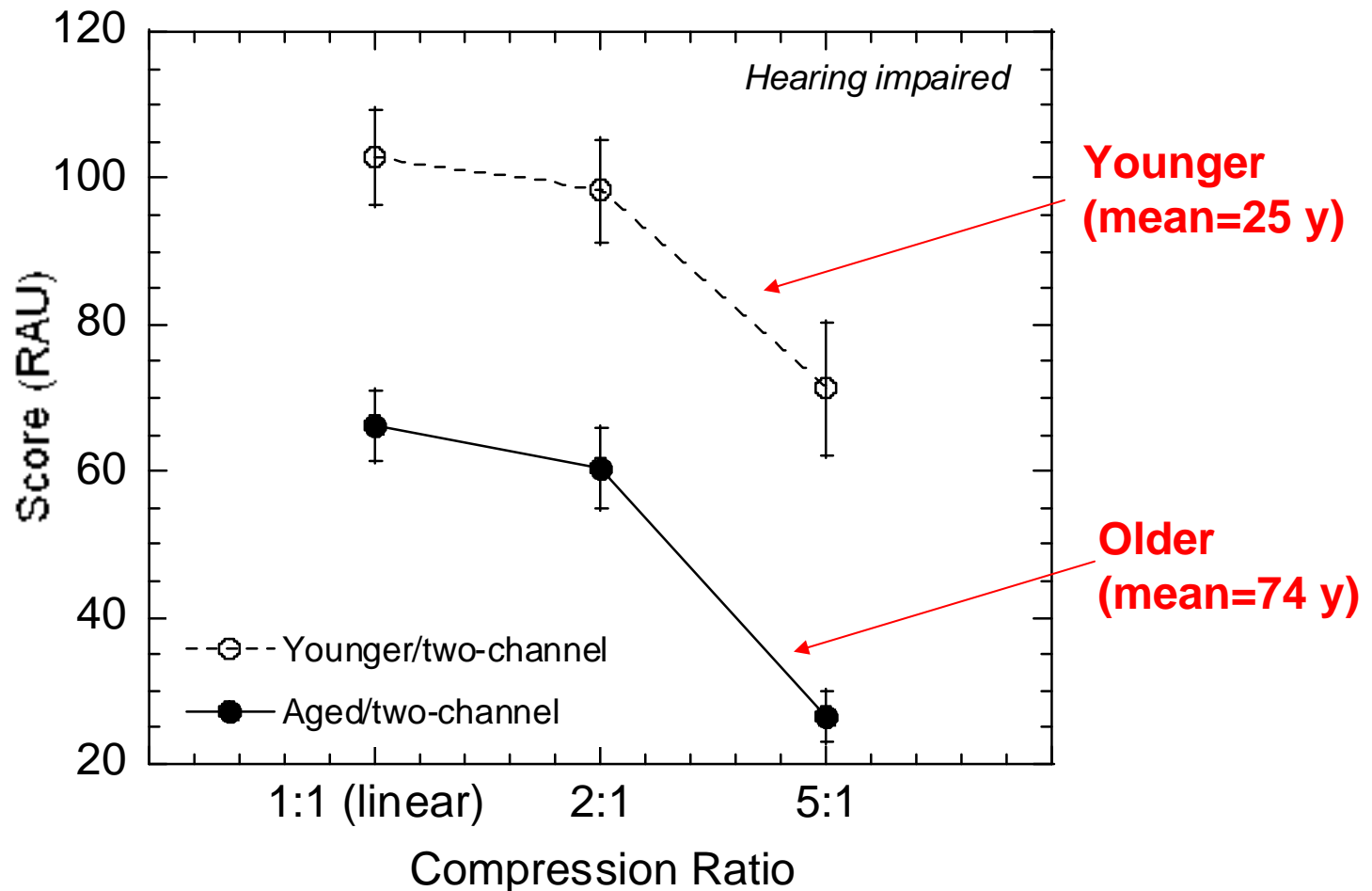
WDRC short release time



WDRC long release time



# With more compression, recognition declines - but no effect of increased age



But: in easy situations, there is redundant information; distorting some cues may not matter. What about difficult situations?



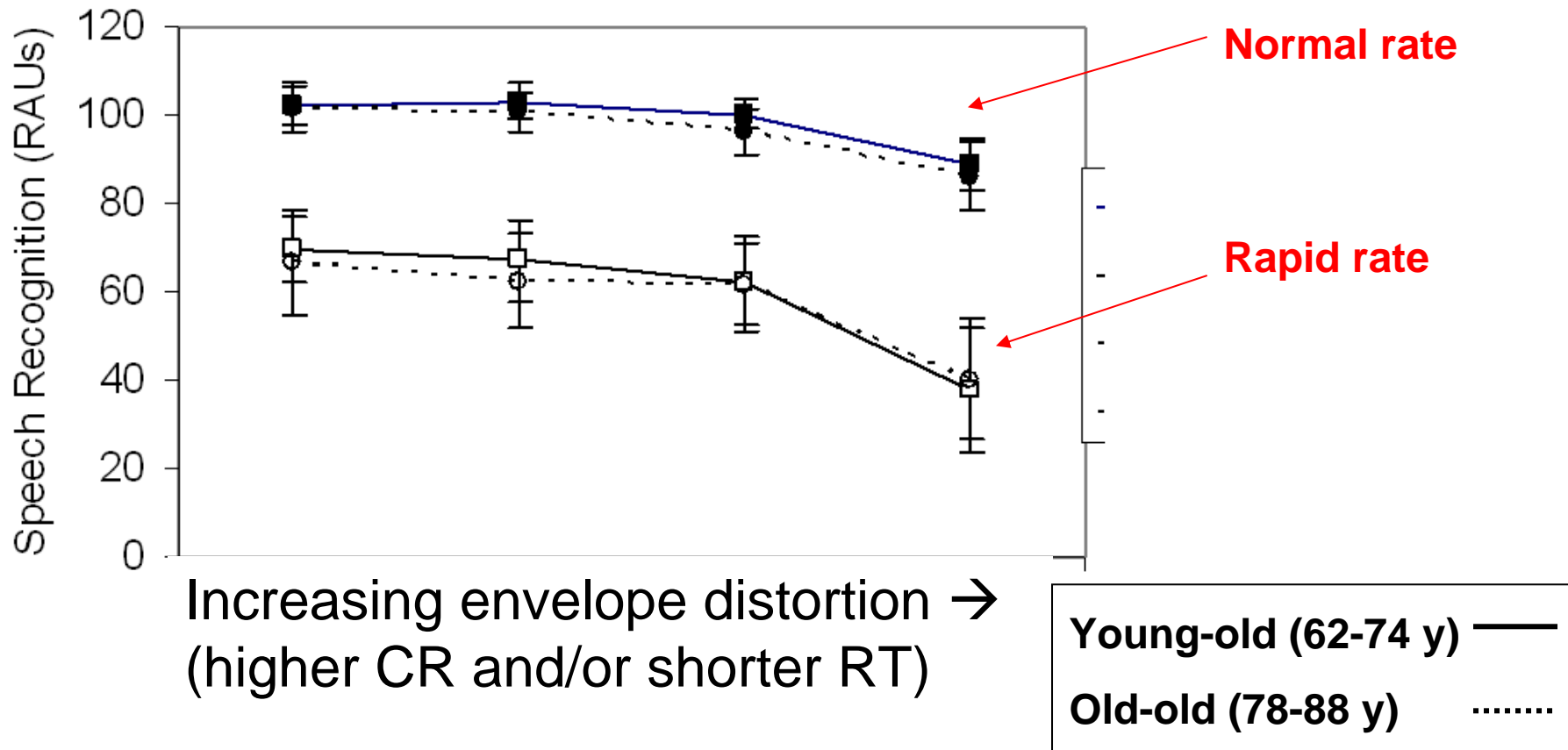
Normal Rate



Time-Compressed (Rapid)

**WDRC**: 4 settings (varying CR & RT) that resulted in different amounts of alteration to the envelope

# Compression has a larger (negative) effect on rapid speech but no age effect



# Summary of WDRC effects

- Some envelope alteration is tolerable
- Small decrease in speech recognition with settings which distort envelope.
- This is more pronounced with more difficult materials (rapid speech) or when fine structure is limited

# Summary of age effects

- Older listeners have more difficulty than younger listeners using envelope cues
- Effects of WDRC on speech in quiet are not worse with increasing listener age
- Interaction between age and WDRC for speech in noise is undetermined

## Part 2: Older patients and hybrid devices (hearing aid-cochlear implant combinations)



# Effects of age on use of electroacoustic stimulation

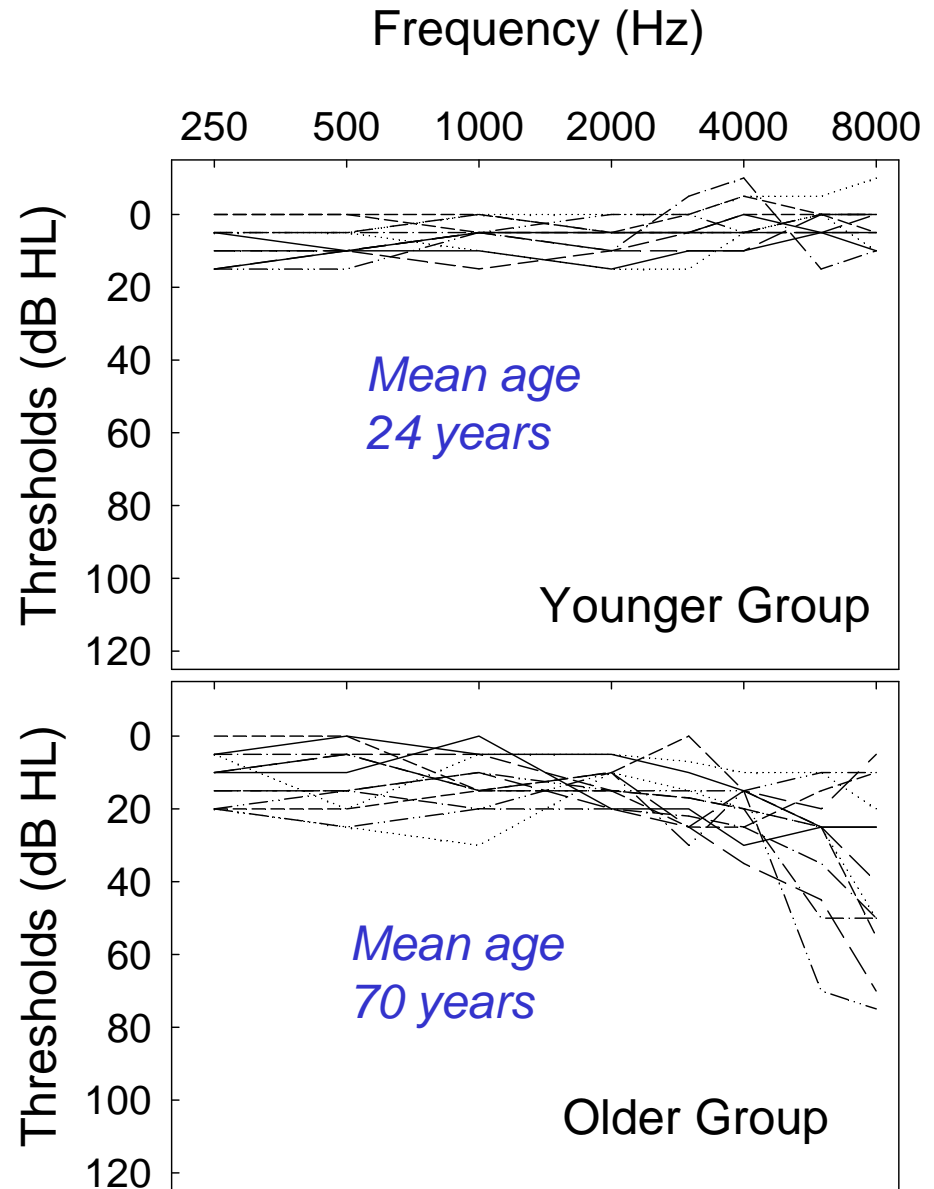
- Hybrid devices rely on benefit of fine structure to improve recognition over envelope-only (cochlear implant) signals
- We know that older adults have poorer perception of envelope-only signals
- Recent reports suggest older CI wearers may not perform as well as younger listeners
- Can older patients use fine structure to same extent as younger listeners?

We studied age  
independent of  
audibility effects by:

Using simulations

Normal hearing  
older & younger  
listeners

Appropriate NAL-R  
response



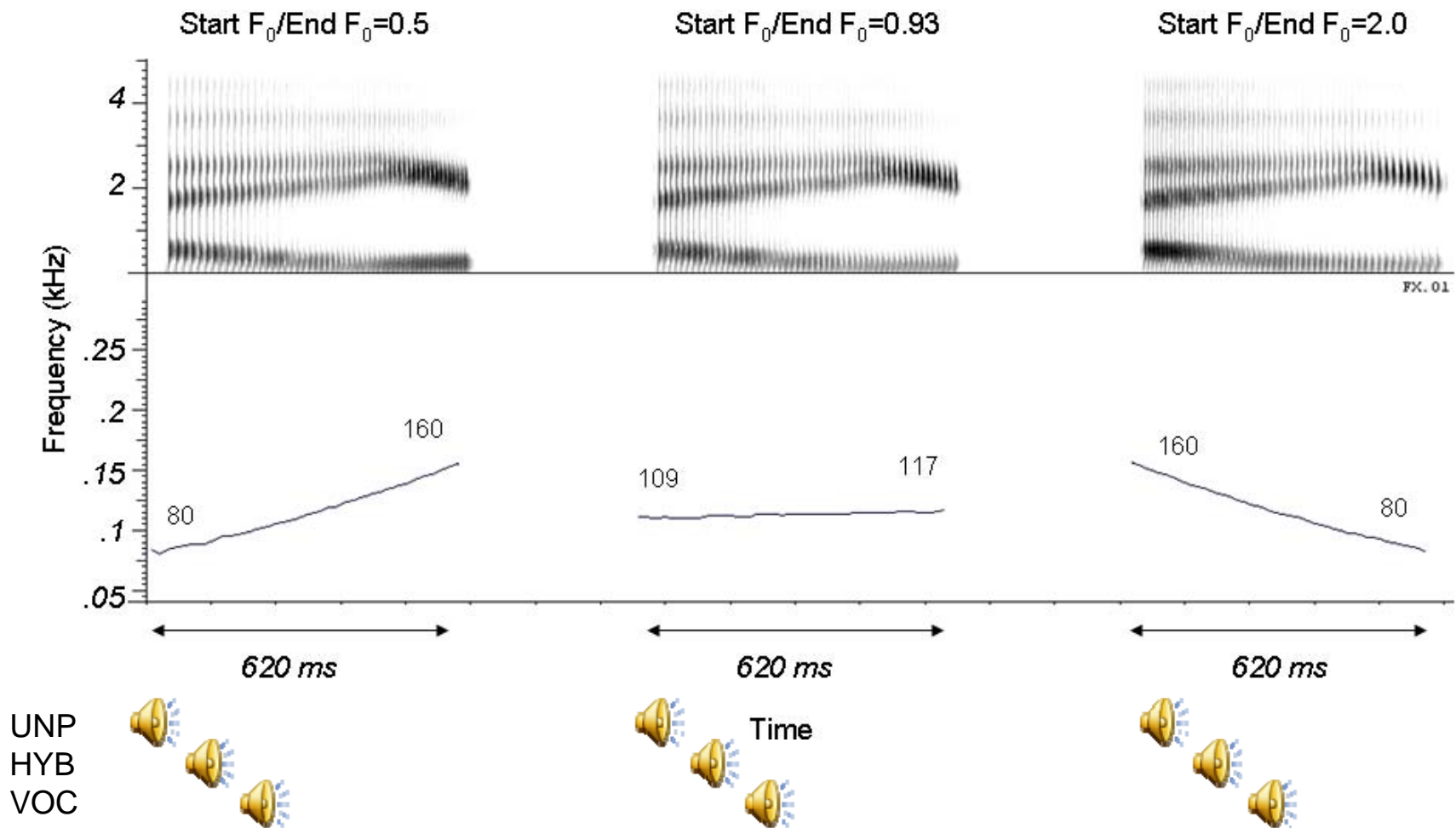
# Comparison of interest: either provide or withhold fine structure

- Unprocessed
- Vocoded (envelope/CI simulation)
  - 300 Hz smoothing filter*
  - 8 channel*
- Electroacoustic simulation (EAS)  
(envelope + fine structure)
  - 300 Hz smoothing filter*
  - Vocoded channels 4-8 + 661 Hz low-pass*

Provide or withhold fine structure in a range of easy to difficult tasks (i.e., sample abilities required to understand speech)

|         | Quiet                             | Competing                           |
|---------|-----------------------------------|-------------------------------------|
| Static  | Detect a difference in pitch (F0) | Recognize simultaneous vowel sounds |
| Dynamic | Rising or falling intonation      | Recognize simultaneous sentences    |

# Ability to perceive rising or falling intonation with/without fine structure



# Ability to recognize simultaneous vowel sounds (a very simple example of talker separation)

- Simultaneously presented (synthetic) vowel pairs
- Vary voice pitch separation between vowels

■ *Example: /ɪ/-/i/ 4 semitones unprocessed*



■ *Example: /ɪ/-/i/ 0 semitone unprocessed*



■ *Example: /ɪ/-/i/ 4 semitones EAS*



■ *Example: /ɪ/-/i/ 4 semitones vocoded*



## Summary: data relevant to hybrid devices

- Some older listeners will receive significant benefit from fine structure, others won't.
- Getting benefit from fine structure may require (a) perceiving fine structure and (b) integrating information across 2 types of cues.
- We don't know what underlies the differing abilities.

## Age-related diversity (or: why we can't base clinical decisions on age alone)

- Some older listeners have difficulty using envelope cues to determine changes in pitch, or perceive intonation, even in quiet. When they are CI candidates, those individuals would likely receive less benefit from a cochlear implant, and more benefit from a hybrid device or bimodal fit.
- Others show no deficits in quiet, but have difficulty in competing environments. Those individuals will likely require effective noise reduction technology



## Age-related diversity (or: why we can't base clinical decisions on age alone)

- Some older listeners cannot access fine structure cues for speech identification in competing environments. We expect those individuals to have significant problems understanding speech in multitalker situations.
- Those individuals report more problems in multitalker situations than others their age, or compared to younger listeners

# Clinical recommendations

- Identify the factors that underlie the variability among older listeners
- Develop screening tests that could be used to identify those individuals unlikely to benefit from “standard” treatment
- On the basis of such tests, select appropriate signal processing strategies for each person
- Fit the device as part of a comprehensive rehabilitation plan which considers peripheral and cognitive abilities

Q: Do older people need different things?

A: No, not as a homogenous group

Thank you

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