Development of linguistic duration in hearing impaired children

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Main Issues

1. Describe duration of linguistic productions in hearing impaired kids.

2. Describe developmental course at 4 and 5 years old.

3. Compare hearing impaired kids with normal hearing kids.

4. Look into reasons for differences.

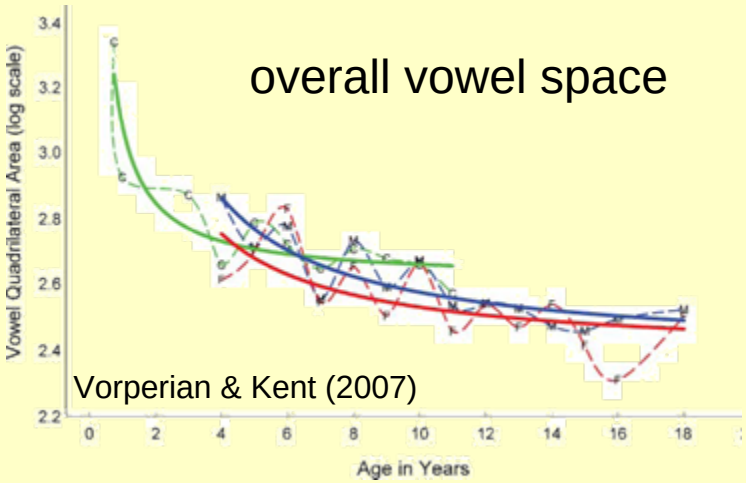
Main Questions

Hearing impaired kids sound different from normal hearing kids.

Are phonetic productions longer for HI kids?

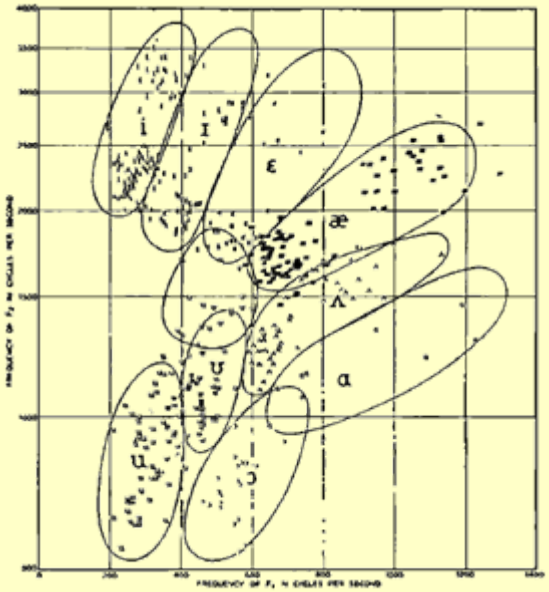
What is the developmental trajectory of HI kids?

Development of phonology



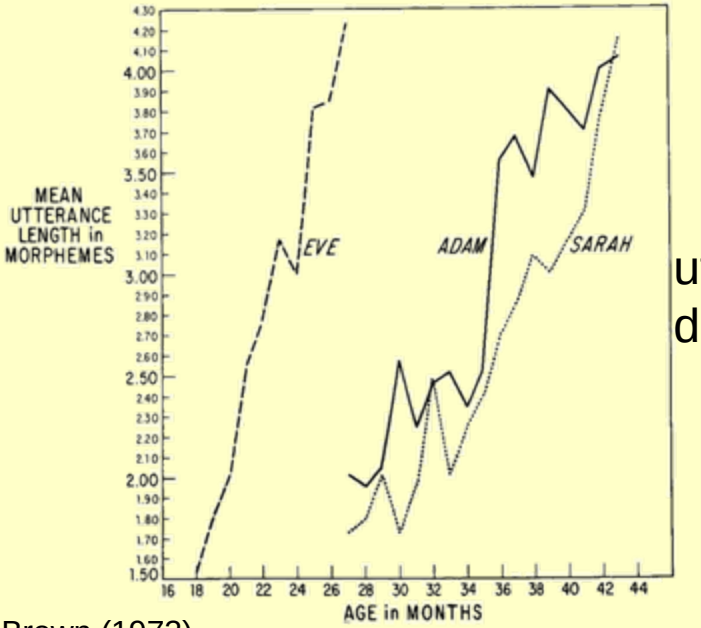
overall vowel space

Vorperian & Kent (2007)



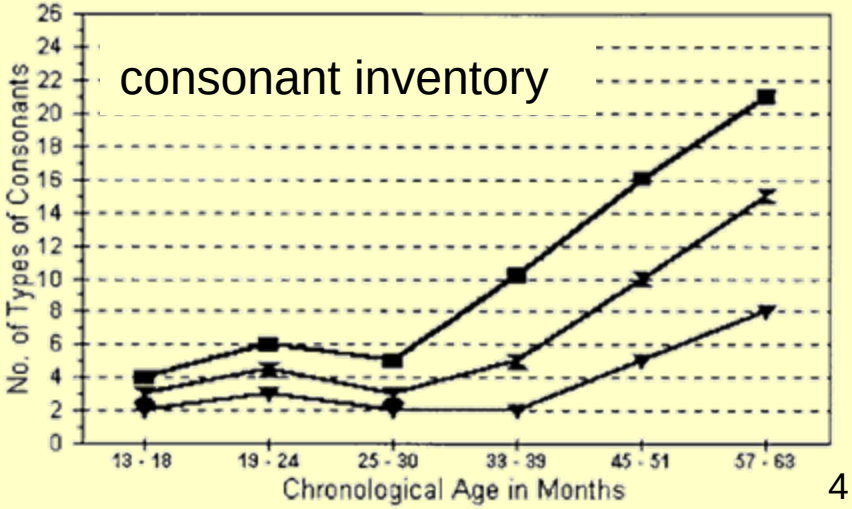
spectral space

Peterson & Barney (1952)



utterance duration

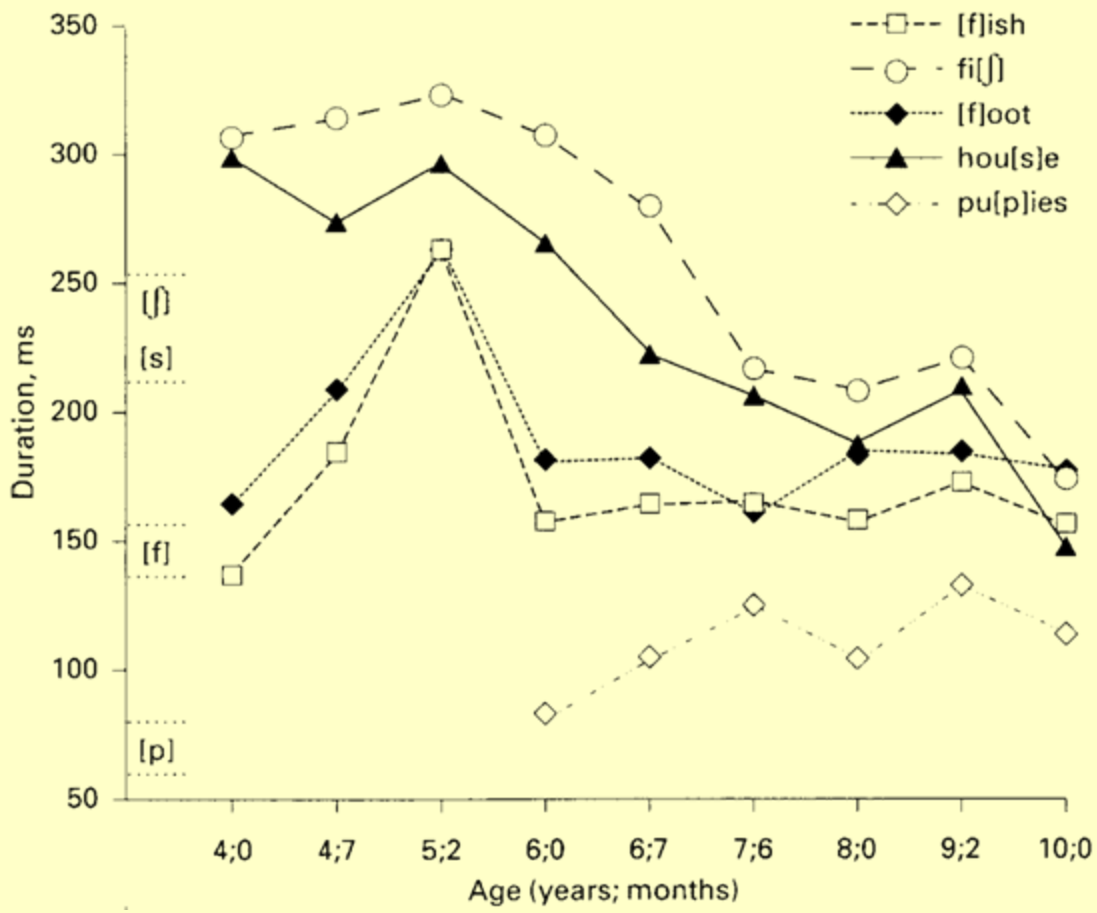
Brown (1973)



consonant inventory

Yoshinaga-Itano (2006)

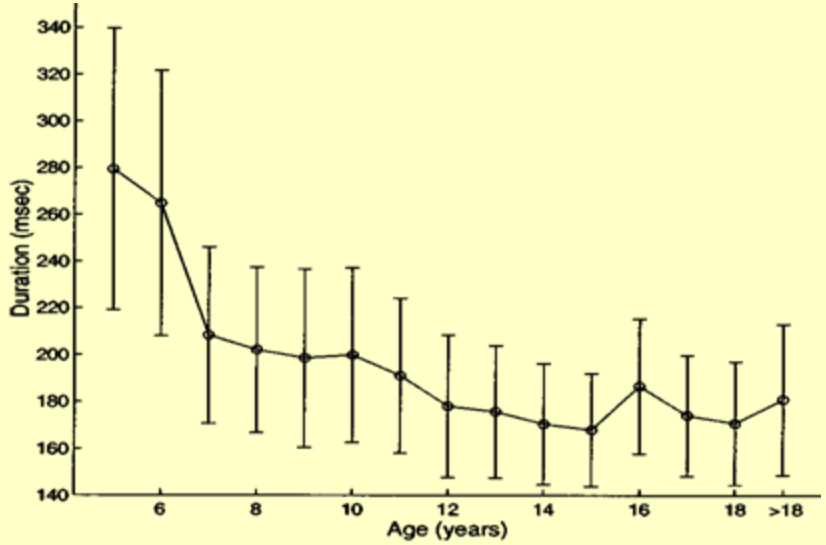
Development of consonants



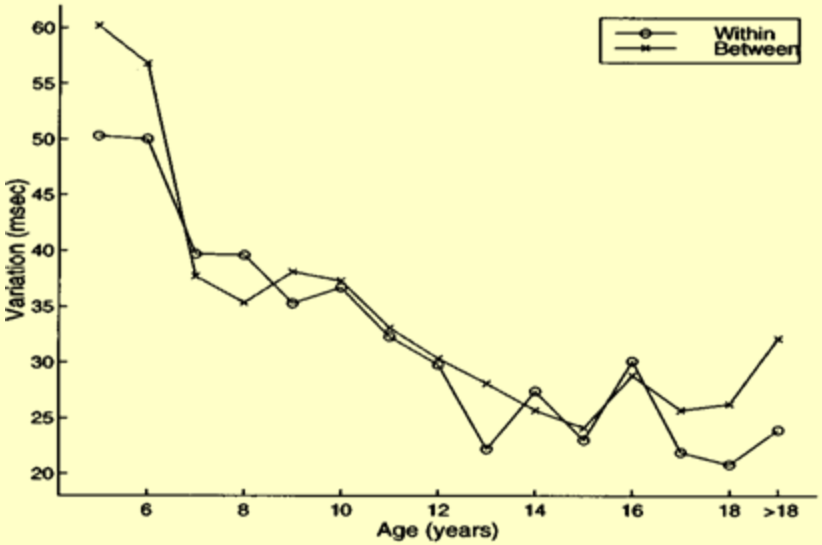
duration reduction

Smith & Kenney (1999)

Development of vowels



duration reduction

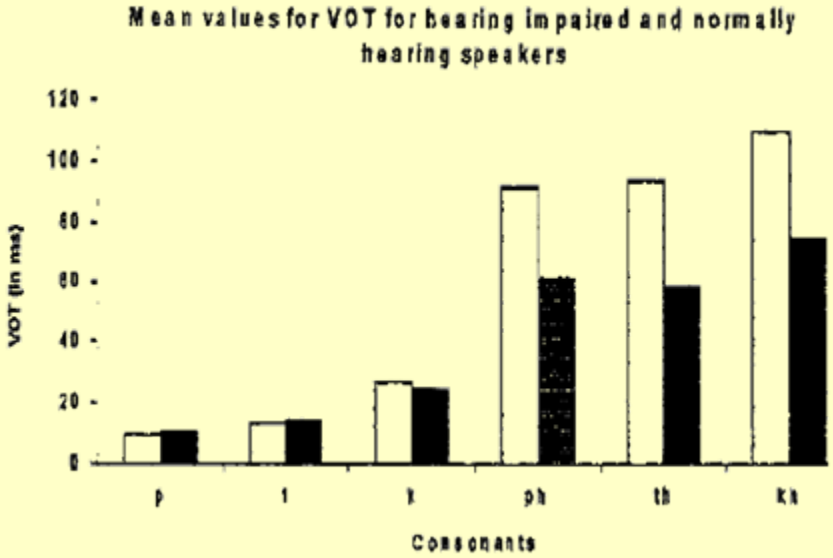


variability reduction

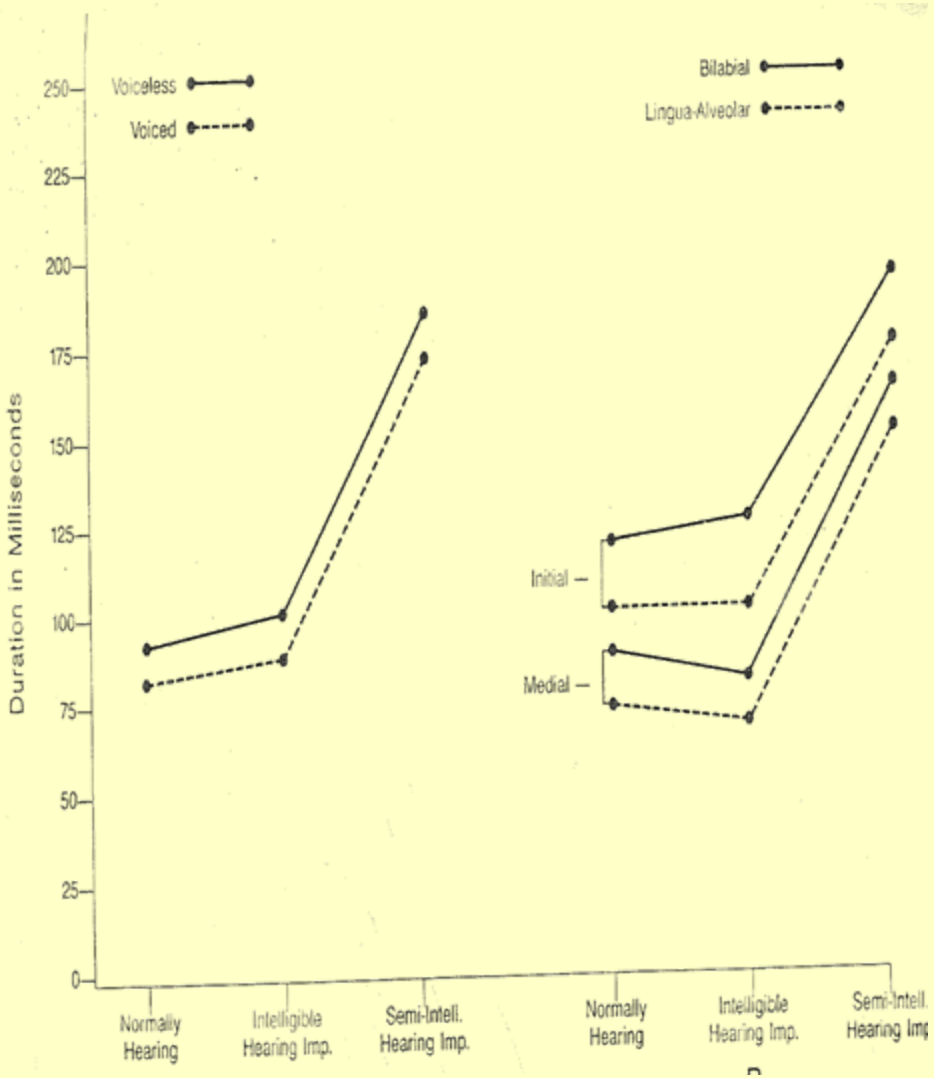
Lee, Potamianos, & Narayanan (1999)

Hearing impaired consonants

HI longer than NH, and might interact with degree of hearing

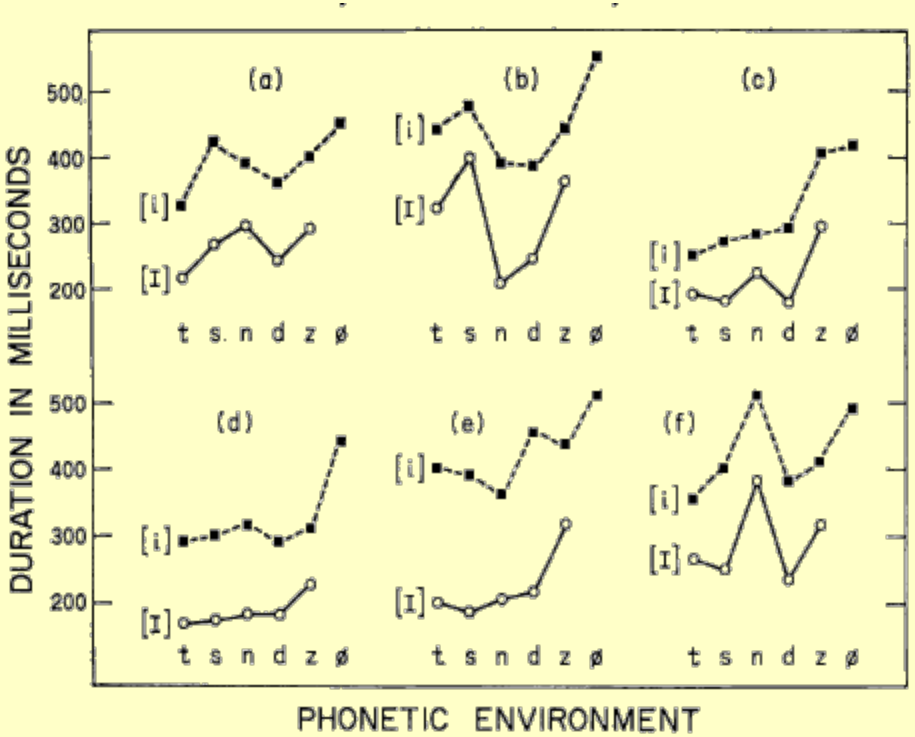


May (1996)

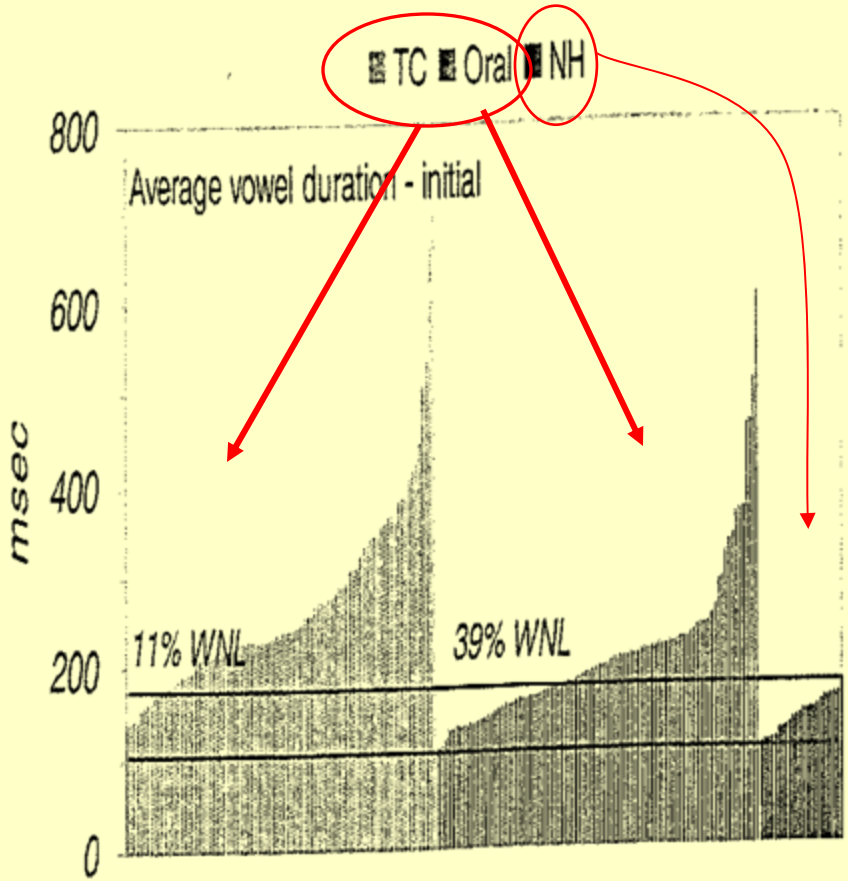


Whitehead (1991)

Hearing impaired vowels



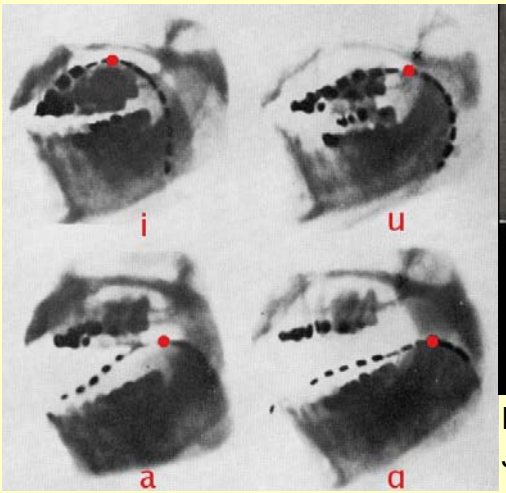
Monsen (1974)

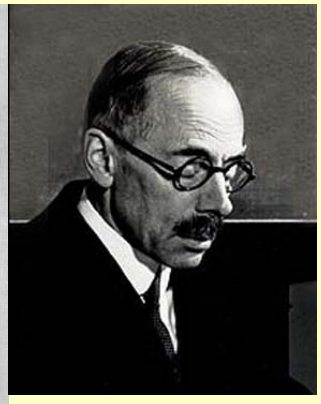


Uchanski and Geers (2003)

Point vowels i u ɑ æ

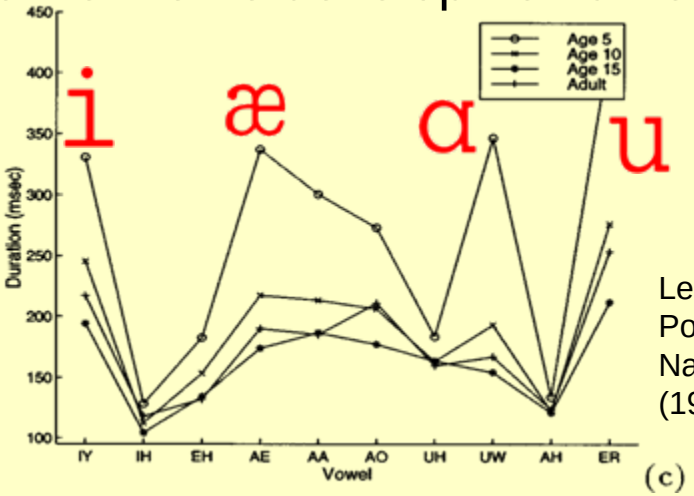
...define articulation space



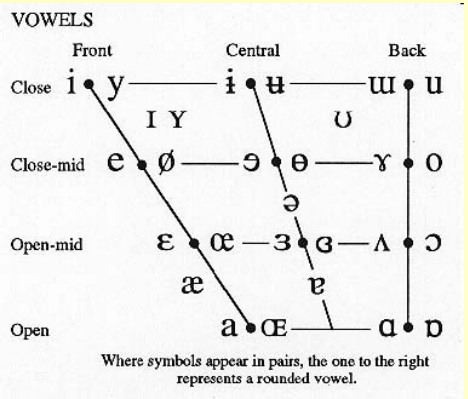


Daniel Jones

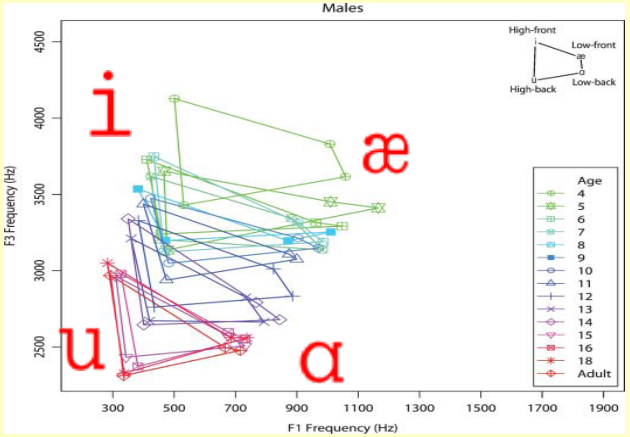
...show extreme developmental reduction

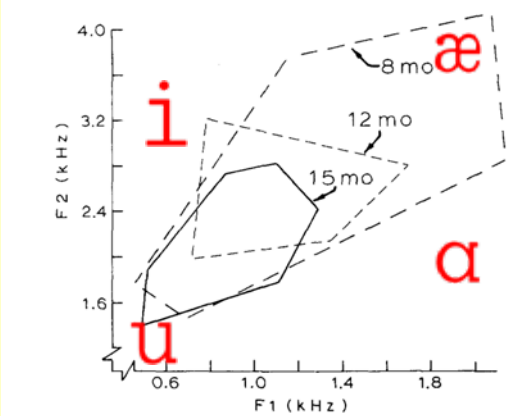


Lee, Potamianos, & Narayanan (1999)



...are important to assess articulation via spectral information (future work on this with these samples)

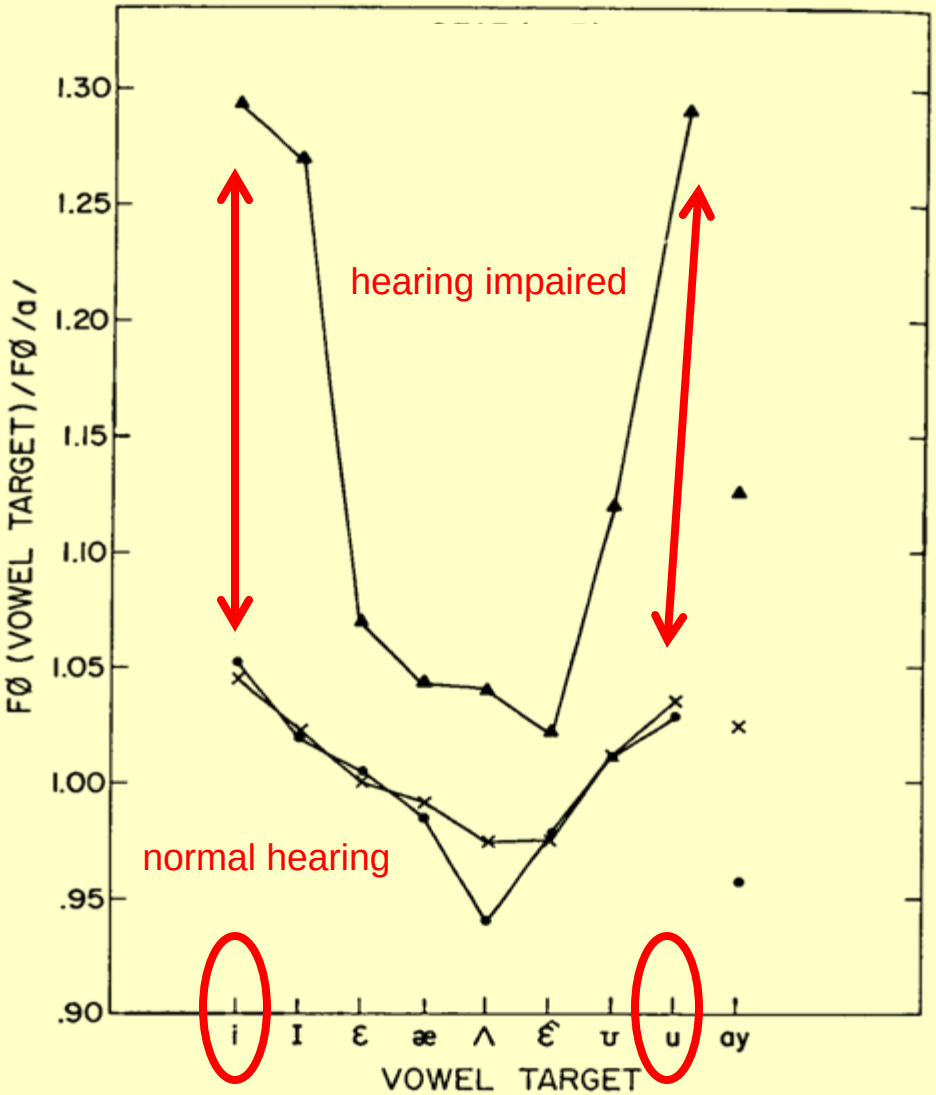




Kent, Osberger, Netsell, & Hustedde (1987)

Vorperian & Kent (2007)

Point vowels: i u



HI kids have bigger production differences with /i/ and /u/ than with other vowels.

Stevens, Nickerson, Rollins (1983)

Children

Normal Hearing (n=12)

Hearing Impaired (n=8)

Early-ID (n=5)

ID at 6.5 months

avg loss +90dBHL

Late-ID (n=3)

ID at 29.3 months

avg loss ~42dBHL

Cochlear Implant (n=4)

Hearing Aid (n=4)

Task

listen-and-repeat game, single word

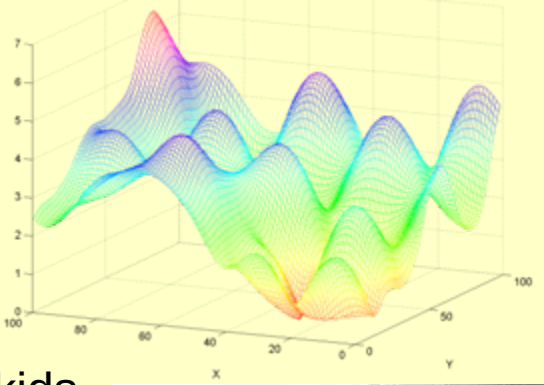
Consonant targets

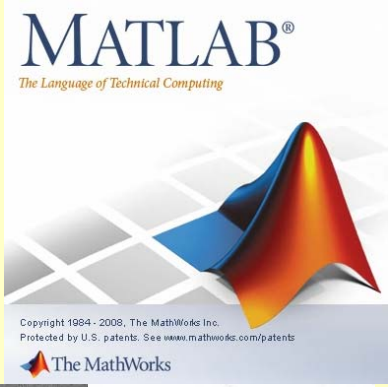
stop			continuant					
obstruent					sonorant			
pat	*tea*	*kids*	*sick*	*hop*	*moon*	*lip*	*write*	*way*
pie	*tap*	*kid*	*spot*	*house*	*my*	*lay*	*right*	*why*
pot	*tie*	*key*	*stick*	*hoop*	*mean*	*light*	*rip*	*white*
	tight	*cap*	*six*		*might*			
			see		*new*			

Vowel targets

point vowels			
æ	u	ɑ	i
bat	*do*	*pot*	*beat*
pat	*zoo*	*spot*	*tea*
tap	*hoop*	*hop*	*key*
cap	*moon*		*see*
	new		*mean*

Data





-about 2000 consonants

-about 2000 vowels

-MATLAB and PRAAT scripts customized for kids

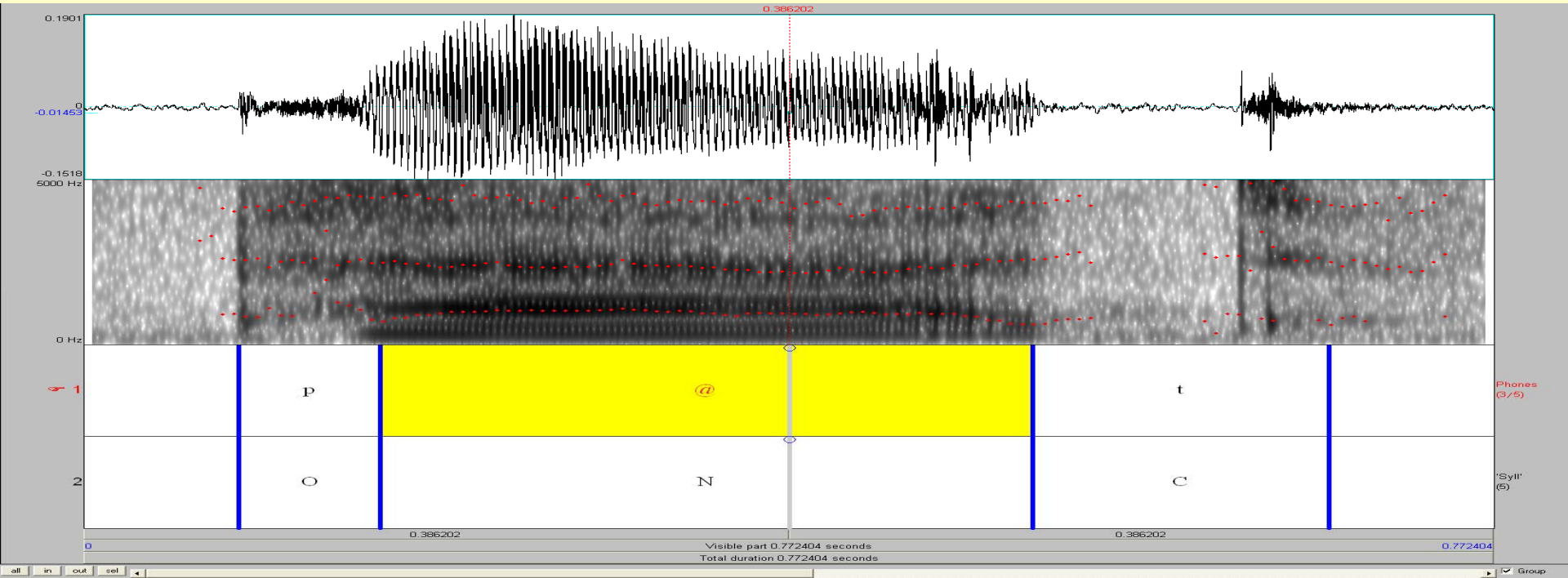
-non-parametric model: >40% of 384+ groups fail *F*-test (σ^2), Lilliefors/Jarque-Bera tests (normality), χ^2 (independence)

-bootstraped mean and confidence intervals

Pearson

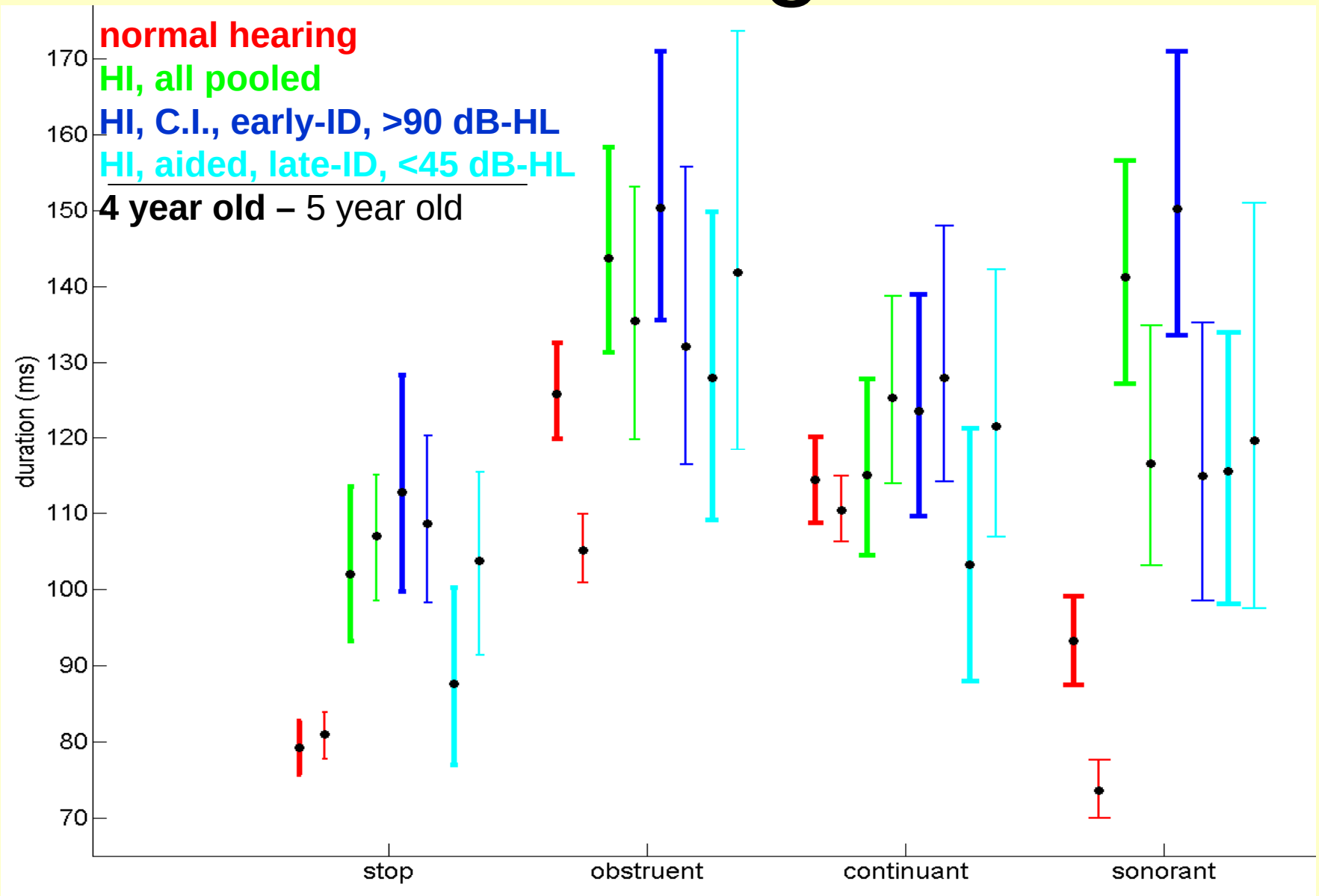
Fisher

Gauss



Results

Consonant targets



Consonants, summary

1. HI kids have longer consonants in general

2. HI kids have more durational variability

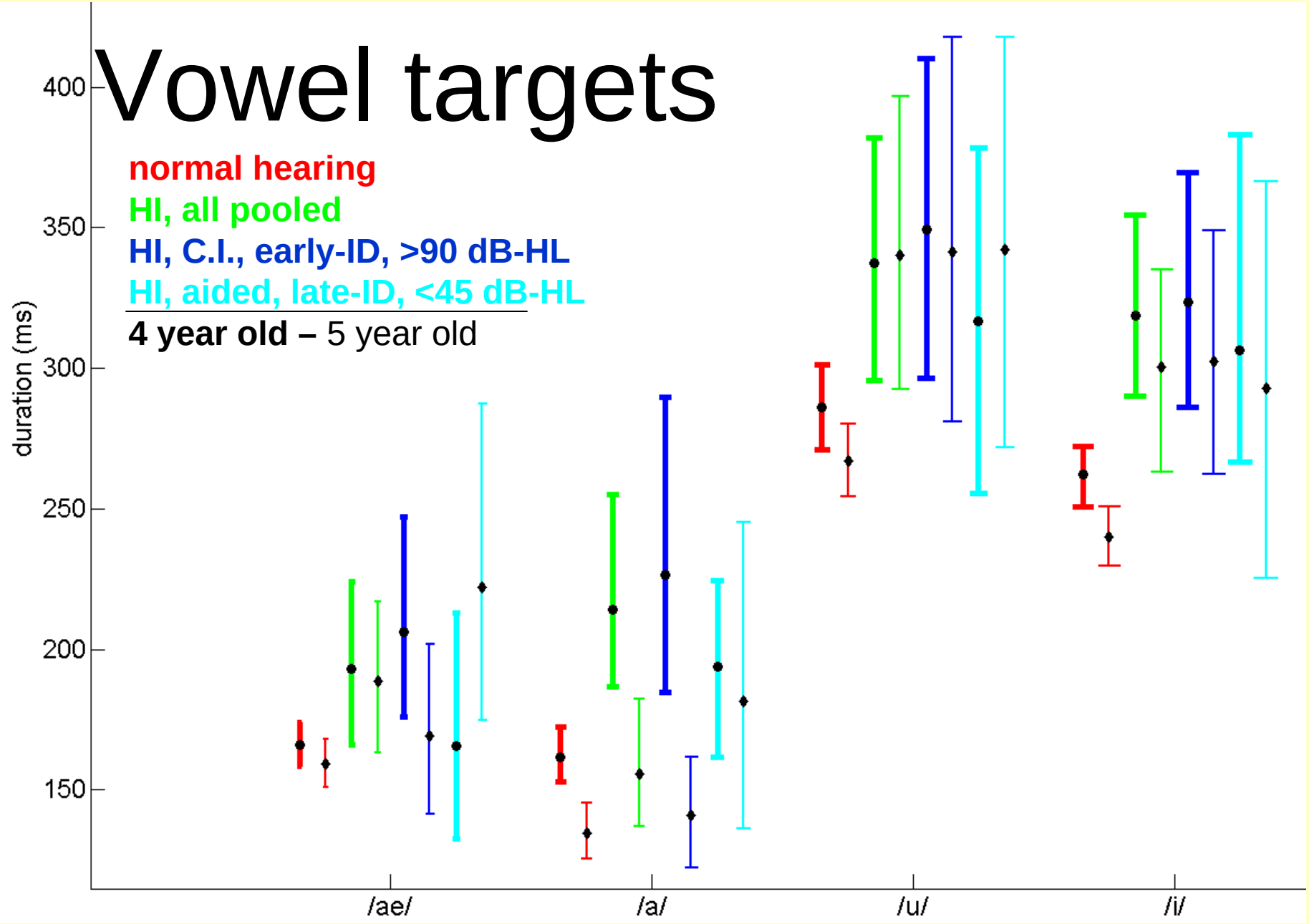
3. development is toward shorter consonants, and early-ID/CI kids appear to have an advantage

Vowels

Vowel targets

point vowels			
æ	u	ɑ	i
bat	*do*	*pot*	*beat*
pat	*zoo*	*spot*	*tea*
tap	*hoop*	*hop*	*key*
cap	*moon*		*see*
	new		*mean*

Vowel targets



Vowels, summary

1. HI kids generally have longer vowels

2. HI kids have more variable vowels

3. high vowels [i] and [u] are longer and more variable for all kids, possibly indicating those are harder for kids to master

4. development is toward shorter vowels, and early-ID/CI kids appear to have an advantage

Main Questions

Hearing impaired kids sound different from normal hearing kids.

Are phonetic productions longer for HI kids?

yes, and more variable

durations of vowels [i] and [u] stand out

What is the developmental trajectory of HI kids?

Not too bad, although early-ID/CI kids seem to have an advantage over late-ID kids