ICPhS 2023
August 7–11, 2023
Prague Congress Center, Czech Republic

20th International Congress of Phonetic Sciences (ICPhS)
August 7–11, 2023
Prague Congress Center, Czech Republic

PHONATION AND AGING IN WHITE HMONG

Esposito C.M.[1], Schäfer K.[2], Khan S.D.[3]
[1]Linguistics, Macalester College, St. Paul, USA; [2]Linguistics, UC Santa Barbara, USA; [3]Linguistics, Reed College, Portland, USA

We know the human voice changes over age in terms of:

1) f0 (Brown, Hollien, & Howell, 1991; Eichhorn et al., 2018; Honjo & Isshiki, 1980)

2) intonational patterns (Barnes, 2013)

3) /s/ spectral mean (Taylor et al., 2020)

4) overall variability (Biever & Bless, 1989; Kahane, 1980; Linville & Fisher, 1985; Linville 1988; Linville, Skarin, & Fornatto, 1989; Ramig, & Ringel, 1983)

5) phonation (voice quality); older voices are:

- perceived as “hoarse” or “breathy” (Gorham-Rowan & Laures-Gore, 2006; Ptacek & Sander, 1966)
- characterized by low harmonics-to-noise ratio (HNR) (Ferrand, 2002)
- more aperiodic/non-modal, i.e. they have lower cepstral peak prominence (CPP) value (Garrett, 2013)
- more unstable, changing glottal configuration more frequently (Gorham-Rowan & Laures-Gore, 2006)

Our questions

Gap: previous studies examine languages that do not have a lexical contrast in phonation type

How will aging affect phonation in a lg that contrasts phonation?

Will we see changes similar to those reported for lgs like English?

Or will the production of phonation types remain acoustically stable across age?

Methods

Language

White Hmong/Hmoob Dawb (Hmong-Mien)

spoken in Laos, China, and Vietnam and by a large diaspora

7 lexical tones, 2 of which carry non-modal phonation

Smalley (1976) / Ratliff (1992)/Esposito (2012)	Orthographic tone symbol	Example in White Hmong orthography
High level (55)	**b**	*pob* ‘ball-like’
Mid level (33)	**Ø**	*po* ‘spleen’
Low level (22)	**s**	*pos* ‘thorn’
High-falling (52)	**j**	*poj* ‘female’
Mid-rising (24)	**v**	*pov* ‘to throw’
Low-Falling creaky (21)	**m**	*pom* ‘to see’
High-Falling breathy (42)	**g**	*pog* ‘paternal grandmother’

Speakers

recorded producing the list of 70 monosyllabic words used in Esposito (2012)

These included all six oral vowels [i, e, ɨ, a, u, ɔ]

Read tokens in the frame *rov hais* ____ *dua* [ʈɔ24 hai22 ____dua33] ‘Say ____ again’.

# Participants	Age
8	20s
12	30s
9	40s
3	60s
3	70s

Phonation	# Tokens
modal	38
creaky	17
breathy	15

Measurements

Two acoustic measures were taken within the **beginning (1)**, **middle (2)**, and **end (3)** of each vowel:

the amplitude of the first harmonic minus the amplitude of the second harmonic **(H1*−H2*)** (Esposito, 2012; Esposito & Khan, 2012; Keating et al., 2023)

cepstral peak prominence **(CPP)** (Garellek & Esposito, 2021)

Results

4 LME regression models for H1*-H2* and CPP, as well as within-category dispersion (SD) of H1*-H2* and of CPP

Fixed effects: phonation category (breathy, modal, creaky), time point (beginning, middle, end), age (year)

Random intercepts for individuals and age of English onset

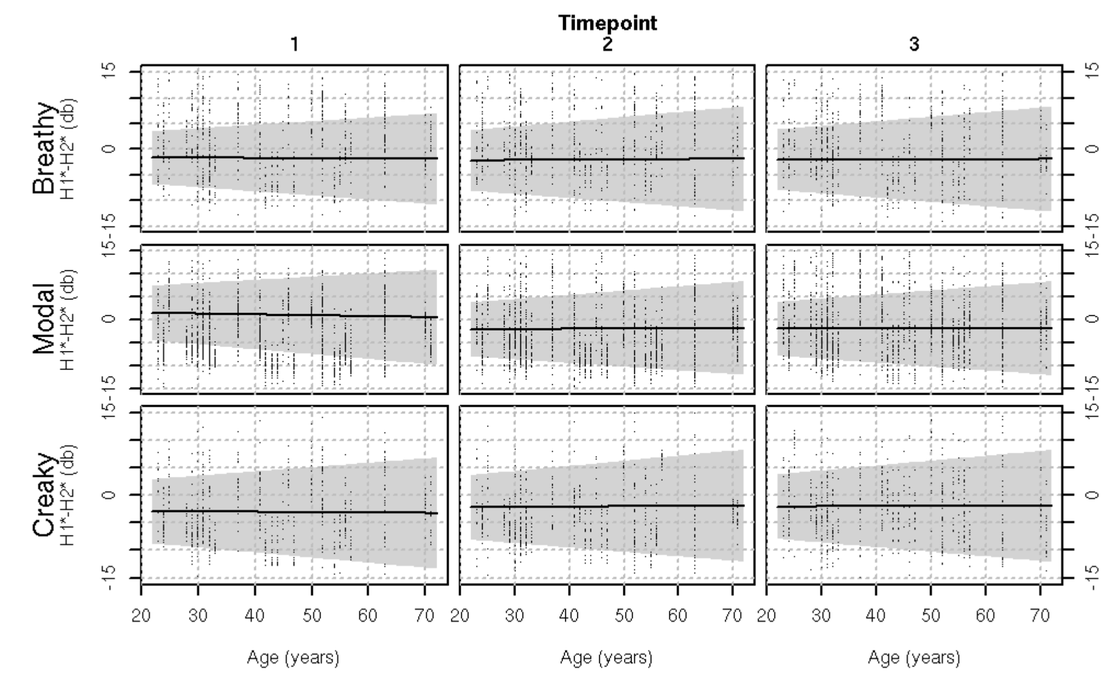

Fig 1: H1*−H2* (dB) by age at time points 1/2/3 (beg., mid., end) for each phonation type with a regression line and 95% CI (cond. r^2=.369). **Age does not affect mean H1*-H2*.**

Sig main effects of time point (χ^2=111.9, df=2, p<0.01) and phonation (χ^2=912.0, df=2, p<0.01), but not age (χ^2=0.0223, df=1, p<1.0). Sig nteractions: age × time point (χ^2=10.7, df=2, p<0.01); age × phonation (χ^2=6.29, df=2, p<0.05); time point × phonation (χ^2=138, df=4, p<0.001), but effect sizes are minuscule.

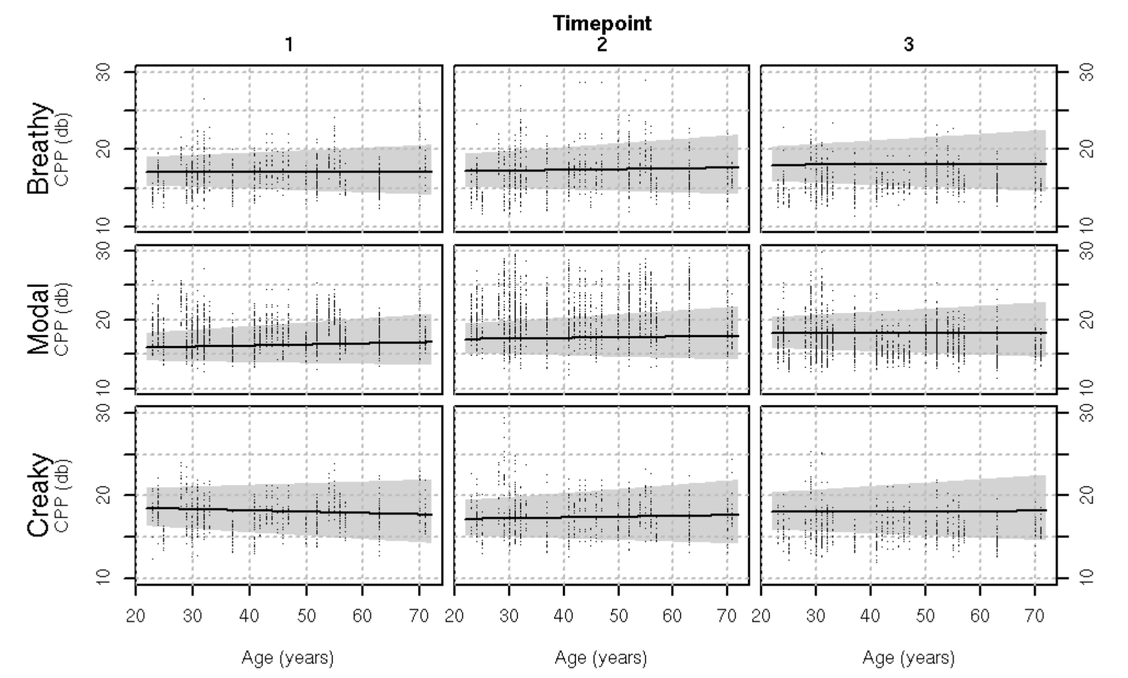

Fig 2: CPP (dB) by age at time points 1/2/3 (beg., mid., end) for each phonation type with a regression line and 95% CI (cond. r^2=.475). **Older voices are marginally more periodic.**

Sig main effects of time point (χ^2=2410, df=2, p<0.001) and phonation (χ^2=1308, df=2, p<0.001). Age was not a sig main effect (χ^2=0.0989, df=1, p<1.0). All two-way interactions were also sig: age × time point (χ^2=36.21, df=2, p<0.001), age × phonation (χ^2=70.70, df=2, p<0.001), and time point × phonation (χ^2=551.8, df=4, p<0.001).

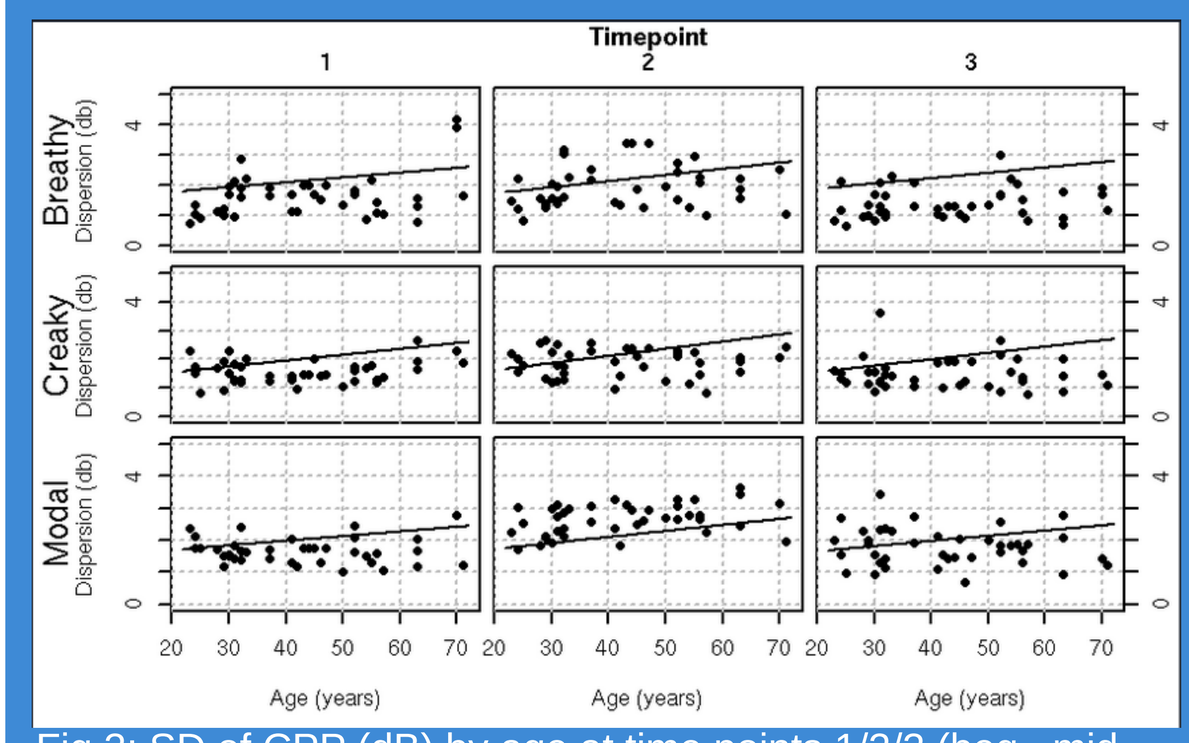

Fig 3: SD of CPP (dB) by age at time points 1/2/3 (beg., mid., end) for each phonation type with a regression line and 95% CI (cond. r^2=.402). **Older voices are more variable.**

Significant main effects of age (χ^2=5.80, df=1, p<0.05), time point (χ^2=102, df=2, p<0.001), and phonation (χ^2=42.0, df=2, p<0.001). Significant interactions: time point × phonation (χ^2=23.9, df=4, p<0.001), age × time point (χ^2=5.77, df=2, p<0.1).

Returning to the Questions

How does aging affect phonation in a lg with contrastive phonation?

It doesn’t, at least not much or and not in the expected direction

Voices do **not** become more aperiodic over time

Means are remarkably stable across age, even if variation increases

Future directions

More speakers and more languages with similar structures

Factor in tone by:

Comparing only falling tones/consider f0 as an independent var

Considering lgs (like Gujarati) with non-tonal phonation contrasts