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, 1988; Raming, & 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

<table>
<thead>
<tr>
<th>Mandarin (b)</th>
<th>Hmong (n)</th>
<th>Orthographic tone symbol</th>
<th>Example in White Hmong orthography</th>
</tr>
</thead>
<tbody>
<tr>
<td>High level (5)</td>
<td>b</td>
<td>🅃</td>
<td>bәt ‘ball-like’</td>
</tr>
<tr>
<td>Mid level (3)</td>
<td>Ø</td>
<td>ᳯ</td>
<td>ɕ ‘spoken’</td>
</tr>
<tr>
<td>Low level (1)</td>
<td>a</td>
<td>o</td>
<td>ɾ ‘thorn’</td>
</tr>
<tr>
<td>High-falling (2)</td>
<td>j</td>
<td>j</td>
<td>ᵌ ‘female’</td>
</tr>
<tr>
<td>Mid-falling (4)</td>
<td>v</td>
<td>v</td>
<td>ᵊ ‘to throw’</td>
</tr>
<tr>
<td>Low-falling-crucial (2)</td>
<td>m</td>
<td>m</td>
<td>ᵋ ‘to see’</td>
</tr>
<tr>
<td>High-falling breathy (42)</td>
<td>(&lt;?)</td>
<td>(&lt;?)</td>
<td>ʂ ‘traditional grandmother’</td>
</tr>
</tbody>
</table>

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’.

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) (Garrellek & 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), and time
Random intercepts for individuals and age of English onset

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

Returning to the Questions
How does aging affect phonation in a lg with contrastive phonation?
It doesn’t, at least not much or not in the expected direction
Voices do not become more aperiodic over time
Means are remarkably stable across age, even if variation increases significantly.