The Aging Voice:
an Acoustic, Electroglottographic and Perceptive Analysis of Male and Female Voices

Ralf Winkler, Markus Brückl, Walter Sendlmeier

Department of Language and Communication

Technical University Berlin, Germany

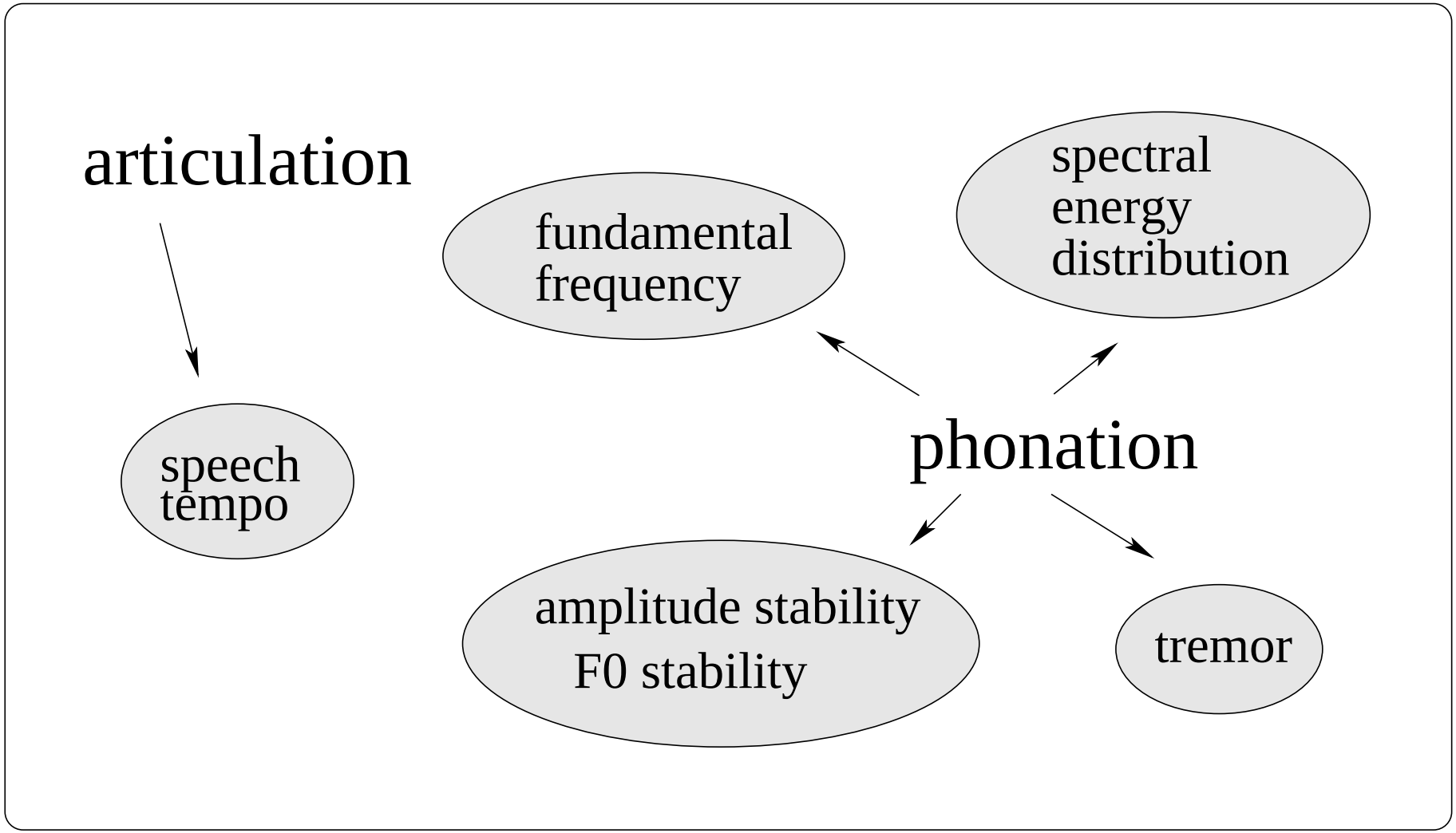
Central questions of this study

- Acoustic features:
  – What are the acoustical cues of aging voices?
- Features of the EGG waveform:
  – Can EGG improve understanding of age-related phonation?
- Perception of speakers age:
  – How is accuracy of age recognition related with stimulus type?

Exp. A: Acoustic Measurements

- Data
  – 56 female speakers - 20 to 87 years old
  – sustained German vowel /a/, /i/, /u/ (onset and stationary), read and spontaneous speech
- Methods
  – measurement of 33 acoustical parameters with MDVP
  – calculation of the *perceived age* per stimulus (mean estimation of 15 listeners)
  – calculation of correlation coefficients between the acoustic measurements and chronological as well as perceived age

Exp. A: Acoustic Measurements



Exp. A: Acoustic Measurements

- Summary of the acoustical Parameters

  – higher correlations of acoustics with perceived age than with chronological age

  – decreasing f_0 is a predictor for increasing age in female voices

  – increasing amplitude perturbation is a better indicator for age than frequency perturbation

- Best predictors dependent from stimulus type:

  – **sustained vowels:** frequency tremor intensity index, independent of vowel quality

  – **read speech:** f_0

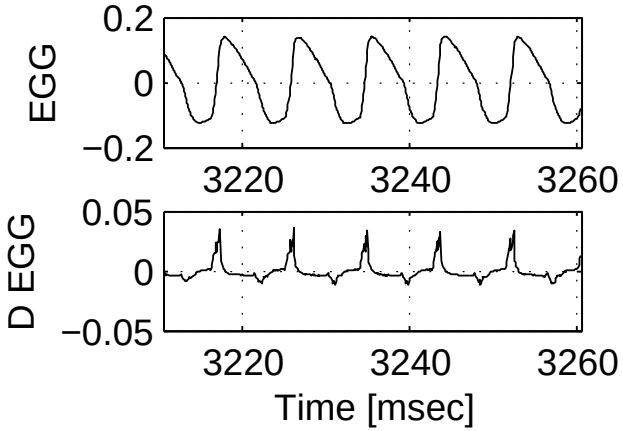
  – **spontaneous speech:** shimmer, f_0

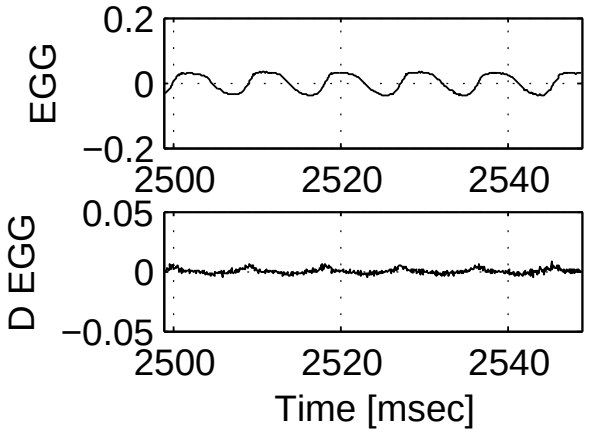
Exp. B: EGG Measurements

- Data
  - 24 female and 26 male speakers differing in age (grouped young vs. old)
  - sustained German vowel /a/
- Methods
  - calculation of perceived age by estimations of 18 listeners
  - qualitative evaluation of EGG signals
  - qualitatively evaluate the corresponding LTAS measurements

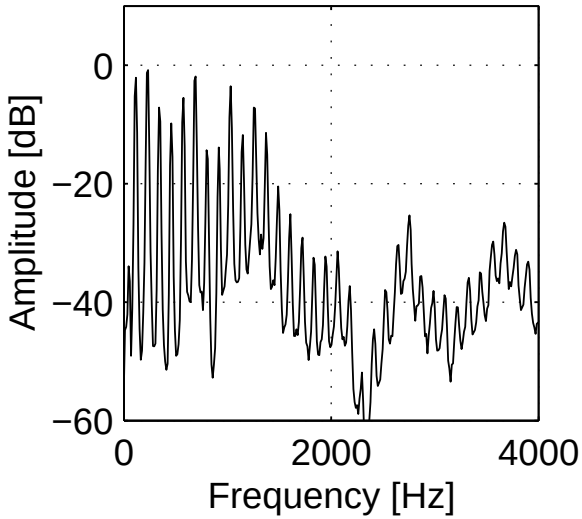
Exp. B: EGG Measurements

Qualitative results of LTAS measurements (male speakers)

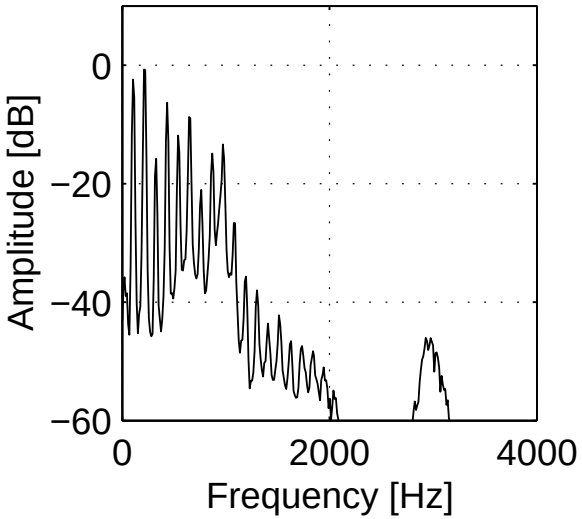




perceived as young



perceived as old



Exp. A: Acoustic Measurements

- Results of age perception depending on stimulus type

Correlation coefficients between chronological and perceived age

	/a/-o	/a/-s	/i/-o	/i/-s	/u/-o	/u/-s	read	spontaneous
r	.559	.443	.738	.603	.460	.344	.862	.864
p	.000	.000	.000	.000	.000	.005	.000	.000

- sustained vowels: /i/ (red ellipse) correlates better than /a/ and /u/
- read/ spontaneous speech (blue ellipse): best estimation possible
- Stimuli *with vowel onset* correlate better than the corresponding stimuli without onset!

Conclusions

- What are the acoustical cues of aging voices?

  – in spontaneous speech the best indicator of age is amplitude perturbation (preferably averaged over 20-250 ms)

  – dependent of stimulus type good predictors of age are frequency tremor intensity index and fundamental frequency

Conclusions

- Can EGG signals improve understanding of age-related phonation?

  – in male voices stimuli with more sinusoidal EGG signals are perceived as older

  – there seems to exist a relation between the sinusoidal shape of the EGG and the spectral damping between 2 and 4 KHz in the LTAS of male voices.

- How is accuracy of age recognition related with stimulus type?

  – vowel onset seems to encode age related informations