



# Stability of prosodic characteristics across age and gender groups



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## I. Summary

- Adult speakers of Czech – a West Slavic language of Central Europe
- Czech native speakers born or permanently living in or around the capital city of the Czech Republic (the region called Central Bohemia)

## II. Material & Processing

- Read an extract from book of narratives by K. Čapek (12 ideal breath-groups)
- 106 females, 94 males (see Table 1), processing in Praat & rPraat in R
- Recordings carefully manually segmented on the phone level
- F0 tracks extracted and manually corrected to eliminate errors
- Intensity measured in 10ms steps, cubic interpolation

Table 1: Composition of the speaker sample.

Age Band	Age Interval (years)	n Females	n Males
20s	(19,29]	19	17
30s	(29,39]	16	18
40s	(39,49]	8	14
50s	(49,59]	13	12
60s	(59,69]	25	14
70s	(69,79]	25	19

- To avoid pseudoreplications in scatter plots & regression analyses, each data point represents one speaker rather than all utterances
- Cumulative slope index to measure variability

$$CSI = \frac{1}{N_{syll}} \sum_{n=2}^N |x(n) - x(n-1)|$$

## III. Temporal domain

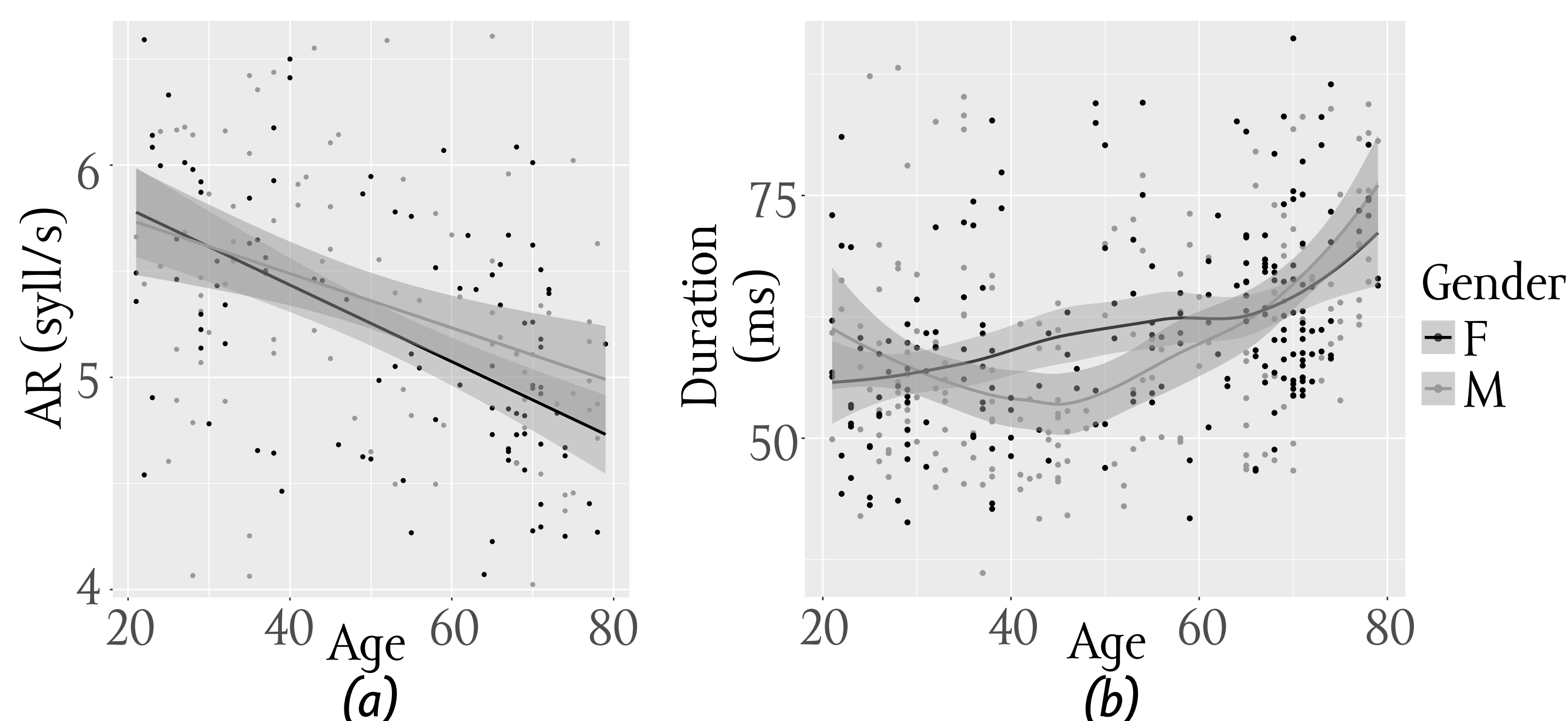


Figure 1: (a) Articulation rate over age, (b) vowel duration over age.

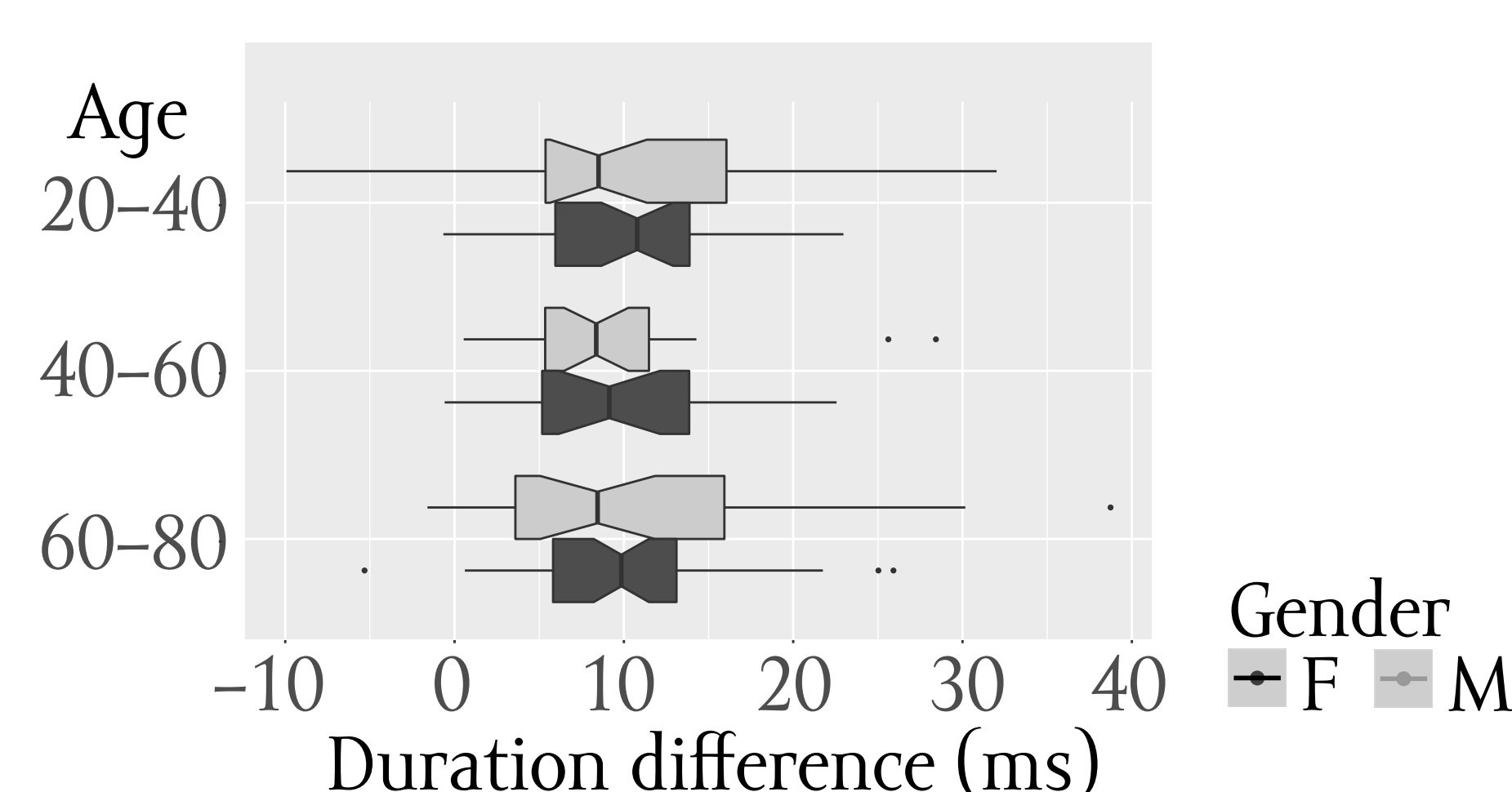


Figure 2: Variation in mean phone duration differences between 2 neighbouring parts.

Correlation over age  
AR (see Figure 1a)  
F:  $r = -0.520$ , M:  $r = -0.339$

## IV. Variation in intensity contours

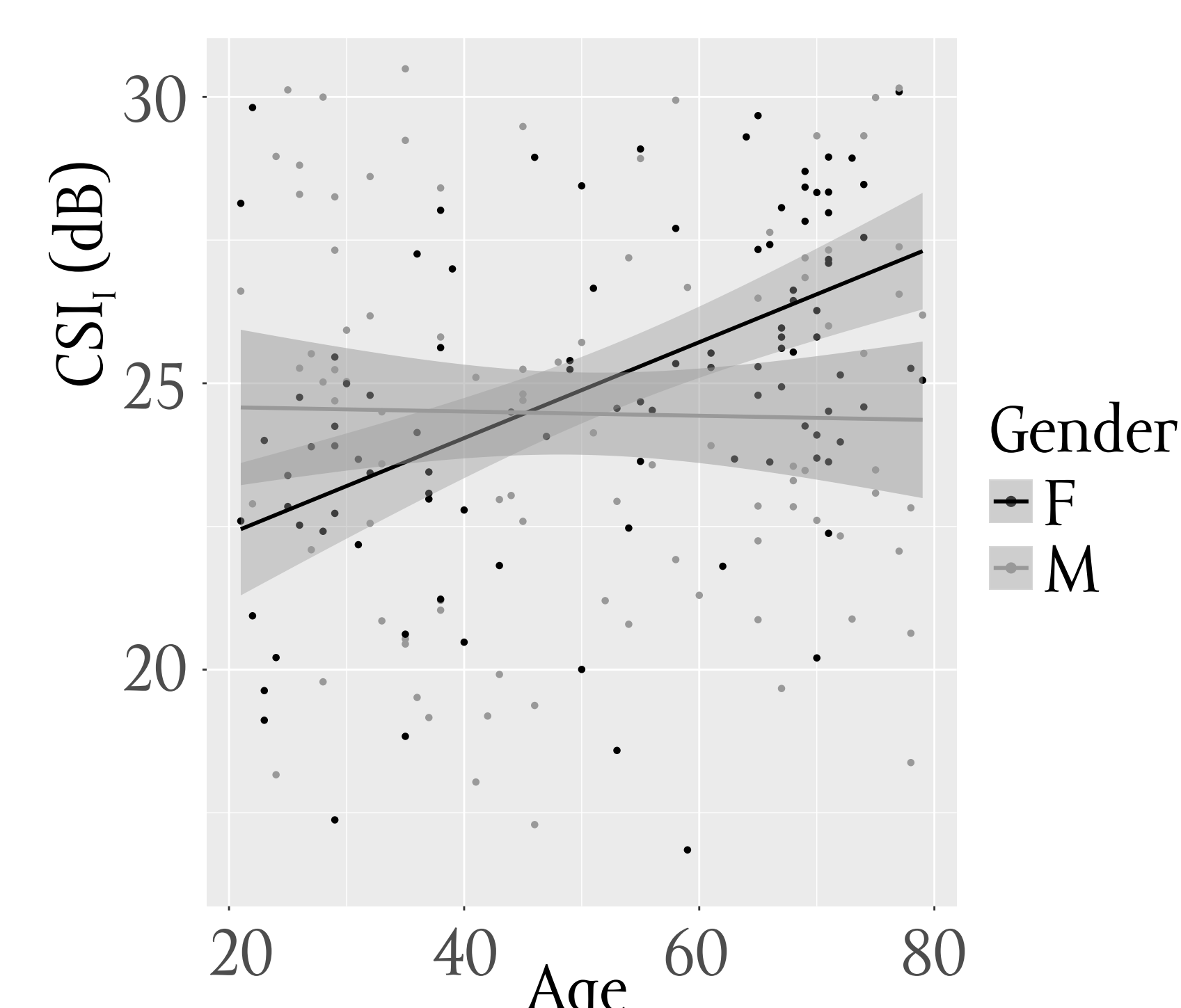


Figure 3: CSI of intensity contours over age.

Correlation over age  
CSI of intensity  
F:  $r = 0.456$ , M:  $r = -0.019$

## V. Fundamental frequency domain

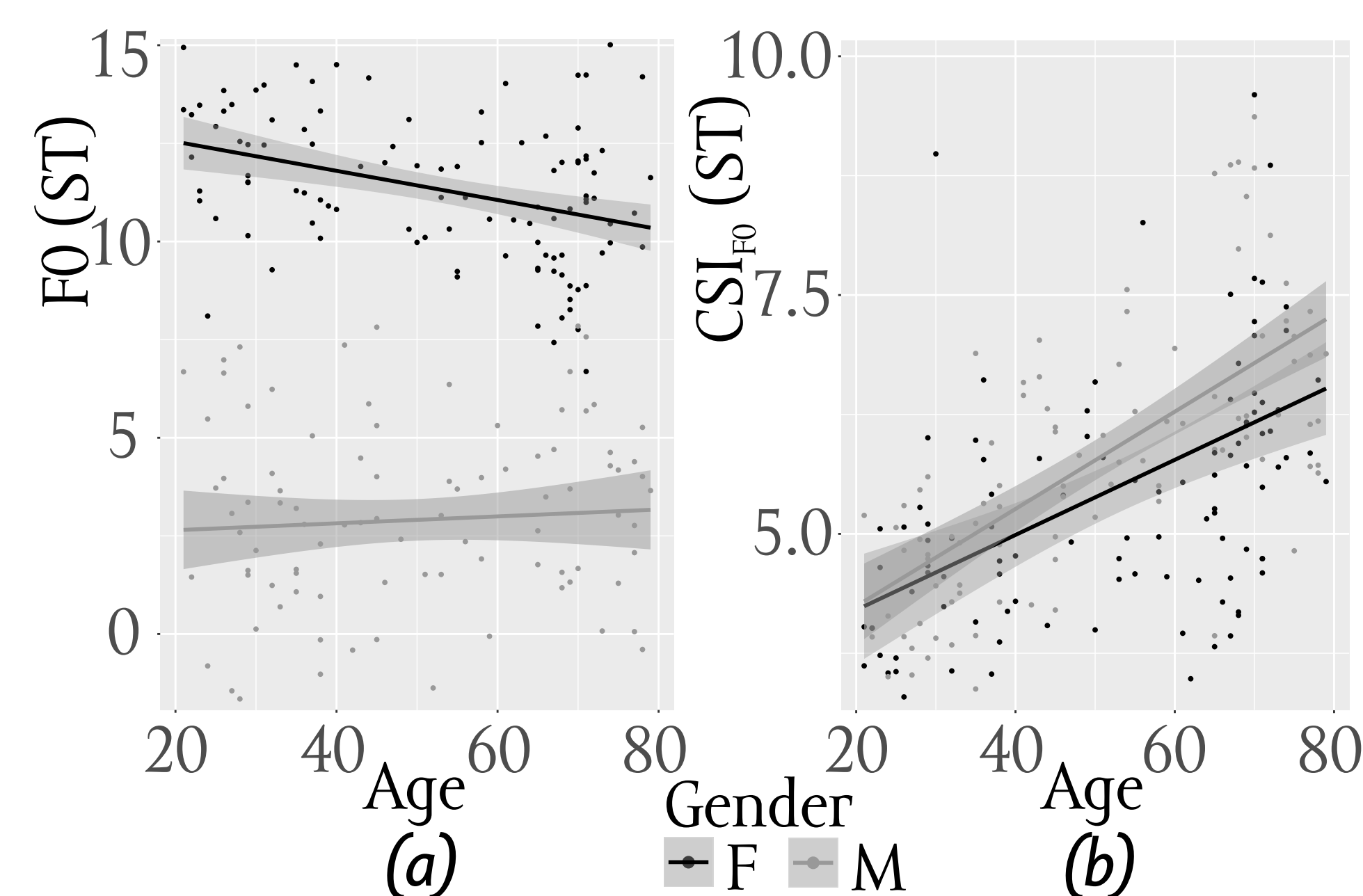


Figure 4: (a) Mean F0 over age, (b) CSI of F0 over age.

Correlation over age  
Mean F0  
F:  $r = -0.365$ , M:  $r = 0.026$   
  
90% range of F0  
F:  $r = 0.348$ , M:  $r = 0.168$   
  
CSI of F0  
F:  $r = 0.451$ , M:  $r = 0.671$

## VI. More regressions and a linear model

Correlation  $AR_{syll}$  vs  $CSI_I$  F:  $r = -0.736$ , M:  $r = -0.631$   
 $AR_{syll}$  vs  $CSI_{F0}$  F:  $r = -0.295$ , M:  $r = -0.381$

Predicted age

$$age_F = 55.7 + 3.7 CSI_{F0} - 8.8 AR_{syll} + 0.9 CSI_I$$

$$age_M = 75.0 + 7.8 CSI_{F0} - 7.2 AR_{syll} - 1.3 CSI_I$$

50% of residuals F: -11.2 to 10.0 yrs, M: -9.6 to 9.3 yrs.

## VII. Fundamental frequency contours in stress-groups

- F0 profiles of several selected 4-syllable stress-groups
- Legendre polynomials (in rPraat)
- K-means cluster analysis
  - Method 1: coefficients of L. polynomials
  - Method 2: equidistantly sampled L. polynomial interpolation of F0 contour

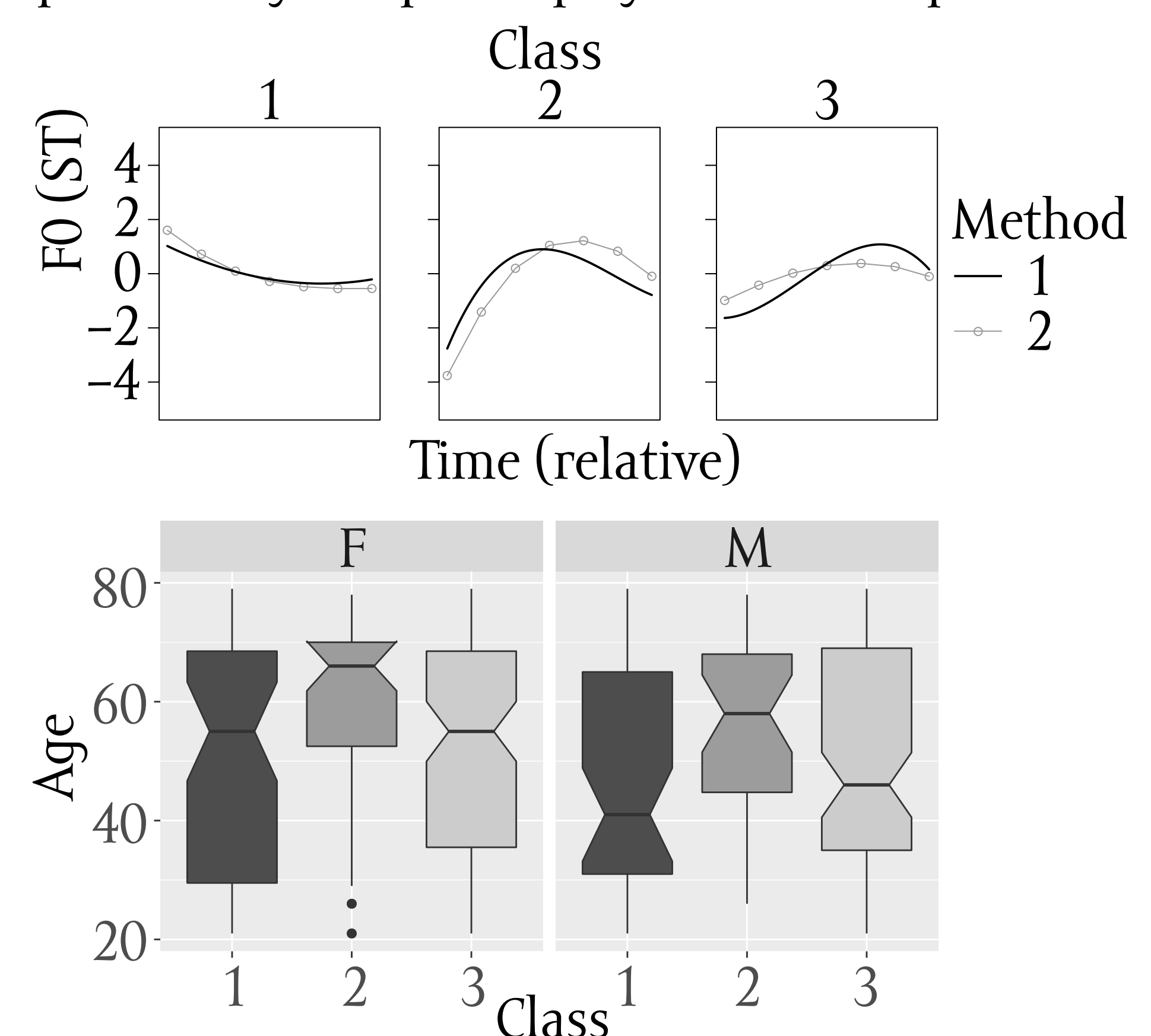


Figure 5: The resulting F0 courses from cluster analysis (top) and preferences of the contour classes by age groups.

## VIII. Conclusions

- Trends found elsewhere were confirmed and quantitatively specified for Czech population.
- The novel CSI index helps to uncover prosodic variability in more detail than the typical 90% range parameter.
- Fast articulation rates tend to iron out prosodic variation: fast speakers make fewer prosodic boundaries and fewer prominences.
- The age should not be reduced to mere physiological deterioration. Aging is also a mental process that influences the attitudes of an individual to the surrounding world.
- Our elderly subjects seemed more self-confident and more talkative. In comparison with the youngest subjects they were also less anxious about making errors in the reading task.