

Does time of day matter for voice assessment?

Clinical implications of longitudinal fluctuations in voice parameters

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Background

Current approaches to clinical voice assessment typically rely on “snapshot” sampling.

There are a few studies of longitudinal voice variation** but limited information about the scale of within-speaker vocal fluctuation in either people with healthy voices or those with voice disorder.

Question - *How do we decide whether an observed change in voice quality is just part of expected within-speaker fluctuation?*

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e.g. Garrett & Healey, 1987; Jonsdottir, Laukkanen, & Siikki, 2003; Ben-David & Icht, 2016

Specific motivation/context – prevention is better than a cure

We are developing mobile phone technology for longitudinal monitoring of vocal health.

Aim: to detect deviations from normal (healthy) patterns of variation and provide targeted voice care advice when it is needed → improved vocal health - a preventative approach.

Requires a better understanding of typical longitudinal variation in healthy voices.

Aim of this study

- to understand typical fluctuations in voice parameters that are commonly used for voice assessment. Specifically:
 - to quantify the range of variation for these parameters
 - to identify any regular diurnal patterns of variation

Method

- **Participants**

- 12 women; no reported voice problems.
- All participants → at least 15 recordings at varying times of day (total = 246 recordings)

- **Data**

- Collected via mobile phone (“Voicecheck” app)
- Audio recordings (vowels + read text)
- Self reports of voice status and recent voice use

- **Acoustic analysis**

- 16 acoustic parameters extracted from voiced portions (concatenated sustained vowels + voiced parts of connected speech)

- **Perceptual analysis**

- A subset of recordings analysed using Vocal Profile Analysis (*Mackenzie-Beck, 2005*)

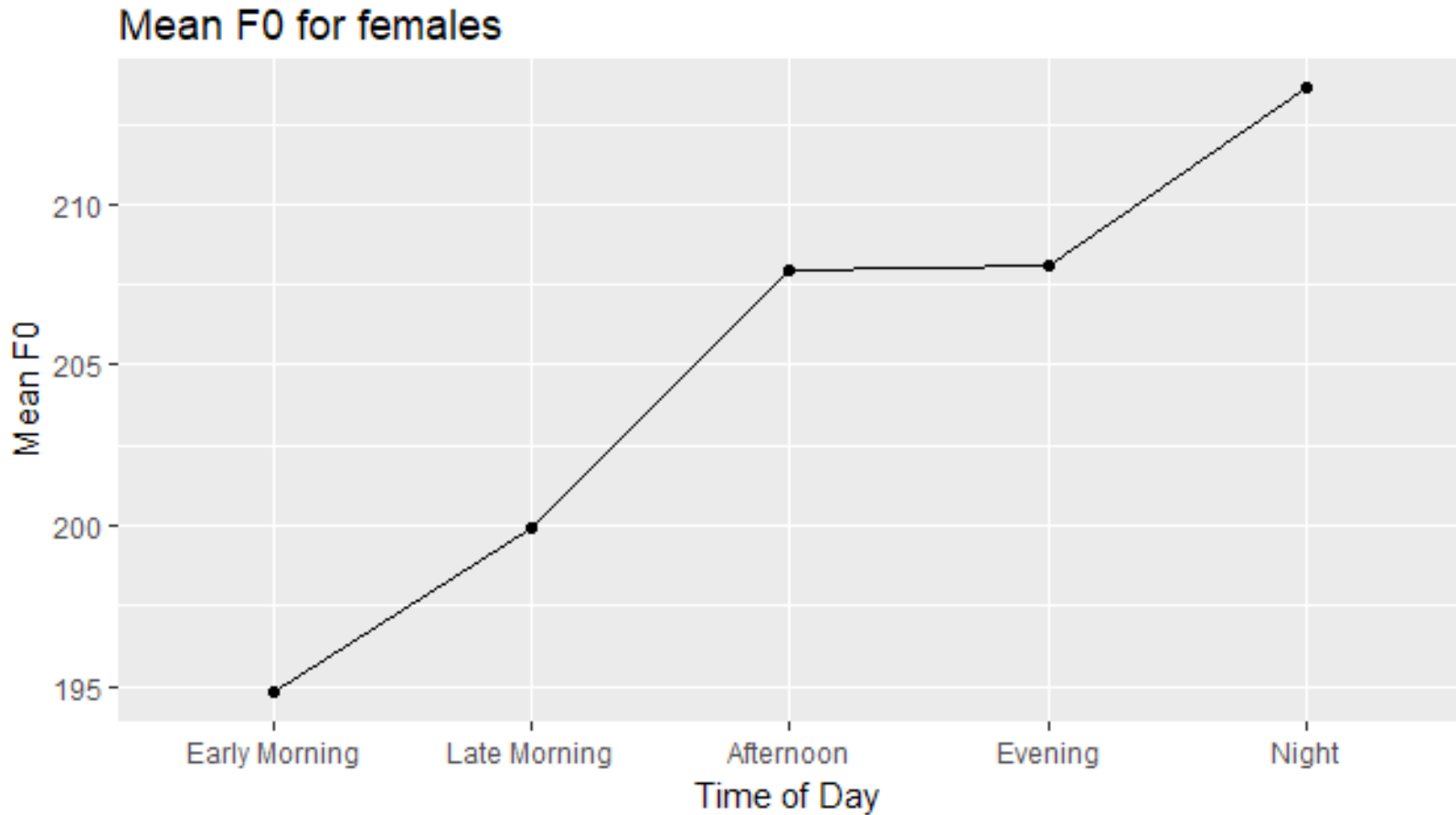
Time of day

Early morning	5 am – 8 am
Late morning	9 am - noon
Afternoon	noon – 5 pm
Evening	5 pm – 9 pm
Late evening	10 pm - midnight

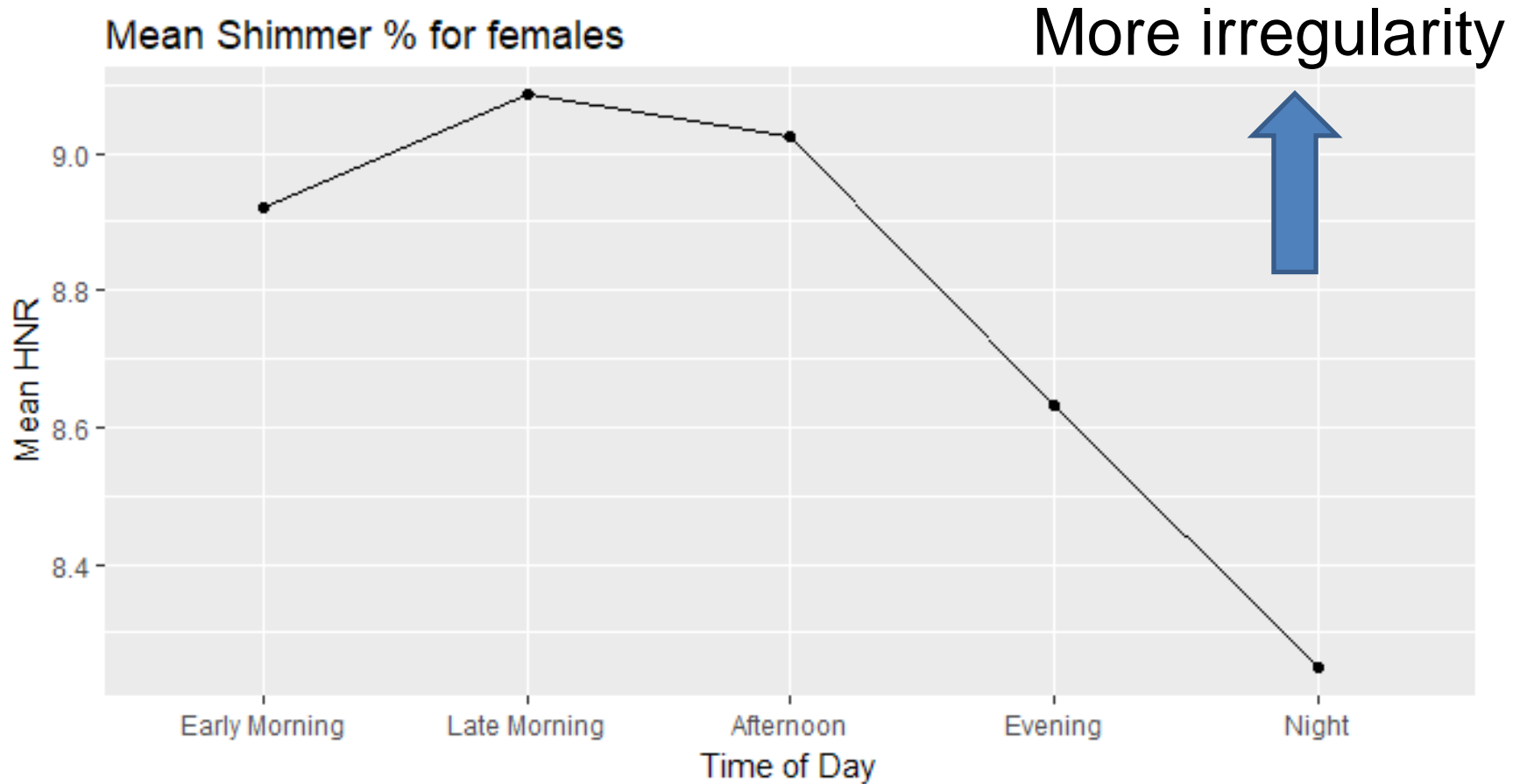
Significant time of day effects

- Harmonics to noise ratio (HNR)
- Shimmer %
- Spectral tilt
- Smoothed Cepstral Peak Prominence (CPPS)
- Acoustic Voice Quality Index (AVQI) - a composite measure

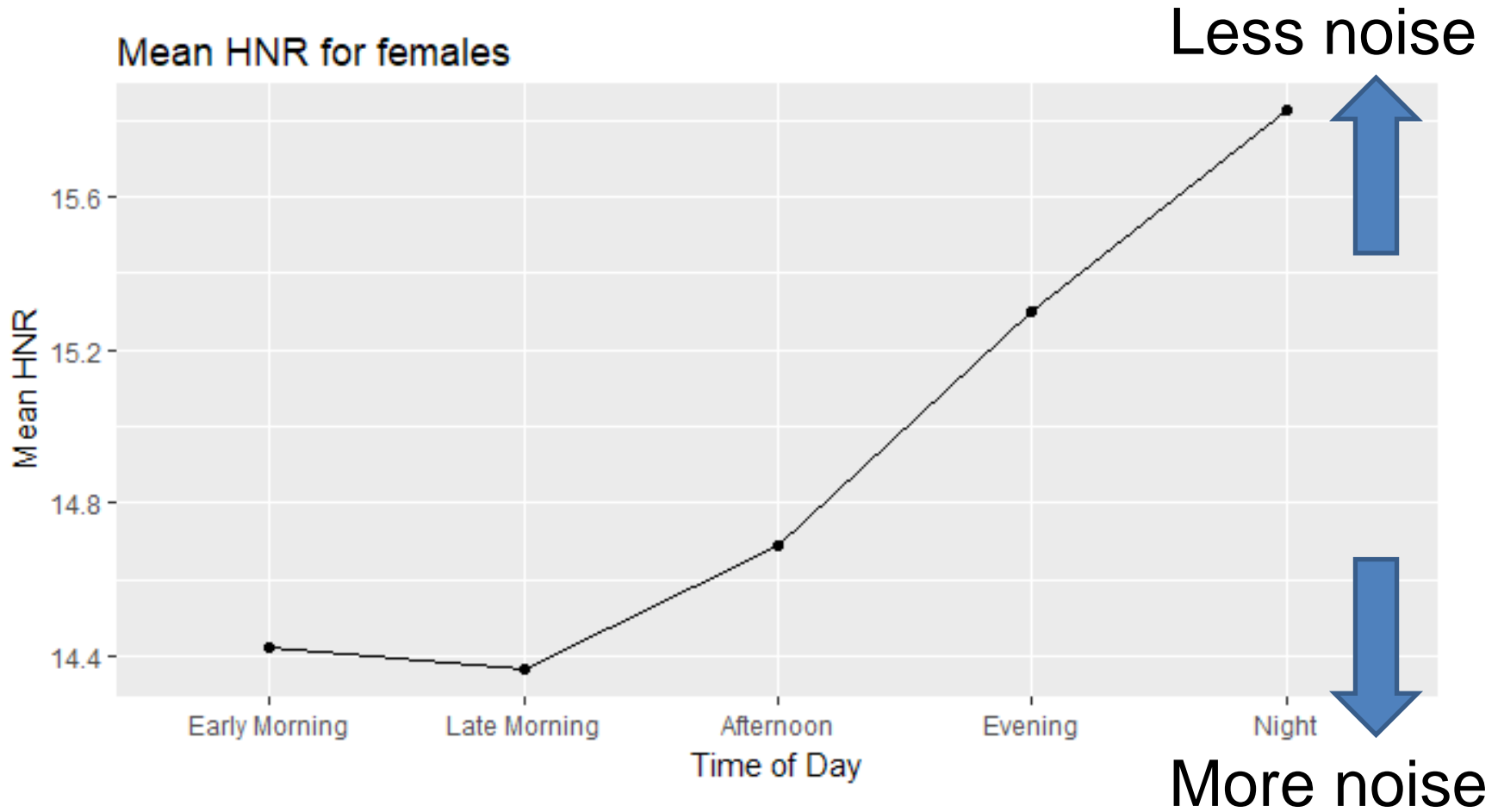
Mean F0 and time of day



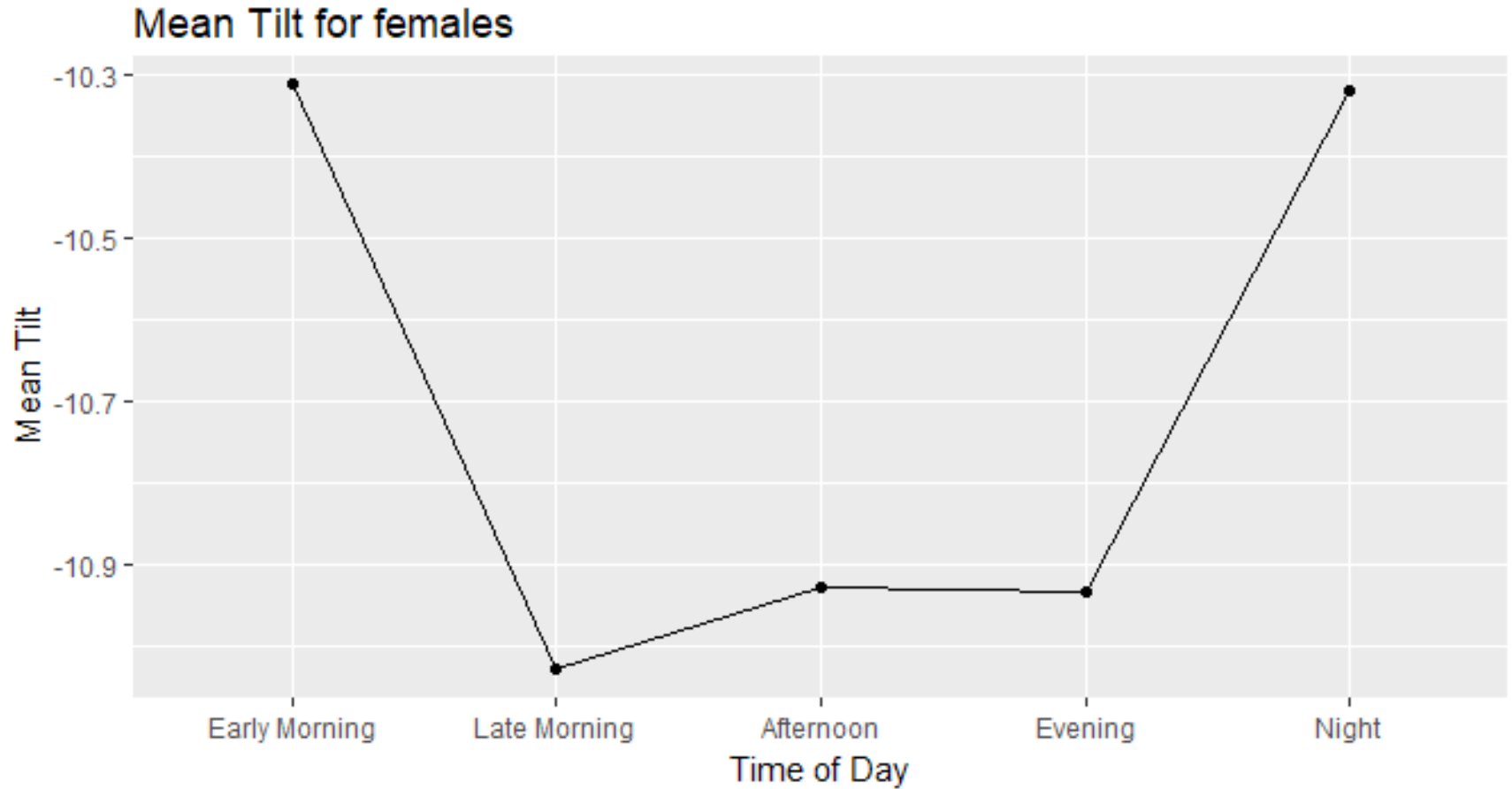
Shimmer and time of day



HNR and time of day



Spectral tilt and time of day



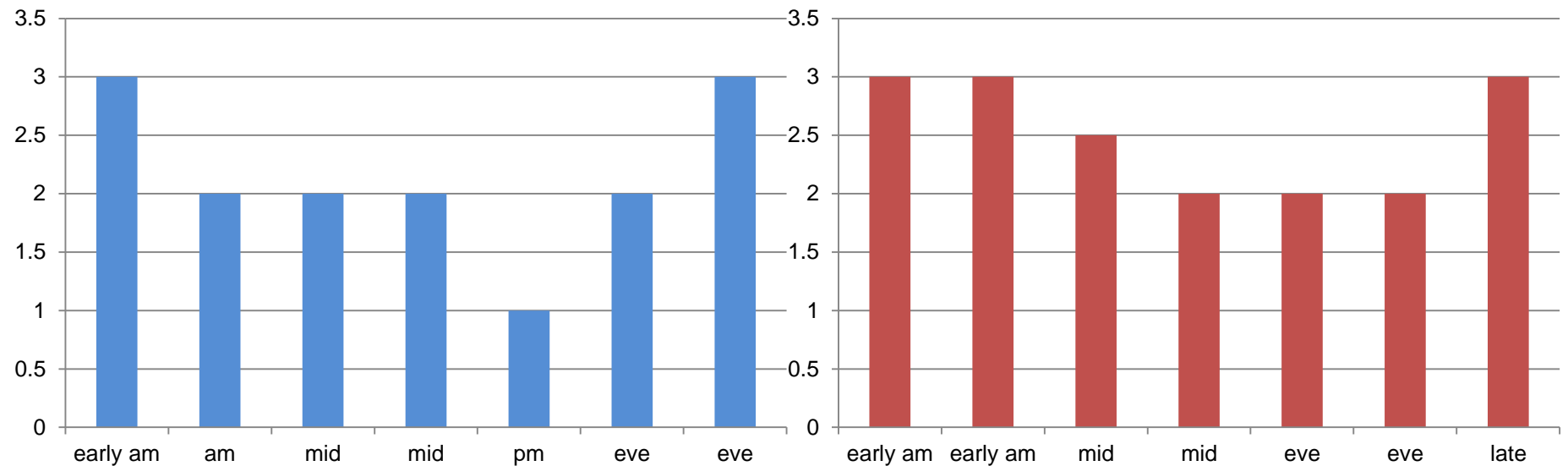
Are these fluctuations audible? (preliminary findings)

- Vocal Profile Analysis – 2 participants, 7 samples each spread over time of day

Minimal variation in vocal tract settings

Some variation in VPA judgements for laryngeal tension, larynx position and phonation type. Early morning recordings perceptually more whispery, lower pitch and less stable.

Whisperiness and time of day



Speaker 1

Speaker 2

Consistent with spectral tilt and HNR findings

Conclusions

- Longitudinal monitoring shows considerable within-speaker fluctuation, with some diurnal tendencies.
- Diurnal patterns of acoustic fluctuation are consistent with gradual increase in muscle tension from early morning to early evening.
- Further research needed, but time of day may indeed matter.

References

- Garrett, K.L.& Healey, E.C.(1987) An acoustic analysis of fluctuations in the voices of normal adult speakers across three times of day. *J. Acoust. Soc. Am.* 82(1):59-62
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- Ben-David, B. M., & Icht, M. (2016) Voice changes in real speaking situations during a day, with and without vocal loading: Assessing call center operators. *Journal of Voice* 30(2):247
- Mackenzie Beck, J. (2005) Perceptual analysis of voice quality: the place of vocal profile analysis. In: Hardcastle, W.J, Mackenzie-Beck, J. *A Figure of Speech: a Festschrift for John Laver*. Mahwah, NJ: Lawrence Erlbrum Associates; p. 285-322.