Vowel Space as a Tool to Evaluate Articulation Problems

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Abstract

- Oral cancers are treated with surgery and chemo-radiotherapy
- Treatment often leads to articulation problems
- Vowel Space useful for informing patient and SLP†
- Vowel Space Dimensions relevant for articulation

Background and Aim

- Patients Receive Speech & Language Therapy
- Understand and communicate cause and effect

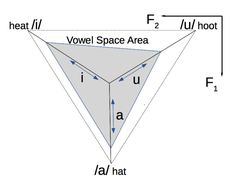
⇒ Visualize vowel space for patient and SLP†

Test relevance of vowel space for disordered articulation

Example: Patient with an oral tumor

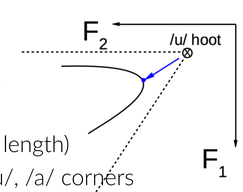
Plotting and Measuring Vowel Space

- Map points on axis *Centroid--Corner*
- Fit triangle on points
- Vowel Space Area (VSA)
- Distances to i, u, a in %



A fully automated *Praat* script

- Scan recording for syllables
- Find vowel F_1/F_2 tracks*
- Normalize M/F (vocal tract length)
- Plot points closest to /i/, /u/, /a/ corners



†SLP: Speech-Language Pathologist

**Praat* Robust formant analysis is used in this presentation

Results: 1. Normal Speakers

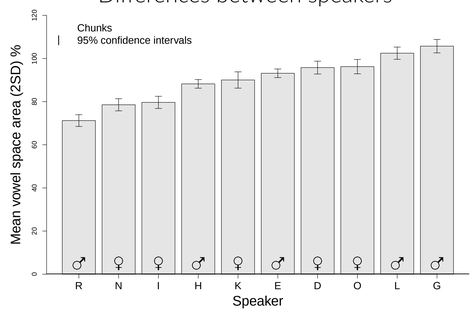
Materials&Methods: IFA corpus

- Normal speech, 10 speakers (F/M: 5/5)
- 6 speaking styles:
  Informal, Retold, Text, Sentences, Words, Syllables
- 1161 fragments, Chunks
- Average chunk duration 30 sec; ∼10 hours total
- Free corpus: `http://www.fon.hum.uva.nl/`

→ `IFA-SpokenLanguageCorpora/`

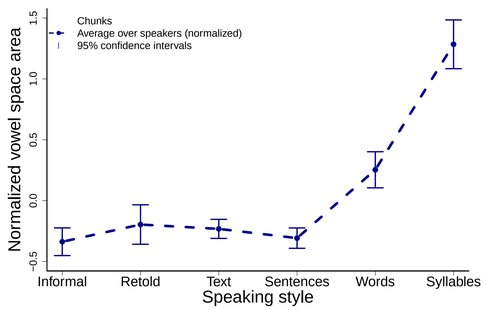
Vowel Space Area (VSA) in IFA corpus

Differences between speakers



Average VSA by speaker

Differences between speaking styles
after normalization for speaker differences



Average normalized VSA by style

Systematic Effects

- Between individual speakers
- Between speaking styles: Vowel reduction

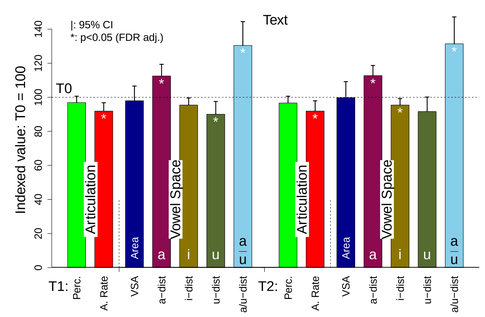
2. Speakers with Oral Tumors

Materials&Methods

- Recordings from 30 patients (F/M: 14/16)
- Treated with surgery and/or (chemo-)radiotherapy
- Recorded before treatment (T0) and after 6&12 months (T1 & T2)
- 86 recorded sessions, 4 missing at T1
- Text reading: neutral story, ∼150 words/65 sec
- *Articulation rate*: fast repeat of /pataka/
- *Deviant articulation* rated by 4 experts (VAS)

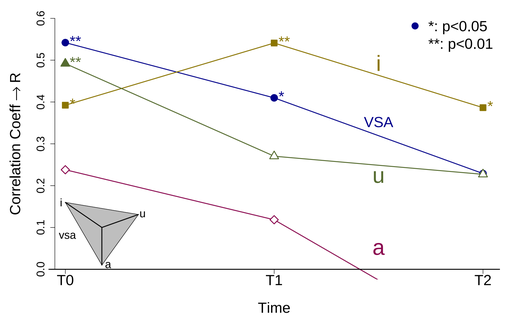
Vowel Triangles of Patients

Changes after treatment (6mnd, 12mnd)



Indexed values at T1 and T2

Correlation Deviant Art. and Vowel Space



Correlation with vowel space

Systematic Effects

- Average Articulation Rate reduces after treatment
- Shift from /u/→/a/-corner ($\frac{/a/}{/u/}$ increases)
- Deviant articulation correlates with VSA, /u/, /i/

Conclusions

Vowel space parameters contain relevant information about articulation

- In normal speakers and speakers with oral tumors
- Patient group too diverse for detailed analysis

From proceedings paper:
- Deformed plots are easy to spot and rate
- Longer speech recordings are better

Future:
- Better vowel detection
- Vocal Tract Length normalization
- Link with tongue mobility

Vowel Triangle Tool

- Aimed at researchers and speech therapists (8 languages, in β-release)
- Praat script
- Must still be validated

Test it yourself (GPL licensed)

`https://github.com/robvanson/VowelTriangle`
`https://praat.org`
Media in Proceedings (requires Praat v6.0.37)

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User Interface