FRYSKE AKADEMY

# Visible Vowels

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## Visible Vowels

- A free application for vowel normalization and visualization.
- Combining user friendliness with maximum flexibility and functionality.
- Available as an online application and as an R package:
  - `visiblevowels.org`
  - download `visvow`
- Uses a live view, i.e. each time the user changes something in the settings, the plot shown in the viewer is immediately adjusted accordingly.

## Characteristics

- Input file: spreadsheet saved in the format .xlsx.
- Data may contain unlimited number of categorical variables and unlimited number of time points.
- The (modified) input table can be downloaded either as tab-delimited text file or as Office Open XML file.
- Graphs can be saved in five different formats (SVG, PDF, EPS, JPG, PNG) and in three different sizes (small, medium, large).
- It has 5 panels: Contours, Formants, Dynamics, Duration and Explore.

## Contours

The f0 and formant contours can be visualized and smoothed.
Hz values can be converted to bark, ERB, ln, mel and ST values.

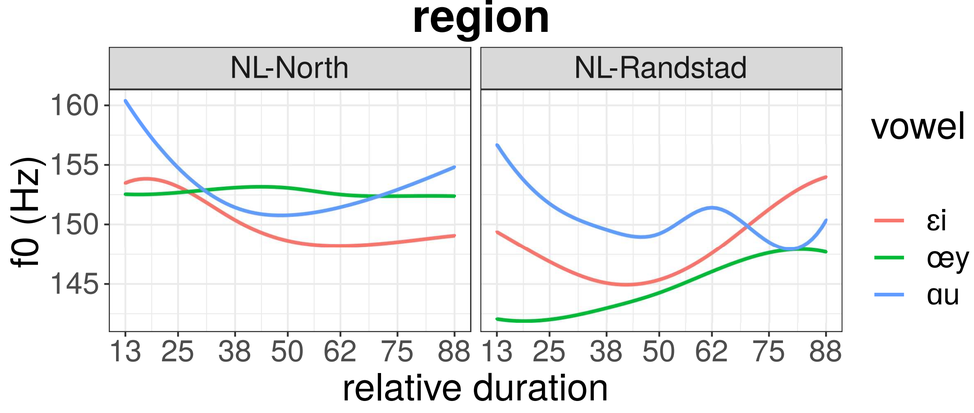


Figure 1. Smoothed f0 contours for diphthongs [œy], [ɑu] and [ɛi] for two regions. Relative duration is expressed in % time points of the total duration of the vowel.

## Formants

- Hz values can be converted to bark, ERB, ln and mel.
- 14 vowel normalization methods.
- Normalization methods can be applied on any scale (Hz, bark, etc.), except the Labov, Miller and Nearey methods, which can only be applied to Hz values.

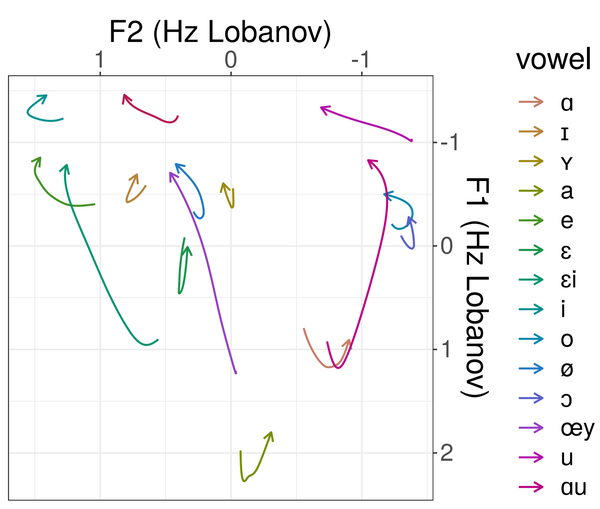


Fig. 2. Smoothed vowel trajectories of 14 vowels using seven measure points per vowel.

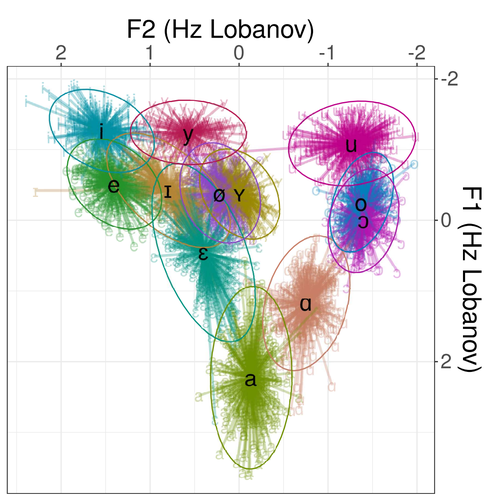


Fig. 3. Formant measurements at the temporal midpoint with 95% confidence ellipses.

## Dynamics

Two acoustic parameters:

- the amount of spectral change, measured as trajectory length ($TL$)
- the spectral rate of change $TL_{roc}$.

See Fox, R. A., & Jacewicz, E. (2009). Cross-dialectal variation in formant dynamics of American English vowels. *The Journal of the Acoustical Society of America*, 126(5), 2603–2618.

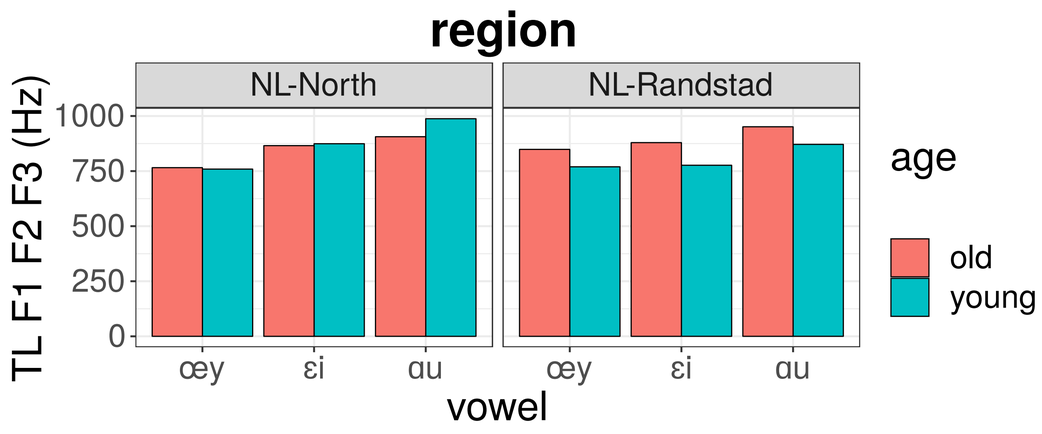


Figure 4. The amount of spectral change ($TL$) is shown for two regions and for two age groups.

## Duration

Durations can be normalized by means of Lobanov's $z$-score transformation.

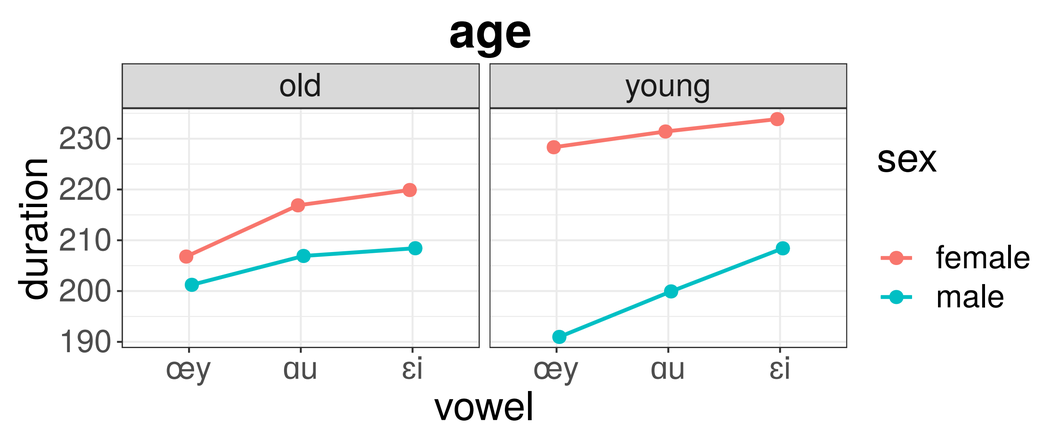


Figure 5. Vowel durations are shown for the diphthongs [œy], [ɑu] and [ɛi], for two age groups, and for male and female speakers.

## Explore

Distances between speakers are obtained by calculating the Euclidean distances on the basis of the differences between the corresponding formants of the corresponding vowels of the speakers, or by comparing the mutual relationships among vowels using Huckvale's (2004) ACCDIST metric.

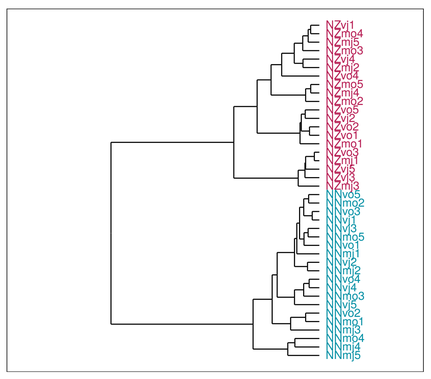


Fig. 6. Clustering on the basis of ACCDIST distances among 40 Dutch speakers confirms a distinction between the North and the South.

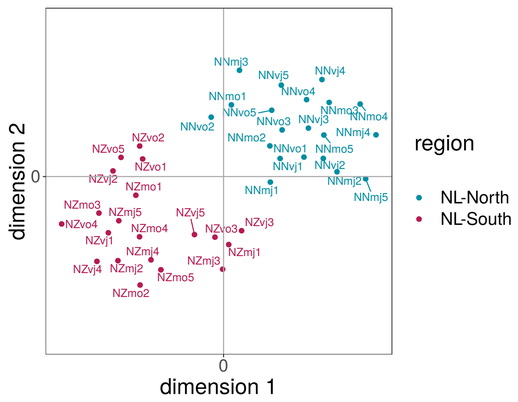


Fig. 7. t-SNE plot obtained on the basis of the ACCDIST distances among 40 Dutch speakers. A clear distinction between northern and southern speakers is found again.

## Implementation

Implemented in the programming language R. The user interface has been built using the packages `shiny` (developed by RStudio) and `shinyBS`. Other packages used: `ggplot`, `plot3D`, `MASS`, `ggdendro`, `ggrepel`, `readxl`, `WriteXLS`, `DT`, `psych`, `pracma`, `Rtsne`, `plyr`, `grid`, `svglite`, `Cairo`. For autocropping faceted plots the function `ggsave_autosize` is used (developed by Z. Lin, GovTech, Singapore).

## Feedback and suggestions

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All figures in this flyer are obtained on the basis of data of Van der Harst, S. (2011). *The Vowel Space Paradox: a Sociophonetic Study on Dutch*. Ph.D. thesis Radboud University of Nijmegen. Utrecht: LOT.