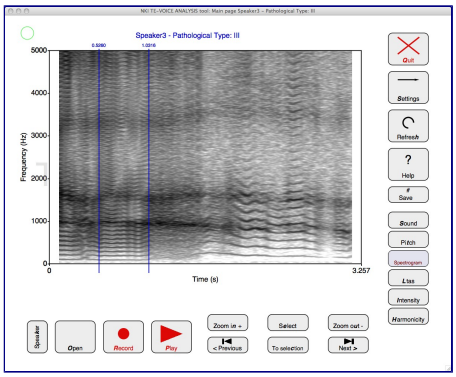
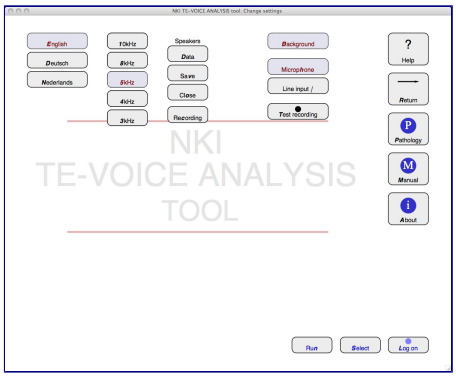
NKI TE-VOICE ANALYSIS tool





The *NKI TE-VOICE ANALYSIS tool* (TEVA) is intended to help the education and research of Speech Pathologists and others who want to study Tracheoesophageal speech. TEVA implements Acoustic Signal Typing from the work of Corina van As-Brooks (Van As 2001; 2006)

Contents

Introduction to TEVA

the NKI TE-VOICE ANALSYSIS tool (TEVA) is developed as a tool for use in education and research. TEVA is intended to help Speech Pathologists and other researchers to study the acoustic characteristics of TE speech and to allow them to get experience with the acoustic analysis of Tracheoesophageal (TE) speech.

Introduction

TEVA is built on top of the Praat phonetics software package (www.praat.org). As such TEVA presents a selection of the relevant analysis methods with an easy to use interface. The approach to the analysis of TE speech used in TEVA is based on the work of Corina van As-Brooks as described in her PhD thesis (Van As, 2001).

Links to this page

- NKI TE-VOICE ANALYSIS tool

Getting started with TEVA

The NKI TE-VOICE ANALYSIS tool (TEVA) is a multi-platform stand-alone application. It is available for MS Windows, Apple Macintosh OSX, and Linux. It is also available as a separate interactive Praat script (www.praat.org).

Getting a copy of TEVA

TEVA is licensed under the GNU GPLv2 and can be freely used and distributed. You can download a copy of TEVA from www.fon.hum.uva.nl/IFA-SpokenLanguageCorpora/NKIcorpora/NKI_TEVA/ . TEVA can be saved on your hard disk or USB thumb drive and started by clicking on the icon.

The TEVA pages

After you start TEVA, a window will appear. This will initially contain the *Main* page. In normal practice, this is the page you will spend most of your time in. There is a second page which allows you to change the settings of the application, the *Configuration* page. You can turn pages using a button on the top right of each page (with an arrow symbol →).

Each page contains a number of buttons. The *Main* page also contains a canvas which is used to draw the results of the analysis on. You interact with TEVA by clicking the buttons. For instance, at the top-right of the Main page, there is a **Quit** button labeled with a red X cross that will terminate the application when you click on it. While the TEVA application is busy processing whatever the click of a button asks it to do, the button will be grayed out (the label will be gray too instead of black or colored). While a button is grayed out, TEVA will not respond to other button clicks.

Every button has a keyboard shortcut. This shortcut is generally a single character, one of the letters of the label on the button. That character will be printed in *italic* in the label. For instance, in English, the Quit button is labeled ***Q*uit** (with an italic *Q*). Hitting the **Q** key (upper or lowercase) will terminate the program.

You can change the size of the TEVA window just as you can with every other window on your desktop. However, you will notice that the positioning of the buttons and texts on the page will be off. Sometimes the windows will look completely scrambled. The page can be redrawn with the **Refresh** button or by hitting the **space bar**. Use the **space bar** when the page is so scrambled that you cannot click the **Refresh** button anymore.

Each page contains a **Help** button. This button is labeled with a **?** question mark. Hitting the **?** or **/** key will start the interactive **Help** service. While **Help** is active, a single line of help text will appear whenever you click a button. Clicking the **Help** button again will stop the **Help** service. The help text for each button will include the keyboard shortcuts in the current language.

General functions

Here are descriptions of a few often used buttons for general use. English labels will be used here. The keyboard shortcuts are given between the [brackets] (might depend on language).

On the *Main* page
• **Quit**: [Q] Stop TEVA. Will save the current preferences
• **Settings**: [S] Go to *Configuration* page
• **Refresh**: [h] Redraw the current page, hitting the space-bar always refreshes the screen
• **Help**: [?] Press on the button you want information on, press *Help* again to continue

On the *Configuration* page
• **Help**: [?] Press the button you want information on, press *Help* again to continue
• **Return**: [R] Go back to *Main* page
• **English**: [E] Use English labels and help
• **Deutsch**: [D] Use German labels and help
• **Nederlands**: [N] Use Dutch labels and help
• **Manual**: [M] Display this manual

More can be found in Overview of Main page and Overview of Configuration page.

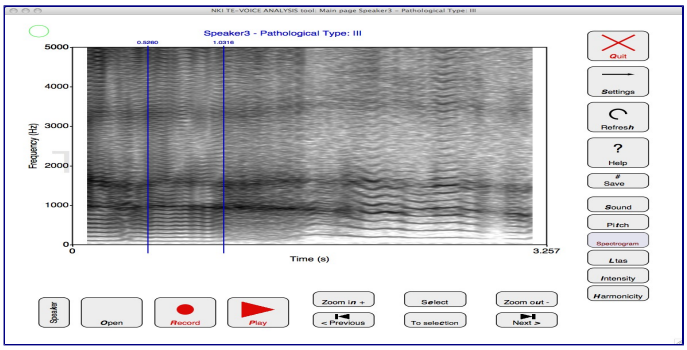
Language support

TEVA supports a few languages, currently English, German, and Dutch. Extending this to other languages is rather easy (just translating a few dozen sentences). But it can only be done with the help of a native speakers of that language. Please contact us if you would like to help to port TEVA to your language.

Links to this page

- NKI TE-VOICE ANALYSIS tool

Overview of Main page



TEVA is used by clicking buttons on the current page. Here is a list of the buttons on the Main page with a description of their use. English labels will be used here. The keyboard shortcuts are given between the []-brackets (might depend on language). See also the Overview of Configuration page.

General functions

- **Quit**: [Q] Stop TEVA. Will save the current preferences
- **Settings**: [S] Go to *Configuration* page
- **Refresh**: [h] Redraw the current page, hitting the space-bar always refreshes the screen
- **Help**: [?] Press on the button you want information on, press *Help* again to continue

Recorded speech

- **Speaker**: [k] Input speaker data. Speakers from a table can be selected by ID, row number, or by stepping to the next, >, or previous , <, speaker. Click **Ready** to complete
- **Open**: [O] Open sound file (or a list of sound files)
- **Record**: [R] Record your speech. You have 4 seconds, watch the recording "light" on the top left
- **Play**: [P] Play back of recording

The sound level of the sound will be indicated as a colored circle in the top left of the page. The diameter scales with the maximal amplitude and the color indicates whether the maximal amplitude is too high (red), good (green), or too low (darker green to black).

Selecting an interval of speech

The current time window will be indicated with vertical blue lines if it is smaller than the current display. Changing the display (eg, zoom in or out) will set the display window to the current time window.

- **Select**: [e] Select a new start and an endtime with the cursor
- **To selection**: [c] Go to selected start and endtime
- **Zoom out**: [u-] Double the current time window

- **Zoom in**: [n+] Halve the current time window
- **Previous**: [<] Previous interval, or shift current time window to the left
- **Next**: [>] Next interval, or shift the current time window to the right

A shortcut to the *Select* button is to click inside the display graph. The point where clicked will be marked as the first boundary and all will proceed as if the *Select* button was pressed.

Saving and printing a report

- **Save** [#] Save recording and a report of the analysis

The current sound, and a report with all graphs and the analysis results can be saved into a seperate map (or directory). The analysis windows are calculated and pictures are stored. A web page (.html and .odt) is created for printing on Apple OSX and Microsoft Windows systems. On Apple OSX the pictures are saved as PDF graphics, on Microsoft Windows as WMF graphics. On these two systems, a web page (.html) is created with the report. On all systems, pictures are also saved as PostScript graphics (EPS) and a report with an .odt extension is created. This report can be opened with OpenOffice.org or LibreOffice word processors for inspection and printing. Both OpenOffice.org and LibreOffice.org are Free and Open Source word processing programs.

Analysis calculations and displays

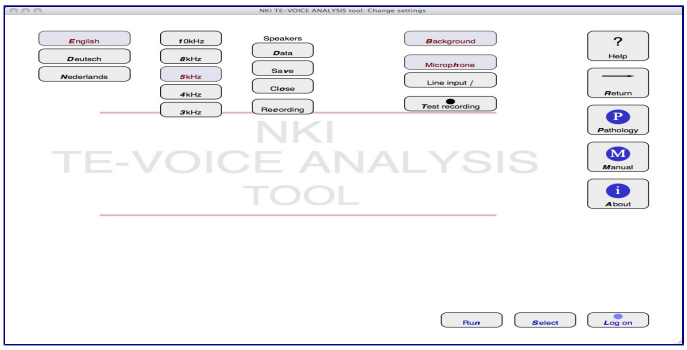
Selected statistics about the analysis will be written below the display. This includes the Acoustic Signal Typing analysis related to the display.

- **Sound**: [S] The Sound waveform
- **Pitch**: [t] Pitch contour
- **Spectrogram**: [L] Narrow band spectrogram (100 ms window)
- **Ltas**: [L] Long time average spectrum
- **Intensity**: [I] Intensity
- **Harmonicity**: [H] The Harmonicity to Noise ratio

Links to this page

- Adding speaker information
- Example evaluating AST
- Getting started with TEVA
- NKI TE-VOICE ANALYSIS tool
- Opening an existing recording
- Recording your own voice
- Saving a report

Overview of Configuration page



TEVA is used by clicking buttons on the current page. Here is a list of the buttons on the Configuration page with a description of their use. English labels will be used here. The keyboard shortcuts are given between the []-brackets (might depend on language). See also the Overview of Main page.

Man buttons are radio type push buttons. When clicked, they remain "pushed down" until another button is pushed. The state of these button is remembered between invocations of TEVA.

General functions

- **Help**: [?] Press the button you want information on, press *Help* again to continue
- **Return**: [R] Go back to *Main* page
- **English**: [E] Use English labels and help
- **Deutsch**: [D] Use German labels and help
- **Nederlands**: [N] Use Dutch labels and help

Spectral display

The display of spectral features should be reduced to exclude irrelevant detail. Set the maximal frequency to a frequency that just includes all the relevant features

- **10kHz**: [01] Display up to 10 kHz
- **8kHz**: [8] Display up to 8 kHz
- **5kHz**: [5] Display up to 5 kHz
- **4kHz**: [4] Display up to 4 kHz
- **3kHz**: [3] Display up to 3 kHz

Speaker data tables and recording duration

It is useful to have a list of speaker data available. TEVA can read and write Tab delimited tables (tsv) with speaker data.

- **Data**: [D] Read table with speaker data

- **Save**: [v] Write current table with speaker data
- **Close**: [o] Close current table and open a new, empty one
- **Recording**: [c] Time of recording in seconds

Each row in the speaker table contains five fields separated by tabs:

[1] Speaker, or Recording, ID (must be unique)
[2] Speaker description (age, sex, etc)
[3] Comments
[4] File name of a recording with path relative to the table
[5] Acoustic Signal Type (*1-4*)

If given, the recording will be automatically loaded if this speaker is selected in the main page.
Recording sets the duration of live recordings.

Miscelaneous

- **Background**: [B] Show background or not
- **Microphone**: [h] Use the built-in microphone for recording
- **Line input** |: [|+] Use the line-input for recording
- **Test recording**: [T] Test recording level

Additional information

- **Pathology**: [P] Information about pathological types
- **Manual**: [M] This manual
- **About**: [iA] Information about NKI TE-VOICE ANALYSIS tool and credits

Links to this page

- Adding speaker information
- Determine pathological type
- Example evaluating AST
- Getting started with TEVA
- NKI TE-VOICE ANALYSIS tool
- Recording your own voice

TEVA Tutorials

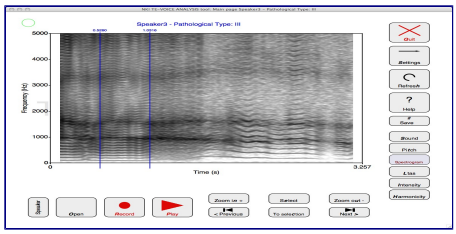
Tutorials to get acquainted with TEVA

- Recording your own voice
- Opening an existing recording
- Selecting stable sounds
- Adding speaker information
- Determine pathological type
- Saving a report
- Example: Evaluating AST

Links to this page

- NKI TE-VOICE ANALYSIS tool

Recording your own voice



How to record and analyze a voice.

Record your voice

First set up your computer for voice recording. You should use a microphone of a reasonable quality. Furthermore, if your computer has some kind of *Microphone* boost feature, make sure it is turned off. Then use some application you know to check whether you can actually record your sound. For instance, if you have Praat (www.praat.org) or Audacity (audacity.sourceforge.net) installed, try to record your voice with them. If recording works, you can continue.

After you started TEVA, click on the *Settings* (→) button to go to the Configuration page. There you should check the relevant sound input, either *Microphone* if you use a built-in microphone or the microphone jack, or *Line input* if you have connected to the line input. You can use the *Test recording* button to open a window where you can check the setup and recording level. Close the window when you are satisfied. Note that your changes in the settings of this window will be ignored.

After you are satisfied that the recording setup is working, go back to the Main page by clicking the *Return* (→) button.

On the Main page, click on the red *Record* (•) button. A bright red spot will appear in the top left corner of the page during the time of the recording. The default duration of a recording is 4 seconds. You can change this duration on the Configuration page, with the *Recording* button. While the red spot is visible, speak a sustained /a/ sound in the microphone.

After the recording has stopped, the wave-form of the recorded sound will be shown in the central part of the Main page. The wave-form display is the default setting of TEVA. However, if TEVA was closed the last time while another display was selected, that display will be used again. The bright red spot in the top left corner will have been replaced by a open colored circle. The diameter and color of the circle indicate the maximum amplitude of the recorded sound. A big red circle means the recorded sound might have been too loud and clipped. A green circle indicates a safe recording level. When the circle becomes smaller and the color becomes darker towards black, the sound level of the recording might have been too soft.

Listen to the recorded sound. You can play the recorded sound by clicking the red *Play* button (right pointing solid triangle). You might notice that the recorded sound is not 4 seconds long (or whatever your recording setting is). TEVA will cut off silence at the start and end of the recording. Check whether there is enough of the /a/ recorded and that there is no background noise in the recording. Repeat the recording procedure until you are satisfied with the result. You do not have to reject the old recording, a new

recording simply replaces the existing recording.

Other displays and analysis

When you click on any of the buttons on the right side below *Sound*, e.g., *Pitch*, *Spectrogram*, *Ltas*, *Intensity*, or *Harmonicity*, these will be displayed instead. Calculation of some of these displays might take some time, so be patient. Below all of the windows, except *Sound* and *Spectrogram*, text will appear with statistics of these analysis types.

Next:

- Opening an existing recording
- Adding speaker information
- Selecting stable sounds
- Determine pathological type
- Saving a report

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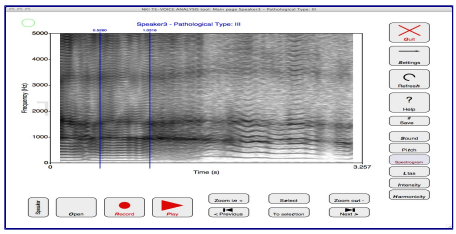
- TEVA Tutorials

Opening an existing recording



How to open existing sound files in TEVA.

Audio formats

TEVA can handle all audio file formats that Praat can read. This includes, among others, WAV, AIFF/C, FLAC, and MP3 files.

Open a file

To open an existing recording, click the *Open* button on the Main page. A file select window will open which allows you to select the file in the customary way. Then click *Choose*. The file will open and the currently selected analysis display will be drawn.

Next:

- Recording your own voice
- Selecting stable sounds
- Adding speaker information
- Determine pathological type
- Saving a report

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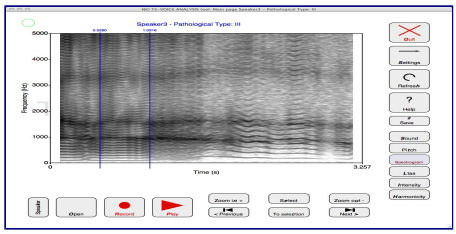
Adding speaker information

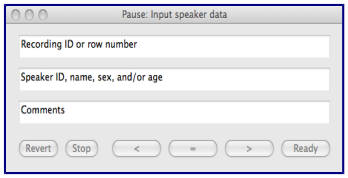


How to add information about a speaker to TEVA.

Record or Open an /a/ sound, select a stable part of the recording:

- Recording your own voice
- Opening an existing recording
- Selecting stable sounds

Adding information about a recording



TEVA can keep a record of recordings. Click the *Speaker* button at the bottom left of the Main page. A window will open where you can enter an identifier (name or code) and other information like sex, age, treatment etc. There is also a field for more informal comments. The top text field is an identifier for the recording, the next lower one contains information about the speaker, ID, name, and so on. The bottom text field is for comments. Click the *Ready* button when you have completed the input. You can change the text later if you like.

Reading a table with speaker information

In general, it is better to collect speaker information in a table beforehand. You can open such a table with the *Open* button in the Main page, or with the *Data* button in the Configuration page. When opened, you will have to select a specific speaker or recording from the list. This is done using the *Speaker* button on the Main page. In the top text field, you can type in the ID code of the recording, or the line number in the table, and click *Ready*. Or you can step through all the records with the next (>) and previous (<) buttons. If you enter a partial ID, it will be matched to the start of the ID's in the table. The first record that matches will be selected. If you enter a non-existing recording ID in the top, ID, field, a new record is added to the table. You can remove the current record by completely emptying the top, record ID field, and replace it with a single dash, -.

You can save changes to the list with the *Save* button in the Configuration page. You can close and purge the current table with the *Close* button in the Configuration page. With *Close*, the current table is not saved. However, all changes made in an existing speaker table will be saved in a backup file with the same name as the original file, but with a tilde (~) added to the name (e.g., *example.Table* becomes *example~.Table*). This backup file will be kept until the table is saved to file using the *Save* button or all changes are purged with the *Close* button, after which the backup will be removed. The backup file will be overwritten the next time the table is opened from file and a change is made.

Format of the speaker info table (*.tsv* or *.Table*)

Speaker Info tables are tab delimited (tsv) lists with five fields, starting with a line with the field names separated by tabs, i.e., *ID*, *Text*, *Description*, *Audio*, *AST* (the order is immaterial). The extension of the file should be *.tsv* or *.Table*.

1: ID of speaker or recording (must be unique)
2: Essential information, often starting with the ID code
3: Free form comments
4: Relative path to the audio file
5: Manually entered Acoustic Signal Type, i.e., *1*, *2*, *3*, or *4*

If the table contains a path to a sound file, this file will be opened automatically when the record is chosen

Missing columns are automatically generated when the table is read. So, if a table without the *Description* and *AST* columns is read, two empty columns with the corresponding labels are created.

An example file: *SignaltypeVoiceSamples.Table*

```
ID Text Description Audio AST
Speaker1 Speaker1, M 66yo, Type I [comments]
signaltype1voicesample.wav 1
Speaker2 Speaker2, M 48yo, Type II [comments]
signaltype2voicesample.wav 2
Speaker3 Speaker3, F 77yo, Type III [comments]
signaltype3voicesample.wav 3
Speaker4 Speaker4, F 48yo, Type IV [comments]
signaltype4voicesample.wav 4
```

A text-only file without the *.tsv* or *.Table* extension will be read as a list of records separated by empty lines. The first line in each block of text is interpreted as a *Text* field and the (unique?) ID is extracted from the text up to the first punctuation mark. If a *Type: IV* or *Type: 4* like string is found in the line, the *AST* is set to this value. The remaining lines up to the next empty line, if any, are interpreted as the *Description* field. The first line of the next block is again interpreted as a *Text* field, and so on. Such a file can only be saved as a full Table (*.tsv*). Backup files too will be saved as *.tsv* files.

Next:

- Determine pathological type
- Saving a report

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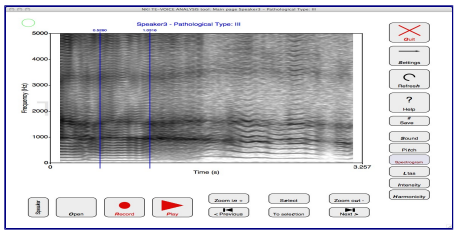
- TEVA Tutorials

Selecting stable sounds



How to select a stable part of the voice.

Record or Open an /a/ sound and add information about the speaker and recording:

- Recording your own voice
- Opening an existing recording
- Adding speaker information

Introduction and basics

Not all parts of your recording will be useful for the analysis. Selecting a part of the recording is done with the buttons around the *Select* button. If the current interval is smaller than the current window, the boundaries of the current interval are indicated by vertical blue lines. With *Zoom in* (+) and *Zoom out* (-) you can decrease and increase the size of the window. With the *Previous* and *Next* buttons you can step through the recording. With the *Select* button you can indicate the start and end of the preferred interval.

Selecting a stable interval of speech

Go to the *Spectrogram* for selecting a stable part of your /a/ recording. *Zoom out* until you see the complete recording. You might notice that the recorded sound is not 4 seconds long (or whatever your recording setting is). TEVA will cut off silence at the start and end of the recording. A stable /a/ sound will show a smooth spectrogram with many harmonics as horizontal lines. The more harmonics are clearly visible, the better the voice is. Find the longest stretch of speech with many, flat harmonics. This will be the interval to analyse. For the Acoustic Signal Typing analysis, around 0.1-0.2 seconds of speech are needed.

Click on *Select*. A blue text will appear below the display "*Select new start time (or press Select or a key to continue)*". If you press *Select* again or press any key on the keyboard, the selection procedure will stop. Use the mouse pointer to click on the start of the desired stable interval inside the display. This procedure can be done much easier by simply clicking on the display at the point where you want the border to be. This will automatically bring you into step two of the *Select* procedure.

A vertical blue line will be draw at the point where you clicked. The text below the display will have changed to "*Select new end time (or press Select or a key to continue)*". Use the mouse pointer to click on the end of the desired stable interval inside the display. A second blue line will appear and the text disappears.

If you now click on the *Play* button, you will hear only the fragment you selected. The blue lines will be present in all other displays, except the *Ltas* display. The *Ltas* display will have changed and will only give the spectrum of the selected interval. All the statistics printed below the displays will refer to only the selected interval.

You can move around the selected interval with the *Previous* and *Next* buttons. You can make the window match the selected interval by clicking on *To selection*.

Next:

- Determine pathological type
- Saving a report

Links to this page

- TEVA Tutorials

Determine pathological type

How to determine the pathological type and read the acoustic signal typing

Record or Open an /a/ sound, select a stable part of the recording and add information about the speaker and recording:

- Recording your own voice
- Opening an existing recording
- Selecting stable sounds
- Adding speaker information

Pathological type

A short description of the criteria to determine the pathological type is displayed when you click on the *Pathology* button on the Configuration page. It can also be found on the Acoustic Signal Typing manual page.

The criteria for the pathological typing are mostly impressionistic. This is about the ability of the speaker to produce a stable /a/ sound with many harmonics. This can be evaluated by listening to the sound, and looking at the *Spectrogram*. Inspection of the *Pitch* and *Harmonicity* displays will give extra information.

When a voice has been evaluated and a type decided upon, the type can be entered by pressing one of the number keys, 1-4 for types I - IV. The types can always be changed. Pressing 0 will erase the type. The currently selected type will be printed over the display and stored in the table with speaker data.

Acoustic signal typing

There is also an automatic evaluation of pathological type. The displays for *Pitch*, *Ltas*, and *Harmonicity* contain pathological type estimates preceded by "AST:" (Acoustic Signal Typing) based on individual acoustic measures. The median value of these measures is displayed in arabic numerals (1-4) as long as no pathological type has been entered by hand. Note that the automatic AST will only be calculated from measures for which the display has been shown (calculated). So it will change until all the relevant displays have been shown. The median AST will be calculated when a report is generated.

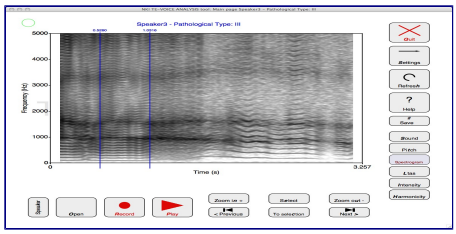
Next:

- Saving a report

Links to this page

- TEVA Tutorials

Saving a report



Generate a printable report.

Record or Open an /a/ sound, select a stable part of the recording and add information about the speaker and recording:

- Recording your own voice
- Opening an existing recording
- Selecting stable sounds
- Adding speaker information
- Determine pathological type

After selecting a stable part of a recording and determining the pathological type, the results should be stored in a report for later use. This is done by clicking the *Save* button on the Main page. A name can be entered and then click *Save*. The default name is the ID code in the Speaker information.

All displays are regenerated and a map (directory) is created with the report in two formats: An HTML document and an ODT (.odt) document. The odt document can be opened with LibreOffice.org and OpenOffice.org and printed on all platforms. On MS Windows and Mac OSX, a web page (HTML) file is generated with the same information:

> Windows: Open the HTML file with Internet Explorer, graphics are in Windows Meta File formant (MFT)
> Mac OSX: Open the HTML file with Safari, graphics are in PDF format

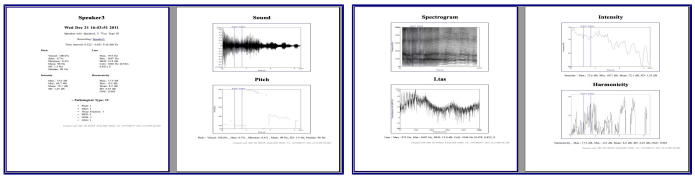
(work is under way to generate HTML files on all platforms using PNG graphics)

Viewing and printing

The report files are in the directory with the name you saved, e.g., *Speaker3*. Inside, there are three files and two directories. The files are *Sample3*.odt and *Speaker3*.html (the latter not on Linux). There is also a copy of the recording in the directory. The two subdirectories contain the graphics, one is called *eps* and contains the graphics in *eps* format, the other is called either *wmf* (Windows) or *pdf* (OSX) and contains the graphics in *wmf* or *pdf* format.

Next:

- Example evaluating AST



Links to this page

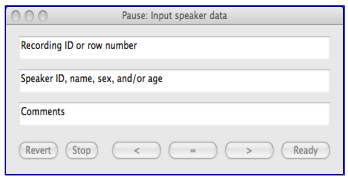
- TEVA Tutorials

Example evaluating AST

A tutorial example of how to evaluate the Acoustic Signal Typing on a sample of recordings

Download and open the example corpus

Download the TEVA_AST_example.zip file from [To be announced] and extract it to a convenient location. Open TEVA and then click the *Open* button on the Main page. A file selection window will open. Navigate into the map you just downloaded and select *SignaltypeVoiceSamples.Table*. Then click *Choose*. The Main page now contains a display of an empty sound. *SignaltypeVoiceSamples.Table* contains data on a number of recordings. You must now select the recording you want to use.



Select speakers

Click on the *Speaker* button (lower left). A new window will open. Click on the = button. You now see a table with 5 columns and 4 lines (enlarge the window if you do not see all of it). The headings read *ID*, *Text*, *Description*, *Audio*, and *AST*. Except for the *Description* column, all columns contain metadata for the recordings mentioned in the *Audio* column. Close the Info window and click in the TEVA window to view the Speaker window.

The Speaker window has three text fields. The top one contains the ID of the recording, the next field a short description of the speaker (e.g., name or ID, age, sex, etc.). You can change this field, or even create it for a newly recorded voice. If you enter an ID, or just the start of the ID, or row number in the table, the corresponding speaker from the Info window will be read and displayed in TEVA. If you empty the ID field completely and replace it with a single dash **-**, the current record will be removed from the table.

Put a single *3* in the top field of the Sepaker window to select the third entry in the Table. Then Click the *Ready* button. You now see a display of the recording of the fourth speaker. You see the ID of this speaker and the Pathological Type as it was recorded in the Table.

Find a stable interval

Inspect the recording using the *Sound* and *Spectrogram* windows. Then decide how the speech can be judged according to following statements as *Good*, *Mediocre*, or *Bad*. See also Acoustic Signal Typing

- The speaker can keep a stable /a/ sound over more than 2 seconds
- There are clear harmonics up to 1000Hz
- There is at least one stable harmonic for longer than 2 seconds
- There are harmonics in part of the sample, for longer than 1 second

With these statments in mind, pick an interval where the vowel is most stable. You can use the *Zoom in* and *Zoom out* buttons as well as the *Previous* (move left) and *Next* (move right) buttons to navigate around.

When you found a part that you think is most stable, select an interval of 200 ms. Click the *Select* button. You are now asked to click on the position in the display where you want the start of the interval. When you do that, a vertical blue line appears. Now you are asked to click on the position in the display where the end of the interval should come. Click there. Alternatively, you can simply click inside the display window to select the first boundary. After that it proceeds as with the *Select* button. Make sure that the interval is at least 100 ms long. You can find the times of start and end points at the top of the graph. You can *Zoom in* or go *To selection*, but that is not necessary.

Acoustic analysis

Inspect the other displays, *Pitch*, *Ltas*, *Intensity*, and *Harmonicity*. Below each of these displays, analysis parameters will be printed about the selected interval (see also Analysis and AST categories). Do these acoustic parameters support your evaluation of the preceding statements? Use the *Previous* (move left) and *Next* (move right) buttons to move the selected interval around and see how this affects the acoustic parameters.

Entering the Pathological Type

When you have decided what type of pathological voice the recording has, you simply push one of the numbers *1-4*, and the type is recorded. The type will be displayed in the window and in the title bar. Push *0* to remove the type.

Saving your work

After evaluating the sounds, the pathological types and remarks added to the Speaker Info table should be saved to disk. Go to the Configuration page and click on *Save*. Fill in the name you want the file to have (or use the default) and click *Save*. During the work, every change or addition made to the Speaker Info table is saved into a backup file with the same name as the original file and an added ~ character. When you *Save* or *Close* the table, this backup file is removed. Otherwise, it will remain until you open the table again and change something in it. If you accidently forgot to save the table, you can simply open the backup file and save it under the old, or a new, name.

To save the analysis of a single recording, use the Save button on the Main page. This will ask for a place and name to save a directory with all the displays and all the analysis data for the current time interval.

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- TEVA Tutorials

Analysis

Praat commands used to calculate the analysis results

TEVA is a Praat script. The commands used to perform the analysis and draw the displays are listed here:

Displays

Sound

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Pitch

```
select Sound SND
To Pitch... 0 60 600
```

Spectrogram

```
select Sound SND
To Spectrogram... 0.1 'F_n' 0.001 10 Gaussian
```

F_n is the Nyquist frequency

Ltas

```
select Sound SND
To Spectrum... yes
To Ltas (1-to-1)
```

Intensity

```
select Sound SND
To Intensity... 60 0 yes
```

Harmonicity

```
select Sound SND
To Harmonicity (cc)... 'dT' 60 0.1 1.0
```

dT is the time step

Measurements

Voiced fraction

```
select Sound SND
To Pitch... 0 60 600
```

Count the number of voiced frames in the window and divide by the total number of frames. Using these settings, the step size (frame duration) is 0.0125s.

GNE (glottal to noise excitation ratio)

```
select Sound SND
Extract part... 'T1' 'T2' rectangular 1.0 false
To Harmonicity (gne)... 500 4500 1000 80
gne = Get maximum
```

T_1 and T_2 are the start and end time, respectively

Jitter

```
select Sound SND
To Pitch... 0 60 600
To PointProcess
jitter = Get jitter (local)... 'T1' 'T2' 0.0001 0.05 5
```

T_1 and T_2 are the start and end time, respectively

Shimmer

```
select Sound SND
To Pitch... 0 60 600
To PointProcess
select Sound SND
plus PointProcess SND
shimmer = Get shimmer (local)... 'T1' 'T2' 0.0001 0.05 5 5
```

T_1 and T_2 are the start and end time, respectively

BED (band energy difference)

```
select Sound SND
To Spectrum... yes
To Ltas (1-to-1)
Get number of bins
```

Average power over bins. Where `lowPower` is the average power over bins between 0 and 500 Hz and

highPower is the average power over bins between 4000 and 5000 Hz

```
bed = 10 * log10(lowPower / highPower)
```

CoG (spectral center of gravity)

```
select Sound SND
To Spectrum... yes
To Ltas (1-to-1)
Get number of bins
```

Sum the power ($10^{(power/10)}$), sumPower over the bins and the product of frequency and energy ($f * 10^{(power/10)}$), productFreq, over all bins.

```
cog = productFreq / sumPower
```

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Acoustic Signal Typing

Introduction

The quality of the voice in Tracheoesophageal (TE) speech is determined by the characteristics of the neo-glottis. Individual differences in the functioning of the neo-glottis after treatment cause great variation in the intelligibility and quality of speech. The voice pathology of TE speech is graded into four levels.

Pathology types (Van As, 2001, Chapter 5)

Type I - Stable & Harmonic (press 1)

- Stable signal for longer than two seconds
- Clear harmonics up to at least 1000 Hz

Type II - Stable & At least one harmonic (press 2)

- Stable signal for longer than two seconds
- At least one stable harmonic at the fundamental frequency for longer than two seconds

Type III - Unstable or Partly harmonic (press 3)

- No stable signal for longer than two seconds, or
- Harmonics in only part of the sample (for longer than 1 second)

Type IV - Barely harmonic (press 4)

- No or only short-term detectable harmonics (for shorter than 1 second)

(press 0 to reset)

Table of the relation between the four types of acoustic signal typing and the perceptual judgment of overall voice quality for 39 speakers (converted to percentages).

Perceptual judgment of overall voice quality
Good Reasonable Poor
Type I 70% 40% 0%
Type II 45% 45% 10%
Type III 20% 35% 45%
Type IV 0% 25% 75%

Acoustic measures of voice quality

In Acoustic Signal Typing, the voice characteristics are determined using acoustic analysis of speech. The

typing is based on both visual inspection of plots of these analysis parameters and quantitive measures of a short (e.g., 0.1 second) stretch of "stable" speech.

Visual determination of pathology uses displays of:

- Waveform
- Pitch
- Spectrogram
- Long Time Average Spectrum (LTAS)
- Intensity
- Harmonicity-to-Noise ratio

A quantitative evaluation is based on the analysis of:

- Voiced fraction, fraction of frames that is voiced (%)
- Jitter (%)
- Standard deviation of the Pitch
- BED (band energy difference), difference in dB between high and low power in the LTAS
- The mean of the Harmonicity
- GNE (glottal to noise excitation ratio), the maximum of a form of Harmonicity

These measures are determined on a short segment (around 0.1 second) of speech from the most stable part of a sustained /a/ sound. Pathological categories are defined using (Van As, 2001). See Analysis calculations and displays for details on the commands used.

References:

- Van As, C.J. (**2001**), *Tracheoesophageal Speech. A Multidimensional Assessment of Voice Quality*, Ph.D.-thesis, University of Amsterdam, 209 pag.
- van As-Brooks, C.J., Koopmans-van Beinum, F.J., Pols, L.C.W., and Hilgers, F.J.M. (**2006**), *Acoustic Signal Typing for Evaluation of Voice Quality in Tracheoesophageal Speech* Journal of Voice, Volume **20** (3), p355-368.
- Van As, C.J. (**2008**), *Acoustic analyses of postlaryngectomy voice and their perceptual relevance* Invitational Round Table "Evidence-based Voice and Speech Rehabilitation in Head and Neck Cancer", p8-14 [dare.uva.nl/document/130984]

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AST categories

Category boundaries

Categories are determined when the corresponding analysis is performed, e.g., when a display is drawn or data are saved. Automatically determined values are displayed in Arabic numbers (1, 2, 3, 4). Categories set by hand are displayed by Roman numerals (*I*, *II*, *III*, *IV*). Category boundaries are taken from (Van As, 2001, Table 5.4 p88) and here indicated by Roman numerals for clarity.

- Voiced Fraction:
- *I* < 90.2% < *II* < 77.45% < *III* < 50% < *IV* (VF < 50% is *IV* also for F_0 sd and Jitter)
- F_0 standard deviation:
- *I* < 3.360 < *II* < 7.495 < *III*; *IV* if Voiced Fraction < 50%
- Jitter:
- *I* < 5.3% < *II* < 8.05% < *III*; *IV* if Voiced Fraction < 50%
- Mean Harmonicity:
- *I* > 7.195 > *II* > 4.050 > *III* > 1.925 > *IV* (dB)
- GNE:
- *I* > 0.820 > *II* > 0.795 > *III* > .745 > *IV*
- BED:
- *I* > 23.85 > *II* > 19.95 > *III* > 13.50 > *IV* (dB)

The final automatic AST category is defined as the median of the individual measures.

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TEVA license

NKI TE-VOICE ANALYSIS tool version 1.0

Netherlands Cancer Institute tool for **Tracheoesophageal Voice Analysis** (TEVA)

For more information, visit our websites: www.fon.hum.uva.nl/IFA-SpokenLanguageCorpora/NKIcorpora/NKI_TEVA/ and www.provoxweb.info/acoustic-analyses.html . TEVA is based on Praat (www.praat.org)

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Links to this page

- Getting started with TEVA
- NKI TE-VOICE ANALYSIS tool
