

Tutorial on Praat

Mafuyu Kitahara¹ Keiichi Tajima²

¹Waseda University

²Hosei University

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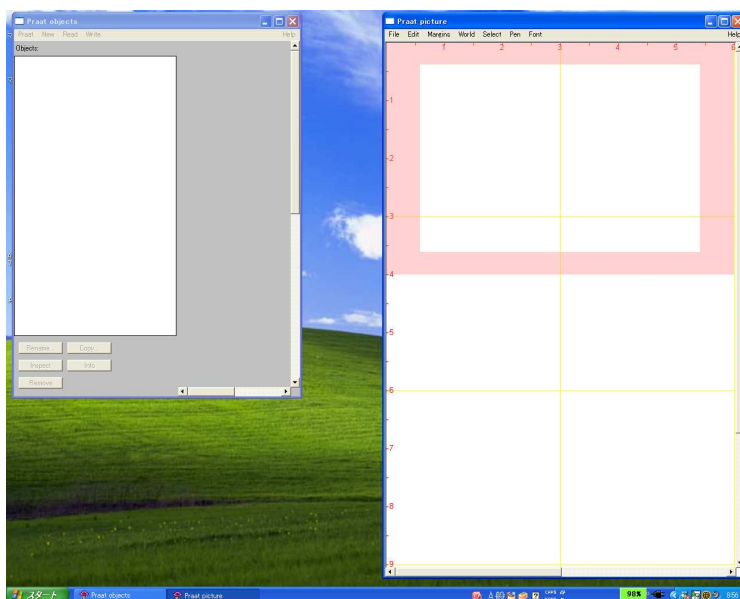
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Preparation, Installation, and Start-up

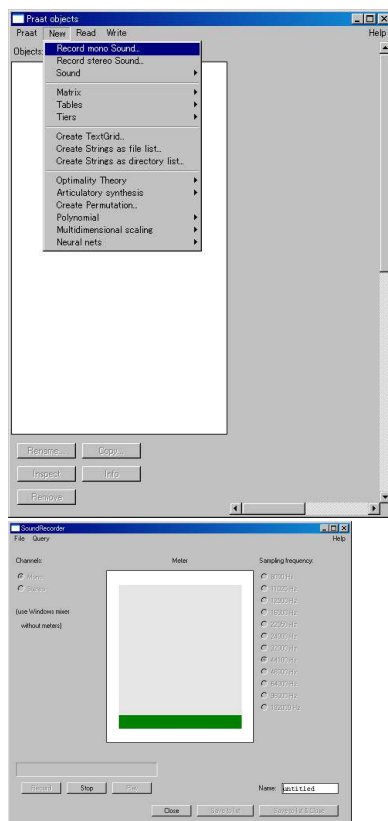
- First of all, show extensions (.txt, .wav...)
- Download from <http://www.fon.hum.uva.nl/praat/>



- Start-up:
 - L = Object Window
 - R = Picture Window
- Menus and buttons are context dependent

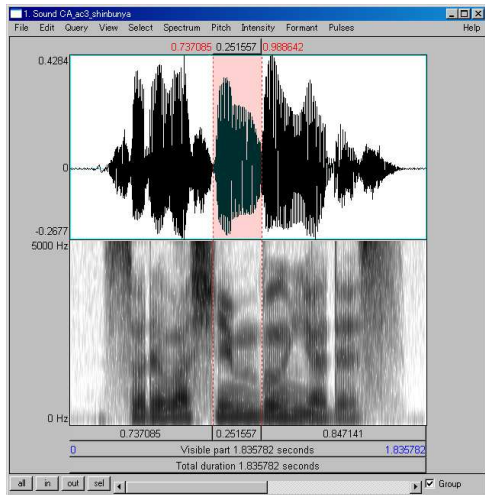
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Recording



- Use [New]-[Record Mono] menu
- SoundRecorder window
 - Click [Record], say "Kenrokuen" for example, click [Stop]
 - Click [Save to list] button to send the recorded sound to Object window
- Use [Write]-[Write to WAV file] menu to save the sound.

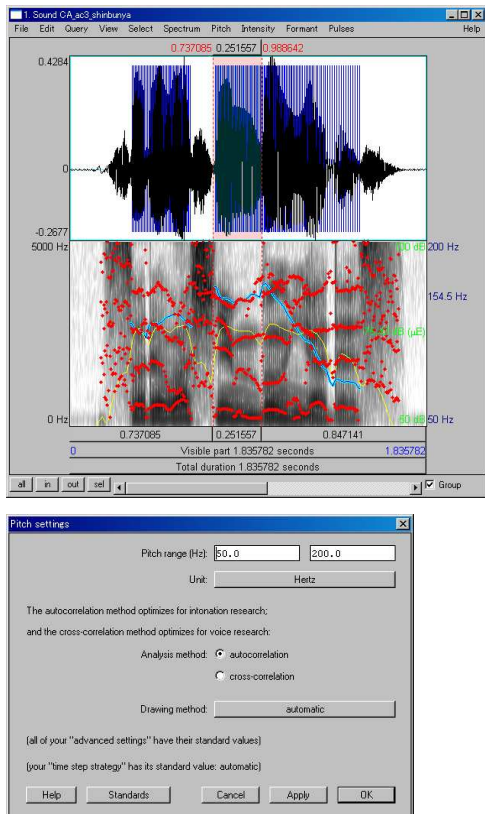
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- When the sound object is selected, [Edit] button is clickable.
- SoundEditor window
 - Upper panel: waveform, lower panel: spectrogram
 - Use the mouse to select a portion of the sound
 - For zooming, use [all][in][out][sel] buttons
 - 3 bars at the bottom to play sound

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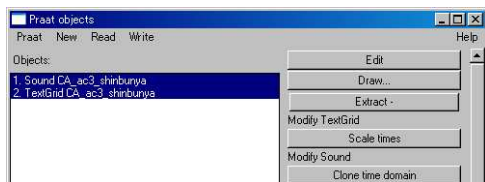
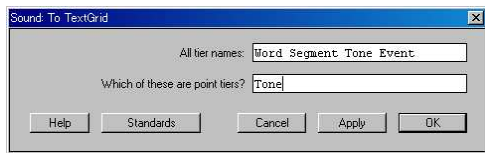
Overview of sound analysis



- Use [Read] menu to read in file: "shinbunya" for today's sample
- Most analysis menus have [Show] [Setting], and [Advanced setting].
 - Need a check for [Show] to see each analysis
 - [View] menu can set "show" status all at once
- Pitch: light blue, Hz on the right end
 - Pitch setting must be adjusted for pitch range
- Intensity: yellow, dB on the inner side of the right end
- Formant: red, Hz on the left end
- Pulse: blue on waveform window

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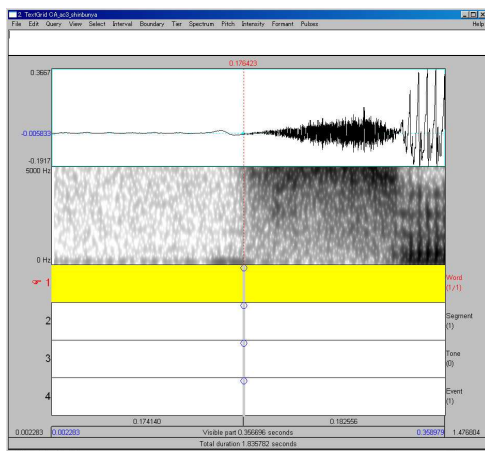
- Use [Annotate]-[To TextGrid] menu to open the setting window for labelling



- TextGrid = a set of tiers under the spectrogram to enter text
- Point Tier = label is put on the marker
- Interval Tier = label is put between markers
- Delete "Mary John bell" in "All tier names" cell.
- Enter "Word Segment Tone Event" instead.
- Delete "bell" and enter "Tone" in "Which...?" cell.
- Click [OK]

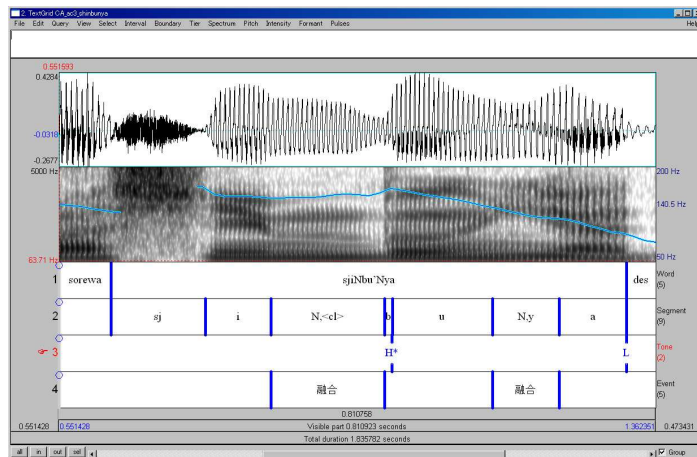
- Select both Sound object and newly created TextGrid object (by shift+click).²⁷

TextGrid editing (1): Word and segment



- Use [sel] or [in] button to zoom in enough to find the edge(s) of the waveform.
 - Click on the appropriate point.
 - Click the blue circle to put the segmentation marker.
 - Segmentation lines are draggable
 - To delete a segmentation line, use [Alt]+[BS] keys
- Enter "sjINbuNya" in Word tier.
- Segmentation on the Segment tier: [sj][i][N,<cl>][b][u][N,y][a], following Kokken (2006)'s schema.
- Use Event tier to note anything irregular, notable, doubtful...

TextGrid editing (2): Tone



- Click [sj i Nbu'Nya] in the Word tier to select the entire word.
- Select [Pitch]-[Move cursor to maximum] to move cursor to the highest pitch point.
- Add a marker in the Tone tier and enter "H*"
- Select [Pitch]-[Move cursor to minimum] to move cursor to the lowest pitch point.
- Add a marker in the Tone tier and enter "L"

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Printing

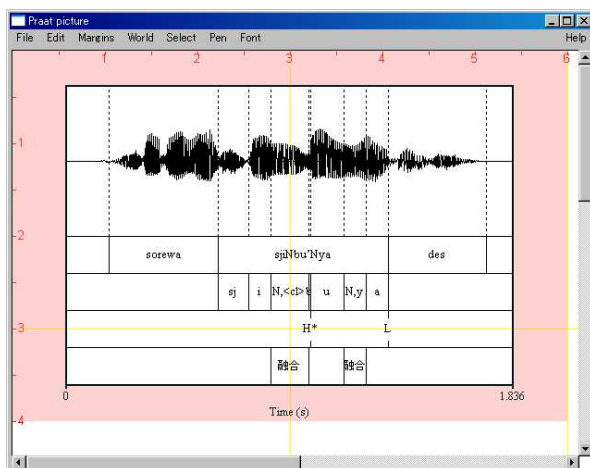
- To save images of waveforms, spectrograms, TextGrids, etc:

- Use the "screen capture" function

- On Windows, select the window you wish to copy, and while pressing the [Alt] key, press [PrtSc].
- Open Paint or other painting/drawing programs, paste the image, and save as an image file.

- Use Praat's Picture window

- Select the object that you wish to draw, and click [Draw...].
- An image is drawn inside the pink box in the Picture window.
- Arrows, texts, and other shapes can be drawn from the [World] menu.
- The output can be saved in an image file or printed out.



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- Motivation

- Manual measurement is OK with just a single token
- What if 10 subjects * 20 words * 5 reps = 1000?

- Procedure

- Search help and the Internet to find existing scripts.

<http://www.ling.ohio-state.edu/~welby/praat.html>

<http://www.psychology.uiowa.edu/students/toscano/scriptarchives/>

- [Praat]-[Script] menu to open the script editor.
- Use "history" function to create a script "on the fly".
- Sample script to measure pitch and formants: see Appendix 1.

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Pitch measurement

- By hand

- Select Sound object and run [Periodicity]-[To pitch...].
- A Pitch object is created. Do [Query] to get various info: e.g., [Query]-[Get value at time]

- By script, e.g.:

Line 16 & 27 in Appendix 1

```
To Pitch... 0.01 50 500
```

```
max_f0 = Get value at time... time Hertz Linear
```

- The idea is... what can be done by clicking menu commands can be done with a script.

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Formant measurement

- By hand
 - Select Sound object and run [Formants & LPC]-[To Formant (burg)...].
 - A Formant object is created. Do [Query] to get various info, e.g., [Query]-[Get value at time]
- By script, e.g.:

Line 18 & 48 in Appendix 1

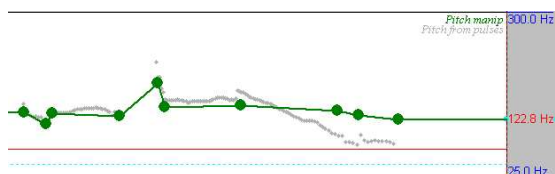
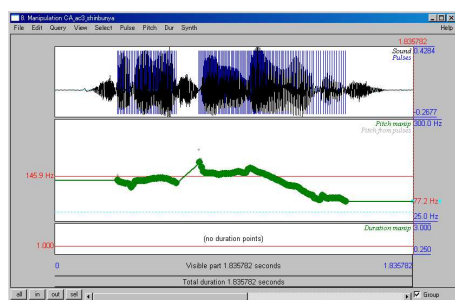
```
To Formant (burg)... 0 5 5500 0.025 50
f1 = Get value at time... 1 smid Hertz Linear
```

- To run script, do [Run]-[Run]
- See Info window
- Better to put results in a spreadsheet-friendly format.

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Resynthesis (1): Pitch

- Select Sound object and click [To Manipulation...] button.
 - Adapt to the pitch range of the original sound (e.g. 75-300Hz).
- Select Manipulation object and click [Edit].



- Upper: waveform and pulse
- Mid: pitch
- Lower: duration (empty at start-up)
- Green dots are draggable (but too many...).
- Line-approximation is helpful: [Pitch]-[Stylize pitch (2st)]
- Click the bars at the bottom to play.
- Select [File]-[Publish resynthesis] and then [Write]-[Write to WAV file] to save the modified sound.

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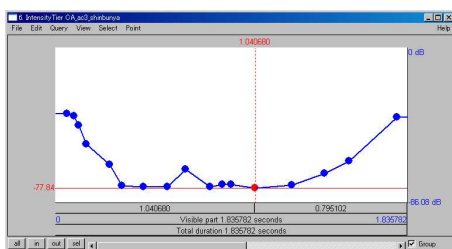
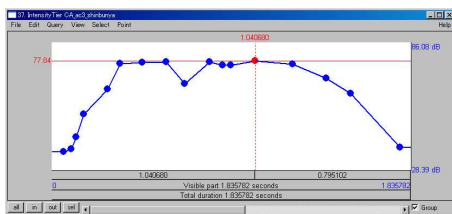
Resynthesis (2): Duration



- Place the cursor at the beginning of the to-be-modified sound portion.
- Select [Dur]-[add duration point at cursor].
- Add three more points.
- Move the middle two points as in the Figure.
 - Up: slower (up to 3.00 times)
 - Down: faster (up to 0.25 times)
- Select [Dur]-[Set duration range...] to change the limits.

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Resynthesis (3): Intensity



- Click [To Intensity...] button.
 - Set the minimum pitch.
- Click [To Intensity Tier(peaks)] button, then [Edit]
 - Blue dots are draggable
 - Select Sound **AND** IntensityTier together (Control+Click), then click [Multiply].
- A flat line in the Editor will not yield a flat intensity output. Need an inverse line.
 - Select IntensityTier object and go to [Modify]-[Formula].
 - Enter "- self" to get the inverse line.

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Listening Experiment (1): Introduction

- Praat lets users run a simple identification or discrimination test: play one or more sounds, have the participant select a response from a set of response buttons.
- Advantages:
 - Free.
 - Simple and relatively easy to learn.
 - Portable across computers.
 - Handles IPA fonts and Unicode characters.
- Disadvantages: Can't do "fancy" things, e.g.,
 - Measuring reaction time
 - Having participants enter text
 - Conditional branching... etc.

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Listening Experiment (2): ID-test in Appendix 2

- First two lines must be typed exactly as they are. The rest depends on the experiment, but the order of the elements cannot be changed, and no elements can be skipped.
- Stimuli
 - All sound stimuli should be under the folder specified by L4: "stimulusFileNameHead", and should have the extension specified by L5: "stimulusFileNameTail". The files should have the same names as specified under L10: "numberOfDifferentStimuli". E.g., "sounds/ame_1_01.wav"

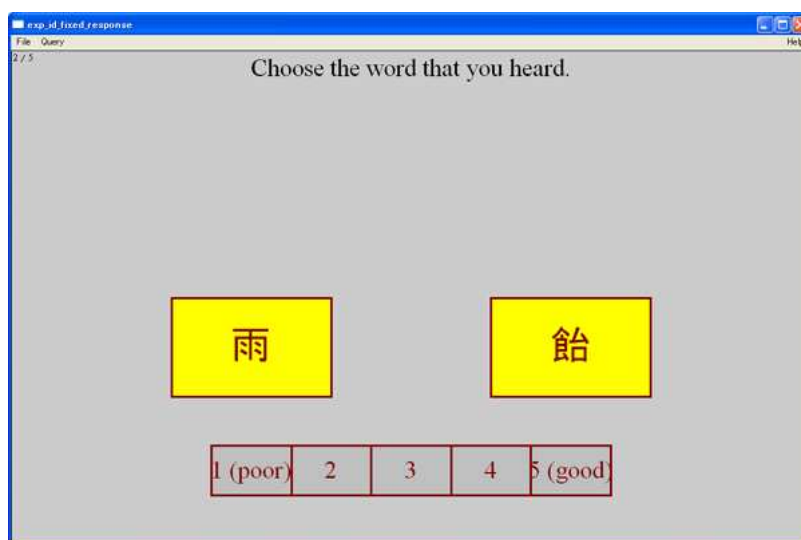
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- Stimulus presentation
 - L16: numberOfReplicationPerStimulus: Obtaining multiple responses to each stimulus is recommended.
 - L18: Randomization strategy:
<PermuteBalancedNoDoublets> Each stimulus occurs exactly once in a random order, then again in another random order, and so on. The randomization is such that the same stimulus never occurs twice in a row.
- Response collection
 - L28-30: Response buttons: specify the left, right, bottom, and top edges of each button, the text to be printed, font size, keyboard response (optional), and text to be recorded in the log file.
 - L31-36: Goodness-of-fit ratings (optional).

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Listening Experiment (4): Running the experiment

- Read the experiment file using [Read]-[Read from file...]. Run it with the [Run] button.



	1	2	3	4
row	subject	stimulus	response	goodness
1	s02	ame_0_02	飴	3
2	s02	ame_0_03	雨	1
3	s02	ame_0_05	雨	5
4	s02	ame_0_01	飴	5
5	s02	ame_0_04	雨	3

- When the experiment is finished, do [Extract results]. Rename the ResultsMFC object to the participant's ID, and click on [Collect to Table]. Save the Table object in a spreadsheet-friendly format using [Write]-[Write to table file...].

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Listening Experiment (5): ID-test with shuffled buttons

- Modify the stimuli. Each stimulus appears twice, with two button orders.

Change L10-15 in Appendix 2 to:

```
numberOfDifferentStimuli = 10
"ame_0_01" "|" 雨 | 飴
"ame_0_01" "|" 飴 | 雨
"ame_0_02" "|" 雨 | 飴
"ame_0_02" "|" 飴 | 雨
"ame_0_03" "|" 雨 | 飴
"ame_0_03" "|" 飴 | 雨
"ame_0_04" "|" 雨 | 飴
"ame_0_04" "|" 飴 | 雨
"ame_0_05" "|" 雨 | 飴
"ame_0_05" "|" 飴 | 雨
```

- Add an "Oops!" button that allows participant to backtrack (indefinitely).

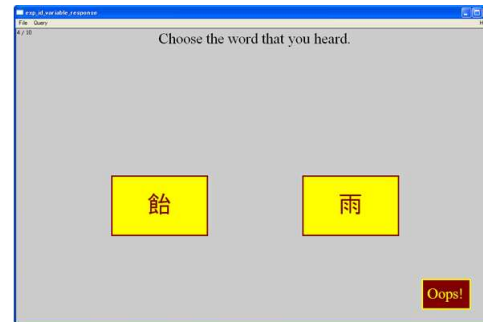
Change L26 in Appendix 2 to:

```
oopsButton = 0.85 0.95 0.05 0.15 "Oops!" ""
```

- Modify response buttons. Responses are recorded as "left" or "right" in the log file.

Change L28-36 in Appendix 2 to:

```
numberOfDifferentResponses = 2
0.2 0.4 0.3 0.5 "" 40 "" "left"
0.6 0.8 0.3 0.5 "" 40 "" "right"
numberOfGoodnessCategories = 0
```



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Listening Experiment (6): Discrimination test (AXB)

- Modify the stimuli. Play 3 stimuli in a row. The second stimulus is the same as the first or the third.

Change L10-15 in Appendix 2 to:

```
numberOfDifferentStimuli = 16
"ame_1_01,ame_1_01,ame_1_02" "" "ame_1_01,ame_1_02,ame_1_02" ""
"ame_1_02,ame_1_02,ame_1_01" "" "ame_1_02,ame_1_01,ame_1_01" ""
"ame_1_02,ame_1_02,ame_1_03" "" "ame_1_02,ame_1_03,ame_1_03" ""
"ame_1_03,ame_1_03,ame_1_02" "" "ame_1_03,ame_1_02,ame_1_02" ""
"ame_1_03,ame_1_03,ame_1_04" "" "ame_1_03,ame_1_04,ame_1_04" ""
"ame_1_04,ame_1_04,ame_1_03" "" "ame_1_04,ame_1_03,ame_1_03" ""
"ame_1_04,ame_1_04,ame_1_05" "" "ame_1_04,ame_1_05,ame_1_05" ""
"ame_1_05,ame_1_05,ame_1_04" "" "ame_1_05,ame_1_04,ame_1_04" ""
```

- Add a "Replay" button that allows the participant to replay the sequence once.

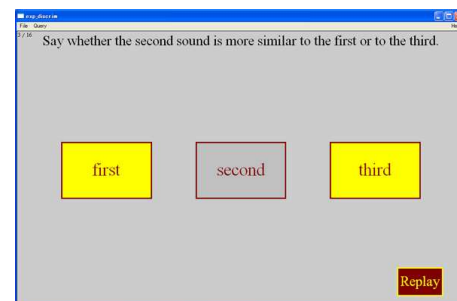
Change L23-24 in Appendix 2 to:

```
maximumNumberOfReplays = 1
replayButton = 0.85 0.95 0.05 0.15 "Replay" ""
```

- Modify the response buttons (the middle button is a dummy button that is not clickable).

Change L28-36 in Appendix 2 to:

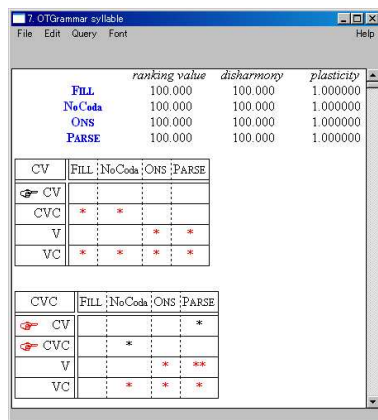
```
numberOfDifferentResponses = 3
0.1 0.3 0.4 0.6 "first" 30 "" "A"
0.4 0.6 0.4 0.6 "second" 30 "" ""
0.7 0.9 0.4 0.6 "third" 30 "" "B"
numberOfGoodnessCategories = 0
```



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OT Grammar (1): Introduction

- Praat has an OT grammar function incorporating not only ordinal OT but also Stochastic/Functional OT and learning simulation.



	ranking value	disharmony	plasticity
FILL	100.000	100.000	1.000000
NoCode	100.000	100.000	1.000000
ONS	100.000	100.000	1.000000
PARSE	100.000	100.000	1.000000

CV	FILL	NoCode	ONS	PARSE
CV				
CVC	*	*	*	*
V			*	*
VC	*	*	*	*

CVC	FILL	NoCode	ONS	PARSE
CV				*
CVC	*	*	*	*
V			*	*
VC	*	*	*	*

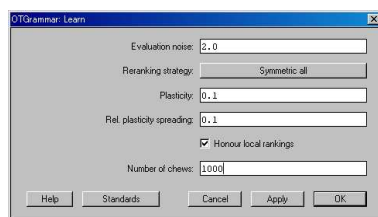
- Sample grammar definitions are accessible via [New]-[Optimality Theory]-[Create XXX grammar].
- Defining your own grammar is reasonably simple: Appendix 3
- Read your own grammar into Praat by [Read]-[Read from file...] menu.
- Click [Edit] button to open OTGrammarEditor window.

- ranking values = change during learning
- disharmony = corresponds to the current ranking
- plasticity = how easily the ranking changes

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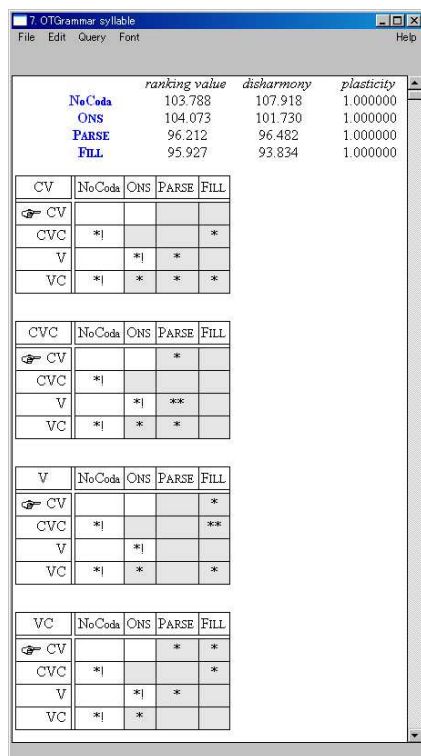
OT Grammar (2): Syllable structure example

In	CV	CVC	V	VC
Out1	CV	CV	CV	CV
Out2	CV	CVC	CV	CVC



- The input set can be obtained by clicking [Get inputs] button.
- Read in Out1: [Read]-[Read from file...].
- Select "OTGrammar" and two "Strings" objects all together, click [Learn...] button.
 - Leave most parameters as default. "Number of chews" must be set to a reasonably large number (e.g. 1000).

OT Grammar (3): Ranking solution for Out1



The screenshot shows the OTGrammar syllable window with the following data:

	ranking value	disharmony	plasticity
NoCoda	103.788	107.918	1.000000
ONS	104.073	101.730	1.000000
PARSE	96.212	96.482	1.000000
FILL	95.927	93.834	1.000000

CV	NoCoda	ONS	PARSE	FILL
CV				
CVC	*			*
V		*	*	
VC	*	*	*	*

CVC	NoCoda	ONS	PARSE	FILL
CV			*	
CVC	*			
V		*	**	
VC	*	*	*	*

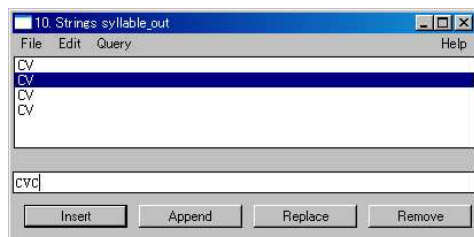
V	NoCoda	ONS	PARSE	FILL
CV				*
CVC	*			**
V		*	*	
VC	*	*	*	*

VC	NoCoda	ONS	PARSE	FILL
CV			*	*
CVC	*			*
V		*	*	
VC	*	*	*	*

- The values and tableaux on the OTGrammarEditor show a possible ranking solution for In-Out1 pairs.
- Note that ranking values for NoCoda and Ons are so close that they might not be crucially ordered.
- We can check the validity of ranking by temporarily changing the order of the two constraints.
 - Click the name of the constraint in OTGrammarEditor.
 - Select [Edit]-[Edit Constraint...] menu
 - Set the disharmony value larger than the other constraint.

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OT Grammar (4): Ranking solution for Out2



The screenshot shows the Strings syllable_out window with a list of syllable types (CV, CV, CV, CV) and a text input field containing 'cvc'. Below the input field are buttons for Insert, Append, Replace, and Remove.

- Now, reset all the values to learn new pairs: [Edit]-[Reset all rankings].
 - Go to "Strings_out" window and select the second line (CV).
 - Enter "CVC" in the lower one-line box.
 - Click [Replace] button.
 - Continue editing to get Out2.
- Select "OTGrammar" and two "Strings" objects all together, click [Learn...] button again.

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- Praat is useful in many areas of phonetics and phonology.
- Praat is continually evolving.
- Please see our column in Gengo from Taishukan.
- Also see the wiki: <http://www9.atwiki.jp/praatman/>
 - Materials for today's tutorial will be downloadable.
- Thank you so much to our editor W. Ogawa.
- Feedback, questions, new ideas... are welcome.