Speech, Hearing & Phonetic Sciences, UCL SSC0158 Science of Talking Laboratory for Week 5



Speech/song imitation Lecturer: Fang Liu

Introduction

Fundamental frequency (F_0) is the rate of vocal fold vibration during voice production, and is related to the listener's perception of the pitch of the voice. It has been found that "tight control of voice F_0 is unnecessary" in speaking but "preferable" in singing (Natke et al., 2003), and that people tend to imitate song better than speech in terms of absolute pitch matching (Mantell & Pfordresher, 2010).

In this experiment you will imitate speech/song fragments (borrowed and synthesized from some examples in the speech/song corpus collected by **Dr. David Gerhard** at University of Regina, Canada), measure the vowel-final F_0 of each syllable in your imitated speech/song, and compare your imitation to the model production.

Scientific Objectives

- To investigate the relationship between speaking and singing through vocal imitation.
- To investigate the effects of stimulus type (speech vs. song), language background (native vs. non-native), gender (female vs. male), and familiarity (familiar vs. unfamiliar) on pitch matching accuracy.

Learning Objectives

- To gain experience of how F₀ changes in speaking and singing.
- To experience how F₀ contours vary across a group of speakers/singers.
- To practise making F₀ measurements from live speech/song, to better appreciate the difficulties that can arise.

Materials

Please download the model speech/song stimuli (which you will be imitating) at <u>http://www.phon.ucl.ac.uk/courses/spsci/SSC_talking/material/week_05/ModelStimuli.zip</u>. After unzipping the file, you will find two folders in it: Female_Stimuli and Male_Stimuli. There are four sound files in each folder.

- (Fe)male_Gently_Song.wav: 'Gently down the stream' sung by a (fe)male singer
- (Fe)male_Gently_Speech.wav: 'Gently down the stream' spoken by a (fe)male speaker
- (Fe)male_OurHome_Song.wav: 'Our home and native land' sung by a (fe)male singer
- (Fe)male_OurHome_Speech.wav: 'Our home and native land' spoken by a (fe)male speaker

Please use the sounds in the Female_Stimuli folder if you are female, and those in Male_Stimuli if you are male.

Apparatus

We will use **Praat** (local location: Desktop\LabPrograms\Praat; downloadable from <u>http://www.fon.hum.uva.nl/praat/</u>) to play and record speaking/singing sounds, to display pitch contours, and to acquire pitch values.

Procedure (the following instructions are adapted from Praat Manual)

1. Read the sounds into Praat:

- 1. Please read the four sound files into Praat with "Read from file...".
- 2. They will appear as Sound objects in the Object window, e.g., "Sound Female_Gently_Song", etc.
- 3. When you read your sounds to the Object window, some buttons will appear in that window. These buttons show you what you can do with the sounds, e.g., "Play" and "Edit".

2. Start recording using Praat:

- 1. Choose "Record mono Sound..." from the "New" menu in the "Object" window. A "SoundRecorder" window will appear on your screen.
- 2. In the "SoundRecorder" window, choose the appropriate input device (e.g., "Internal microphone") and sampling frequency (e.g., "44100 Hz").
- 3. Press the "Record" button to start recording.

3. In the "Object" window:

- 1. Select one of the sounds, e.g., (Fe)male_Gently_Song.
- 2. Play it with the "Play" button.
- 3. Imitate its pitch patterns as closely as possible immediately afterwards.

4. In the "SoundRecorder" window:

- 1. Press the "Stop" button to stop recording.
- 2. Use the "Play" button to hear what you have recorded.
- 3. Click the "Save to list" button. Your recording will now appear in the "Object" window, where it will be called "Sound sound".

5. Pitch analysis:

- 1. To see the pitch contour of your imitated sound as a function of time, select the sound in the "Object" window and choose "Edit".
- 2. A SoundEditor window will appear on your screen. The bottom half of this window will contain a pitch contour, drawn as a blue line or as a sequence of blue dots. If you do not see the pitch contour, choose "Show pitch" from the "Pitch" menu.
- 3. To the right of the window, you may see three pitch values, written with blue digits: at the bottom, you see the floor of the viewable pitch range, perhaps 75 Hz; at the top, you see the ceiling of the pitch range, perhaps 600 Hz; and somewhere in between, you see the pitch value at the cursor, or the average pitch in the selection.
- 4. You will measure the final F_0 of the vowel in each syllable (e.g., /e/ in "gent"),



as demonstrated in the following waveforms, spectrograms, and labeling tiers.

6. Write down your measurements in the following tables (Tables 1-2 for females and Tables 3-4 for males). Repeat Steps 2-5 to imitate and measure vowel-final F_0 's of your imitations for all four sound files.

Female_Gently		gent	ly	down	the	stream
Song	Model	262 (C4)	246 (B3)	262 (C4)	277 (C4#)	311 (D4#)
Song	Imitation					
Speech	Model	208	236	196	201	164
Speech	Imitation					

Table 1. Vowel-final F_0 values (in Hz) of "gently down the stream" in song and speech by the female model singer/speaker and in your imitation.

Table 2. Vowel-final F_0 values (in Hz) of "our home and native land" in song and speech by the **female** model singer/speaker and in your imitation.

Female_OurHome		our	home	and	na	tive	land
Song	Model	233 (A3#)	262 (C4)	277 (C4#)	311 (D4#)	349 (F4)	233 (A3#)
Song	Imitation						
Speech	Model	179	246	190	204	215	126
Speech	Imitation						

Table 3. Vowel-final F_0 values (in Hz) of "gently down the stream" in song and speech by the male model singer/speaker and in your imitation.

Male_Gently		gent	ly	down	the	stream
Song	Model	133 (C3)	126 (B2)	133 (C3)	142 (C3#)	159 (D3#)
Song	Imitation					
Speech	Model	105	110	96	96	76
Speech	Imitation					

Male_OurHome		our	home	and	na	tive	land
Song	Model	117 (A2#)	131 (C3)	139 (C3#)	156 (D3#)	175 (F3)	117 (A2#)
Song	Imitation						
Speech	Model	89	122	94	101	106	63
Speech	Imitation						

Table 4. Vowel-final F_0 values (in Hz) of "our home and native land" in song and speech by the male model singer/speaker and in your imitation.

7. At <u>http://www.phon.ucl.ac.uk/courses/spsci/SSC_talking/material/week_05/SSC_week5_lab_results.xls</u>, download the Excel file SSC_week5_lab_results.xls. Open the file, answer the background questionnaire in the "Questionnaire" worksheet, and input your results in the "Female_Results" or "Male_Results" worksheet.

8. Your imitation accuracy is assessed by absolute pitch difference (in semitones; averaged across the syllables in each sequence) between the model production and your imitation (the smaller the value, the better the imitation), which is automatically calculated in the "Female_Results" /"Male_Results" worksheet. Please copy your results into the following table.

Absolute pitch difference	'Gently down the stream'	'Our home and native land'
Song		
Speech		

9. When you finish it, please email the Excel file to <u>fangliufangliu@gmail.com</u> so I can summarize the group results and send them back to you at a later time.

Based on the group data, please answer the following research questions.

Is song imitated better than speech?

Is the familiar song imitated better than the unfamiliar one?

Do native speakers of English imitate speech better than foreign speakers?

Do women have better imitation skills than men?

Do people tend to have similar (in)accuracy in imitating speech and song?