

English Phonetics

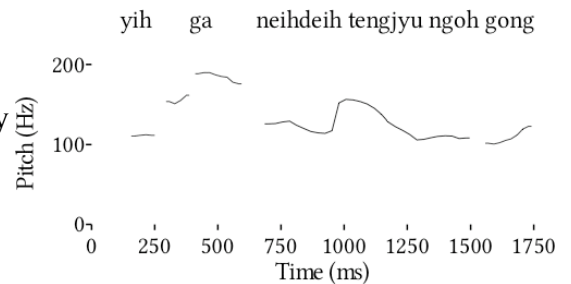
Prosodic Analysis

Introduction

- Prosodic analysis involves those aspects of the phonetic system that are traditionally referred to as prosody
- the study of prosody includes the examination of tone, stress, and pitch accent systems
- also higher level phrasal and sentential intonation

Tone

- Tone systems are relatively common in the languages of the world
- found in East Asia, Central America, and Sub-Saharan Africa
- a number of types of tone systems
- they share one common property: a change of the pitch will result in a change of meaning
- before discussing the use of pitch to explain tone, we must first understand the nature of pitch
- pitch is a term used to refer to variations in fundamental frequency (F0)
- this can be measured using Praat



Measuring Pitch

- the fundamental frequency of the voice, ranges from approximately 30–300 Hz
- this varies according to the speaker: typically males' pitch ranges from 50-180Hz and females from 80-250Hz

Lexical Pitch

- this type of variation in pitch is not related to the phrase or larger intonational units
- it varies from syllable to syllable in unpredictable ways
- this is typical of tone languages: each syllable or morpheme may have its own pitch
- in this situation, each syllable is assigned a specific lexical tone, giving rise to lexical differences in only the tone
- demonstrated by example from Standard Chinese:
- Note: ˥ marks high, ˨ falling, ˨˨ falling-rising, and ˨˨˨ falling tone

- a. [ma˥] 媽 'mother'
- b. [ma˨˨] 麻 'hemp'
- c. [ma˨˨˨] 馬 'horse'
- d. [ma˨˨˨] 罵 'scold'

Contrastive Pitch

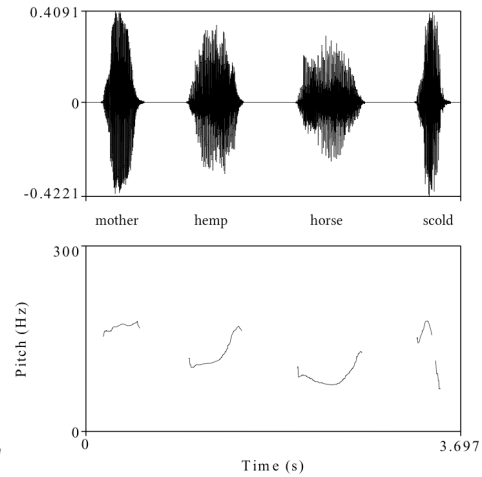
- the differences are contrastive and, therefore, tone is a contrastive lexical property of Standard Chinese
- in Standard Chinese, the tonal distinctions are maximal, involving not only levels of pitch, but also changes in the pitch profile
- this distinction is an important one: tones may occur at different levels of pitch, but they may also involve a transition from one level to another one
- such cases of changes in level are referred to as contour tones

Analyzing Tone

- now let's take a look at how we analyze tone using Praat
- we will use a recording of the four Standard Chinese words discussed above
- the recording is digitized using Audacity
- a WAV file is created with just the four words mā `mother', má `hemp', mǎ `horse', and mà `scold'
- this is then loaded into Praat
- select Edit, giving us a window like this:
- remove the spectrograph window from the display, by deselecting Show spectrogram under Spectrum
- now turn on the pitch analysis window by selecting it under Pitch in the Praat menus
- this provides us with a graphic presentation of the variation in fundamental frequency, measured in Hz
- there are several adjustments that can be made to the pitch display to make the analysis clearer
- first, one can adjust the range of analysis
- different speakers have different pitch ranges: men have pitch ranges in the 50–180 Hz range; women's

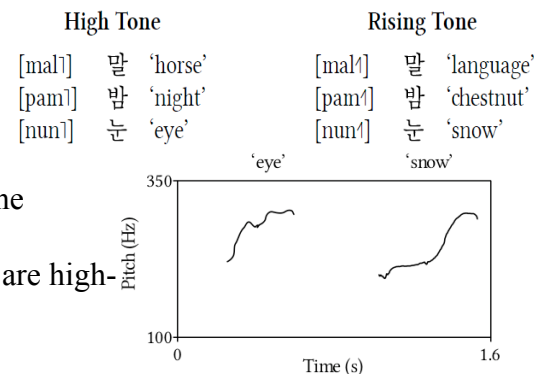
pitch tends to be higher, in the 80–250 Hz range

- to set this, we must open the Pitch menu and select Pitch settings...
- we can adjust the pitch range by entering numbers in the two boxes, left for bottom of the range, right for top of the range
- choose Hertz for the unit of measurement
- autocorrelation is preferred for intonation studies and cross-correlation for tone studies
- it is possible to measure the pitch at any point by placing the cursor at the desired position and clicking
- the pitch at that point appears on the right side of the window, in this case 179 Hz
- save the pitch track as a graphic for presentation
- select 'Extract visible pitch contour' from the Pitch menu
- the result will be an entry in the Praat objects window entitled 'Pitch untitled'
- close the Edit window and return to the Praat objects window
- you can select 'Pitch untitled' and rename it by pressing the 'Rename' button at the bottom of the window
- useful when you have many objects in the window
- select the pitch track again and choose Draw from the menu on the right side
- this will give you a new window, Pitch:Draw
- this allows you to specify the time and frequency range of the graphic
- it also allows you to tick a box labelled 'Garnish' which will provide a basic format for the graphic
- the result is a picture of the pitch track
- this graphic may now be saved as a graphic file
- it may be inserted into other documents
- choose one of the items in the File menu, for example 'Write to EPS file...'



Busan Korean

- Korean has a limited degree of vowel length distinctions, but only in the first syllable of the word
- there is a concomitant of that vowel length that is realized as tone differences in some varieties of Korean
- the first member of the pair has a short vowel and a high tone (1) and the second member has a long vowel and a rising tone (1)
- According to Y.-H. Chung (2006), "monosyllables with a short vowel are high-toned and those with a long vowel are rising-toned."



Stress

- in some languages a variation in pitch or intensity or vowel length may be associated with a certain prominence within the word
- each word is assigned a single, most prominent syllable; all other syllables are subordinate
- this phenomenon is referred to as stress
- there are different kinds of stress systems
- some systems are completely regular and predictable
- in French, stress is placed on the last syllable of a word, no matter how short or long the word is
- Hungarian stress is on the 1st syllable of the word
- Polish stress is on the second syllable from the end (penultimate)
- in all these cases, the placement of stress is regular and predictable

Demarcative Stress

- the placement of stress in such languages is a very useful indicator of word boundaries
- if you are listening to a sentence in French you can tell that each time you hear a stressed syllable, the word is ending and the next word is beginning

a. table	[ˈtabl]	'table'
b. secours	[søˈkuʁ]	'aid'
c. dépendance	[depɑ̃ˈdɑ̃s]	'dependence'
d. indépendance	[ɛ̃depɑ̃ˈdɑ̃s]	'independence'

- the same strategy works for the other languages mentioned above and many others
- in French, stress appears on the final syllable of the word, no matter how long it is
- the placement of stress is a good indicator of the word boundary

Lexical Stress

- some languages, particularly those that use tone like Chinese, may not make very much use of stress at all
- on the other hand, languages like English and Russian have variable stress, which moves about in the word
- stress should be viewed as a relative property, one that may have degrees such as primary and secondary or no stress at all
- typically, there is only a single primary stress per word, but there may be several secondary stresses depending on the length of the word

Lexical Stress in Russian

- stress may be used to indicate differences in word meaning
- Russian stress is relatively mobile and the placement of stress can affect the meaning of words that are otherwise identical
- the placement of stress can indicate a different word
- it may also indicate a different grammatical category
- stress marking of this type is not demarcative, but lexical

a. 'muka	'torment'	mu'ka	'flour'
b. 'zamok	'castle'	za'mok	'lock'
c. 'atlas	'atlas'	at'las	'satin'
d. 'stoit	'be worth'	sto'it	'stand'

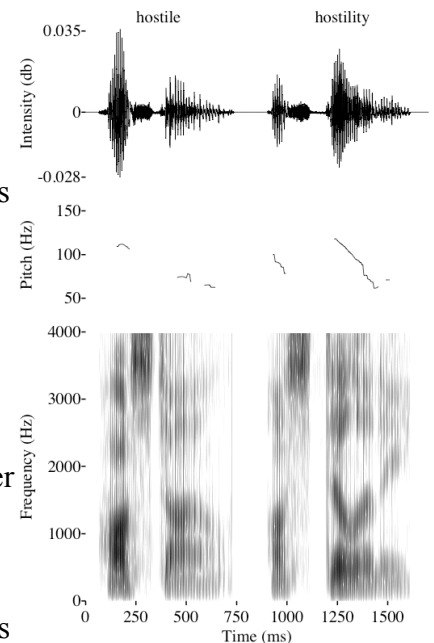
a. 'ruki	'hand (NP)'	ru'ki	'hand (GS)'
b. 'zemli	'lands, soils (pl.)'	zem'li	'land, soil (gen.)'
c. 'srezat'	'cut off (PERF)'	sre'zat'	'cut off (IMPERF)'

Acoustic Correlates of Stress

- we should examine the physical properties of stress to clarify exactly what it is that we are investigating.
- stress in language may be correlated with one or more of the following phonetic properties:
 - Pitch or Fundamental Frequency (F0)
 - Intensity or Loudness (amplitude)
 - Vowel Length
- stress can be measured acoustically using various instruments and software

Stress Correlates

- this representation provides a number of pieces of information regarding stress placement
- at the top, the waveform indicates the greater intensity of the stressed syllable
- in the middle, it shows the higher pitch shown in the pitch track
- at the bottom, the spectrogram indicates the greater length of the stressed syllable



Analyzing Stress

- since stress is manifested as rise in pitch, greater intensity (loudness) or greater vowel length, the analysis of stress must make use of various elements of acoustic analysis
- these include the waveform, spectrogram, and pitch track
- the analysis will be similar to that of tone, but will involve additional windows to indicate the waveform and the spectrogram

Stress Analysis

- [1.] Digitize the sound recording
 - [2.] Open the sound file in Praat
 - [3.] Select the file and Edit
 - [4.] In the Edit window, select Spectrum: Show spectrogram and Pitch: Show pitch
 - [5.] This will give you a window that looks like this:
- the pitch analysis is overlain on the spectrogram
 - the frequencies indicated on the left side of the window apply to the spectrogram and those on the right side apply to the pitch
 - the two objects are treated as separate entities in spite of their appearance
 - when you export them to the Praat objects list they will be treated as separate objects

- [6.] To export the different windows go to Spectrum and choose Extract visible spectrogram
- [7.] Then go to Pitch and choose Extract visible pitch contour
- [8.] Now, close the Edit window and return to the Praat objects list
- we can build our composite graphic of the data
- to do this we must build separate graphics of each part, step by step
- the graphics may appear in any order
- the output is as above
- it shows waveform, pitch track, and spectrogram
- this is the normal procedure for investigating stress assignment

Pitch Accent

- in some languages, a phenomenon exists which seems to be somewhere in between tone and stress
- only a single prominent syllable appears in each word
- this *accented* syllable acts as a cue or anchor for a change in tonal pattern within the word
- this is described as pitch accent
- it is a property of languages like Japanese, Serbo-Croatian, and perhaps some varieties of Korean

Tsuruoka Japanese

- In the Tsuruoka dialect of Japanese, pitch contrasts exist as shown below, from Haraguchi (1988:125)
- there is a difference between *unaccented*, *initial*, *medial*, and *final*
- this is not a property of individual syllables, but rather of the phonological phrase as a whole
- this distinguishes pitch accent systems from tone systems
- the analysis of pitch accent will be very much like that of tone and stress

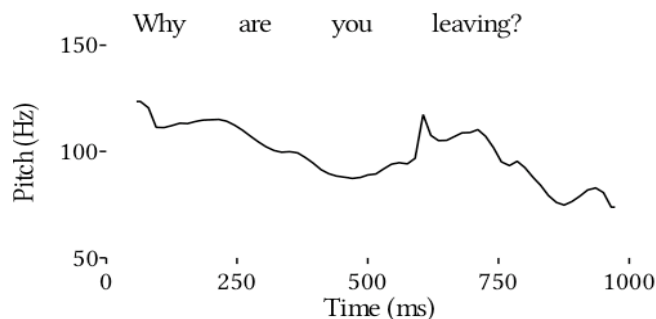
a. Unaccented	•••	<u>sakana</u> (to)	'fish (and)'
b. Initial	•••	kā <u>buto</u> (to)	'helmet (and)'
c. Medial	•••	koko <u>ro</u> (to)	'heart (and)'
d. Final	•••	ata <u>ma</u>	'head'
	•••	atama <u>to</u>	'head and'

Intonation

- Intonation is the variation of pitch over units larger than the word
- typically the phrase or sentence
- intonation may serve a variety of functions including the indication of various grammatical categories, and the demarcation of boundaries
- the realization of intonation may vary from language to language
- all languages make some use of intonation

Analyzing Intonation

- the analysis of intonation is very much like the analysis of tone, except that it spans larger units than tone
- intonation in a stress-type language will tend to have longer stretches of more or less flat or gliding pitch than in a tone language
- compare the earlier Cantonese sentence with the intonation pattern of the English sentence



Wh-question Intonation

- notice that this utterance appears to have two main peaks
- one at the beginning, on the word *why*, and a second on the stressed syllable of the verb, *leaving*
- Furthermore, the intonation gradually declines toward the end of the sentence, beginning around 125 Hz and ending around 75 Hz
- this is typical of a wh-question type of sentence in English