

Acoustic Phonetics

Lesson 13

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- Segmental
 - refers to phonemes and allophones and their attributes
- Supra- or extra-segmental
 - Elements that transcend or extends across segmental boundaries

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Suprasegmentals

Speech has...

- Rhythm

- Stress

- Tempo

- Rate and/or duration
- Quantity

- Melody

- Intonation

Prosody

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Studies on Rhythm & Tempo

Are aimed to determine the processing of
linguistic information

- Connection between information structure
(syntax) and linguistic planning

- Role of pauses, hesitations, etc.
- Stretches of speech, etc...

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Tempo

Rate/durational aspects of speech

- **Relative rate/durational measures**
 - Relative duration *within a phrase/utterance*
- **Absolute rate/durational measures**
 - Speech rate
 - Articulation time
 - Pause time
 - Articulation rate

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Speech Tempo

- Typically expressed as # of speech elements/time
- Can be quite variable depending on communication pressures
- Quite variable from person to person
- Habitual tempo is somewhat stable within a speaker

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Tempo Measures

Can be informative about overall rate of information transfer

(related to fluency, intelligibility...)

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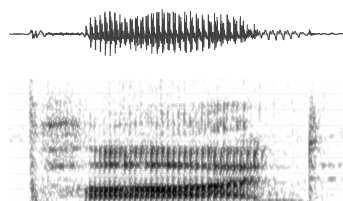
Relative Duration

Phonetic influences

- Local phonetic environment
 - Vowel duration preceding voiced consonants
 - Consonant duration / clusters
- Marking grammatical events
 - Phrase final lengthening
- Marking Rhythm/Prominence
 - Stress

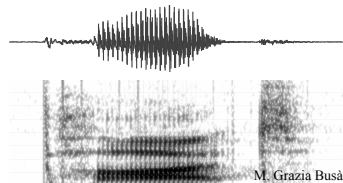
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Vowel duration preceding consonants



“pod”

Vowel=303 msec

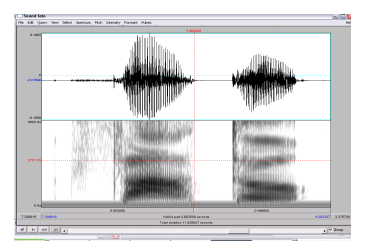


“pot”

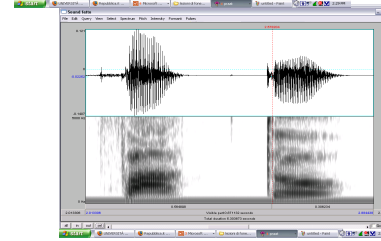
Vowel=221 msec

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Differences in consonant duration in Italian



[fatɔ] “fato”



[fatːɔ] “fatto”

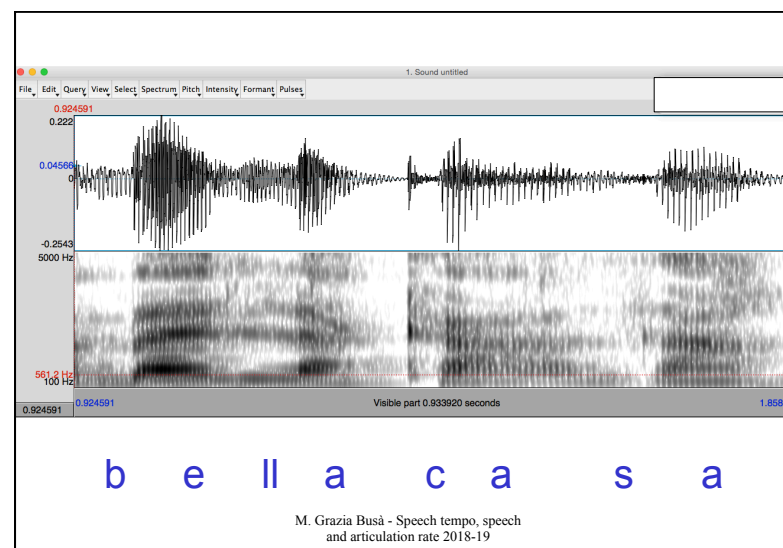
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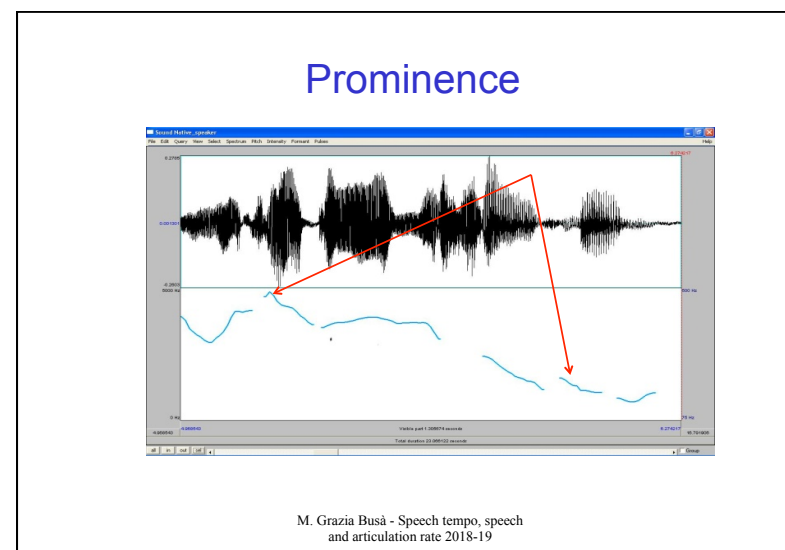
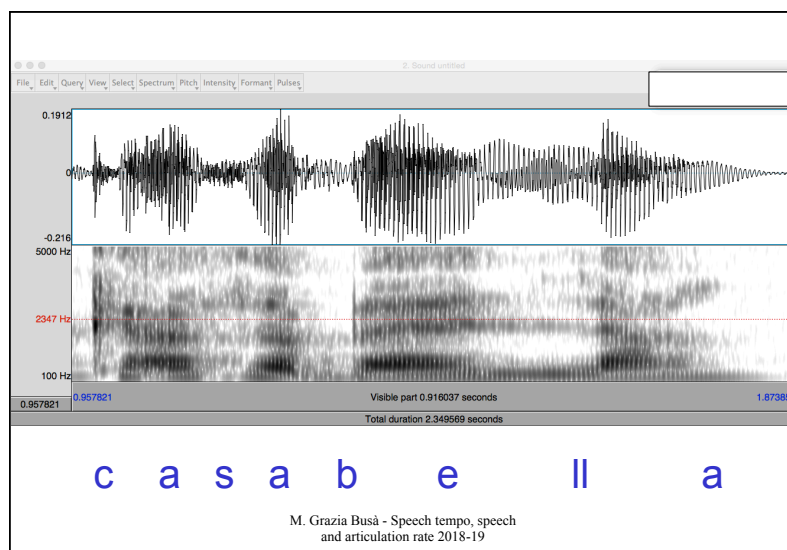
Phrase final lengthening

marks grammatical constituents

Compare:

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Absolute rate/durational measures

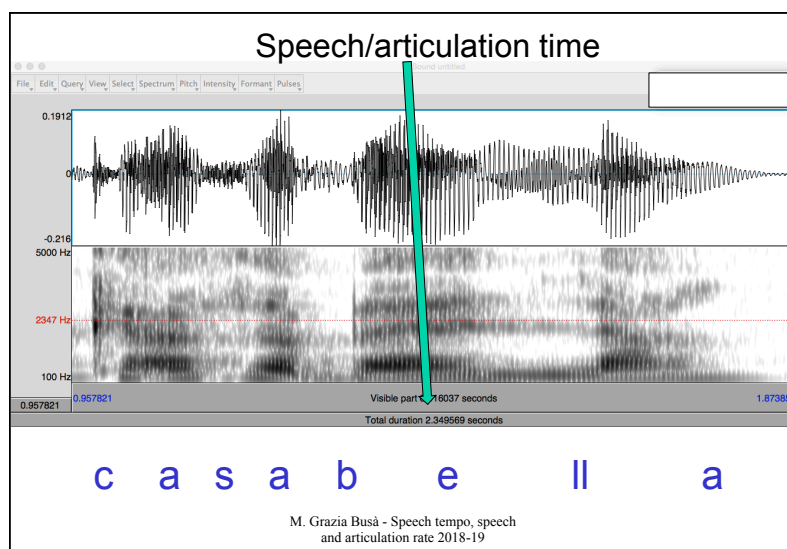
- Speech rate
- Articulation time
- Pause time
- Articulation rate

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Tempo Measures

- Articulation time
 - Duration occupied by speech-related acoustic energy
- Pause time
 - Duration between “runs” of speech-related acoustic energy
 - Associated with inspiration and/or syntactic boundaries
- Speech rate
 - Number of syllables or words/speech time
- Articulation rate
 - Number of syllables or words/articulation time

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Speech rate

prosodic cue

= relationship between
number of syllable and total
speech time

$$\frac{\text{n.syll.}}{\text{sec}}$$

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Articulation rate

Prosodic cue

= relationship between number of syllables and the time needed to produce them

$$\frac{\text{n.syll.}}{\text{sec}}$$

In other words = variability in syllable duration

$$\text{Syll.dur.} = \frac{1}{\text{Artic.rate}}$$

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Fluency

prosodic cue

= relationship between the number of syllables and the number of silent pauses

$$\frac{\text{n.syll.}}{\text{n.silent pauses}}$$

Indicates how many syllables are there in a speech chain

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Pauses

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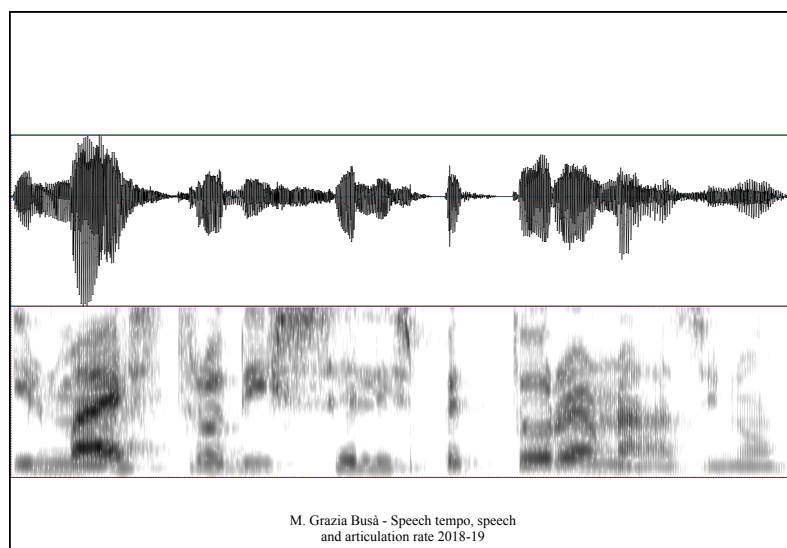
Silent pauses

il maestro disse l'ispettore è un asino

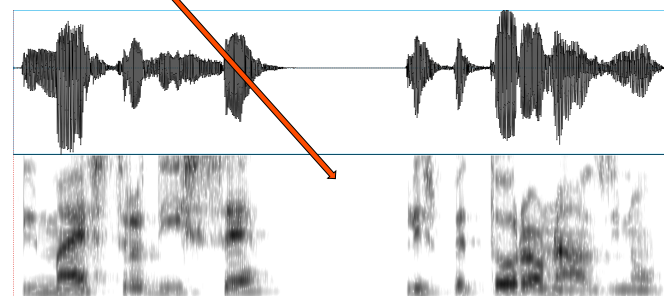
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il maestro // disse l'ispettore // è un asino

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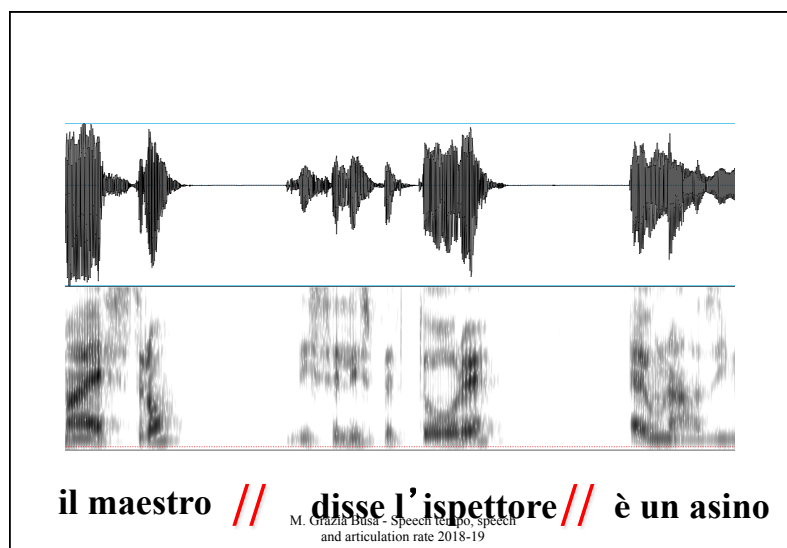


For a pause to be heard it should be at least 150 ms
This is 555ms



il maestro disse // l'ispettore è un asino

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silent pauses

non intentional:

- ✓ respiration pauses
- ✓ planning pauses

intentional:

- ✓ emphatic pauses
- ✓ grammatical or boundary pauses
- ✓ control pauses

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non silent pauses

non intentional:

- ✓ Moments in which the speaker is planning speech (choices and decisions)
- ✓ Discourse signals the speaker gives to the listener to keep the conversation turn

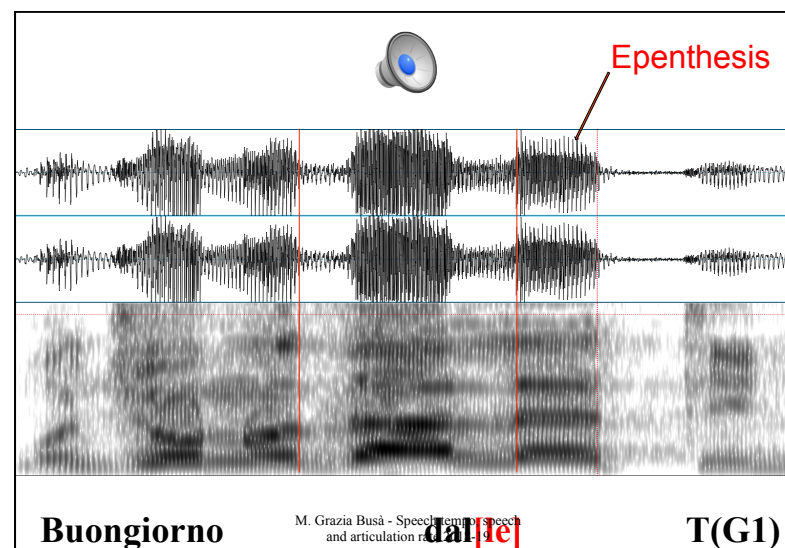
Typologically divided into:

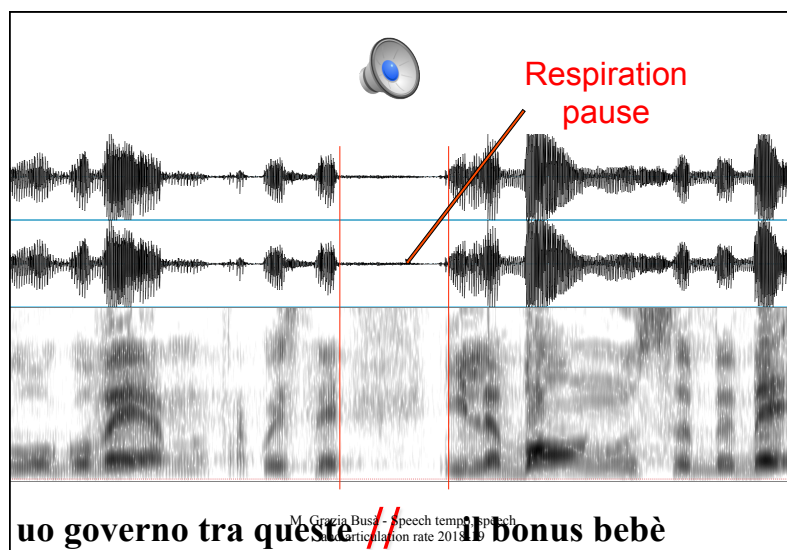
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non silent-pauses

false starts
lengthenings
vocalizations
repetitions
corrections

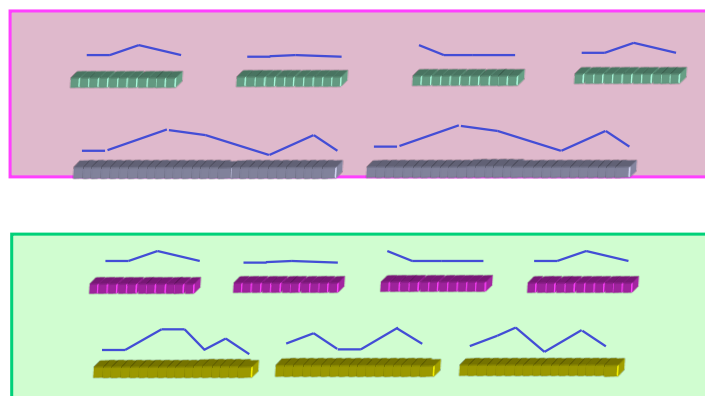
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Differences in
position/duration/
type of pauses
characterise
differences in
individual speech

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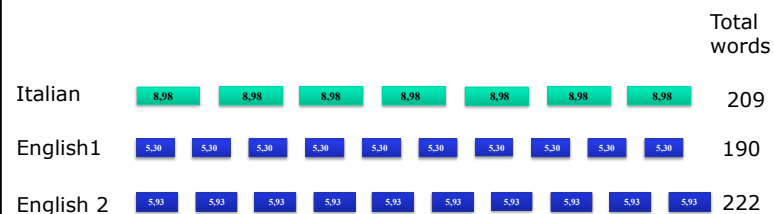


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Differences in
position/duration/
type of pauses may
characterise
differences between
L1 and L2 speakers

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Differences between language groups



More pauses and disfluencies in English 1 than in English 2

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Speech data

		Ita1	Ita2	Eng1	Eng2
Duration (sec.)	Speech Rate	0.39	0.39	0.56	0.50
	Articulation Rate	0.32	0.31	0.40	0.39
	Tot. Pauses	6.8	6.5	19.75	14.48
	Tot. Duration	47.8	47.1	70.47	62.15
	Tot. Disfluencies	2.7	2.4	16.3	13.67
Average Occurrence	Tot. Pauses	16.3	14.5	40	36.5
	Tot. Disfluencies	14.9	12.9	35.3	31.8
	Word Count	121.6	123.6	125	128

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Ita is sign. different from Eng, $p < 0.05$

Intelligibility

- Estimate of how well the speaker is understood
- Ways to estimate intelligibility
 - Scaling methods
 - Transcription/forced choice tasks
 - Word level
 - Sentence level

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Communication Efficiency

- some have attempted to estimate the efficiency of communication by combining
 - Speech rate
 - Intelligibility
 - i.e. intelligible syllables per second (or syllables/words per minute)

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