Phonetics.
The Sound of Language

The Description of Sounds

Fromkin & Rodman: *An Introduction to Language.* Fort Worth etc., Harcourt Brace Jovanovich

Read:

Chapter 5, (p. 176ff.) (or the corresponding chapter)

Phonetics: The Sounds of Language

The Concepts "Phonetics" und "Phonology"

Phonetics	**Phonology**
Spoken language (*substance*)	The sound system (*abstract units*)
Articulation Acoustic signal Perception	Sound regularities (*which sounds; sound patterns*)

What are "Phonetis" und "Phonology"

They are not completely separable because each depends on the other.

Looking at the nature of the sounds of (a) language without taking into consideration that they work as the basis of a system of communication is meaningless.

Looking at the sound system of a language without knowing is behind it in terms of articulation, acoustics and perception is useless.

In principle, phonetics deals with concrete utterances, whereas phonology deals with the systematic workings of the structure (i.e., it is more abstract)

Plan:

We start by explaining how phonetic events can be described.

Then we shall discuss the relationship between phonetic and phonological description.

Finally (tomorrow), we shall deal with some principles of phonological description.

Areas of phonetics

- Speech production
- Speech acoustics
- Speech perception

Basic questions in phonetics

I. What do we do to produce speech sounds (and utterances made up of speech sounds)?

II. How can we describe the sounds? (phonetic classification und sound symbols)

III. How can we describe the melodic und rhythmic aspects? (utterances are not just a sequence of sounds)

How do we produce speech sounds?

i) We produce an airstream
(*Energy source*)

ii) We transform the airstream (kinetic energy) into acoustic energy
(*Excitation signal*)

iii) We modifiy the excitation signal, to produce different speech sounds
(S*peech signal*)

(Differences = information ← different words)

i) Airstream

• Excess pressure in the lungs results in an *egressive pulmonic airstream,*

• Other types of airstream are also used in speech:

- egressive glottal airstream (*Ejectives*)
- ingressive glottal airstream (*Implosives*)
- ingressive "velic" airstream (*Clicks*)

I.i) Airstream

Excess pressure in the lungs results in an *egressive pulmonic airstream,*
which is the normal airstream for speaking, (normal for German, English, French, etc.)

• but it is not the only airstream used in the languages of the world:

- egressive glottale airstream (Ejectives)

(The pressure is built up by the upward movement of the closed larynx)

- ingressive glottale airstream (Implosives)

(The pressure is ***reduced*** by the *down*ward movement of the closed larynx)

- ingressive "velic“ airstream (clicks)

(The pressure is ***reduced*** by increasing the size of the cavity between tongue and palate).

ii) Excitation

- *Transformation of kinetic energy* into *acoustic energy* (= excitation)
- At the glottis (=gap between the vocal folds): vocal fold vibration (= voicing; phonation)
- At a point of constriction somewhere in the vocal tract (= noise, friction)
- When a closure in the mouth is released (= release impulse, explosion)

I.ii) Excitation

The airstream (kinetic energy = energy in the laminar movement of air particles) is transformed into acoustic energy (vibrating air particles)
- At the glottis: Vocal fold vibration.
(= voicing; phonation) defining the class of sounds we call (= Vokale (i, a, u, usw.), Sonoranten (m, n, l, r, usw.)

- If the vocal folds don‘t vibrate, the excitation has to take place in a different way.

- AN articulatory constriction somewhere in the mouth or throat makes the airstream turbulent = acoustic energy perceived as friction noise. . (= fricatives (f, s, sch, ch etc.))

- An articulatory occlusion (blockage) leads to a build-up of air-pressure in the mouth. The quick release of the stoppage causes a small explosion as the excess air escapes. (= plosives (p, t, k etc.)

iii) Modification

- How is the excitation signal modified to produce different speech sounds?

  By shaping the vocal tract.

  → acoustic filtering

  → which changes the quality („colour of the sound“)

E.g. [i] → [y] (change of lip shape),

[u] → [y] (change of tongue position)

I.iii) Modification

The excitation (the sound produced) can be modified further because different sizes and shapes of the cavities in the mouth have different resonance properties. So they filter the sound and “colour“ it.

How can we describe sounds?

Consonants

- ***Excitation type*** (±voiced), e.g. [s z]
- ***Manner of articulation*** (from closure to narrow constriction to almost vowel-like), e.g. [b, v, w]
- ***Place of articulation*** (from the lips to the Glottis), e.g. [p, t, k, ʔ]

Vowels

- ***Degree of opening*** (tongue height/jaw opening),
- ***Tongue position*** (from front to back),
- ***Lip shape*** (rounded, neutral, spread)

II. How can we describe speech sounds?

The first distinction we make is between vowels and consonants:

Consonants: We have already mentioned different types of excitation (***voiced and voiceless***); that gives us **one** Classification criterion.
When we described excitation, we mentioned the narrow constriction (which produces friction) und complete closures (which leads to an explosion when released).

These are two of the several ***Manners of articulation***, which result in different types of sound, thus giving us a second criterion for classification.: ***Plosives***, ***Fricatives, Sonorants*** (Nasals, Trills, Approximants = Laterals, Glides),

The place in the mouth where the articulation takes place provides the third criterion: ***Place of Articulation***. Different places of articulation change the shape of the oral cavities, i.e. of the resonances (filter) and differentiates the colour of the sounds produced: There are ***labial*** (lips), ***dental*** (teeth), ***alveolar*** (upper teeth ridge), ***palatal*** (hard palate), ***velar*** (soft palate), ***uvular*** (uvula), ***pharyngeal*** (throat), ***glottal*** (vocal folds) sounds.

The distinction ***voiced vs. voiceless*** doesn‘t occur with the „*sonorant consonants*“ (nasals, liquids, approximants). They are, by definition, always voiced. ***Vowels*** are also always voiced. In addition, they have no point of contact, so that the normal distinction according to ***manner*** of articulation isn‘t used. Since they are all „vocalic“ they all belong to the same manner of articulation.

But ***vowels*** are still differentiated and categorized according to similar principles:

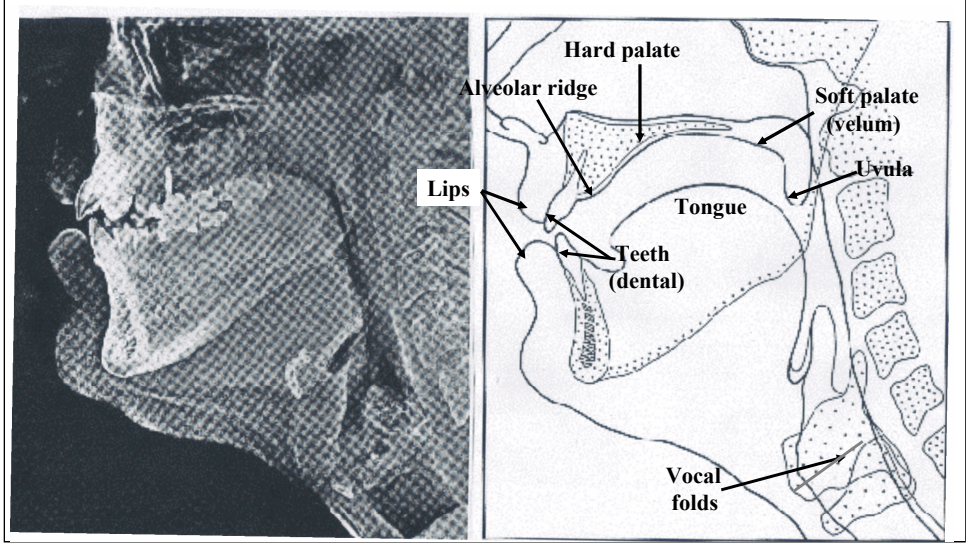
Similar to the ***manner*** of articulation, we have ***closed*** and ***open*** vowels.

Similar to der ***place*** of articulation, we have ***front*** and ***back*** vowels (and *central* vowels between them)

Also, vowels can be produced with ***rounded*** or ***unrounded*** lips, more or less independent of what the tongue is doing.

They can also be produced ***short*** and ***long.***

Places of Articulation



This „***sagittal cross-section***“ of someone‘s head (x-ray on the left, schematic line drawing on the right) is the traditional way of portraying our vocal tract.

You need to learn the ***places of articulation*** that are labeled. The organs of speech are also given in the book.

The ***articulators*** are essentially the bottom lip and the tongue (which can move both independently and with the jaw to get close to (or make contact with) various places of articulation).

Being two-dimensional, it doesn‘t show anything of the teeth except the incisors, nor does it show much of the complexity of the tongue shape.

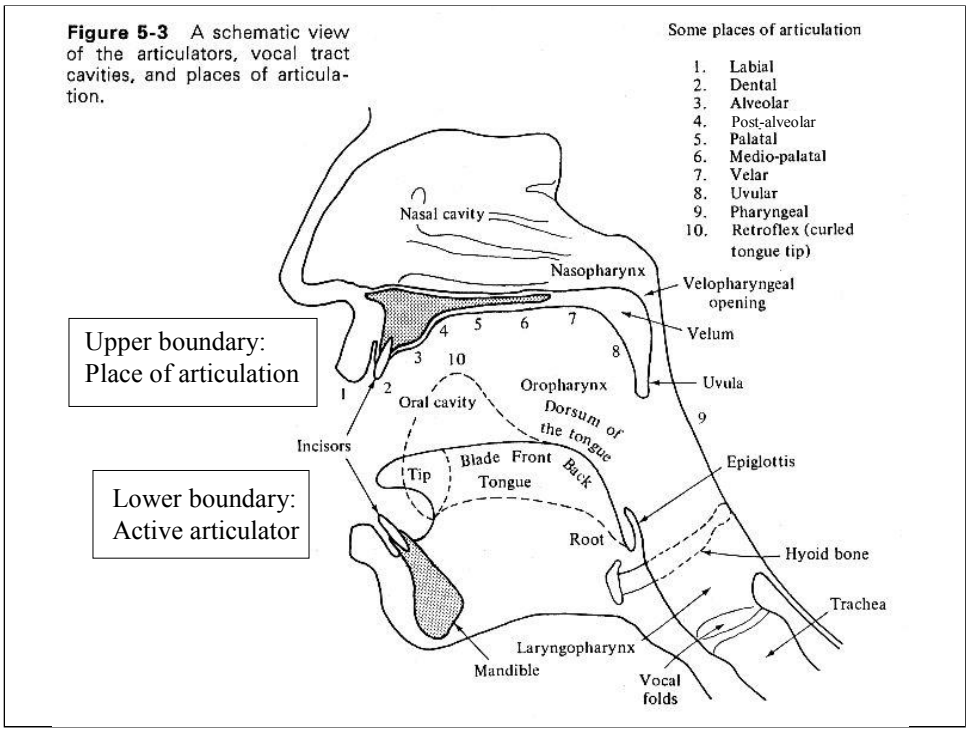


Figure 5-3 A schematic view of the articulators, vocal tract cavities, and places of articulation.
Some places of articulation
1. Labial
2. Dental
3. Alveolar
4. Post-alveolar
5. Palatal
6. Medio-palatal
7. Velar
8. Uvular
9. Pharyngeal
10. Retroflex (curled tongue tip)
Upper boundary: Place of articulation
Lower boundary: Active articulator
Nasal cavity
Nasopharynx
Velopharyngeal opening
Velum
Uvula
Oropharynx
Oral cavity
Dorsum of the tongue
Incisors
Tip
Blade
Front
Back
Tongue
Root
Epiglottis
Hyoid bone
Trachea
Laryngopharynx
Mandible
Vocal folds

German Consonants

Manner/place	*lab.*	*alv.*	*p-alv.*	*pal.*	*vel.*	*uvul.*	*glot.*
Plos:	p b	t d			k g		(ʔ)
Affric:	pf	ts	tʃ(dʒ)				
Fric:	f v	s z	ʃ ʒ	ç	x	ʁ	h ɦ
Nas.son:	m	n			ŋ		
Approx:		l		j			

German consonants

An additional, more complex category of sound is quite common in German, namely the affricate, which is a combination of a stop + a fricative. It is also described as a stop with a slow, fricative release.

English Consonants

Man./place	*lab.*	*dent.*	*alv.*	*p-alv.*	*pal.*	*vel.*	*uvul.*	*glot.*
Plos:	p b		t d			k g		
Affric:				tʃ dʒ				
Fric:	f v	θ ð	s z	ʃ ʒ				h ɦ
Nas.son:	m		n			ŋ		
Approx:	w		l		ɹ j			

English consonants

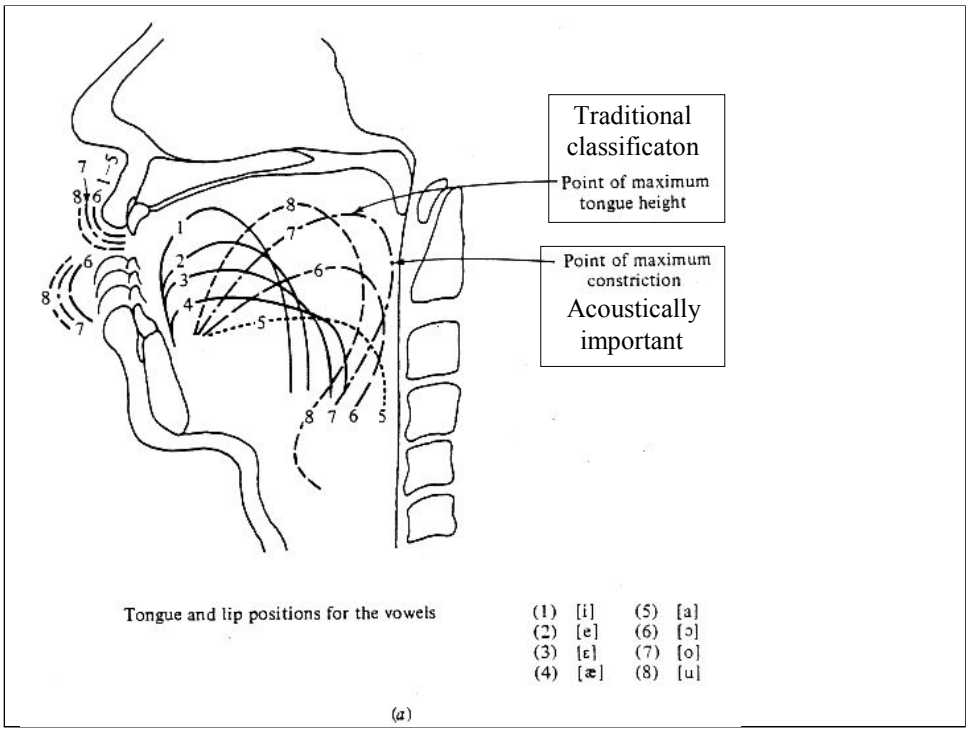
English has less affricates than German,

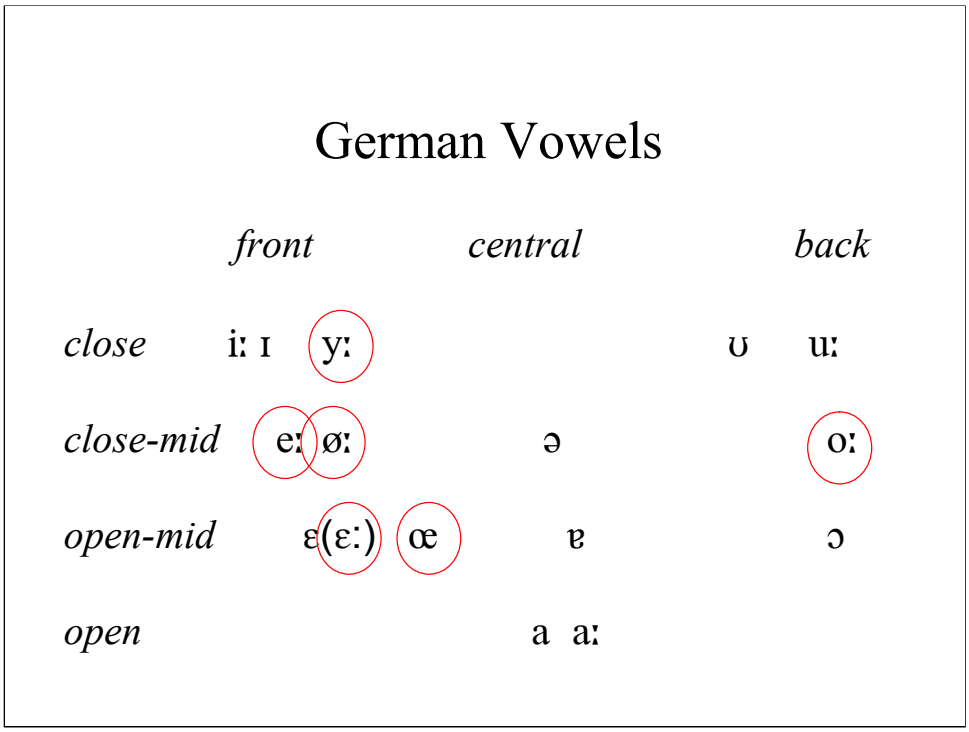
the fricatives are more fronted (additional dental fricatives and no palatal, velar or uvular fricatives),

And English has more approximants than German

Vowels

- ... Do not have a clear place of contact (constriction or closure)
- The tongue body (***dorsum***) changes shape and moves its centre of gravity around the vocal tract.


Traditional classificaton
Point of maximum tongue height
Point of maximum constriction
Acoustically important
Tongue and lip positions for the vowels
(1) [i] (5) [a]
(2) [e] (6) [ɔ]
(3) [ɛ] (7) [o]
(4) [æ] (8) [u]
(a)



German Vowels German vowels are distributed very systematically around the vowel space

long vowels: : i: (bieten), y: (Tüte) u: (tuten)
short vowels: ɪ (bitten) ʏ (Hütte) ʊ (Busch)

long vowels e: (beten), ø: (Höhle) o: (boten
unstressed
central vowel: ə (bitte)

Short vowels ɛ (Betten) ɔ (Socken)
(long vowel) ɛ: (bäten)

ɐ (bitter)

a: (baten)

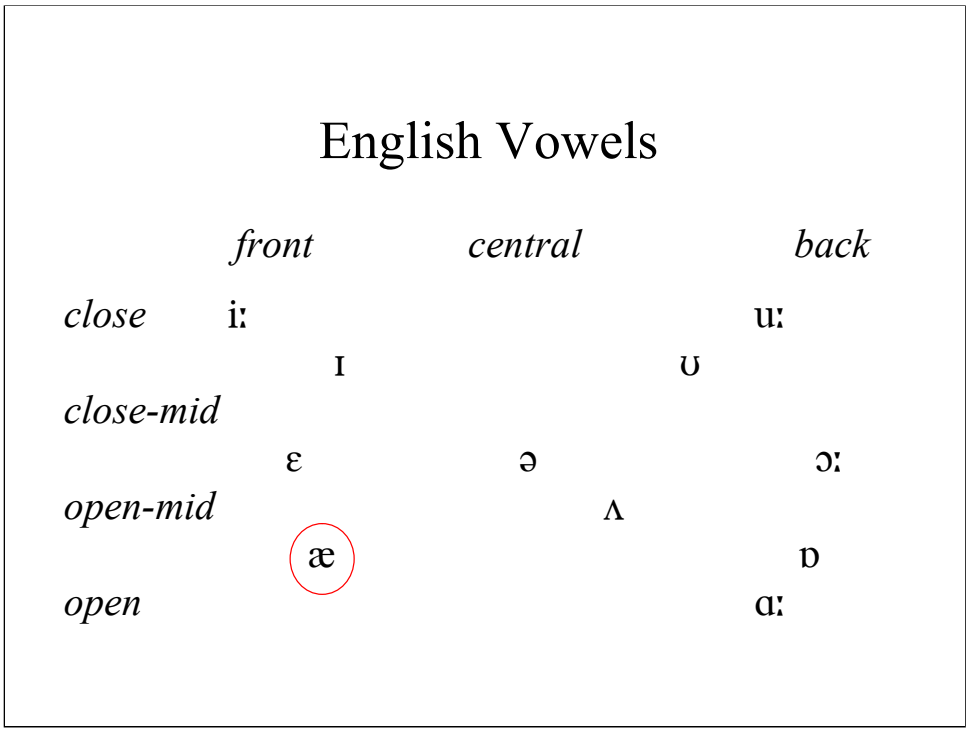
open short and long a (hatten)

Different languages often use the same symbols for their vowel descriptions without the vowels in question necessarily having the same quality. A transcription like that is called a „broad transcription“

Example: German: "bieten" /bi:tn/ vs. English: "beaten" /bi:tn/

German also has 3 diphthongs (long vowels with changing quality) :

aɪ as in *Wein*, aʊ as in *Haus*, and ɔɪ as in *Heu*



English vowles: English vowels are less systematically distributed. And there are less rounded vowels.

Long: i: (beaten), u: (tooting)
short: ɪ (bitten) ʊ (bush)
:
short: e (bet) ə (bitter)
long ɔː (law)

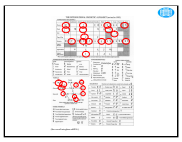
short æ (bat) ʌ (cut) ɒ (hot)

long ɑː (hard)

English has similar diphthongs to German (aɪ as in *wine*, aʊ as in *house*, and ɔɪ as in *boy.* It also has some diphthongs which start close to the quality of German long monophthongs:

eɪ as in *eight, late, bay, stay*, etc.

əʊ as in *coat, bowl, note*, etc.



Do we really need transcription?

- Orthography cannot capture how we pronounce things.
- Transcription allows us to record deviations from standard pronunciations
- If we are only interested in e.g. speech recognition, or speech synthesis, **we need to know how things are actually said**.

Hearing *what's* said vs. listening to *how* it's said.

- Primarily, we listen to someone to hear WHAT she/he is saying.

- *What did the person say?*
  - "Ich bin in den Laden reingegangen...." ?
  - "Bin in den Laden reingegangen...." ?
  - "Bin in'n Laden reingegangen...." ?
  - "Bin in'n Lad'n reingegang'ng...." ?
- *Orthography is not VERY good at capturing the details of the pronunciation:* [bɪn ɪnn̩ ˈlaːdn̩ raŋgəgaŋ̩]

Hearing WHAT is said is the primary goal of speech communication (for a listener).

We're mostly very good at it --- in fact so good that when we often reconstruct something that wasn't actually pronounced.

Of course that is easy in our native langusge – We don't have to hear the exact pronunciation because we speak as we learned when we were growing up.

We do all the stylistic reductions that suit the situation quite automatically, because we know HOW to speak WHEN.

….. well in principle anyway (can you remember a situation where you have heard someone speaking wrongly for the situation?)

Which sounds convey the most information?

Consonants or vowels?

What do you think?

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Vowels and Consonants

- Letters as Information carriers:
  Orthography separates words – the acoustic signal doesn't.
- *Vowels only*
  o e a e + ü + e i + a + i o + e i + e + a + i + e e a u e + u + ö + a.
- *Consonants only*
  V h rs g + f r + B rl n + m + M ttw ch + b g nnt + d r + T g + m t + T mp r t r n + m + zw lf + Gr d.

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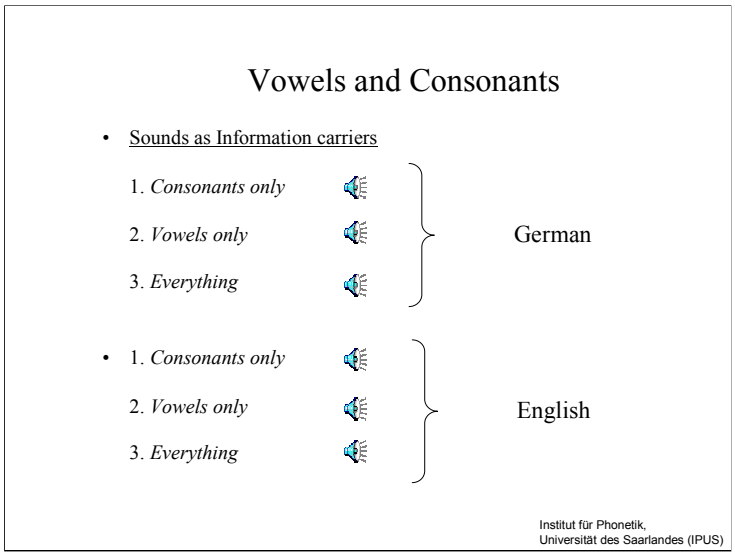

English text:

The weather forecast for tomorrow: rather cloudy in the morning with a few sunny spells in the afternoon.

Phonetics is more than just vowels & consonants

- Things happen to words when they are put together.
- The mouth prepares for the next word at the end of this one.
- Some words are more important than others
- In general: Lexical words > function words
- For "economy of effort" we don't invest much in function words.

Connected speech

- *The president will be elected for a period of four years.*
- connected speech
- with silences between words
- as chain of isolated words
- as chain of isolated without silences
- function words: isolated vs. connected

For Speech Recordings & Analysis

- www.praat.org
  (by Paul Boersma & David Weenink, Phonetics Amsterdam)

Don't forget to do the exercises

(on the web page for the course)