Phonetics & Phonology

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Introduction
Structure of Spoken Language (from Crystal 1997)

Structure ← Pragmatics → Use

Medium of Transmission
- Phonetics
- Phonology

Grammar
- Morphology
- Syntax

Meaning (semantics)
- Lexicon
- Discourse
Phonetics

- the study of speech sounds and their physiological production and acoustic qualities
- deals with the physical realisation of the elements of the sound system
Fields

• *articulatory phonetics*
  → deals with the configurations of the vocal tract used to produce speech sounds; studies the physiological mechanisms of speech production

• *acoustic phonetics*
  → measuring and analyzing the physical properties of sound waves we produce when we speak

• *auditory phonetics*
  → studies speech sounds in terms how we hear them

• *linguistic phonetics*
  → the manner of combining sounds so as to make syllables, words, and sentences
Units of Representation

**Feature**
A subunit of segment, reflects individual aspect of articulatory control produced by articulation

**Segment**
A segment of speech that consists of a vowel, with or without one or more accompanying consonant sounds immediately preceding or following

**Syllable**
Individual speech sound
Phonology

• the study of the sound system of a language
• the component of a grammar which includes the inventory of sounds (phonetic and phonemic units) and rules for their combination and pronunciation
Scope

Phonetics

• What are the sounds?
• How are they made in the mouth?

Phonology

• How are sounds systematically organized in a language?
• How do sounds combine to form words?
• How are they categorized by, memorized and interpreted in, the mind of speakers?
Phonetic Transcription

IPA
International Phonetic Alphabet

represents each sound of human speech with a single symbol
$#@*??

$#@*??!!
Phonetic symbols

[ ] → phonetic transcription (narrow transcription)
‘the reality of phonemes’, as each speaker said it.
It gives detailed information of the speech produced, e.g. +coronals, lateral

// → phonemic transcription (broad transcription)
an abstraction of the phonetic transcription,
specific to a particular language
recording speech sounds accurately

English: not phonographic (spelling ≠ pronunciation)

- Same sound [i], different letters
  e.g. see, sea, scene, receive, thief, amöeba, machine
- Same letters, different sounds
  e.g. sign [s], pleasure [ʒ], resign [z]
- One sound, multiple letters
  e.g. lock [k], that [ð], book [ʊ], boast [ɔ], shop [ʃ]
- One letter, multiple sounds
  e.g. exit [gz], use [ju]
- Silent letters
  e.g. know, doubt, though, island
Sound Classes

Based on the phonetic properties shared

Vowel
Diphthong
Consonant
Glide
How many letters?
How many sounds?

Indonesian

English
## English Consonants

<table>
<thead>
<tr>
<th>Category</th>
<th>Bi-labial</th>
<th>Labio-dental</th>
<th>Labio-velar</th>
<th>Dental</th>
<th>Alveolar</th>
<th>Post-alveolar</th>
<th>Palatal</th>
<th>Velar</th>
<th>Glottal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stop</strong></td>
<td></td>
<td>p  b</td>
<td></td>
<td></td>
<td>t  d</td>
<td></td>
<td>k</td>
<td>g</td>
<td></td>
</tr>
<tr>
<td><strong>Affricate</strong></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>tf  dʒ</td>
</tr>
<tr>
<td><strong>Nasal</strong></td>
<td></td>
<td>m</td>
<td></td>
<td></td>
<td>n</td>
<td></td>
<td>η</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fricative</strong></td>
<td></td>
<td>f  v</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>θ  ð</td>
<td></td>
<td>s  z</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Approximant</strong></td>
<td></td>
<td></td>
<td>m  w</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Lateral approximant</strong></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>l</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# English Vowels

<table>
<thead>
<tr>
<th>Monophthongs</th>
<th>Short</th>
<th>Long</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Front</td>
<td>Back</td>
</tr>
<tr>
<td><strong>Close</strong></td>
<td>i</td>
<td>ъ</td>
</tr>
<tr>
<td><strong>Mid</strong></td>
<td>æ</td>
<td>ð</td>
</tr>
<tr>
<td><strong>Open</strong></td>
<td>æ</td>
<td>ø</td>
</tr>
</tbody>
</table>
# English Dipthongs

<table>
<thead>
<tr>
<th>Diphthongs</th>
<th>Closing</th>
<th>Centring</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>to /ɪ/</td>
<td>to /ʊ/</td>
</tr>
<tr>
<td>Starting close</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Starting mid</td>
<td>eɪ, ɪɛ</td>
<td>ʊɛ</td>
</tr>
<tr>
<td>Starting open</td>
<td>aɪ</td>
<td>ʊo</td>
</tr>
</tbody>
</table>
How are sounds produced?
A poem by Richard Krogh

I take it you already know
Of tough and bough and cough and dough
Some may stumble, but not you
So now you are ready perhaps,
To learn of less familiar traps
Beware of the heard, a dreadful word
That looks like beard and sounds like bird
And dead; it’s said like bed, not bead
For goodness’ sake, don’t call it deed!
Watch out for meat and great and threat
(they rhyme with suit and straight and debt)
A moth is not a moth in mother
Nor both in bother, broth in brother
Morphophonemic Rules
Morphophonemic Rules

→ rules that account for alternations among allomorphs.

- Allomorphs are variant forms of a morpheme.
- A morpheme is the smallest unit of a language that carries information about meaning or function.
- A word can be simple or complex.
  - A simple word consists of one morpheme.
  - A complex word consists of more than one morpheme.
In English

- Plural
- Past
- Negative prefix in-
- Other
Plural

- \{PLURAL\} \Rightarrow [s], if the stem ends in a voiceless phoneme
- \{PLURAL\} \Rightarrow [z], if the stem ends in a voiced phoneme
- \{PLURAL\} \Rightarrow [ız], if the stem ends in a sibilant phoneme

Because morphemes such as \{PLURAL\} has different pronunciation, we say that a morpheme may have allomorphs. The \{PLURAL\} morpheme has the allomorphs /s/, /z/, /ız/.

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>cab</td>
<td>cap</td>
<td>bus</td>
<td>child</td>
</tr>
<tr>
<td>bag</td>
<td>back</td>
<td>buzz</td>
<td>mouse</td>
</tr>
<tr>
<td>love</td>
<td>cuff</td>
<td>bush</td>
<td>sheep</td>
</tr>
</tbody>
</table>
Past

- \{PAST\} \Rightarrow [t], if the stem ends in a voiceless phoneme
- \{PAST\} \Rightarrow [d], if the stem ends in a voiced phoneme
- \{PAST\} \Rightarrow [ıd], if the stem ends in a /t/ or /d/ phoneme

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>grab</td>
<td>reap</td>
<td>state</td>
<td>is</td>
</tr>
<tr>
<td>hug</td>
<td>kiss</td>
<td>raid</td>
<td>sing</td>
</tr>
<tr>
<td>love</td>
<td>wish</td>
<td></td>
<td>have</td>
</tr>
</tbody>
</table>
Negative Prefix *in-*

- `{in-} \Rightarrow [ı̝n], \text{ before vowel and alveolar phonemes}
- `{in-} \Rightarrow [ı̝m], \text{ before vowel and alveolar phonemes}
- `{in-} \Rightarrow [ı̝n̥], \text{ before vowel and alveolar phonemes}
Other constraints

- Delete a /g/ when it occurs before a final nasal consonant

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>sign</td>
<td>[saɪn]</td>
</tr>
<tr>
<td>paradigm</td>
<td>[pærədæɪm]</td>
</tr>
</tbody>
</table>

- Delete a word final /b/ when it occurs after an /m/

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>bomb</td>
<td>[bɒm]</td>
</tr>
<tr>
<td>crumb</td>
<td>[krʌm]</td>
</tr>
</tbody>
</table>
Organs of Speech and Airstream Mechanisms

Week 2
How Speech Sounds are Produced

Speech sounds are produced by moving the column of air in a resonating chamber – just like a musical instrument.

Different sounds are produced by varying the speed of the column of air, the size and shape of the resonating chamber, and by introducing various kinds of vibrations into the column.
• This is why different musical instruments sound different.

• This is also why different people sound different when they talk.
By changing the speed of the column of air, the shape of the resonator, and the kind of vibration introduced into the air stream, we produce the phonetic differences that constitute the sounds of speech.
Four main components of speech mechanism

1. Airstream process: pushing air out from the respiratory system (e.g. lungs, if pulmonic)
2. Phonation process: actions of the vocal folds (vibrating or not voiceless)
3. Articulatory process: the movement of the tongue and lips interacting with the roof of the mouth and the pharynx
4. Oro-nasal process: the raising or lowering of velum controls; it determines if the airstream is going out through the mouth or nose
Airstream Mechanism
PHONATION

- Definition: the process of vocal fold vibration
- Three dimensions of phonation:
  1. Loudness: related to sub glottal pressure
  2. Pitch: the perceptual correlate of the frequency of vibration
  3. Timbre: “mellowness” or “sharpness” of the voice
FIGURE 2.7.1 Vibratory cycle of the vocal folds

Adapted from: Schneiderman 1984, p. 76.
Articulatory Process

- Vowels and vowel-like sounds are made by varying the geometry of the pharyngeal and oral cavities, but without any major obstruction or impediment to airflow.
- Consonantal sounds are generally made by exploiting the articulatory capabilities of the tongue, teeth and lips in such a way that airflow through the mouth cavity is radically constricted or even temporarily blocked.
Organs of Speech

- Sound-producing system
- The vocal tract
- The tongue
alveolar ridge
hard palate
larynx
lips
nasal cavity
velum
pharynx
teeth
tongue body
tongue tip
tongue root
Articulatory Phonetics

Parts of the Vocal Tract

• alveolar ridge—bony area behind teeth
• hard palate—roof of mouth
• velum (soft palate)—soft area at back of throat
Glottis/Glottal

vocal folds
English Consonants and Vowels

- IPA chart
Place and Manner of Articulation

The tongue contacts (or nearly so) the roof of the mouth in producing many of the consonantal sounds in English.

Anterior
Labial [p] [b] [m]
Labio-dental [f] [v]
Inter-dental [th] [dh]

Central
Alveolar [t] [d] [n] [s] [z]

Posterior
Palatal [sh] [zh]
Velar [k] [g] [ng]

Chameleon
Rhoticized [r]
Lateral [l]
Approximant [hh]
PLACE OF ARTICULATION

- LABIAL: bilabial and labiodental
- DENTAL
- ALVEOLAR
- POSTALVEOLAR
- PALATAL
- VELAR
- UVULAR
- PHARYNGEAL
- GLOTTAL
MANNER OF ARTICULATION

• STOP: there is complete *occlusion* (blockage) of both the oral and nasal cavities of the *vocal tract*, and therefore no air flow
• FRICATIVE: 1) sibilant, 2) lateral fricative
• APPROXIMANT: 1) lateral approximant, 2) semivowel
• NASAL: there is complete occlusion of the oral cavity, and the air instead passes instead through the nose
• FLAP (or TAP): is a momentary closure of the oral cavity. The "tt" of "utter" and the "dd" of "udder" are pronounced as a flap in North American English.

• TRILL: in which the articulator (usually the tip of the tongue) is held in place, and the airstream causes it to vibrate. The double "r" of Spanish "perro" is a trill.
TONGUE POSITION

- **APPICAL**  
  tip or front edge of the tongue

- **LAMINAL**  
  blade

- **DORSAL**  
  blade to the root

- **SUBLAMINAL**  
  anterior part of the undersurface of the tongue, corresponding to the blade
Airstream Mechanism

1. Pulmonic
   a. Egressive → English sounds
   b. Ingressive → implosives and clicks
2. Glottalic → implosives and ejectives
   Hausa, American Indian Languages → ejectives
   Vietnamese, Cambodian languages → implosives
3. Velaric → clicks

In groups of three, define and discuss each type.
Describing Consonants

Week 3
**Places of Articulation**

- **Labial**
  - the lips are the primary articulators
  - *bilabial sounds*: p, b, m
  - *labiodental sounds*: f, v

- **Interdental**
  - the tongue is inserted between the upper teeth and lower teeth.
  - e.g. ð, θ
→ the tongue tip or the blade is raised to the alveolar ridge
  e.g. d, t, n, s, z, l, r

Alveolar

→ the tongue blade is raised to the back part of the alveolar ridge
  e.g.ʃ,ʒ, tʃ, dʒ

Palato-alveolar
Palatal

→ the front part of the tongue is raised to a point on the hard palate just behind the alveolar ridge

e.g. j

Velar

→ raising the back of the tongue to the soft palate or velum

e.g. k → voiceless, oral, velar
g → voiced, oral, velar
η → voiced, nasal, velar
Glottal

→ the vocal cords are the primary articulators

e.g. h

Retroflex

→ the tongue tip is curled to touch the back of the alveolar ridge (not commonly used in English)

Try to say these words: row, rye, ray
Pharyngeal

→ articulated with the root of the tongue against the pharynx

Uvular

→ articulated with the back of the tongue against or near the uvula, that is, further back in the mouth than velar consonants
Manner of Articulation

→ describes how the tongue, lips, and other speech organs are involved in making sound

- stops
- affricates
- glides
- fricatives
- liquid
Stops

• the sounds are stopped completely in the oral cavity for a brief period

  e.g. p, b, t, d, k, g → the oral stops

  m, n, η → the nasal stops

• Oral stops are also called “PLOSIVES” because the air that is blocked in the mouth ‘explodes” when the closure is released.
Fricatives

• the airstream is not completely stopped but is obstructed from flowing freely.

e.g. s, z, f, v, θ, ð, ʃ ,ʒ

• The air passage, however, is very narrow causing friction (turbulence)
Affricates

- the sounds are produced by a stop closure followed immediately by a slow release (of the closure characteristic of a fricative)

e.g. tʃ, dʒ
Liquid

- There is some obstruction of the airstream in the mouth but not enough to cause any real friction

  e.g. l (usually called as lateral)
  r (usually called approximant)
Glides

- there is little or no obstruction of the airstream in the mouth

e.g. j, w
Stops and fricatives are classified according to:

- The place in which they are articulated
- Whether they are voiced/lenis or voiceless/fortis (vibration of vocal folds)
- Whether they are oral or nasal (for stops only)
A stop is composed of three phases

- Closure
- Hold (the passage of air from the lungs is blocked)
- Release – the difference in air pressure between the area behind the closure and the atmosphere results in a small explosion
The place of articulation is where the passage of air is blocked

- For example /t/ and /d/ are both produced by blocking the passage of air at the **alveolar** ridge/dental region
What consonant pair is this?
That’s right! /p/, /b/
And this?
/k/, /g/
What is the difference between these two slides?
In the first (/b/, /p/) the passage of air to the nose is blocked by the raised velum, in the second this passage is open, giving us a nasal. What consonant is it?
It’s /m/
Let’s look at other positions – in the alveolar position we have /t/ and /d/, and the nasal /n/:
In a similar way at the velum we have /k/ and /g/, and the nasal /\n\":

\[\text{Diagram showing the position of the velum for /k/ and /g/, and the nasal symbol.}\]
Fricatives

- Are created by forming a constriction through which air from the lungs may pass, but not freely.
- This lack of freedom causes audible turbulence, or friction, hence the name fricative.
- As for stops they may be voiceless or voiced.
Let’s look at a fricative pair which causes non-native speakers of English a lot of trouble and /ʃ/:
Air passes through a small gap between the tongue and the upper teeth causing a low friction sound:
In the alveolar fricatives /s/ and /z/, the friction noise is quite loud, as air hits the upper teeth causing a hiss.
What fricative pair is represented here?
That's right - /f/, and /v/
And here?
This is the post-alveolar pair /ɾ/ and /ʃ/. Note that a small shift of the tongue from the /s/, /z/ position directs the flow of air onto the alveolar ridge.
Affricates

- These may be considered as stop + fricative

An affricate is composed of the following stages:
- Closure
- Hold
- A small opening instead of the complete opening of the stop.
- This small opening causes friction just like a fricative
In English we have two affricates:

- /ʃʃ/ church and /θθ/ George
- Both are realised in the post-alveolar position
Here are the two main phases.

1. Hold
2. Release with constriction
Describing Vowels & Diphtongs
What differ vowels from consonants?
Vowels
are made by shaping the column of air rather than by obstructing it

Organs involved:
1. Tongue (forward, backward, up, and down)
2. Jaw (raised, lowered)
3. Lips (spread, rounded)
Ways to describe vowels

- Quality (i.e. the difference between /i:/ and /u:/
  - high/mid/low
    → the height of the tongue
  - Front/central/back
    → the position of the highest part of the tongue on the horizontal axis
  - Rounded/spread
    → lips rounding

- Oral or nasal production (unlike French, this does not have a phonemic function in English)

- Length: long vs short; tense vs lax
Vowels are:

- high/mid/low
  the height of the tongue

- Front/central/back
  the position of the highest part of the tongue on the horizontal axis

- Rounded/spread
  lips rounding
These are x-rays of a person producing different vowels.
In the close front position (unrounded) we produce /i/
In the open front position (unrounded) we produce /a/
Back open (unrounded) : ///lists/2009
Back close (rounded): /u/
Connecting these points gives us a box called the *Vowel Quadrilateral*.
All the vowel sounds that the human voice can produce may be plotted within the limits of the quadrilateral
Here is the vowel quadrilateral divided into sectors with the IPA symbols at fixed points. These are called *Cardinal Vowels*. 
This is the full set:
The vowels appear in pairs depending on whether they are articulated with spread lips, unrounded (green) or with rounded lips (red):

[Diagram showing vowel articulations with color-coded pairs for spread and rounded lips]
Generally, front vowels are unrounded and back vowels rounded (Italian & English)
These are the places of articulation of English short and long pure vowels
However, it is important to remember that the cardinal vowel system describes vowels from an articulatory point of view whereas vowels are an acoustic phenomenon and may also be described according to their acoustic properties.
Spectrogram of four vowels: /i:/, /ʊ/, /ɐ:/ and /u:/
Each vowel has a different disposition of formants (peaks at certain frequencies)
Length

- English vowels differ in length as well as in quality.
- These differences are as important to perception as quality.
- English long vowels are far longer than Italian equivalents (e.g. /i:/, /u:/)

<table>
<thead>
<tr>
<th>Pure Vowels</th>
<th>Short</th>
<th>Long</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>![Hand]</td>
<td>![Crossing]</td>
</tr>
<tr>
<td></td>
<td>![Coin]</td>
<td>![Peace]</td>
</tr>
<tr>
<td></td>
<td>![Buddha]</td>
<td>![су]</td>
</tr>
<tr>
<td></td>
<td>![Bell]</td>
<td>![flag]</td>
</tr>
<tr>
<td></td>
<td>![Inverted Bell]</td>
<td>![Black Square]</td>
</tr>
<tr>
<td></td>
<td>![Bird]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>![Dagger]</td>
<td></td>
</tr>
</tbody>
</table>
The realisation of long and short vowels depends on their context, this is called **Clipping**

This means that long vowels and diphthongs tend to be shortened before voiceless consonants e.g. /p/, /t/, /k/, /f/ etc.
Vowel length in centiseconds:

<table>
<thead>
<tr>
<th>Word</th>
<th>Pronunciation</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>leave</td>
<td>liːv</td>
<td>30.0</td>
</tr>
<tr>
<td>lead</td>
<td>liːd</td>
<td>28.5</td>
</tr>
<tr>
<td>lea</td>
<td>liː</td>
<td>28.0</td>
</tr>
<tr>
<td>lean</td>
<td>liːn</td>
<td>19.5</td>
</tr>
<tr>
<td>leaf</td>
<td>liːf</td>
<td>13.0</td>
</tr>
<tr>
<td>leap</td>
<td>liːp</td>
<td>12.3</td>
</tr>
<tr>
<td>live</td>
<td>liːv</td>
<td>18.6</td>
</tr>
<tr>
<td>lid</td>
<td>liːd</td>
<td>14.7</td>
</tr>
<tr>
<td>limb</td>
<td>liːm</td>
<td>11.0</td>
</tr>
<tr>
<td>tiff</td>
<td>tiːf</td>
<td>8.3</td>
</tr>
<tr>
<td>lip</td>
<td>liːp</td>
<td>7.5</td>
</tr>
</tbody>
</table>

(Data from Gimson 1980:98)
Potential ambiguity

- Italian speakers of English often produce vowel sounds that can be misinterpreted by native speakers.
- This is particularly important in the case of minimal pairs i.e. where substituting one vowel sound for another leads to semantic changes.
- This can be due to the irregular orthography of English or interference from L1.
Italian speakers often use one vowel sound, the Italian /i/ for both. In the case of *sheep* the vowel length is too short, in that of *ship* the quality does not exclude ambiguity.
Other cases

- /æ/ and /ɶ/, e.g. *ban* and *bun* – here the problem is one of vowel quality
- /ɔ/ and /ɔ/ e.g. *coat* and *court* – the Italian /o/ is often used for both
- Italian speakers often produce a very short /uː/. This is not very important as there are very few minimal pairs /uː/ v. /ɶ/
Diphtongs
While the position of the tongue is more or less stable for a pure vowel, a diphthong is characterised by a graceful movement from one point to another, for this reason they are also sometimes known as glides.
This is also visible on a spectrogram: this is the pure vowel /a/...
...and this is the diphthong /ʊə/. Notice how the formants (the dark bands) separate towards the end.
If one has a clear idea of where pure vowels are articulated on the quadrilateral then interpreting the diphthong symbols is not difficult.
Technically, English diphthongs are divided into two groups:

- Closing diphthongs – which tend to move from an open to a close position, these roughly correspond to Italian sounds
- Centring diphthongs – which tend towards a central position ( / ʌɪ əʊ ɔɪ /)
Closing Group

... the ‘pay’, ‘made’, ‘maid’, ‘reign’, ‘obey’, sound:
Then we have the ‘I’, ‘my’, ‘tie’, ‘sigh’, ‘either’, ‘eye’, ‘Thai’, sound:
Then there is ‘boy’, ‘choice’:
Then ‘down’, ‘loud’:
To end the closing group, the most common diphthong in English, that of ‘no’, ‘know’, ‘bone’, ‘foam’, ‘sew’, ‘though’, ‘don’t’, ‘foe’, ‘crow’:
To start with the centring group, we have the most common, that of ‘clear’, ‘deer’, ‘here’, ‘wier’:

\[ e \ddot{o} \]
Finally, there is a diphthong which is quite rare and is often realised as /ʊə:/ - ‘tour’, ‘poor’:
Some Important Notes

- Although the symbols indicating pure vowels and the starting and closing points of diphthongs are often the same they do not necessarily correspond to the same points.
- Lip rounding is another variable, generally associated with back vowels.
- Diphthongs are the element in a language which are most liable to change. The majority of the characteristics of a given accent are usually to be found in this area, so understanding of the underlying mechanics is vital if one wants to understand accents and accent change.
Those properties that occur *above the level* of segments (regardless of their place or manner of articulation) are called *suprasegmental (or prosodic) properties*.

These are *pitch, loudness, and length*. 
Pitch

- the auditory property of a sound that enables us to put it on a scale that ranges from low to high
- Control: controlling the tension of the vocal folds and the amount of air that passes through the glottis
  → tensed vocal folds + greater air pressure → higher voice pitch vowels/sonorant consonants
- Includes tone and intonation
Tone

- a pitch that signals differences in meaning
- Types: Level/register & contour tones
Level/Register Tone

- does not change pitch

E.g. Nupe (spoken in Nigeria)

- The line drawn from the letters (H, M and L) to the respective vowel is called *association line*.
- This type of notation is known as *autosegmental notation*.
Contour Tone

- changes pitch on a single syllable

E.g. Mandarin

ma ‘mother’ (high level)
ma ‘hemp’ (high rising)
ma ‘horse’ (low rising)
ma ‘to scold’ (falling)
# Register vs Contour

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pitch movement in spoken utterances that is not related to differences in word meaning

Types: terminal & non-terminal

Terminal (intonation contour)
→ falling pitch pattern at the end of utterances

Non-terminal (Intonation) Contour
→ rising or higher level pitch patterns
Differences in length may signal differences in meaning.

E.g. Finnish:

- laki [k] ‘law’
- lakki [k:] ‘cap’
- tuli [u] ‘fire’
- tuuli [u:] ‘wind’
The combined effect of pitch, loudness, & length

Representation:
- Primary stress: an acute accent [ / ]; $^1$
- Secondary stress: a grave accent [ \ ]; $^2$
Articulatory Processes

- Assimilation
- Dissimilation
- Deletion
- Epenthesis
- Metathesis
- Vowel reduction
Assimilation

- Occurs when one segment influences another
- Results from a sound becoming more like another nearby sound in terms of one of more of its phonetic characteristics

Types:
- Regressive & progressive (nasalization)
- Voicing & devoicing
Regressive & Progressive Assimilation

- Regressive assimilation
  → the preceding segment takes on the nasality of the following consonant
  → the nasalization moves backwards to a preceding segment
- Progressive assimilation
  → the nasality moves forward from the nasal consonant onto the vowel

e.g. *impossible* not *inpossible*
*intangible* not *imtangible*
Dissimilation

- Results in two sounds becoming less alike in articulatory or acoustic terms
- The resulting sequence of sounds is easier to articulate and distinguish

e.g. fifths [fθs] → [fts]
Deletion

- Removes a segment from certain phonetic contexts
-Usu occurs in everyday rapid speech
- In English, [ə] is often deleted when the next vowel in the word is stressed

e.g. suppose [səpəuz]
Epenthesis

- Inserts a syllabic or non-syllabic segment within an existing string of segments

e.g. p 56
Metathesis

- Reorders a sequence of segments
- Often results in a sequence of phones that is easier to articulate
- Common in children

e.g. partisisapi
Vowel Reduction

- The articulation of vowels moves to a more central position when the vowels are unstressed
- Usually resulting in [ə]

E.g. considerate – consideration
MINIMAL PAIRS
Try pronouncing this:

- She sells sea shells on the seashore.
- The sick sixth sheik’s sixth sheep is sick.
Phonology

- The study of the function and patterning of sounds
- Unit of analysis:
  - segment
  - feature
  - Syllable
Minimal pair

- How do you define minimal pairs?
- Why are *fine* and *vine* considered as minimal pairs, while *soup* and *group* are not?

→ A pair of word that differs in only one segment
1. Decide whether the following pairs of words are minimal pairs or not and give reasons.
   - oma : opa
   - rand : rat
   - rad : rat
   - mile : mild
   - chunk : hunk

2. List some examples of minimal pairs contrasting these sounds in the initial and final position: /p, b/, /k, g/, /f, v/, /m, n/, /n, n/, /θ, η/ and /t, d/.

3. Have a look at O’Grady p.125-127, then do exercise 1(i) and 4.
PHONETICS AND PHONOLOGY

Segments, Features, Phones and Allophones
Find the answers for the questions below.

- What are the differences between the broad transcription and narrow transcription?
- Find the definition of a syllable, segment, and feature.
- What is the relationship between a word, syllable, segment, and feature? Give examples to make it clearer.
- What are phones, phonemes, and allophones? Give examples to make the differences clearer.
- How can we determine if a phone is a phoneme or the allophone of a phoneme?
- List the English allophones as many as you know.
- What is a minimal pair and near-minimal pair? Give examples of each term.
- Find the definition of a complementary distribution. Give examples.
What are the differences between the broad transcription and narrow transcription?

Symbols used:
phonetic transcription (narrow transcription)
   ‘the reality of phonemes’, as each speaker said it.
   Gives detailed information of the speech produced, e.g. (un/as)pirated, nasalized, etc.
Symbols used: [ ]
phonemic transcription (broad transcription)
   an abstraction of the phonetic transcription, specific to a particular language (differs among languages)
Symbols used: //
Pill
Narrow transcription: [phil]
Broad transcription: /pil/

Spill
Narrow T: [spil]
Broad T: /spil/

Ten
Narrow T: [then]
Broad T: /ten/
Find the definition of a word, syllable, segment, and feature.

- **Syllable**
  * A basic unit in which segments are grouped,
  * A unit of linguistic structure that consists of a syllabic element and any segments that are associated with it.

- **Segment (a phoneme)**
  an individual speech sound
  
  /p/

- **Feature**
  The smallest building blocks of phonological structure, corresponding as they do to articulatory or acoustic properties
What is the relationship between a word, syllable, segment, and feature? Give examples to make it clearer.

- Check O’Grady et al. p. 69
- Like a family tree
- Word – syllable – segment – feature
- Grandparents– parents – children – grandchildren
Give

/giv/

/g/ - syllabic + consonant etc.

/i/ + syllabic - consonant etc.

/v/ - syllabic + consonant etc.
Phones

* A phoneme-token, a single instance of the utterance of a phoneme of a particular occasion by a particular speaker.
* A phonetic unit or segment

→ the realization of a phoneme

Symbols: using narrow transcription.
Example: [p], [pʰ] are the realization/phones of /p/
Phonemes

Smallest discrete units of sound
The underlying mental representation (abstract representation) of the phonological units of a language
◦ the abstraction of phones
Symbol: slant lines (broad transcription)

- Examples:
  - English: *pan* and *ban*
  - Indonesian: *Tanah* and *panah*
  - Javanese: *tutuk* (mouth) and *thuthuk* (hit)

- Are the sounds in the Javanese example above also phonemes in English?
Allophones

- Different phones that ‘represented’ or derived from one phoneme; a predictable phonetic variants of a phoneme
- Any different forms of a phoneme, but they do not change the meaning when we make substitution. They are never contrast in identical of analogous environments (complementary distribution)

- /l/ → a. /’l’/ after voiceless stops
  b. /l/ elsewhere
- aspirated and unaspirated /t/ in top and stop
- /e/ and schwa in Indonesian word ‘Peta’
‘anak kembar’ analogy

Example:
A family has three children, Santi, Sinta and Suli. Santi and Sinta are twins.
The number of the children: 3 → phones (santi, sinta, suli)
The number of the children (counted from how many times the mother gave birth): 2 → phonemes (santi/sinta, suli)
The number of ‘similar’ children (twin): 2 → allophones – santi dan sinta
How can we determine if a phone is a phoneme or the allophone of a phoneme?

- Phonemic Analysis
  A procedure for finding the phonemes of a language

Check: O’Grady p. 74–75

1. A minimal pair test
2. Complementary distribution test
If the two segments contrast, they are members of different phonemes.

e.g.
Pig–big  paku–baku  tampaka–tamba
Bee–tea  batu–satu  panah–nanah

yet, the contrast is language–specific.
* Every language has its own system of phonemes
* A phoneme in one language may not be a phoneme in another

e.g. glottal stop in Arabic, r and l in Japanese

English  Javanese
/bu’e(r)/ or /bute(r)/  /su?on/ and /sukon/
Phonemic analysis—Complementary distribution test

- If certain phonetically similar sounds are non-contrastive and in complementary distribution, they may be considered as allophones of one phoneme.
- Superman–Clark Kent illustration
- Exception: ng and h
Find the definition of a complementary distribution. Give examples.

- Two or more sounds which never occur in the same environment and so are not distinctive.
- Example:
  - [p] and [pʰ] → aspiration in /p/
  - [iː] and [ĩː] → nasalization in /iː/
List the English allophones as many as you know.

- Check O’Grady p. 73–77
- /l/ → dark n clear /l/ in lip vs pill
- /r/ → fricative and flapped /r/ in very, merry and marry
- /j/
- /w/
- /p/ → /p/, /ph/, /?p/
- /t/
- /k/
What is a minimal pair and near-minimal pair? Give examples of each term.

- Check: O’Grady p. 70–71
- Minimal Pairs
  * two words in a language which differ from each other by only one distinctive sound and which also differ in meaning, or
  * Two forms with distinct meanings that differ by only one segment found in the same position in each form
- Near–Minimal Pairs
  two words in a language which differ from each other by more than one distinctive features and which also differ in meaning
1. How many segments and syllables are there in
   a. Knight
   b. phonemic
2. How many (a) phones (b) phonemes, and (c) allophones in the word **pin** and **spin**?
3. Write these words below using broad and narrow transcriptions.
   Let’s split up.
pin and spin
Broad T: /pin/ /spin/
Narrow: [pʰin] [spin]

a. Phones: 7
b. Phonemes: 4
c. Allophones: 2
d. Segments:
Blue, plough
Broad T:/blu:/, /plau/
Narrow: [blu:], [plau]

a. Phones: 6
b. Phonemes: 5
c. Allophones: 2

/t/
Bottle /ʔ/
Phonotactic Rules in English

Week 8
PHONETICS AND PHONOLOGY:
SYLLABLES AND FEATURES
Do you know how to determine when /p t k/ are aspirated?

Pronounces these words. Are they aspirated?

1. pill, till, kill
2. spill, still, skill
3. repair, return, record
4. respond, disturb, discard

To be able to pronounce the words correctly, you should know their syllable structure.
1. How many syllables are in the words below.
   a. about
   b. meadow,
   c. dangerous
   d. antidisestablishmentarianism

2. What are the components of a syllable?
Analyze the words below (determine their syllable structure)

1. I
2. Be
3. It
4. Beat
5. Little
6. Bottle
7. Meadow
8. Dangerous
Components of a syllable

- Onset
- Rhyme, consisting of
  - Nucleus
  - Coda

Which one is compulsory (must be present) and which ones are optional in a syllable?

**NOTE:** you have to be familiar with the symbols used.

What are the steps in determining the syllables of a word?
Steps to determine a syllable

1. Determine the nucleus
2. Determine the onset
3. Determine the coda
Feature: +syllabic

1. vowels $\rightarrow$ always
2. sonorant consonants (nasals and liquids) $\rightarrow$ sometimes
e.g. /l/, /m/, /n/, and /r/ $\rightarrow$ rhotic
   e.g. Kitten, bottle, metal, manner, bottom , button, butter

Note: although glides are sonorants, they are not +syllabic

Slow down in the pronunciation of yet and wet. What happens to the /y/ and /w/?
In the syllables, the /w/ and /j/ are actually the extended /u:/ and /i:/, therefore, they can not become the nucleus of a syllable
Codas and Onsets

- each, if filled, will contain one or more consonants.

- The number of consonants in onsets and codas must conform with the Onset Maximalism and Sonority Sequencing Generalisation
Three initial clusters: O’Grady p. 85)
- /s/ + a voiceless stop (/p/t/k/) + liquid/glide, i.e., (l), r, (w),j
- No /p/+s/, yet in Indonesian?
- no onsets like *[lp], *[jm], *[Jg] onsets, although English has onsets with the same segments in the opposite order, such as the ones found in play, muse, grey.
Sonority scale (from the most sonorous to the least sonorous)

- Low vowels [ɑ ] ...
- High vowels [i u] ...
- Glides [j w]
- Liquids [l ſ]
- Nasals [m n ŋ]
- Voiced fricatives [v z] ...
- Voiceless fricatives [f s] ...
- Voiced plosives [b d ]
- Voiceless plosives [p t k]
The grammar of syllables: patterns of acceptability

The universal, basic syllable type is CV (McMahon, 2004: 106) however, patterns of permissibility vary in terms of filling these constituents of the syllable.

- Examples:
  - Arabic, every syllable must have an onset;
  - Hawaiian, no codas are allowed
  - English, onsets and codas are allowed

- Each language has some restrictions on the permissible contents of slots in a syllable structure (known as phonotactic constraints).
Defining stress in nouns based on the syllables (O’Grady p. 94-95)

1. Stress on penultimate (next to last) syllables
2. Stress on antepenultimate (third to last) syllables

The attention here is paid to the syllable in next-to-last position.

English nouns are stressed on the penultimate syllable when it is heavy; otherwise, they are stressed on the antepenultimate syllable.

Heavy syllable includes:
- closed syllable (with a coda)
- Tense vowels / diphthongs
Phonotactics = phonotactical constraints

- Phonotactics is the part of phonology which studies and describes constraints on co-occurrence.
- Phonotactics/phonotactical constraints are defined as the constraints on sequences of segments
- Examples of phonotactics: (Fromkin, p. 231)
  - Only clusters that can begin a syllable can begin a word
  - Only a cluster that can end a syllable can end a word
English phonotactic constraints

- In a CCC onset, C1 must be /s/.
- /ŋ/ does not appear in onsets.
- /v d z/ do not form part of onset clusters.
- /t d θ/ plus /l/ do not form permissible onset clusters.
- /h/ does not appear in codas.
- Coda clusters of nasal plus oral stop are only acceptable if the two stops share the same place of articulation.
- /lŋ/ is not a permissible coda cluster.

Note: C = consonants
the Sonority Sequencing Generalisation

- Rules for all languages
- the Sonority Sequencing Generalisation:
  i.e., the nucleus constitutes the sonority peak of the syllable, with sonority decreasing gradually towards the margins.

Therefore,

no onsets like *[lp], *[jm], *[Jg] onsets, although English has onsets with the same segments in the opposite order, such as the ones found in play, muse, grey.

No codas like *[pm], *[kl], *[mr] codas, although again clusters with the opposite order, which do show descending sonority, are attested in lamp, silk, harm (the last in rhotic accents only).
Exception of sonority rules in English

involves the behaviour of /s/, in onsets or codas
Onset Maximalism

- Where there is a choice, always assign as many consonants as possible to the onset, and as few as possible to the coda. However, remember that every word must also consist of a sequence of well-formed syllables.

- lea, or Lee, dirty, oyster
antidisestablishmentarianism


aen-ti-dis-e-stab-lish-men-tea-ri-e ni-z(e)m

- anti  /"{n.ti}/
- disestablishment  /dis-i.staeb-lish-ment/
- parliamentarian  /pa:.li.men.tea.ri.en/
- Vegetarianism  /vedj.i.tea.ri.e.ni.zem/
Sound Combinations

In English, a word begins with three consonant-type phonemes always obeys three strict rules:

- First phoneme: /s/
- Second phoneme: /p/, /t/, /k/
- Third phoneme: /l/, /r/
Free Variation

- alternative pronunciations of a word in which one sound is substituted for another without changing the word's meaning

  e.g., pronunciation of "bottle" with a glottal stop as the medial consonant, as opposed to a [t]
Syllables

- A segment of speech that consists of a vowel, with or without one or more accompanying consonant sounds immediately preceding or following—for example, a, I, out, too, cap, snap, check.

- A syllabic consonant, such as the final n sound in button and widen, also constitutes a syllable.

- Closed (checked) syllables are those that end in a consonant; open (free) syllables end in a vowel.
The Internal Structure of Syllable

σ

Onset (O)  Rhyme (R)

Nucleus (N)  Coda (C)

s  p  r  i  n  t
Exercise

- Describe the structure of the syllables in the following words:
  1. button
  2. mother
  3. sparkling
  4. however
  5. trigger
Syllable and Stress in English

- **Stress:** the perceived prominence of one or more syllabic elements over others in a word
  → the structure of individual syllables plays a role in determining which vowel is stressed

- **Metrics:** the study of stress placement

- Which syllable is stressed in “agenda, archipelago, and cabinet”?
Notice the stresses in the following words:

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<th>A</th>
<th>B</th>
<th>C</th>
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<tbody>
<tr>
<td>agénda</td>
<td>archipélago</td>
<td>cábinet</td>
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<td>veránta</td>
<td>aróma</td>
<td>América</td>
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<td>synóopsis</td>
<td>horízon</td>
<td>cinema</td>
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<td>uténsil</td>
<td>Minnesóta</td>
<td>aspáragus</td>
</tr>
<tr>
<td>appéndix</td>
<td>coróna</td>
<td>jávelin</td>
</tr>
</tbody>
</table>
English nouns are stressed on the *penultimate* syllable when it is *heavy*; and on the *antepenultimate* syllable when it is *light*.

- ultimate → last
  - penultimate → next to last
  - antepenultimate → the third syllable from the end of the word

- heavy → having two rhythmic elements in the rhyme
  - light → syllables with just a short vowel