

# Unit 5

## The syllable nucleus in the material world

shaping the airflow to form vocoids.

Slides for the session of

*Practical English Phonetics (British) /*

*Phonetics with Listening Practice (British)*

held on

11 November 2025

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{ English Department | LangSciTech }

Saarland University

- 1 Goals
- 2 Acoustic phonetics and vowels
- 3 Where vowels are formed in the mouth
- 4 Vowels: phonetics vs phonemics
- 5 Vowel quadrilateral and cardinal vowels
- 6 English vowel phonemes vs. cardinal vowel positions
- 7 Using diacritics for vowels
- 8 English sounds classified
- 9 Listening Exercise

## The goals of today's session are:

- 1 To briefly discuss the acoustics of sound, concentrating on vowel sounds as made in the human vocal tract



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- ② To become acquainted with the vowel quadrilateral and the cardinal vowels



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- ④ To check which vowel phonemes in English fall close to cardinal vowels, and which do not



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# Brief overview of acoustic phonetics in relation to vowels



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- 1 Physics of sound waves
- 2 Overtones and formants
- 3 Distinguishing vowels by means of formants
- 4 How to read a spectrogram

- Motion of particles in direction of propagation of wave ...



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- <http://www.spence.saar.de/akustik.jpg>

- voiced continuants and nasals have a fundamental frequency ( $F_0$ , “F zero”)

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- voiced continuants and nasals have a fundamental frequency ( $F_0$ , “F zero”)
- partial overtones (or ‘upper harmonics’):
- [http://upload.wikimedia.org/wikipedia/commons/c/c5/Harmonicpartials\\_on\\_strings.svg](http://upload.wikimedia.org/wikipedia/commons/c/c5/Harmonicpartials_on_strings.svg)

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- formants: *amplified* upper harmonics
- identifying vowels by their formants ( $F_1$  and  $F_2$ )

# Distinguishing vowels by means of formants

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- The distinctive ‘quality’ of a vowel depends on how the vocal tract was shaped when it was being formed, and thus on the acoustic ‘formants’ (especially  $F_1$  and  $F_2$ )



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# How to read a spectrogram

- a spectrogram records: frequency (y), time (x), intensity (shading)

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# Outer boundaries of the space where vowels can be formed

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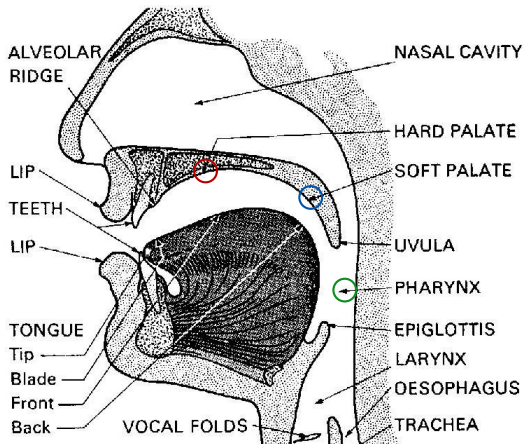
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THE INTERNATIONAL PHONETIC ALPHABET (revised to 2005)

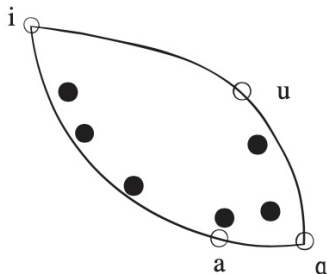
CONSONANTS (PULMONIC)

© 2005 IPA

|                     | Bilabial | Labiodental | Dental | Alveolar | Postalveolar | Retroflex | Palatal | Velar | Uvular | Pharyngeal | Glottal |
|---------------------|----------|-------------|--------|----------|--------------|-----------|---------|-------|--------|------------|---------|
| Plosive             | p b      |             |        | t d      |              | ʈ ɖ       | c ɟ     | k ɡ   | q ɢ    |            | ʔ       |
| Nasal               | m        | ɱ           |        | n        |              | ɳ         | ɲ       | ŋ     | ɴ      |            |         |
| Trill               |          |             |        | r        |              |           |         |       | ʀ      |            |         |
| Tap or Flap         |          | ɸ ɸ̌        |        | ɾ        |              | ɽ         |         |       |        |            |         |
| Fricative           | ɸ β      | f v         | θ ð    | s z      | ʃ ʒ          | ʂ ʐ       | ç ʝ     | x ɣ   | χ ʁ    | ħ ʕ        | h ɦ     |
| Lateral fricative   |          |             |        | ɬ ɮ      |              |           |         |       |        |            |         |
| Approximant         |          |             |        | ɹ        |              |           | j       | ɰ     | ɯ      |            |         |
| Lateral approximant |          |             |        | l        |              |           | ʎ       | ʟ     |        |            |         |

\*Where symbols appear in pairs, the one to the right represents a voiced consonant. Shaded areas denote articulations judged impossible.

## Position of highest part of tongue in relation to the four basic cardinal vowels



Source: Alex Jones *australian english grammar*, Wild and Woolley, 2001, page 170.

The empty circles show the location of the four basic cardinal vowels [i], [a], [ʌ], [u].

The black circles show the location of the six short vowels of Australian English that are heard in KIT, DRESS, STRAP, STRUT, LOT, FOOT (counter-clockwise from upper left).

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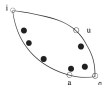
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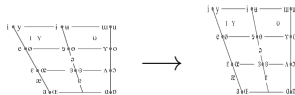
Listening Exercise

# From the 'AFL football' to the 'vowel quadrilateral' ... and beyond

The roughly oval ARTICULATORY shape as measured in the mouth:



can be stylised to form the 'vowel quadrilateral', based partly on anatomical and partly on psychological (PERCEPTUAL) criteria; this, in turn, can be modified on the basis of ACOUSTIC measurements:



Finally, the quadrilateral shape can be idealised further to form a square or rectangle, if necessary:

|     |     |     |
|-----|-----|-----|
| /ɪ/ |     | /ʊ/ |
| /e/ |     |     |
| /æ/ | /ʌ/ | /ɒ/ |

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## Vowels: phonetics vs phonemics

- How many ***phonetically*** distinct vowels are there along the continuum [i] – [a] – [ɑ] – [u] ?

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- **Arabic** has / i a u / (each of these three can be short or long)

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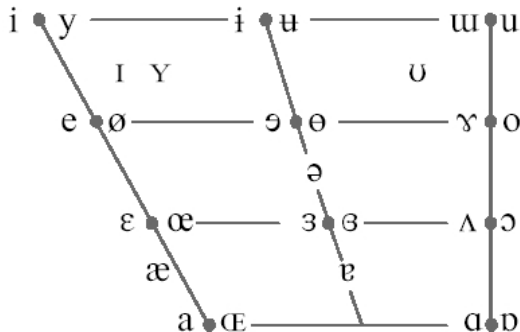
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**JAW IS:**

**CLOSE**



**OPEN**

**lips** are *unrounded* (symbol to the *left* of the dot) or *rounded* (symbol to the *right* of the dot); beware [ə] [ɐ] (*unrounded*), [ʊ] (*rounded*): NOTE: [a] is '*front*' (just like [i])

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## Only for freaks

- the meaning of the vowel quadrilateral in terms of **formants**:

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  - back** [u] [ɑ] (**low**  $F_2$ , **small**  $F_2-F_1$  **difference**)  
VS  
**front** [i] (**high**  $F_2$ , **large**  $F_2-F_1$  **difference**)

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**front** [i] (**high**  $F_2$ , **large**  $F_2-F_1$  **difference**)
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[https://de.wikipedia.org/wiki/Datei:Spectrogram\\_-iua-.png](https://de.wikipedia.org/wiki/Datei:Spectrogram_-iua-.png)
- synthesise some vowels:  
<http://www.asel.udel.edu/speech/tutorials/synthesis/vowels.html> **LINK BROKEN!**
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## Only for freaks

- the meaning of the vowel quadrilateral in terms of **formants**:
  - CLOSE** [i] [u] (**LOW**  $F_1$ )  
vs  
**OPEN** [a] (**HIGH**  $F_1$ );
  - back** [u] [ɑ] (**low**  $F_2$ , **small**  $F_2-F_1$  **difference**)  
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  - try  $F_1 = 240$  &  $F_2 = 2400$  (leave  $F_3$  blank); what did you hear?
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## English vowel phonemes vs. cardinal vowel positions

- The **cardinal vowel positions** on the IPA chart are **reference points**, designed to *‘sound equidistant’*.

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- We write /e/ rather than /ɛ/ because ⟨e⟩ is **easier to typeset** than ⟨ɛ⟩ and because we want to discourage German speakers from pronouncing that English phoneme as [ɛ], which might sound too German; pronouncing it as [e] would merely sound too Australian.

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- See if you can identify ***other*** cardinal vowels that are used in pronouncing English phonemes.

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- See if you can identify **other** cardinal vowels that are used in pronouncing English phonemes.
- **Beware** the English phoneme /ʌ/. This has evolved away from the [ʌ] position, and is now nearly [e]. (Should it be written as /e/?)

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- See if you can identify **other** cardinal vowels that are used in pronouncing English phonemes.
- **Beware** the English phoneme /ʌ/. This has evolved away from the [ʌ] position, and is now nearly [ɐ]. (Should it be written as /ɐ/?)
- Look at the **diacritics** on your IPA chart for ways of '**fine-tuning**' phonetic transcriptions of vowels.

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## Using diacritics for vowels

ē Raised

ū Advanced

ä Centralized

ö More rounded

ẽ Nasalized

Lowered ē

Retracted ī

Mid-Centralized ĭ

Less rounded ȳ

Rhoticity ɹ̥

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| SOUNDS                                                                        |                                   |                                                                                                                 |
|-------------------------------------------------------------------------------|-----------------------------------|-----------------------------------------------------------------------------------------------------------------|
| OBSTRUENTS                                                                    | RESONANTS                         |                                                                                                                 |
|                                                                               | NASAL AND LATERAL<br>RESONANTS    | CENTRAL ORAL<br>RESONANTS                                                                                       |
| <p>[ p t tʃ k ]</p> <p>[ b d dʒ g ]</p> <p>[ f θ s ʃ ]</p> <p>[ v ð z ʒ ]</p> | <p>[ m n ŋ ]</p> <p>[ l / ɫ ]</p> | <p>[ w ɹ j ]</p> <p>[ ə ]</p> <p>[ ɪ e æ ʌ ʊ ]</p> <p>[ iː eɪ aɪ ɔɪ uː əʊ aʊ ]</p> <p>[ ɪə eə ʒː ɑː ɔː uə ]</p> |
| [ h ]                                                                         |                                   |                                                                                                                 |
| CONTOIDS                                                                      |                                   | VOCOIDS                                                                                                         |
| SOUNDS                                                                        |                                   |                                                                                                                 |

# Listening Exercise

If you have time, do this listening exercise:

[http://www.spence.saar.de/phonetics/exercise\\_sheet\\_02-01/exercise\\_sheet\\_02-01.pdf](http://www.spence.saar.de/phonetics/exercise_sheet_02-01/exercise_sheet_02-01.pdf)



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