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Learning Outcomes

- Understand the basics of the source filter model of speech production and how it relates to the production of different consonant sounds

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Speech Production – the source

- Air is forced out the lungs by the raising of the diaphragm.
- The air flow passes through the vocal cords.
- **Voiced** sounds: the vocal folds shut, air pressure build up behind them, folds forced open, air flows through, folds snap shut and the cycle begins again - for voiced sounds the air flow is periodically interrupted (c.f. click-trains)

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Speech Production – the source

- Air is forced out the lungs by the raising of the diaphragm.
- **Voiceless** sounds: the vocal cords are open all the time, there is no periodic structure to the sounds produced – these are often noise-like sounds.

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- e.g.
 - (1) feel the larynx with your fingers, say the vowels "aaah", "eeee", "oooo" "eeri" trying to keep a constant pitch - the vocal folds vibrate at the same rate but the tongue moves around.
 - (2) repeat this with the same vowels but with a higher pitch - the articulators move in the same way, but the vocal folds vibrate faster
 - (3) Now repeat this with whispered (voiceless) vowels - the vocal folds no longer vibrate.

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Speech Production – the filter

- Air flows up through the pharynx into the mouth (buccal cavity) and, for nasal sounds where the soft palate is lowered, into the nasal cavity.
- The position of the *articulators* (tongue, lips, teeth, soft palate) can be moved around to change the shape of the resonant cavities which change the spectral shape (i.e. filter) the of the sound entering them.
- The speech sound is radiated from the lips.

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Adapted from: Denes & Pinson – The Speech Chain

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Speech production (recap)

- Air forced out from lungs
- Vocal folds vibrate (voiced sounds) or stay open (unvoiced)
- Air-flow enters the mouth (& nasal cavity for nasal sounds such as m & n)
- Resonances in these cavities result in formants (e.g. in vowel sounds)
- Consonants are produced by differing degrees of constriction of the vocal tract occurring at different places
- Narrow constriction – fricatives (e.g. s, sh, z etc)
- Complete closure - stops or plosives (e.g. p, t, k, b, d, g)

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Phonemes

- When talking about speech sounds we need to be able to describe them individually
- We do this on the basis of the shortest discrete “chunk” of speech – what we term **phonemes**
- **“A phoneme is a family of sounds that function in a language to signal a difference in meaning”** (Speech Science Primer)
- “pat” has three phonemes the sounds: associated with “p”, “a” and “t”
- “bat” has three phonemes the sounds: associated with “b”, “a” and “t”

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Voice, Place, Manner – labelling consonants.

- Human speech sounds (phonemes) can be described in terms of:
 - (a) vibration or not of vocal folds (**voicing**)
 - (b) position of articulators (**place** of closure or near closure in the vocal tract).
 - (c) the type of constriction caused by the articulators (**manner** - plosive, fricative, affricate, nasal, approximants, ...).

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Part of IPA chart showing consonants

THE INTERNATIONAL PHONETIC ALPHABET (revised to 2005)

CONSONANTS (PULMONIC) © 2005 IPA

	Bilabial	Labio-dental	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				ʀ					ʁ		
Tap or Flap			ⱱ	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			
Lateral approximant				l		ɭ	ʎ	ʟ			

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

See web links at end of presentation

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Consonant contrasts - voicing

- Whether or not the vocal folds are vibrating during production of the phoneme – in normal (non-whispered) speech

Voicing	Speech Sound
Voiced	/b/, /d/, /g/, /v/, /ð/, /z/, /ʒ/, /dʒ/, /m/, /n/, /ŋ/, /w/, /j/, /l/, /l/
Unvoiced	/p/, /t/, /k/, /f/, /θ/, /s/, /ʃ/, /tʃ/, /h/

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Consonant contrasts - manner

Manner	Speech Sound
Stop (plosive)	/p/, /t/, /k/, /b/, /d/, /g/
Fricative	/f/, /θ/, /s/, /ʃ/, /v/, /ð/, /z/, /ʒ/, /h/
Affricate	/tʃ/, /dʒ/
Nasal	/m/, /n/, /ŋ/
Approximant	/w/, /j/, /l/, /l/

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Consonant contrasts - place

Place	Speech Sound
Bilabial	/p/, /b/, /m/, /w/*
Labiodental	/f/, /v/
Dental	/θ/, /ð/
Alveolar	/t/, /d/, /n/, /s/, /z/, /ʃ/, /ʒ/
Palato-alveolar	/tʃ/, /dʒ/
Palatal	/j/
Velar	/k/, /g/, /ŋ/, /w/*
Glottal	/h/

BACK ↔ FRONT

*w/ is in two "places" because there is both a narrowing of the lips, and a raising of the tongue towards the soft palate

⏪ ⏩ ⏴ ⏵