

# Theoretical Phonology: Suprasegmental Phonology

## Consonants: Voice & Place of Articulation

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# Outline

- 1 Speech Sounds
- 2 Degree of Stricture
- 3 Aspect of Articulation
- 4 Co-ordination
- 5 Length
- 6 Linear vs. Parametric Approaches
- 7 Manner of Articulation
  - Plosives
  - Fricatives
  - Affricates
  - Trills, Flaps and Taps
  - Nasals
  - Approximants

# Sound Classification

## ① initiation

- ① airstream mechanism
- ② airflow direction

## ② phonation

## ③ articulation

- ① place of articulation
- ② degree of stricture
- ③ aspect of articulation

## ④ co-ordination

# Consonants

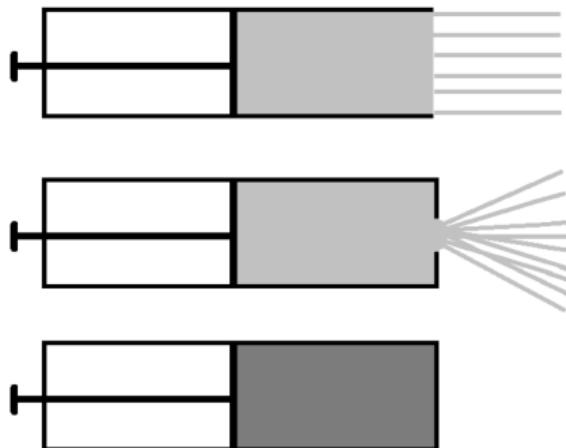
## CONSONANTS (PULMONIC)

© 2005 IPA

	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Glottal
Plosive	p b		t d		t̪ d̪	c j	k g	q G			?
Nasal	m	n̪j		n		ɳ	jn̪	ɳj	N		
Trill	B		r						R		
Tap or Flap		v̪		f		t̪					
Fricative	ɸ β	f v	θ ð	s z	ʃ ʒ	ʂ ʐ	ç j	x y	χ ʁ	ħ ŋ	h ɦ
Lateral fricative			ɬ ɭ								
Approximant		v̪		ɹ		ɻ	ɺ	ɻɻ			
Lateral approximant			ɬ		ɬɻ	ɻɺ	ɺɻɺ	ɻɻɺɻɺ			

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

# Degree of Stricture



- ① open approximation - resonant
- ② close approximation - fricatives
- ③ complete closure - stops

# Aspect of Articulation: Conformational

- ① oral vs. nasal (*stops, fricatives, and resonants*)
- ② central vs. lateral (*fricatives and resonants*)

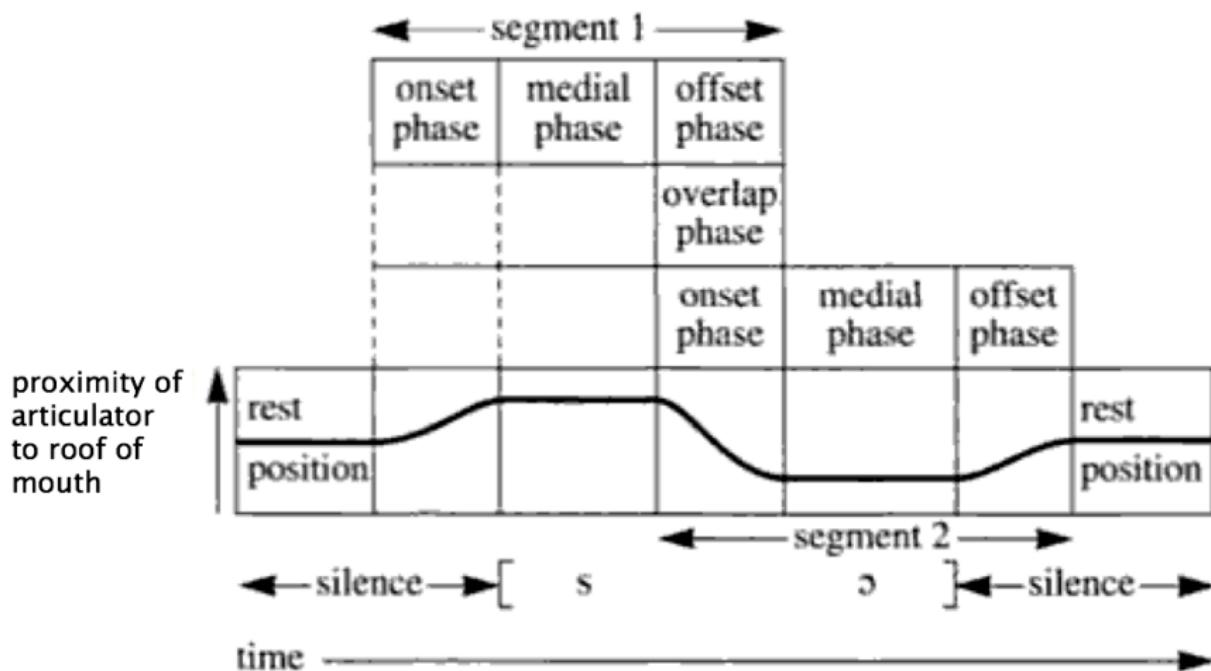
# Aspect of Articulation: Topographical (tongue surface convex/concave)

- ① grooved (*fricatives*)
- ② retroflex (*stops, fricatives and resonants*)
- ③ cupped (*stops, fricatives and resonants*)
- ④ withdrawn tongue root (*resonants*)
- ⑤ extented of the tongue tip (*stops, fricatives, and resonants*)
- ⑥ advancement of the tongue root (ATR) (*stops, fricatives and resonants*)

# Aspect of Articulation: Transitional (steady/dynamic)

- ① flapped (*stops, fricatives and resonants*)
- ② tapped (*stops and fricatives*)
- ③ trilled (*stops and fricatives*)
- ④ diphthongal (*resonants*)
- ⑤ triphthongal (*resonants*)

# Co-ordination<sup>1</sup>



<sup>1</sup>Laver 1994, p. 133

# Co-ordination: Devoicing

- partial devoicing
- initial devoicing
- final devoicing

The diacritic for devoicing is a subscript [ ç ]

English sonorants (see *Slide 59*) (/j, w, l, r, m, n, ŋ/) become partially devoiced when they follow a voiceless sound within the same syllable.

# Co-ordination: Release

- Release
- Unreleased apt [æp<sup>‿</sup>t<sup>h</sup>]

The diacritic for unrelease is superscripted under the consonant as in [ p<sup>‿</sup> ].

# Co-ordination: Plosion

- Oral plosion
- Nasal plosion
- Central plosion
- Lateral plosion

English plosives ([p t k b d g]) have nasal plosion when they are followed by a nasal, inside a word or across word boundaries.

# Co-ordination: Aspiration

- Unaspirated
- Aspirated pen [p<sup>h</sup>en]

English voiceless plosives [p t k] are aspirated at the beginning of a stressed syllable or at the beginning of a word.

The diacritic for aspiration is the superscript h [p<sup>h</sup>]

# Co-ordination: Affrication

Affricates are co-ordinated sounds usually a stop and a fricative as in [ts] and [tʃ].

# Length

- Short segments
- Long segments
  - Long vowels e.g. the English vowels in feet /fi:t/) and fit /fit/
  - Geminate consonants e.g. the Cypriot Greek /po"li/ and /po"l:i/.<sup>2</sup>

<sup>2</sup>Some languages (e.g. Estonian) comprise of extra long consonants (supergeminates).  

# Linear vs. Parametric Approaches

- **Linear approach:** one segment follows the other in a linear manner (like letters in writing)
- **Parametric approach:** parameters (e.g. the state of the vocal cords, the position of the tongue, the shape of the lips etc.), which (potentially) change in time.

# Parametric Approaches

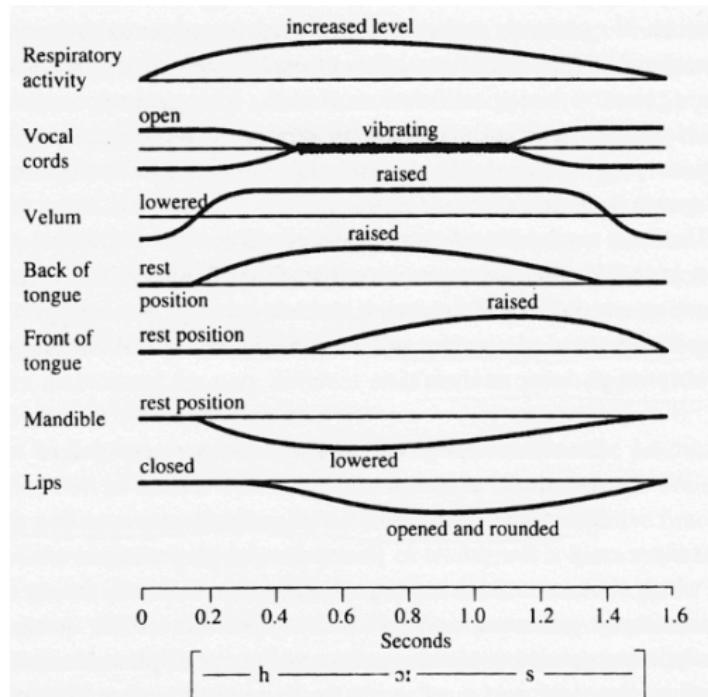


Figure 4.1 Parametric analysis of the articulatory actions of some of the vocal organs in the production of the English (RP) word *horse* /hɔ:s/ (after Brosnahan and Malmberg 1970: 70)

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# Plosives

Place	Voiceless	Voiced
Bilabial	[ p ]	[ b ]
Dental	[ t ]	[ d ]
Alveolar	[ t̪ ]	[ d̪ ]
Palatal	[ c ]	[ ɟ ]
Velar	[ k ]	[ ɡ ]
Uvular	[ q ]	[ ɢ ]
Glottal	[ ? ]	

- [p] voiceless bilabial plosive
- [b] voiced bilabial plosive
- [t] voiceless alveolar plosive
- [d] voiced alveolar plosive
- [t̪] voiceless palatal plosive
- [d̪] voiced palatal plosive
- [k] voiceless velar plosive
- [g] voiced velar plosive
- [q] voiceless uvular plosive
- [g] voiced uvular plosive
- [?] glottal stop

# English Plosives

- English sound inventory comprises of bilabial [ p b ], alveolar [ t d ], and velar [ k g ] consonants.
- *Aspiration*. Voiceless [ p t k ] are aspirated when initial in an accented syllable or at beginning of a word: pen [p<sup>h</sup>ɛn], can [k<sup>h</sup>an], tin [t<sup>h</sup>ɪn]. See however spin [spn] spoon [spun], stop [stp], score [sk].
- *Devoicing*. When [l r w j] follow voiceless [ p t k ] in such positions, they are devoiced: play [p<sub>ø</sub>ei], pray [prei], try [trøi], clean [klø:n], twice [twøis], quick [kwøik], pew [pju:]:
- [b d g] in initial or final word positions (i.e. following or preceding silence) are devoiced: [b̥ d̥ g̥]
- Syllables closed by voiceless consonants are shorter than syllables closed by open syllables.

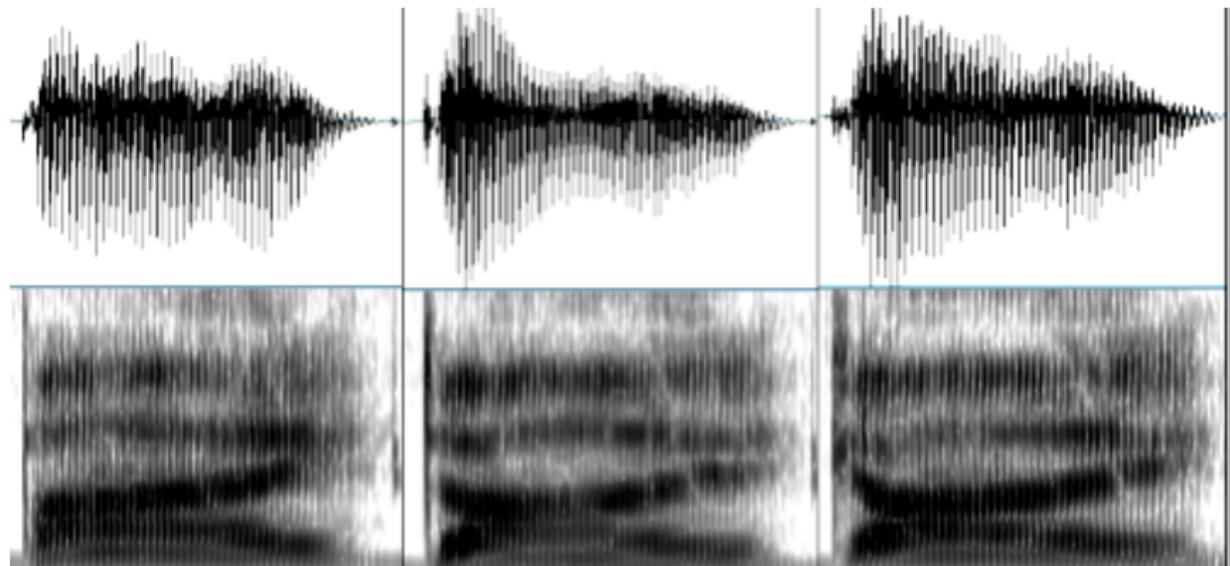
# Advice to Greek Speakers

- Greek speakers pronounce [k] and [g] as [c] and [j] when these sounds precede front vowels. There are no palatal plosives in English. Check your self by pronouncing: *akin, cake etc.*)
- Standard Modern Greek speakers pronounce *p t k* in *pin, ten, and kin* unaspirated. Try to pronounce with aspiration.
- Cypriot Greek speakers neutralise [p d g] at the end of syllables and tend to pronounce [b d g] as in the words *club, bed* and *bag* as [p t k]. Remember that syllables are longer if the end in a voiced stop and shorter if they end in a voiceless stop.

# Producing Stop Consonants

- Onset Phase: Closing phase
- Medial Phase: Closed phase
- Offset Phase: Release phase or Plosion

# Voiced Plosives: Locus



buy /baɪ/ die /dai/ guy /gai/

# Voiced Plosives

- The first formant marks plosives as having a stop closure.
- The second and third formant distinguish stop consonants.
- The frequency of the first formant increases when they are at the beginning of a syllable and falls when they are at the end.

# Voiced Plosives: Locus<sup>3</sup>

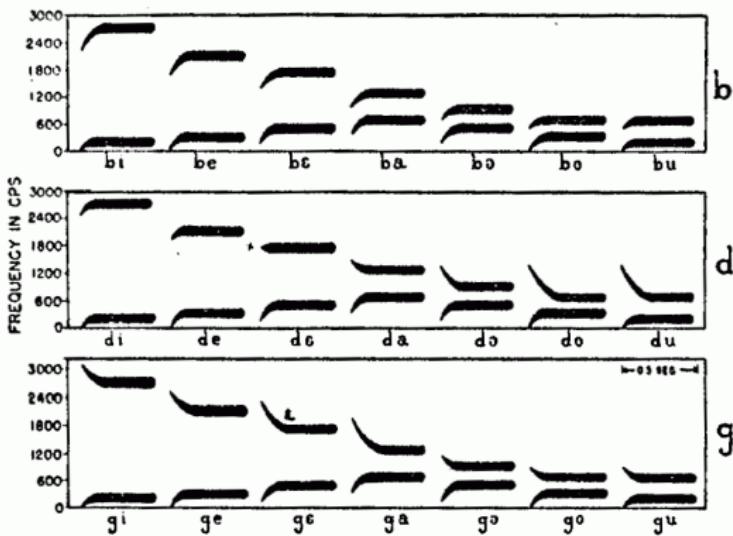


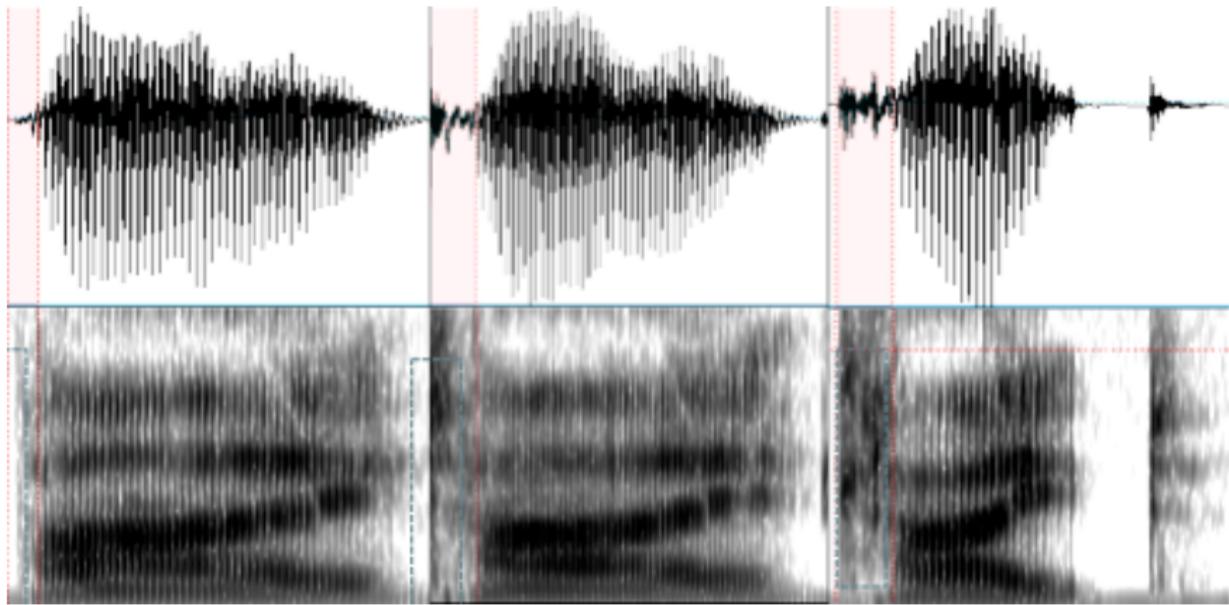
FIG. 1. Synthetic spectrograms showing second-formant transitions that produce the voiced stops before various vowels.

<sup>3</sup>from Dellatre, Liberman & Cooper, 1955.

# Transitions: Rules of thump

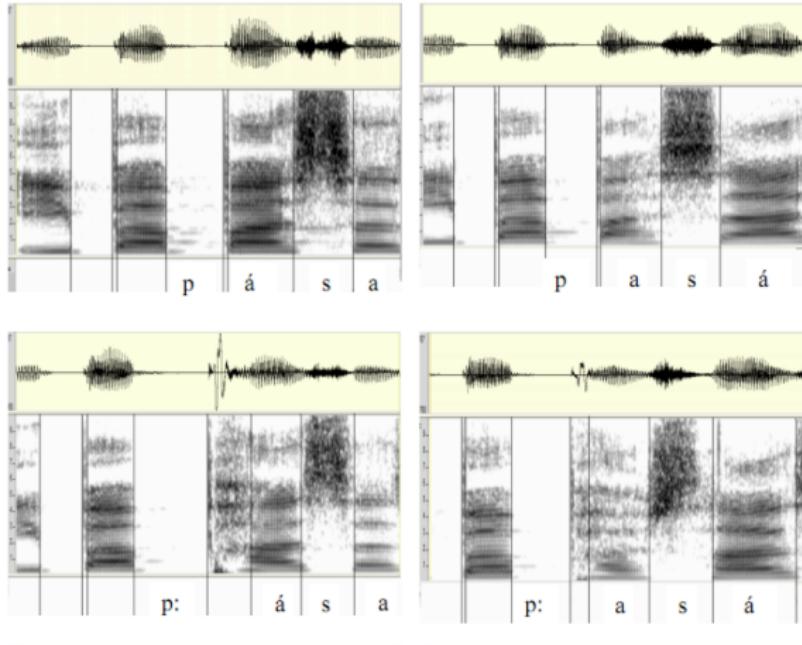
- if a word or syllable starts with a second and a third formant rapidly increasing in frequency, the sound is [b].
- If the third formant falls and the second formant has only a small movement then the formant is [d].
- If the third and the second formant are close together the back of the tongue has contacted the roof of the mouth, as in [ʃ]. The same is true when the stop follows the vowel.

# Voiceless Plosives



pie /paɪ/ tie /taɪ/ kite /kaɪt/

# Cypriot Greek Singletons and Geminates

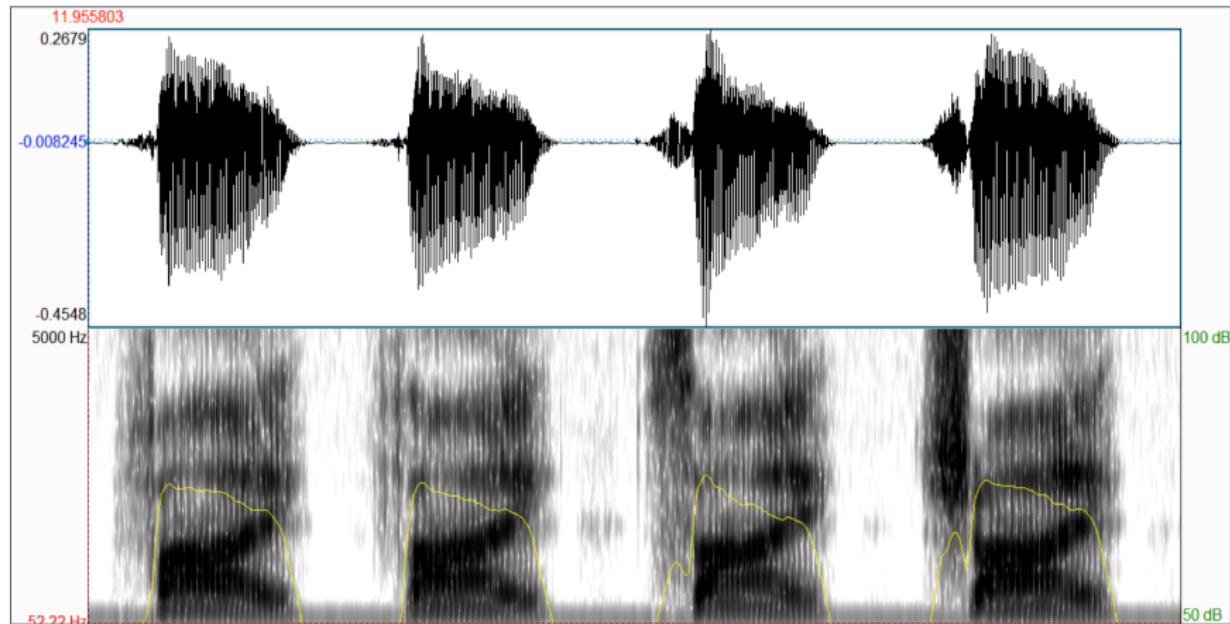


/'pasa/ and /pa'sa/ (upper panel) vs. /' $p^h$ :asa/ and / $p^h$ :a'sa/ (lower panel) (from Botinis, Christofi, Themistocleous and Kyprianou 2004)

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  - **Fricatives**
  - Affricates
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# Fricatives: Acoustics



fie thigh sigh shy



# Fricatives

Place	Voiceless	Voiced
Bilabial	ɸ	β
Labiodental	f	v
Dental	θ	ð
Alveolar	s	z
Postalveolar	ʃ	ʒ
Palatal	ç	ɟ
Velar	x	ɣ
Uvular	χ	ʁ
Pharyngeal	ħ	ʕ
Glottal	h	ɦ

- [ɸ] voiceless bilabial fricative
- [β] voiced bilabial fricative
- [f] voiceless labiodental fricative
- [v] voiced labiodental fricative
- [θ] voiceless dental fricative
- [ð] voiced dental fricative
- [s] voiceless alveolar fricative
- [z] voiced alveolar fricative
- [ʃ] voiceless postalveolar fricative
- [ʒ] voiced postalveolar fricative
- etc...

# English Fricatives

- English fricative phonemic inventory comprises of /f v θ ð s z ʃ ʒ/ and the /h/.
- / v ð z ʒ / tend to be fully voiced between voiced sounds such as in cover, other, easy, leisure etc.
- in initial or final positions (as in the words leave, breath, and peas) the voiced fricatives become devoiced [v ð z ʒ].
- / f θ s ʃ / tend to reduce the length of the preceding vowel as in *fife*, *leash*, *self* (cf. *five* and *selves*).

# Fricatives

- Degree of stricture: Close Approximation
- Friction

# Fricatives: [f] and [θ]

- The differences in the fricative noise of [f] and [θ] are very small and it is not surprising that English is one of the few languages in the world that uses these sounds. Greek and Spanish are the only other well-known European languages that contrast them as in the Greek words 'faros and 'θaros.
- The fourth formant is below 4,000 Hz in *fie* and above it in *thigh*.
- The second formant in *fie* also starts at a slightly lower frequency at around 1,200 Hz and then moves noticeably upwards. At the start of *thigh* the second formant is fairly level at around 1,250 Hz.

# Fricatives: [s] and [ʃ]

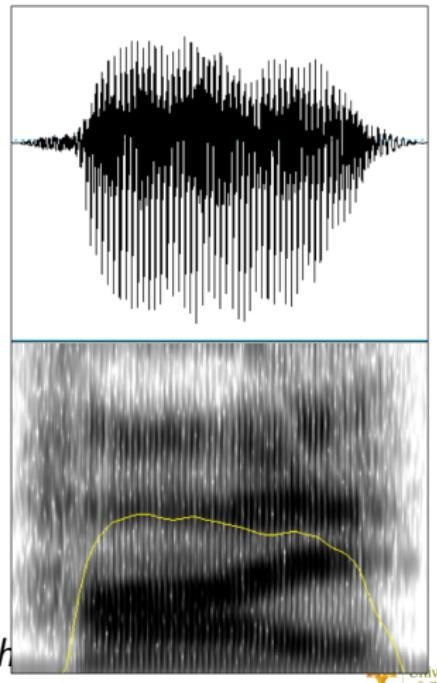
- [s] and [ʃ] are sometimes called sibilants (i.e. hissing sounds).
- Sibilants have greater intensity from [f] and [θ].
- [s] has a large amount of energy that extends above the 10,000 Hz. There is comparatively low energy below 3,500 Hz. And noticeable intense band above 5,000 Hz.
- The sound [ʃ] has more energy at a slightly lower frequency, centered at a little above 3,000 Hz.

# Fricatives: [h]

- [ h ] is not really a voiceless fricative because the source of the noise is not air being forced through a narrow gap; instead the origin of the sound is the turbulence-the random variations in air pressure-caused by the movement of the air across the edges of the open vocal folds and other surfaces of the vocal tract.
- The sound of [ h ] is more like a noisy vowel.

The

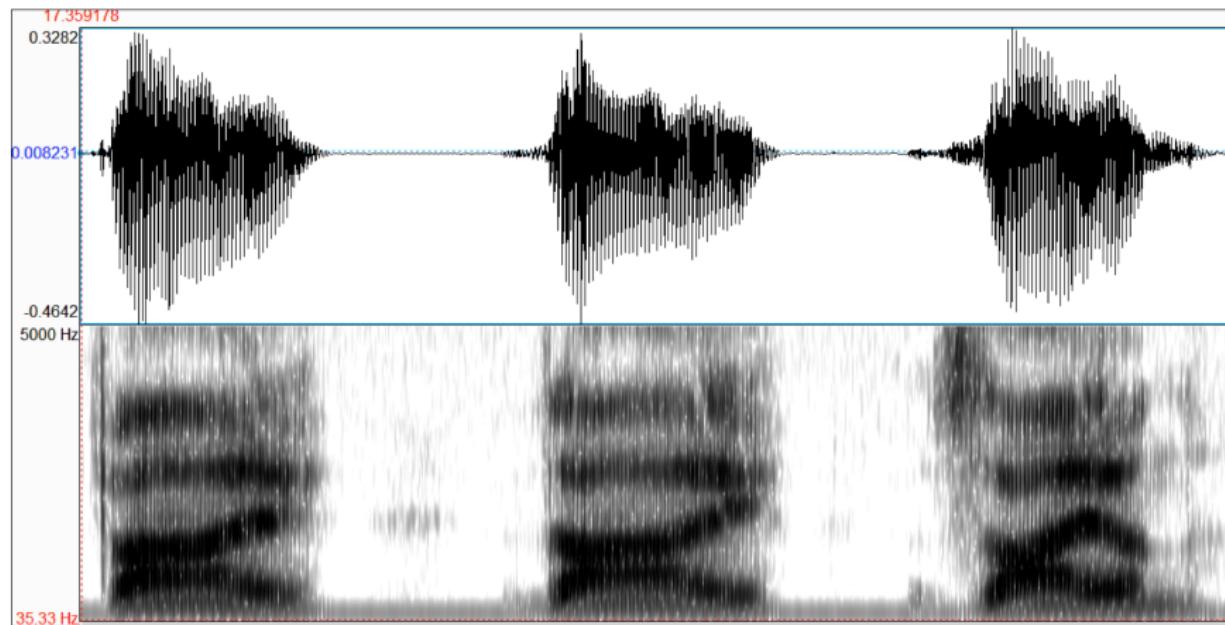
*3<sup>rd</sup> formant is around 3,000Hz; there are faint traces of the*



# Voiced Fricatives

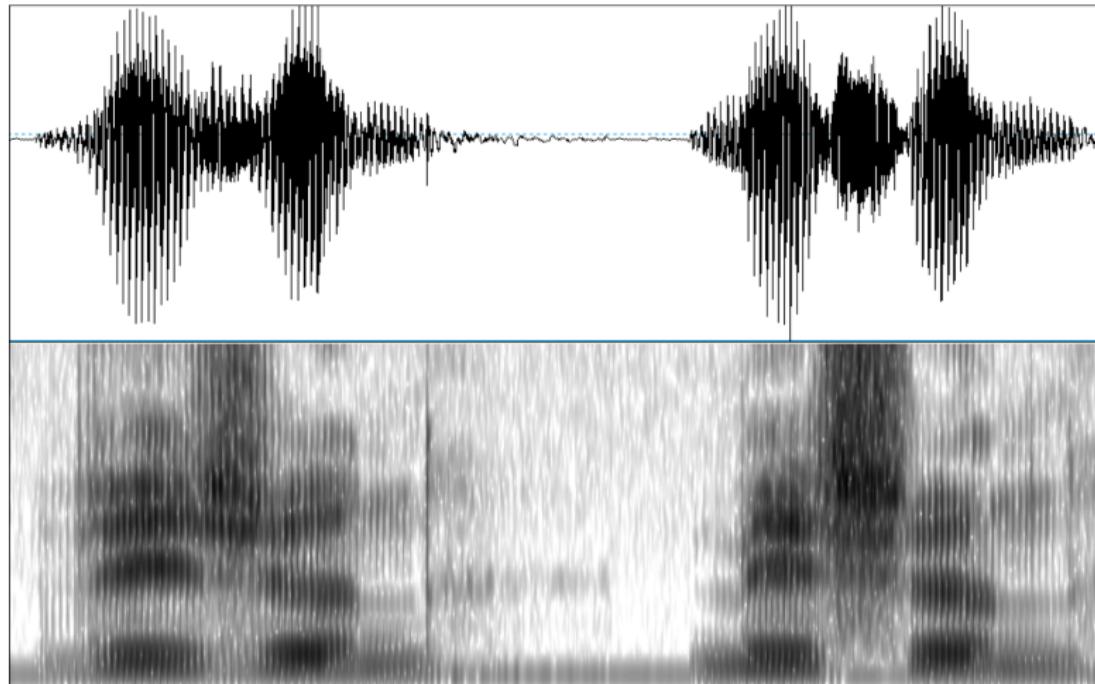
- The four voiceless fricatives [f], [θ], [s], [ʃ] have a voiced counterpart, in which the vocal folds are vibrating while the fricative noise is being formed by forcing air through a gap: the [v], [ð], [z] and [ʒ].
- Voiced fricatives have formants produced by pulses from the vocal folds as well as more random energy produced by forcing air through a narrow gap.

# Voiced Fricatives



vie /'vai/ thy /'ðai/ zion /'zaiən/

# Voiced Fricatives



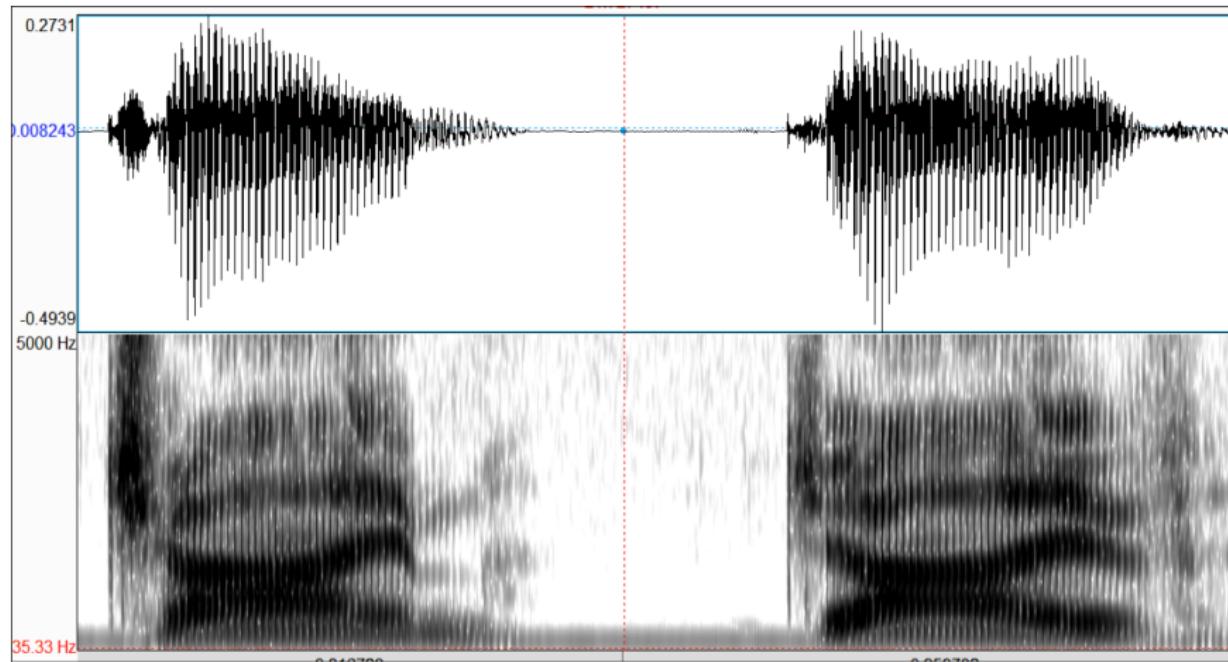
vision /'vɪʒən/ mission /'mɪʃ(ə)n/



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# Affricates



chime /tʃaɪm/ jive /dʒaɪv/

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# Trills

- Alveolar trills (e.g., Cypriot Greek word /ka'rɔtʰon/) and uvular trills (as in the German word German Rübe /'Rÿ:bə/) are by far the most common trills.
- The active articulator in an alveolar trill [r] is usually the blade and sometimes the tip of the tongue.
- In the uvular trill [R] is the uvula.

# Flaps

- Flapped are produced by a process which involves the active articulator hitting the passive articulator in passing.
- Flap [ɾ]

# Taps

- Taps are a limiting case of a trill, with only one contact of complete closure instead of repeated closures.
- Tap: [ɾ]

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# English Nasals

- English Nasal Sounds are [m] [n] and [ŋ]
- The nasals have different distributions: [m n] occur both syllable initially and syllable finally, but [ŋ] occurs only syllable finally.
- English nasals are voiced.

# English Syllabic Nasals

- Nasals can be syllabic in English. This means that they occur in syllables without vowels in unstressed syllables.
- Plosive - Nasal: *open* ['əʊpən], *happen* [hæpən], *button* [bʌdn̩], *sudden* [sʌdn̩], *bacon* [beɪkn̩].
- Alternatively speakers pronounce the above words with a central vowel *open* ['əʊpən], *happen* [hæpən], *button* [bʌdən], *sudden* [sʌdən], *bacon* [beɪkən].

# Nasals

- Describe these sounds by using the voice, manner, place labels.
- Write in IPA these words: none, nun, ring, money, Any, meal, mat, smack, smock, Demon, salmon, Seem, lamb, harm

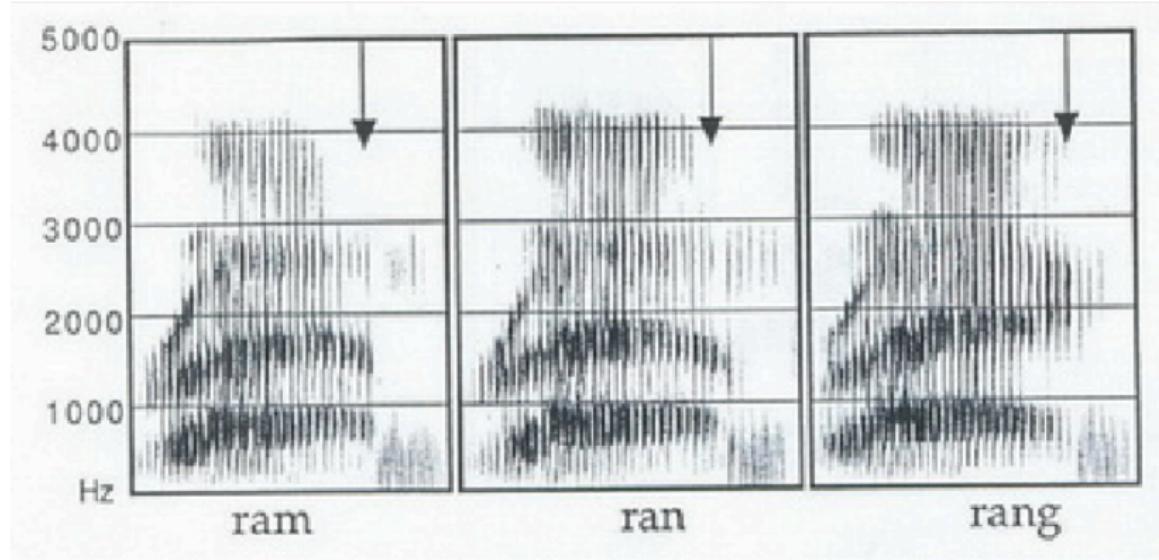
# Nasals. Production

- The velum is lowered and allows the air to flow out of the vocal tract via the nasal cavity.
- There is complete closure somewhere in the vocal tract.<sup>4</sup>

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<sup>4</sup>The oral gestures for [m n ɳ] are the same as those for [b d ɠ] except that the velum is raised for [b d ɠ] and lowered for [m n ɳ].

# Nasals. Acoustics



chime ram /ræm/ ran /ræn/ rang /ræŋ/

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# English Approximants

- Alveolar /ɹ/
- Alveolar Lateral /l/
- Palatal /j/
- Labio Velar /w/

# Lateral Approximants

- After voiceless plosives in a cluster syllable-initially, as in play, plum, clay, clunk lateral approximants become voiceless.
- We use a diacritic to transcribe voicelessness: [ p̥l̥ ]ay, [ k̥l̥ ]ay, etc.
- [j] and [w], it is hard to produce frictionless sounds in combination with voicelessness, so these sounds typically have some degree of friction.

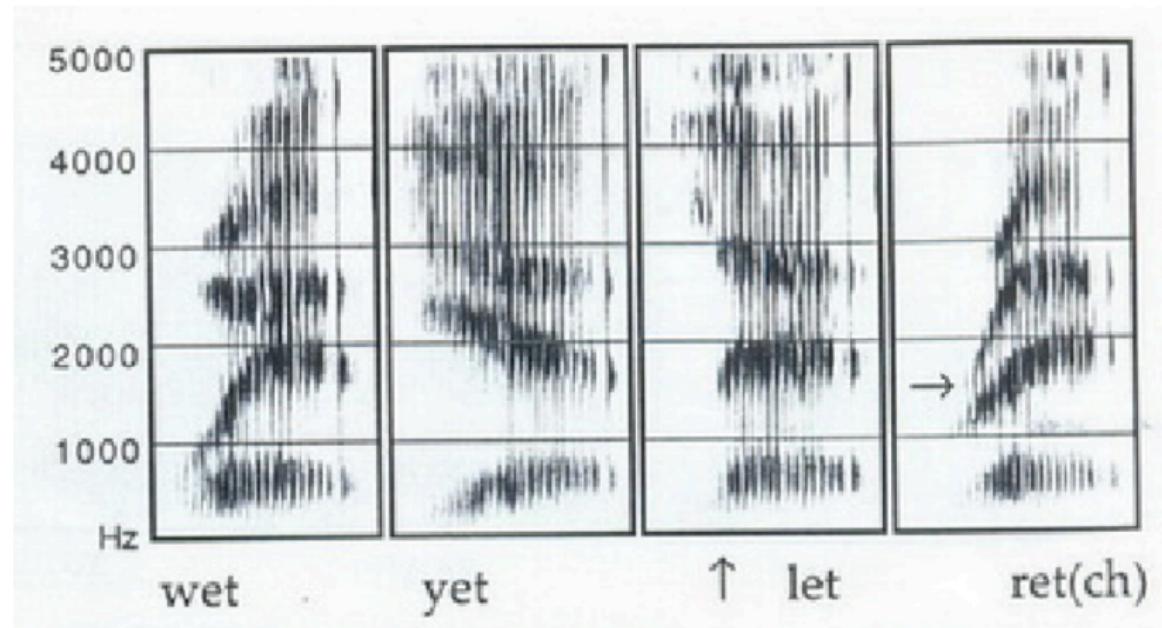
# Syllabic Laterals

- Syllabic laterals are generally found word finally: bottle ['bɒtl̩], little ['lɪtl̩], handle ['hændl̩] facial ['feɪʃl̩], etc.
- The distribution of syllabic laterals is similar to that of syllabic nasals.

# Laterals

- Laterals are produced with a dental place of articulation when the next sound is also dental. Laterals combined with [θ] regularly have a dental articulation: hea[θ]th, wea[θ]th, stea[θ].

# Approximants



wet [wet] jet [jet] let [let] ret [jet̪]

## Other Articulations

There are more place neutral articulations to consider: the dental voiced/voiceless, the epiglottal voiced oral stop and the glottal stop, which doesn't have a paired voiced since by definition it is impossible to produce a voiced glottal. There is no symbol for epiglottal stop but it is a possible sound (see Laver 1994:206)

# Notes on terminology

- plosives are phonologically termed *stops*.
- laterals and rhotics are collectively termed *liquids*.
- the non-lateral approximants are termed *glides*.
- plosives and affricates are collectively termed **obstruents** whereas glides, liquids, nasals and vowels are termed **sonorants**.

# Summary

## Topics Discussed this Week

- The Place of Articulation, Manner of Articulation, Voicing.
- The Initiation, Phonation, Articulation, Co-ordination
- Manner of Articulation: Plosives, Fricatives, Affricates, Trills, Flaps, and Taps.
- Diacritics and sound production.
- Next Week
  - Vowels
  - Vowel classification differs from that of consonants.

# Further Reading I



A. Gruttenden.

*Gimson's Pronunciation of English.*

Edward Arnold, 1994.



J. Laver.

*Principles of Phonetics.*

Cambridge, 1994.