Phonetics and Phonology

- **OUTLINE :**

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❖ Syllable structure

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❖ Closed vs open syllables

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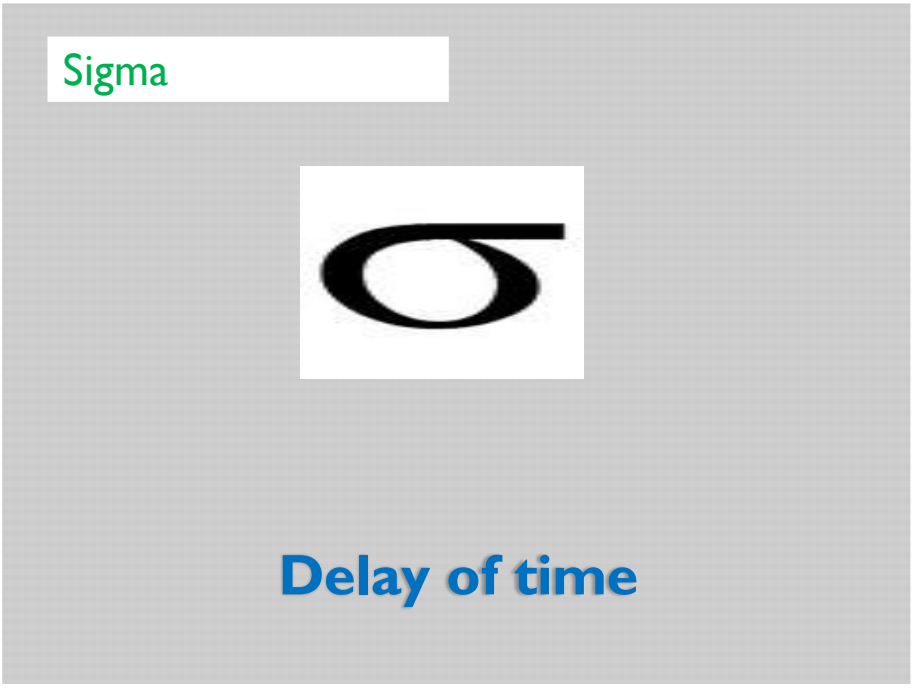
DEFINITION:

It is a unit at a higher level than the phoneme and distinct from that of the word or morpheme.

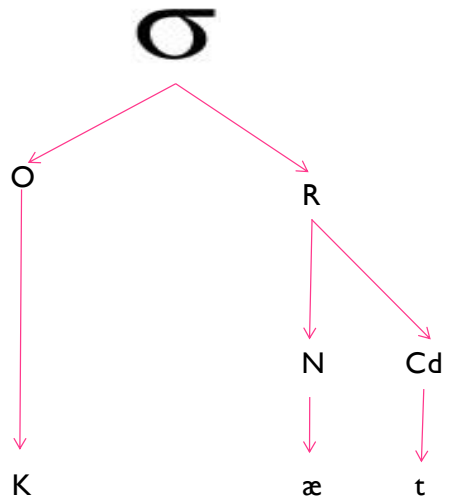
SYLLABLE STRUCTURE:

- The syllable has two main constituents:
- ONSET and RHYME.



Minimal syllable: Monosyllabic wrd

- K æ t



Wrd	Onset	Nucleus	Coda
/Si:/	S	i:	Ø
/ɒn/	Ø	ɒ	n
/ai/	Ø	ai	Ø

Closed Vs Open Syllables

- Closed syllables are syllables which have a branching rhyme.
- Open syllablles are syllables which have no branching rhyme.

MORAIC Vs MORA TIMING LGES

- English is one of the moraic languages, since it uses mora in the analysis as a phonological unit.
- For mora timing languages, Japanese is an example.

MORAIC THEORY OF SYLLABLE STRUCTURE

- Under this concept syllables are given weight according to the slots that the rhyme contains. That is, a heavy syllable has two moras whereas a light one has just one, since two moras are for two v slots, and one mora is for one v slot.

Phonotactic restrictions on onset

- In English there are some onset clusters that are not permissible as a possible combination, for example, if an onset cluster has a sequence of three consonants, the first one should be an/s/

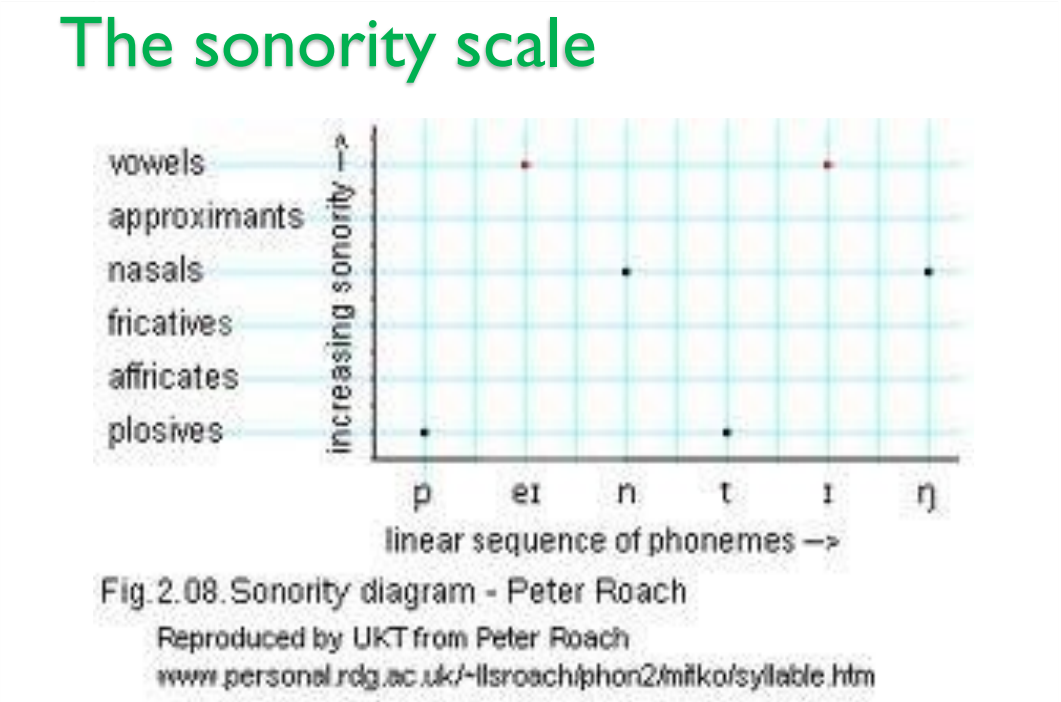
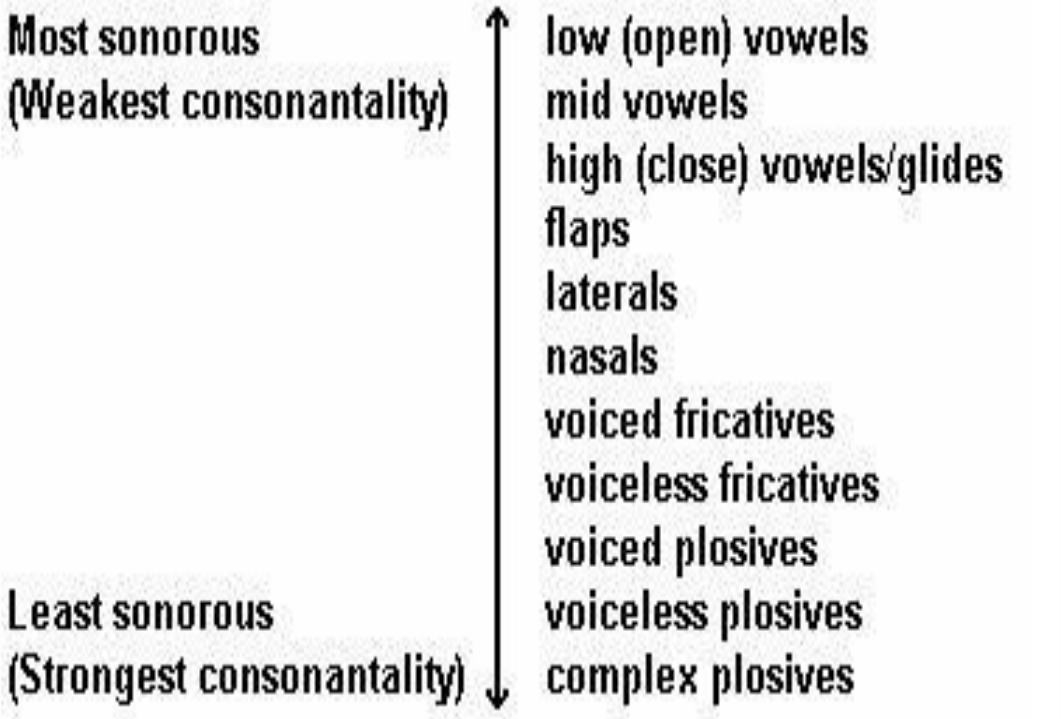
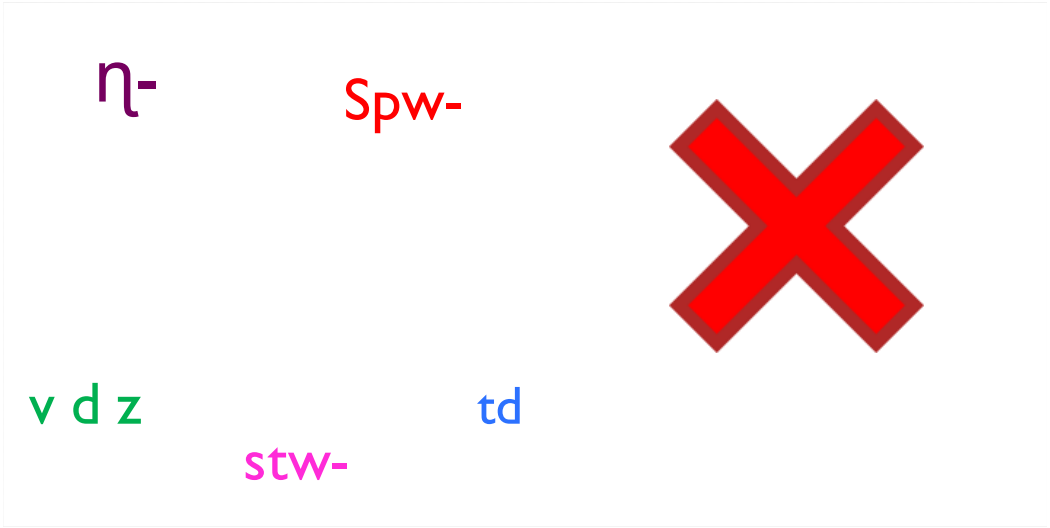


Fig.2.08.Sonority diagram - Peter Roach

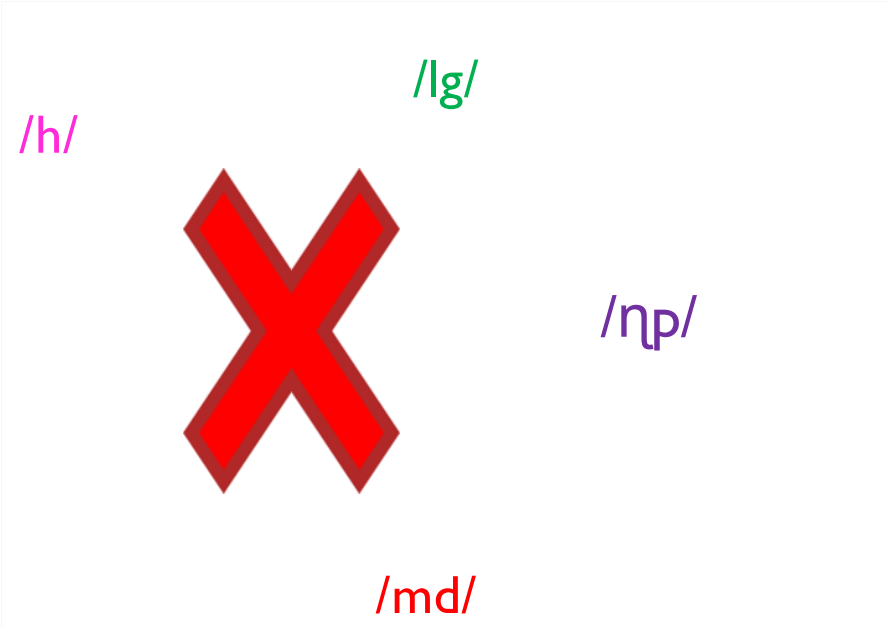
Reproduced by UKT from Peter Roach
www.personal.rdg.ac.uk/~llsroach/phon2/mifko/syllable.htm





Restrictions on the coda

- As any element of a syllable, coda has its own restrictions that determine the allowed and the disallowed coda combinations.



THE HOMORGANIC CONSONANTS

- The rule on homorganic consonants states that a cluster of nasal Cs + oral stops is allowed only if these two stops occur at the same place of articulation. Such as:

- /hʌmbl/
- /hændl/
- /æŋgl/
- /æŋkl/

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The syllable

The concept of the syllable is a unit at a higher level than that of the phoneme or sound segment, yet distinct from that of the word or the morpheme; a unit of sound that is larger than a single segment and usually smaller than a word, but it is not always easy to define the number of syllables in a word or identify where one ends and the next begins.

Phonetically, syllables are always described as consisting of a center which has little or no obstruction to airflow and which sounds comparatively loud; before and after that center, there will be greater obstruction to airflow and/or less loud sound (Roach, 2000: 70).

Phonologically, the syllable involves the possible combinations of phonemes in a given language (phonotactics).

Humans seem to need syllables as a means of segmenting the stream of speech, giving it a rhythm of strong and weak beats. Syllables exist only to make speech easier for the brain to process.

Syllable **structure** is language-specific.

The syllable, conventionally marked as a small Greek sigma, has two immediate constituents: **the onset,** which includes any consonant which precedes the nuclear element, and the **rhyme,** which branches into the **nucleus** as well as any consonants that might follow it (**coda**). The nucleus represents the most sonorous element in the syllable. Syllable structure may be represented graphically by means of a **tree diagram** or **immediate constituent structure.**

Diphthongs are treated as branching peaks; each element of the diphthong occupies a single V-slot. It is the same for long vowels. In terms of syllable structure, they're considered as sequences of two identical V-elements. /i:/ is represented as V1 = i + V2 = i.

Closed and open syllables:

Syllables ending in a consonant (as in cat, eat, it) are traditionally known as **closed syllables;** those ending in a vowel as (sea, eye) are **open syllables**. In terms of syllable

structure, in closed syllables, the coda is present, i.e., we have a branching rhyme; whereas open ones have non-branching rhymes: the coda is absent.

In recent phonological theory, this is referred to as **syllable weight.** Syllables are heavy when the rhyme is branched to contain:

1) a long vowel or diphthong followed by one or more consonants.
2) A short vowel followed by at least one consonant.

Light syllables are those with no branched rhymes. They are termed in phonological length as a mora; whereas heavy syllables are being greater than one mora.

Moraic theory of syllable structure

It is popular alternative to the representations of syllable structure. Under this concept, the syllable does not consist of an onset and rhyme but two morae (from the Latin word meaning 'a short period of time' or 'delay'). The main generalization is the following:

1) Heavy syllables consist of two morae
2) Light syllables consist of one mora.

Suppose we're dealing with a language in which closed syllables &syllables with a long vowel are heavy, whereas other syllables are light, we can represent syllable structure in this language in the following way:

a-light b-heavy c-heavy

Weight usually refers to coda consonants and not onset consonants; however, there are few languages for which it seems true that onsets count for weight.

FLSH –Ain Chock

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Phonology

The syllable: typically contains a consonant or set of consonants followed by a vowel followed by another consonant or set of consonants.

A string of more than one consonant is called a cluster. However, in some syllables, there are no final consonants (as in spray); in others, there are no initial consonants (as in imps), or no consonants at all (as in eye). Words with one syllable are **monosyllabic**, while others with more than one syllable are **polysyllabic.** Thus, it seems the only obligatory part of a syllable is a vowel or **nucleus.** However, in restricted cases, it is possible for the nucleus of a syllable to be a consonant, as in the word *table.*

We can divide the syllable into two halves: the **rime** and the **onset**. The consonant or consonant cluster after the nucleus will be called the **coda**.

Some consonants yield impossible words. Compare:

Nelp * nepl

Lump * lupm

Play *lpay

Pray *rpay

Why is this? The answer lies in the degree of **sonority** of phonemes. We know that vowels are **more sonorant** than consonants. Here, I will give some approximate values of the degree of sonority of different classes of sounds, starting with the most sonorant.

Vowels

Approximants

Nasals

Fricatives

Plosives

In a word, the sonority of each sound gradually rises to a peak at the nucleus and then falls at the coda. Each word has a **sonority profile**. That helps explain why certain types

of consonant cluster are impossible in onsets or codas. Such restrictions on sound combinations are called **phonotactic constraints.** The notion of the syllable (and its constituents) helps us explain why the sequence –lp is possible in *help* but not at the beginning of a word, and why, conversely, the sequence br- is fine in *brush* but not at the end of a word: given the **sonority principle** (that the sonority profile of a legitimate syllable must rise continuously to a peak and fall continuously after that peak) –lp is a possible coda, but not a possible onset, while br- is a possible onset, but not a possible coda.

Other phonotactic constraints are more subtle. Thus, in English, we cannot have an onset consisting of a plosive + a nasal. Hence, kn-, pn-, gm- and so on are excluded. However, plosives are less sonorous than nasals, so, we might expect these clusters to be possible, as they are in many languages. The only sounds that combine happily with obstruents to form an onset cluster are the approximants /l w j r /. On the other hand, the reverse order of nasal + plosive is perfectly good as a coda (e.g., imp, ink).

Normally, only two consonants are allowed in an onset. However, the phoneme /s/ behaves in an unusual fashion. It can combine with almost any onset to form a cluster of up to three consonants. Thus, we get spl-, str-, skw and so on. We don't find *sbr-, *sdw- or *sgl, however, because there is a mismatch between the voicelessness of the first segment and the voiced second segment in these cases. As a result, we can have only an unvoiced obstruent immediately after /s/.

However, we can have a voiced sonorant (nasal or approximant) in this position: sn-, sm-, sl-, sw-.

The syllable Structure

What is a syllable?

The concept of syllable is a unit at a higher level than the phoneme and distinct from that of the word or morpheme.

It is a unit of sound that is larger than a single segment and usually smaller than a word, but it is not always easy to define the number of syllables in a word or identify where one ends and the next begins.

Phonetically, syllables are usually described as consisting of a centre which has little or no obstruction to airflow, and which sounds comparatively loud. Before and after that obstruction there will be greater obstruction to airflow and/or less loud sound.

Syllable Structure

- The syllable has two main constituents: onset and rhyme, which subsumes the Nucleus and the Coda.
- The onset refers to any consonant which precedes the Nucleus.
- The Nucleus represents the most sonorous element in the syllable.
- The Coda includes all the consonants that follow the peak.

Minimal Syllable

- In the case of cat, the Onset, Peak and Coda each consists of one segment. However, there are syllables in English where either or both Onset and Coda are absent.
- Only the Peak is an obligatory element in all languages.
- In English, both the Onset and Coda are optional elements.

Closed and open syllables

- Syllables ending in a consonant are traditionally known as closed syllables.
- Syllables ending in a vowel are open syllables.
- In closed syllables the Coda is present: we have a branching rhyme.
- Open syllables have non-branching rhymes: Coda is absent.

Heavy Vs light syllables

- In recent phonological theory, this is referred to as syllable weight.
- A heavy syllable is a syllable with a branching Nucleus or a branching rhyme (Latin Criterion).

- A branching Nucleus generally means that the syllable has a long vowel or a diphthong: CVV.
- A syllable with a branching Rhyme is a closed syllable (one or more conso. At the end: CVC.
- Light syllables are those with no branching rhyme or with a coda of no more than a consonant (Khalkha Mongolian Criterion).
- Light syllables are termed in phonological length as a Mora whereas heavy syllables are greater than one Mora.
- Other languages have CVVC syllables (with both branching Nucleus and Coda) and CVCC (with a Coda consisting of two or more conso..These are referred to as Super-heavy Syllables.

Latin Criterion Vs Khalkha Criterion

- The vast majority of weight sensitive stress systems (87% in Gordon, 2006) are described as treating weight as binary.
- Two roughly equally frequent criteria (i.e., schemes for categorizing syllables as heavy or light) stand out as being more common than all others.
- The first is the Latin criterion by which only short vowel final syllables are light.
- The other, as in Khalkha Mongolian, treats syllables as heavy when they contain a long vowel or diphthong.
- These criteria differ from each other only in their treatment of syllables with a short vowel plus coda, which is heavy for Latin but light for Kharkha.

Moraic theory of syllable structure

- It is a popular alternative to the representations of syllable structure.
- Under this concept, the syllable does not consist of an onset and rhyme but of two morae (from the Latin word meaning: a short period of time or delay).
- The main generalization is the following:
- Heavy syllables consist of two morae.
- Light syllables consist of one mora.

Syllabification

- Pulgram (1970) defines syllabification as a phonotactic operation which is performed in conformity with the distributional criteria of the language under analysis.
- Although it is possible to specify the number of syllables in words, it is very difficult to determine syllable boundary placement (Ladefoged, 1975).

Maximal Onset Principle

- It was proposed by Pulgram (1970) & Kahn (1976).
- According to MOP, consonants between vowels should be syllabified as the onset of the following vowel as far as possible.
- How would you syllabify: *singer, Atlas, lemon, tiny?*

Maximal onset principle

- Whenever we have a number of consonants between two syllable nuclei, we will group together the maximum number of consonants that form an acceptable onset according to the phonotactics of the respective language and the remaining number of consonants will be included in the coda of the preceding syllable.
- For example *conscript* is syllabified as *con.script* (*skr* being the maximal structure allowed by English phonotactics as a valid syllable onset; *nskr* is ruled out by these rules).
- Thus, *n* went to the coda of the first syllable, while *skr* formed the onset of the second.
- A word such as *central* can't be syllabified as *ce.ntral* or *centr.al,* why is that?
- A clue as to how to answer this question comes from looking at the syllable structure found in the languages of the world.
- In many languages, codas are highly restricted or even impossible (as in Hawaiian).
- In many other languages, all syllables must have an onset. (Give an example)
- All this demonstrates that onsets have priority over codas cross-linguistically.
- We will assume that where there is indeterminacy, we make sure that a consonant is placed in an onset rather than a coda.
- Answer:
- Because *ntral & centr* are not permissible syllables in English.

- If we apply this principle in the syllabification of *master & rooster,* we will get *ma.ster & roo.ster* respectively.
- Another difficult case as far as syllable division is concerned is the word *extra.*
- If we apply the MOP we will have to divide it as *e.xtra.*
- Our rule must, therefore, state that consonants are assigned to the right-hand syllable as far as possible within the restrictions governing syllable onsets & codas.
- This means that we have to reject this division because of its impossible onset.
- What about *extr.a?*
- Or *ex.tra?*
- or *ext.ra?*

Ambisyllabicity

- English has some puzzling cases with regard to syllabification.
- Consider words like *butter, camel, upper,* etc. Native intuition seems to waver on whether these should divide as *bu.tter* or *butt.er.*
- The basic idea is that some consonants can belong to more than one syllable at a time.
- They are called ambisyllabic.
- In looking at isolated syllables, we never find one ending with a short vowel (unless the vowel is a schwa or *i* or *u*).
- So, we must conclude that syllables with short vowels and no coda do not occur in English.
- How, then, should we divide words like *better?*
- The MOP tells us to put *t* in the right-hand syllable, giving *be.tter,* but that means that the first syllable is analysed as *be,* which we have just seen is not allowed.
- When one consonant stands between vowels and it is difficult to assign it to one syllable or the other, we could say that the consonant belongs to both syllables, it is ambisyllabic.

English phonotactics

- Phonotactics are restrictions on the types of sounds that are allowed to occur next to each other or in particular positions in words.
- Consider the following data:

- A) vlug – nrak – tsagm
- B) skot – porl – narber
- Which of these are possible combinations in English?
- Is it possible to find a word starting with the velar nasal or the alveo-palatal fricative or the cluster *tl*? Or a word ending with */h/?*
- Initial two-consonant clusters are of two sorts in English.
- One sort is composed of /*s*/ followed by one of a small set of consonants:
- *Sting – sway – smoke*
- The other sort begins with one of a set of 15 consonants followed by one of the set */l/-/w/-/r/-/j/.*
- *Play -*

Syllabic Consonants

Syllabic l

- Perhaps the most noticeable.
- Occurs after another consonant.
- The most obvious case is where we have a word ending with one or more consonant letters followed by *le/les*:
- With alveolar consonants preceding:
- cattle, wrestle, bottle, muddle…
- With non-alveolar consonant preceding:
- Couple, struggle, trouble, knuckle.
- Such words usually lose their final *e* when a suffix beginning with a vowel is attached, but the *l* usually remains syllabic:
- Bottling, muddling, struggling.
- We also find syllabic *l* in words spelt at the end with one or more consonant letters followed by *al* or *el:*
- Panel, petal, kernel, pedal, parcel, Babel, ducal
- In some more common or more technical words it is not obligatory to pronounce syllabic *l* and the sequence *schwa+l* may be used instead: *missal, acquittal.*

Syllabic n

- The most frequently used nasal.
- It is most common after alveolar plosives & fricatives: *threaten, eaten, Eden.*
- We do not find it after affricates & *l:*

Pigeon, sullen, christian (though this word may be pronounced with *t plus i* or *j.*

It is not so widespread after non-alveolar consonants:

- In words where the syllable following a velar consonant is spelt *an* or *on* (for example, toboggan, wagon), it is rarely used.
- The more usual pronunciation being schwa+n
- After bilabial consonants in words like *happen, ribbon,* we can use both.
- Syllabic *m* is also possible in this context.
- In a similar way, in words like *thicken, waken* both are possible.

- After *f* or *v,* syllabic n is more common:
- *Seven, heaven often.*
- In all the examples given so far, syllabic n has been following another consonant; sometimes it is possible for another consonant to precede that consonant, but in this case, a syllabic consonant is less likely to occur:
- If n is preceded by l and a plosive, as in Wilton, both are possible.
- If s precedes as in Boston, a final syllabic nasal is less frequent.
- While clusters formed by nasal + plosive + syllabic nasal are very unusual:
- London, lantern, abandon will normally have a schwa.

Bilabial & velar nasals

- As for m & the velar n, they occur as syllabic only as a result of processes such as assimilation & elision.
- We find them, sometimes, in words like *happen,* which can be pronounced as *haepm, haepn* (the form with the schwa sound is also acceptable).
- Syllabic *m* can occur also in *uppermost* (though the form with the schwa would be more usual).
- The syllabic velar nasal can be found in *thicken* (the form with schwa and syllabic *n* are also possible).
- In *broken key* (again the schwa form & syllabic *n* are possible).

Syllabic r

- It is very common in rhothic accents.
- The word *particular,* for example, is pronounced with two syllabic *r's,* while BBC speakers would use the schwa instead.
- Syllabic *r* is less common in R.P.
- We find some minimal pairs in which a difference in meaning appears to depend on whether a particular *r* is syllabic or not:
- Hungary is pronounced with syllabic *r* or with a schwa, whereas hungry is not.
- But we find no case of syllabic *r* where it would not be possible to substitute either non syllabic *r* or the schwa form.

Combinations of syllabic consonants

- Examples are *national, veteran, literal, visionary.*

Stress in simple words:

The production of stress is generally believed to depend on the speaker using more muscular energy than is used for unstressed syllables. From the perceptual point of view, all stressed syllables have one characteristic in common, and that is **prominence**. What makes a syllable more prominent? At least four different factors are important;

1) Loudness
2) Length
3) Pitch
4) Quality

Generally, these four factors work together in combination, although syllables may, sometimes, be prominent by means of only one or two of them. Experimental work has shown that these factors arenot equally important, the strongest effect is produced by pitch, and length is also a powerful factor. Loudness and quality have much less effect.

Levels of stress: There are intermediate levels in stress. In the word *around,* for example, stress fallson the last syllable, whereas the first syllable is unstressed. But in *photographic & anthropology,* the first syllable bears **secondary stress** and **primary stress** falls on the third syllable.

Unstressed syllables containing I, i, u, or a syllabic consonant will sound less prominent than an unstressed syllable containing some other vowel. For example, the first syllable of *poetic* is more prominent than the first syllable of *pathetic*. This could be used as a basis for a further division of stress levels giving us a third (tertiary) level. It is also possible to suggest a tertiary level of stress in some polysyllabic words. To take an example, it has been suggested that the word *indivisibility* showsfour different levels: the syllable **bil** is strongest (carrying primary stress), the initial syllable **in** has secondary stress, while the third syllable **viz** has a level of stress which is weaker than those two but stronger than the second, fourth, sixth and seventh. We can use the symbol * to mark this tertiary stress.

Placement of stress within the word: Practically all the rules have exceptions and

readers may feelthat the rules are so complex that it would be easier to go back to the idea of learning the stress of each word individually.

As we know, in strong syllables, the rhyme has a peak which is either a long vowel or diphthong, or avowel followed by a coda (that is, one or more consonants). Weak vowels have a syllable peak whichis a short vowel, and no coda unless the syllable peak is the schwa vowel or, in some circumstances,the vowel **i.**

Examples of strong syllables are: *die, heart, bat.* .

Examples of weak syllables (with syllable divisions shown) are: **re-** (in *reduce*), **bi-** (in *herbicide*),

pen (in *open*).

The important point to remember is that, although we do find unstressed strong syllables (as in thelast syllable of *dialect,* only strong syllables can be stressed. Weak syllables are always unstressed.

Two-syllable words: Here the choice is simple, either the first or the second syllable will be stressed

_not both. We will look first at verbs. The basic rule is that if the second syllable of the ver bis astrong syllable, then that syllable is stressed. Thus:

apply *attract*

arrive *assist*

If the final syllable is weak, then the first syllable is stressed:

enter equal

envy open

A final syllable is also unstressed if it contains the diphthong as in the one we

find et the end of:Follow borrow

Two syllable simple adjectives are stressed according to the same

rule giving: Lovely divine

Even correct

Hollow alive

As with most stress rules, there are exceptions:

Honest and perfect

Both of which end with strong syllables but are stressed on the first syllable.

Nouns require a different rule: if the second syllable contains a short vowel, then stress will usuallycome on the first, otherwise, it will be on the second syllable.

Money estate

Product balloon

Larynx design

Other two syllable words, such as adverbs and prepositions seem to behave like verbs and adjectives.

Three syllable words:

In verbs, if the final syllable is strong, then it will be

stressed:Entertain resurrect

I f the last syllable is weak, then it will be unstressed and stress will be placed on the preceding(penultimate) syllable if that syllable is strong. Thus:

Encounter determine

If both the second and third syllable are weak, then the stress falls on the

first syllable.Parody

Nouns require a slightly different rule. If the final syllable is weak, or ends with , then it is unstressed; if the syllable preceding this final syllable is strong, then that middle syllable will bestressed. Thus:

Mimosa disaster

Potato synopsis

If the second and third syllables are both weak, then the first

syllable is stressed: Quantity emperor

Cinema custody

Most of the above rules show stress tending to go on strong syllables. Three-syllable simple nouns are different. If the final syllable is strong, the stress will usually be placed on the first syllable. Thelast syllable is usually quite prominent, so that in some cases, it could be said to have secondary stress.

Intellect marigold

Alcali stalactite

Adjectives seem to need the same rule, to produce stress

patterns such as: Opportune insolent

Derelict anthropoid

There are many cases of English words with alternative possible stress patterns

(e.g. controversy) Other words change their stress pattern according to the

context they occur in.

Despite exceptions, it seems better in many ways to attempt to produce some stress rules (even if they are rather crude and inaccurate) than to claim that there is no rule or regularity in English wordstress.

Complex word-stress: complex words are of two major types: 1) words made from a basic word form (a stem) and an affix and 2) compound words which are made of two (or occasionally more) independent English words (e.g., ice-cream, arm-chair).

Affixes have one of three possible effects on word stress:

1) The affix itself receives primary stress, e.g., *semicircle, personality.*
2) The word is stressed just as if the affix were not there, e.g., pleasant/unpleasant, market/marketing.
3) The stress remains on the stem, not the affix, but is shifted to a different syllable, e.g., magnet/magnetic.

A-Suffixes:

1) **Suffixes carrying primary stress themselves:** in Japan, primary stress is on the last syllable, but when we add the stress-carrying suffix *-ese,* the primary stress is on the suffix, and the secondary stress is placed not on the second syllable but on the first:

This applies also to the suffixes: *-ee, -eer, -ette, -esque.*

2) **Suffixes that do not affect stress placement:** *-able, --age, -al, -en, -ful, -ing, -ish* (this is the rule for adjectives; verbs with stems of more than one syllable always have the stress on the syllable immediately preceding *-ish:*), *-like, -less, -ly, -ment, -ness, -ous, -fy, -wise, -y.*
3) **Suffixes that influence stress in the stem:** *-eous, -graphy, -ial, -ic, -ion, -ious, -ty, -eve.*

When the suffixes *–ance, -ant & -ary* are attached to single-syllable stems, the stress is almost always placed on the stem. When the stem has more than one syllable, the stress falls on the last syllable if it is a strong one (as in importance), if not, the syllable before the last one receives stress:

B- Prefixes: their effect on stress does not have the comparative regularity, independence and predictability of suffixes, and there is no prefix of one or two syllables that always carries primary stress. Consequently, the best treatment seems to be to say that stress in words with prefixes is governed by the same rules as those for words without prefixes.

Compound words: Perhaps the most familiar type of compound is the one which combines two nouns and which normally has stress on the first element, e.g. typewriter, suitcase, teacup, etc. Compounds with an adjectival first element and the –ed morpheme at the end receive stress instead on the second element, e.g., bad-tempered, left-brained, right-handed…

Compounds in which the first element is a number also tend to have final stress, e.g., second-class, Three-wheeler.

Compounds functioning as adverbs are usually final-stressed: North-east, down-

stream. Finally, compounds which function as verbs and have an adverbial first

element take final stress: Down-grade, back-pedal, ill-treat.

Twen ty

The word *places* has the same form:

Pla ces

In the phrase *twenty places, places* normally carries stronger stress than *twenty,*i.e. is rythmicallystronger. We can make our tree diagram grow to look like this:

Twen ty pla ces

If we then look at this phrase in the context of a longer phrase 'twenty places further back', and buildup the 'further part' in a similar way, we would end up with an even more elaborate structure.

Twen ty pla ces fur ther back

By analysing speech in this way, we are able to show the relationships between strong and weak elements, and the different levels of stress that we find. The strength of any strong syllable can bemeasured by counting the number of times an **s** symbol occurs above it.

In normal speech, many English speakers would feel that, although in 'twenty places' the right-handfoot is the stronger, the word 'twenty' is stronger than 'places' in 'twenty places further back' whenspoken in conversational style. It is widely claimed that English style tends towards a regular alternation between stronger and weaker, and tends to adjust stress levels to bring this about. The effect is particularly noticeable in cases such as the following, which all show the effect of what is called **stress-shift:**

Compact(adj) but compact disc

Thirteen but thirteenth place

Westminster but Westminster Abbey

In brief, it seems that stresses are altered according to context: we need to be able to explain why and how this happens, but this is a difficult question and one for which we have only partial answers.

An additional factor is that in speaking English we vary in how rhythmically we speak: sometimes, we speak very rhythmically (this is typical of some styles of public

speaking) while at other times we may speak arythmically if we are hesitant or nervous. Stress-timed rhythm is thus perhaps characteristic ofsome styles of speaking, not of English speech as a whole; one always speaks with some degree of arhythmicality, but the degree varies between a minimum value (arhythmical) and a maximum value (completely stress-timed rhythm). In a stress-timed language, all the feet are supposed to be of roughly the same duration, but the evidence for the existence of truly stress-timed rhythm is not strong. There are many laboratory techniques for measuring time in speech, and measurement for time intervals between stressed syllables in connected speech has not shown the expected regularity; moreover, using the same techniques, it has not been possible to show a real difference between stress-timed and syllable-timed languages.

Complex Word Stress

Complex Words

- Complex words are of two major types:
- Words made from a basic word form (stem) with the addition of an affix.
- Compound words.
- Affixes have one of three possible effects on word stress:
- The affix itself receives the primary stress, eg. *`semicircle, person`ality.*
- The word is stressed just as if the affix were not there, eg. *`pleasant, un`pleasant.*
- The stress remains on the stem, not the affix, but is shifted to a different syllable,eg. *`magnet, mag`netic.*

Suffixes

- There are so many suffixes that it will only be possible here to examine a small portion of them. We will concentrate on those which are common and productive.

Suffixes carrying primary stress themselves

- In *Ja`pan,* primary stress is on the last syllable, but when we add the stress-carrying suffix *-ese,* the primary stress is on the suffix

and secondary stress is placed not on the second syllable but on the first.

- Other suffixes in this category are: *-ee, -eer, -ese, -ette, -esque.*

Suffixes that do not affect stress-placement

- *-able, -age, -al, -en, -ful, -ing, -ish* (adj), *-like, -less, -ly, -ment, -ness, -ous, -fy, -wise, -y.*

Suffixes that influence stress in the stem

- *-eous* : *ad`vantage/ advan`tageous.*
- *-graphy: `photo/ pho`tography.*
- *-ial: `proverb/ pro`verbial.*
- *-ic: `climate/ cli`matic.*
- *-ion: `perfect/ per`fection*
- *-ious: `injure/ in`jurious*
- *-ty: `tranquil/ tran`quility*
- *-ive: `reflex/ re`flexive*
- When the suffixes *–ant, -ance & -ary* are attached to single-syllable stems, the stress is almost always placed on the stem.
- When the stem has more than one syllable, the stress is on one of the syllables

of the stem. If the final syllable of the stem is strong, that syllable receives the stress, for example *im`portance, cen`tenary.* Otherwise, the syllable before the last one receives the stress: *in`heritance, `military.*

Prefixes

- We will deal briefly with prefixes.
- Their effect on stress does not have the comparative regularity & predictability of suffixes.
- There is no prefix of one or two syllables that always carries primary stress.
- The best treatment seems to be to say that stress in words with prefixes is governed by the same rules as those for words without prefixes.

Stress in Compounds

- A few rules can be given, though not completely reliable.
- Generally, in compounds of two nouns, stress falls on the first element, eg. *`typewriter.*
- A variety of compounds receive stress instead on the second element.
- For example, compounds with an adjectival first element and the *–ed* morpheme at the end receive stress on the second element.
- Compounds in which the first element is a number in some form also tend to have final stress: *three-`wheeler, second `class.*
- Compounds functioning as adverbs are usually final-stressed: *head-`first, down-`stream, North-`east.*
- Compounds which function as verbs & have an adverbial first element take final stress: *back-`pedal, ill-`treat.*

Variable Stress

- It would be wrong to imagine that the stress pattern is always fixed & unchanging in English words.
- Stress position may vary:
- 1) As a result of the stress on other words occurring next to the word in question.
- 2) Because not all speakers agree on the placement of stress in some words.
- 1)The stress on a final-stressed compound tends to move to a preceding syllable if the following word begins with a strongly stressed syllable: *bad-`tempered/a`bad*-tempered `teacher.
- 2) Some words have more than one stress-pattern: *controversy, ice-cream, kilometre & formidable.*

Word Class Pairs

- There are several dozen pairs of two-syllable words with identical spelling which differ from each other in stress placement, apparently according to word-class (N,V or Adj).
- Stress is placed on the second syllable of the verb & on the first syllable of nouns & adjectives.
- Some common examples are: *abstract, conduct, contract, contrast, desert, escort, export, import, insult, object, perfect, permit, present, produce, protest, rebel, record, subject.*

WEAK FORMS

- There are two main reasons:
- First, most native speakers of English find an all-strong-form pronunciation unnatural and foreign sounding.
- Second, speakers who are not familiar with the use of weak forms are more likely to have difficulty understanding speakers who use them.
- Since, practically all native speakers of English use them, learners need to know about them.
- Almost all the words which have both a strong & a weak form belong to a category that may be called function words, such as prepositions, conjunctions, auxiliary verbs, etc..
- It is important to remember that there are certain contexts where only the strong form is acceptable, and others, where the weak form is the normal pronunciation.
- There are some fairly simple rules.
- The strong form is used
- When words occur at the end of sentences. For example, *of* has a strong form in the sentence: '*chips are 'what I'm 'fond of* but a weak form in *I'm 'fond of 'chips.*
- 2) when a weak form word is being contrasted with another word, for example:
- *The letters from him not to him.*
- 3) When a weak form word is given stress for the purpose of emphasis, fo example:
- You 'must 'give me 'more 'money.
- 4) When a weak form word is being cited or quoted, for example:
- You 'shouldn't put «'and » at the end of a sentence.

The most common weak form words

- *The*: with schwa (before consonants); with short *i (*before vowels).

- *a/an:* schwa (before consonants); schwa+*n (*before vowels).
- *And:* schwa+*n* (sometimes *syllabic n* after *t,s,z,sh): come and see; fish and chips.*
- *But:* with schwa: *it's good but expensive.*
- *That:* that word has a weak form when used in a relative clause; when used as a demonstrative, it's always strong: *the price is the thing that annoys me.*
- *Than:* with schwa.
- *His: iz* (*hiz* at the beginning of a sentence).
- *Her:* schwa (before consonants); schwa+*r* (before vowels): *take her home; take her out*.

Phonological Rules

Aspiration

- Aspirate a voiceless stop /p/,/t/ or /k/ when it occurs word initially or syllable initially before a stressed syllable.
- Initially: *pit, kit, tool.*
- Syllable-initial: *export, import, escort.*
- Despite the phonetic difference between the aspirated & unaspirated phones, speakers of English usually consider the */p/* in *pill* and the */p/* in *spill* to be the same. Why?
- They are in complementary distribution.
- They don't occur in the same position and they don't distinguish meaning.
- The distinction between them is predictable, nondistinctive and nonphonemic.
- In Thai, however, it is not predictable.
- Example: *paa,* without aspiration means *forest* and *paa* with aspiration means *to split.*
- *Tam* without aspiration means *to pound,* but with aspiration means *to do.*
- *Kat : to bite – kat* (with asp.) : *to interrupt.*

Nasalization

- Nasalize a vowel or diphthong when it occurs before a word final or syllable-final nasal consonant.
- Before a word-final nasal: c*ream, moon, bang.*
- Before a syllable-final nasal: *mountain, controversy, advantageous.*
- Nasalization of vowels in English is predictable by a rule.
- It is not a distinctive feature.
- It is not phonemic.
- In French, however, nasalization of vowels is phonemic.
- *Pot/pont – taux/ton – faux/font – seau/son*

The rule of homorganic nasal/oral consonants

- This rule states that only homorganic nasal+non nasal consonant clusters may occur.
- Homorganic consonants are articulated at the same place of articulation.
- For example: uncle, ample, under…
- There are exceptions to this rule, however.
- In complex words, with prefixes like un-.
- For example, *unbound, uncap.*

Phonological Alternation

- In linguistics, alternation is a variation in the form and/or the sound of a word or word part.
- Alternation is equivalent to allomorphy in morphology.
- For example, certain English nouns ending in the consonant f form their plurals with v instead.
- For example: *leaf/leaves – wife/wives – knife/knives…*
- In this case, we say that we have *f/v* alternation.
- A somewhat different alternation is found in related words like: *electric/electricity.*
- The 3-way alternation that occurs in *–s* of the regular plural is phonologically determined.
- In phonological alternations, the shape of a morpheme usually depends on its immediate environment.
- For example, the indefinite article in English has two phonologically conditioned allomorphs:
- *a* before consonant-initial words: *a cat.*
- *an* before vowel-initial ones: *an exam.*
- Another example of phonological alternation concerns the suffix *–al.*
- This suffix helps derive adjectives from nouns: *nation/national.*
- The pronunciation of this suffix changes when an adjective is converted to another noun by the suffixing of *–ity : nationality.*
- It changes from a syllabic /*l*/at the end of a word to *–al* before *–ity: national/nationality.*
- *-ity* causes the word stress to shift within the stem.
- When *–al* is unstressed, it is produced as syllabic */l/.*
- when it is stressed, it is pronounced with the vowel /*a/.*

Stress alternations

- Japan/Japanese
- Advantage/advantageous
- Photo/photography
- Proverb/proverbial
- Climate/climatic
- Perfect/perfection
- Injure/injurious
- Tranquil/tranquillity
- Reflex/reflexive

Allomorphic alternation

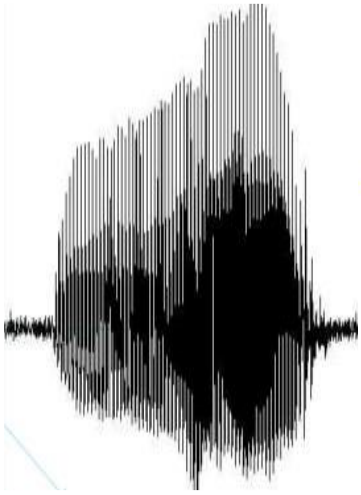
- Foot/feet – mouse/mice – tooth/teeth – man/men.
- This is also referred to as « umlaut alternations », where back vowels alternate with front vowels.
- Sing/song/sang/sung: ablaut alternation.
- The feminine form in French ends with a consonant sound which is missing in the masculine, for example: *petit/petite.*
- The alternations that we see in the plural of words such as *stimulus/stimuli, alumnus/alumni…* are but remnants of a once productive plural ending.
- In prehistoric English, the plural had an *–i* ending.

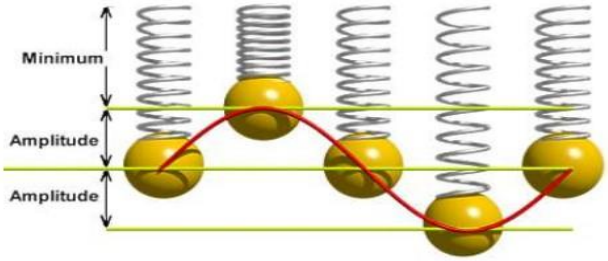
Prosodic alternation

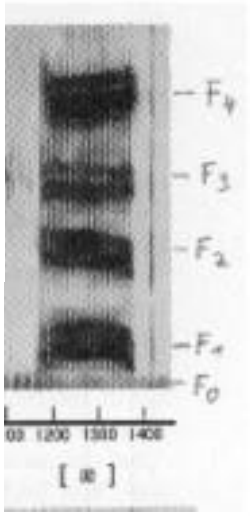
- Short/shorter
- Big/bigger
- Intelligent/more intelligent
- Beautiful/more beautiful
- Exercise:
- Identify the sounds which are alternating in the following morphophonemically related pairs:

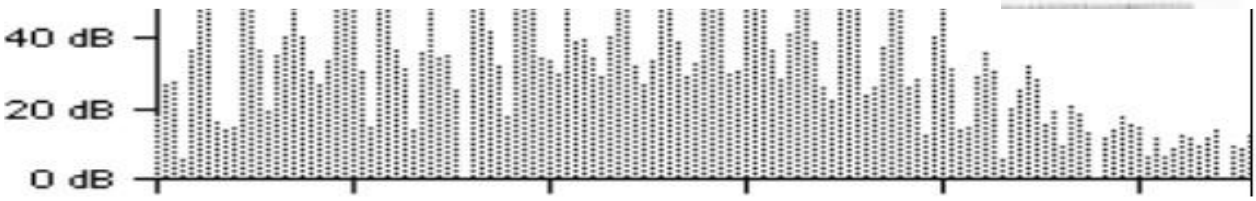
- Profane/profanity
- Serene/serenity
- Pedagogue/pedagogy
- Receive/receptive
- Mine/mineral
- Consider the French data. What alternations did you notice?
- Jupe grise
- Jupe rouge
- Jupe blanche
- Give an example of phonological alternation from Arabic.

Acoustic phonetics









Overview

1- The definition of acoustic phonetics.
2- Introduction to PRAAT.
3- Spectogram.
4- Oscillogram.
5- Spectrum.
6- Simple sound waves.
7- Complex sound waves.
8- Vowels' acoustic characteristics.
9- Fricative acoustic features.
10- Aspects of sound transmission.
11- Frequency, Pitch and Resonance.
12- Amplitude, Intensity and Loudness.
13- Spectrographic make up of vowels.
14- Nasals' Acoustic Characteristics and their spectral Characteristics.
15- Laterals' Acoustic Characteristics.
16- Vowels' main Characteristics.
17- Acoustic cues of fricatives.
18- Stops' Acoustic Characteristics.
19- Acoustic cues of stops.

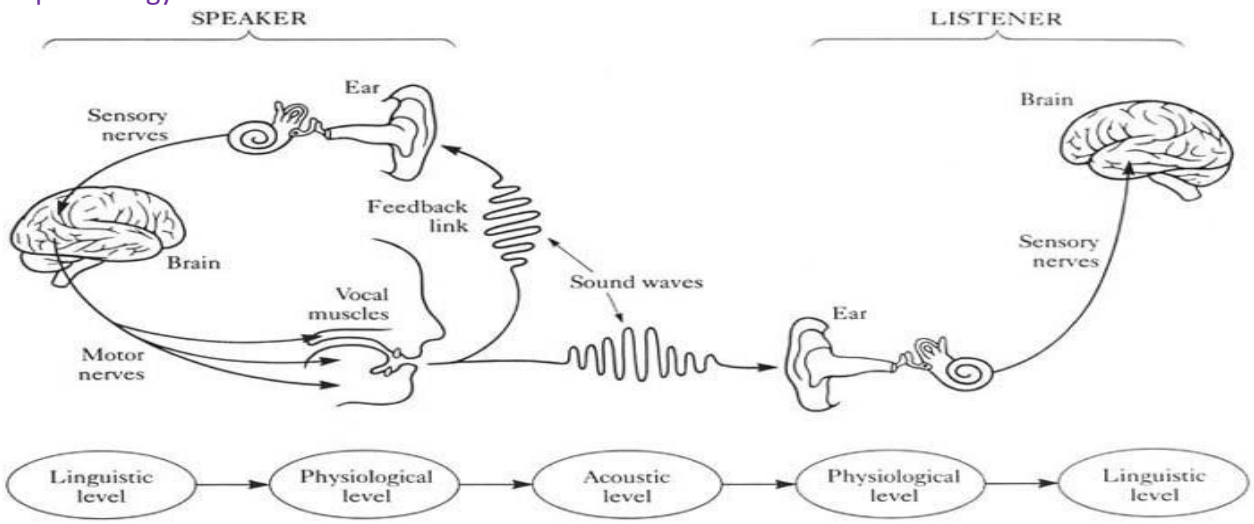
20- Definitions of: Co-articulation, Nasalization, Labialization and Devoicing.
21- Correlation between acoustic phonetics and auditory phonetics.
22- Summary.

What is acoustic phonetics?

- branch of phonetics dealing with:
- physical characteristics of sound waves which carry speech sounds between mouth and ear (transmission of sound).

Acoustic phonetics in context of phonetics and phonology

- Phonetics refers to the physiological and acoustic parts of the following diagram, while phonology resides in the brain.

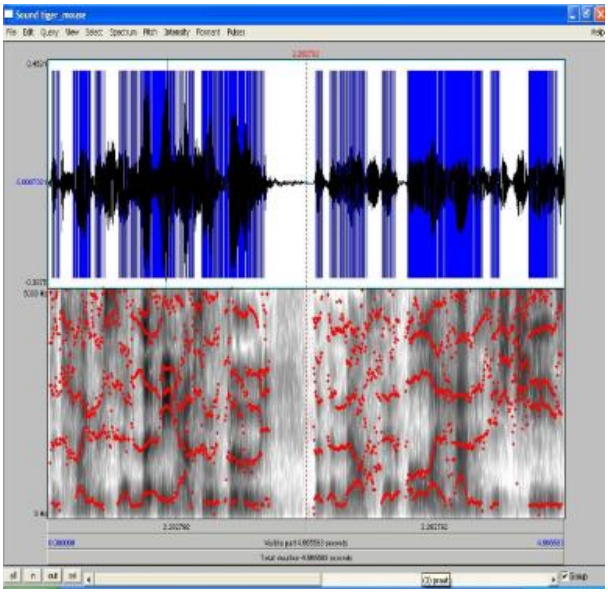


Acoustic phonetics and Praat, What is Praat ?

- Speech sound waves can be analysed in terms of their acoustic properties.

. Praat: Computer program enables visualizing, playing, anotating, and analyzing sound object in terms of its properties (E. g. Frequency, Pitch, etc.).

Praat: was designed, and continues to be developed, by Paul Boersma and David Weenink of the University of Amsterdam

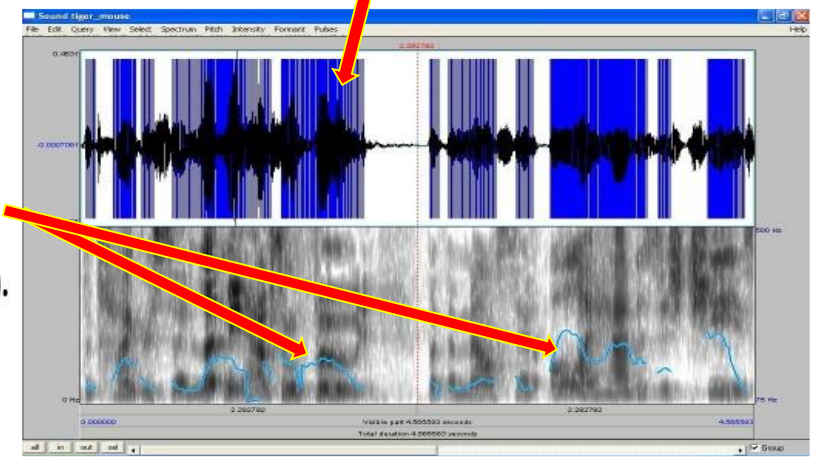


Pulse and Pitch

In the Oscillogram: pulses which are indicated by

blue solid lines = pulses show phonation mode (voice).

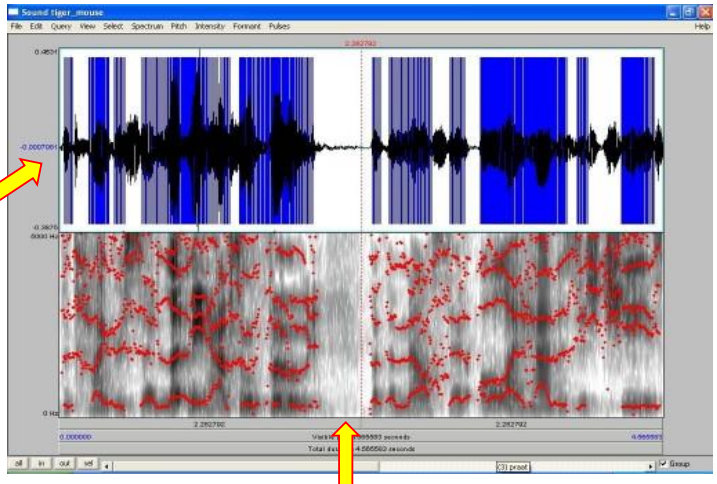
Here you see the pitch track of the voice, i.e. what you perceive as high and low (Acoustics: Frequencies).



What does Praat show ?

- **Speech acoustic analysis can be analyzed by using :**

Spectogram & Oscillogram

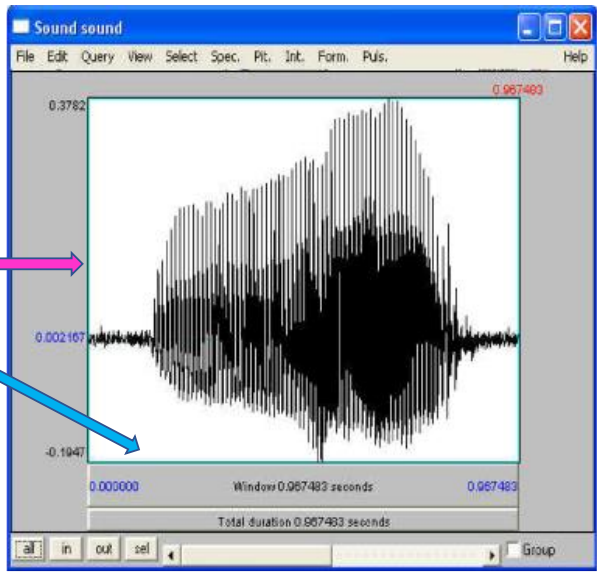


Oscillogram

Spectrogram

What is an Oscillogram ?

- **Represents speech signals**



Vertical axis: Amplitude

Horizontal axis: time (total duration).

Spectrogram

- Graphic representation of sounds in terms of their component frequencies.

➢ Vertical axis: frequency

➢ Horizontal axis: time

Dark shading (third dimension): acoustic energy (Formants: F1, F2, F3).

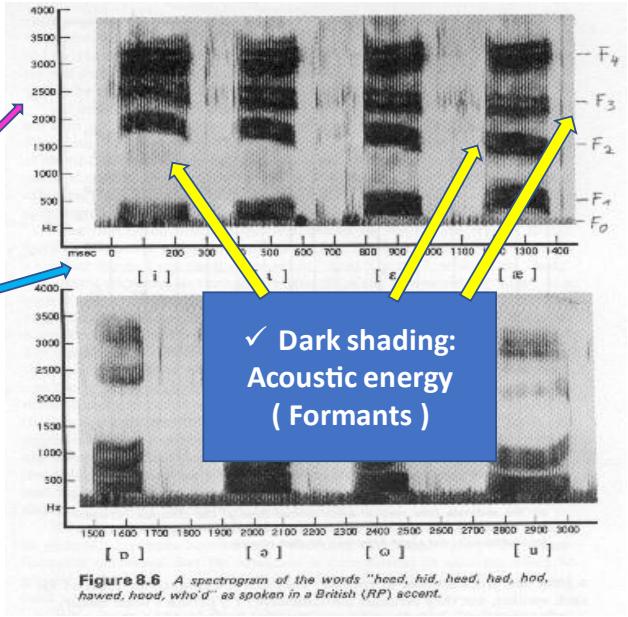
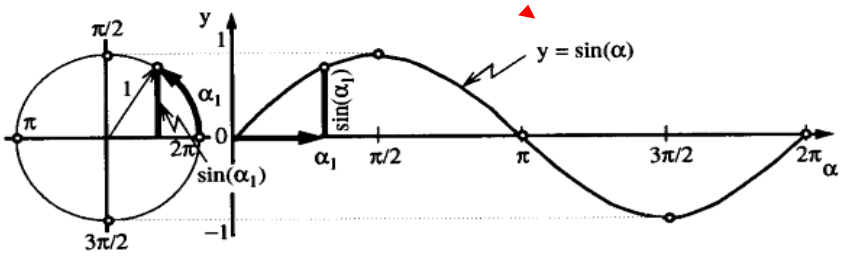


Figure 8.6 *A spectrogram of the words "heed, hid, heed, had, hod, hawed, hood, who'd" as spoken in a British (RP) accent.*

What is Frequency ?

- Number of cycles completed per second; measured in Hertz (HZ).
- When the cycle meets the axis for the second time, one cycle is completed: one cycle.



- Sine wave: simplest kind of periodic wave → made by an ideal tuning fork
  Lowest frequency sine wave component F[illegible]mental frequency (F0).

What are formants?

- Spectrogram also shows formants

- concentration of acoustic energy
- group of overtones corresponding to resonating frequency of the air in the vocal tract.

- Vowels are characterized by three formants (F1, F2, and F3).

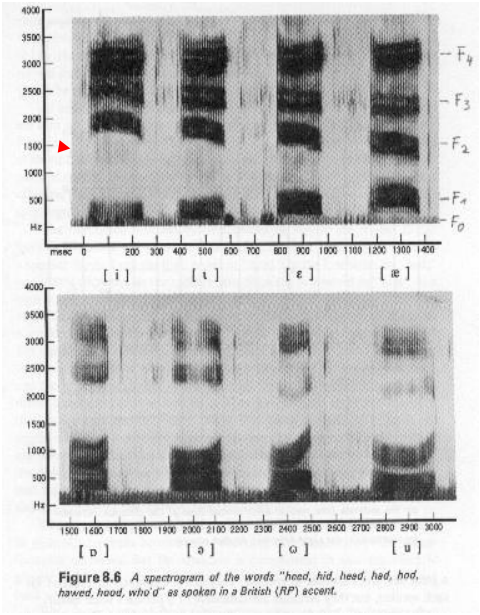
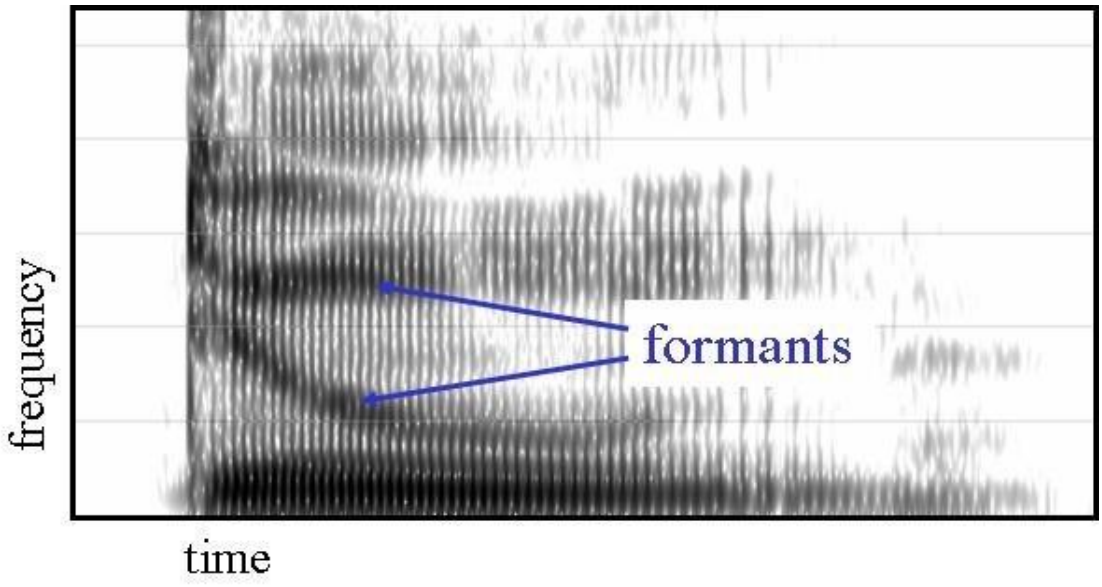


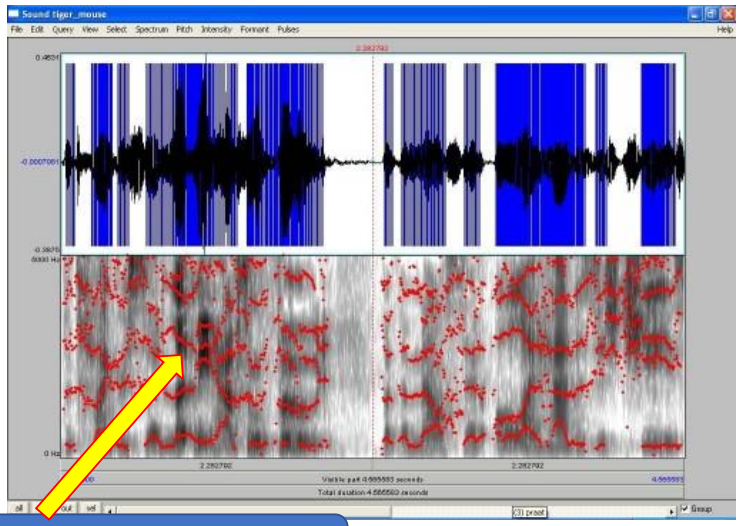
Figure 8.6 A spectrogram of the words "heed, hid, heed, had, hod, hawed, hood, who'd" as spoken in a British (RP) accent.

Formants



Formants in Praat

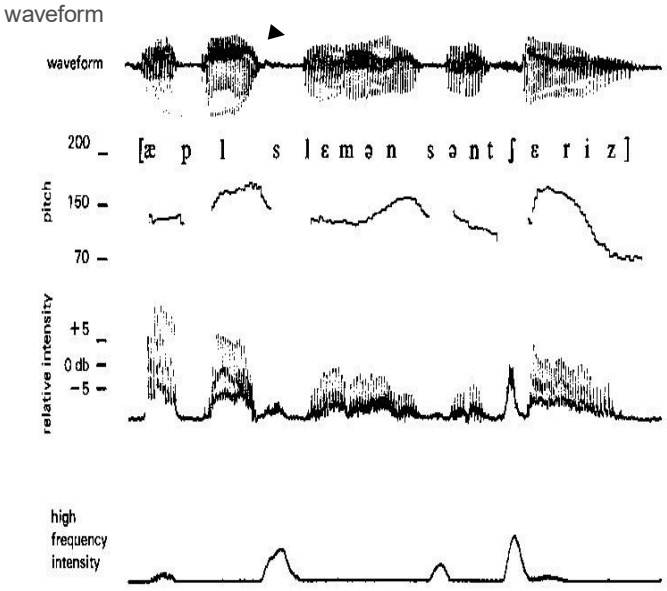
- Formants in Praat are also shown « red dotted lines » in the spectogram.



The « red dotted lines » and especially dark shadings show the formants

What is Amplitude ?

- given in an oscillogram.
- displacement of the vibrating medium from its rest position (example: tuning fork).
- measured in relation to time, measured in dB.



Simple Sound waves:

Sound is caused by small areas of small and high pressure propagating out of its source.

This is referred to as sound wave.

• simple sound waves are regular in motion & are referred to as periodic
• Two properties are central to the measurement of SSW:
1) Frequency is measured in Hz. It denotes the number of cycles/second.

2) Amplitude: is represented by the height of the wave. When there is a loud sound, the wave is high & the amplitude is large.
• Total sensation of loudness (intensity) of a sound is a combination of frequency and amplitude.
• The term intensity measured in decibels is used to refer to the overall loudness of a sound.

Complex Sound Waves

• They are two kinds: periodic and a-periodic.
• Vowels are basically periodic, whereas consonants range from periodic to a-periodic.
• Each sound consists of a sound source which is referred to as the fundamental frequency or F0.

• F0 is filtered or intensified by numerous parts of a resonating body.
• The resulting bundles of resonance of frequencies or harmonics are multiples of F0 in speech, they are called formants.
• They are numbered F1, F2, F3
• F1 = pharynx resonance
• F2= oral resonance

Vowels' Acoustic Characteristics

• Vowels are acoustically distinguished by the frequencies of the formants.
• The higher the vowel, the lower the F1 frequency.
• The backer the vowel, the lower the F2 frequency.
• Lip rounding further lowers F2.
• The formants smoothly change in frequency during a diphthong from the values of the first vowels to those of the second.

Fricatives' Acoustic Features

• Fricatives involve a-periodic (hissing or cracking noise) sound.
• The alveolars /S/ & /Z/ = 4000Hz.
• Post-alveolar fricatives = 2000Hz.
• The other fricatives are all much quieter.
• The labiodentals are slightly louder than interdentals with more noise below 4000Hz.

Aspects of Sound Transmission:

• Every sound begins with a body of air which is set in vibration.
• A short and narrow body in vibration will produce a higher pitched sound than will a longer & wider body of air.
• The basic frequency derives from vocal folds vibration rate.
• The frequencies that we have seen are called harmonics and are multiples of F0.
• The complex wave form which characterizes speech: vocal folds vibration+ filtering
effect of articulators & vocal tract.

Frequency and Pitch

• The relative pitch of a sound derives from the speed of vibration & tension of vocal folds combined with their inherent size and shape.
• Our perception of pitch relates to the number of cycles that are completed within a given time.

• In acoustics, cycles are measured in seconds & cycles/ seconds are known as Hz.

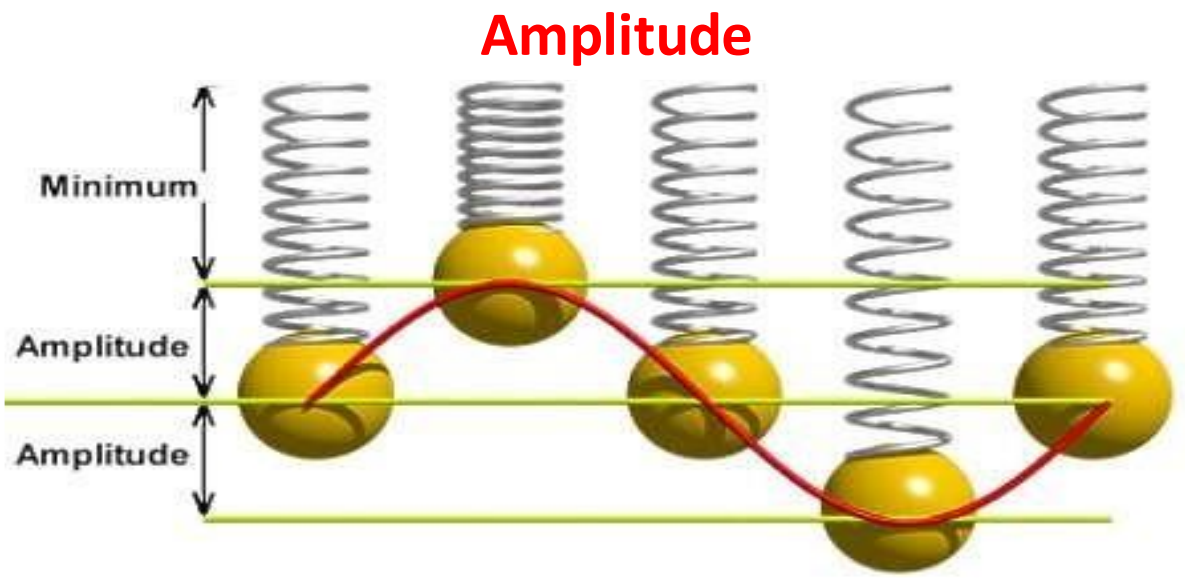
Resonance:

• The resonant properties of any speech sound are dictated by a number of factors:
• Size & shape of sound source.
• Size and shape of the chamber into which the sound is directed.
• Males may have thicker vocal folds which will affect the basic fundamental frequency.

Amplitude, Intensity and Loudness

• It is possible to initiate sounds with greater or lesser force, resulting in perceived loudness.
• Intensity, the acoustic basis of what we perceive as loudness is the result of the energy of displacement of air.
• The more extreme the fundamental in pressure, the greater the amplitude of wave.

All vowels are voiced. This means that a spectrographic representation of a vowel will contain a voicing bar .i.e. pressure of energy of fundamental frequency level (100-200Hz), which is speaker specific. They are characterized by clear bands of energy, i.e.
formants, which are quite unlike the energy distribution in other sounds.



Spectrographic make up of vowels

- Given that spectrograms capture the shape of the sonorant properties of the articulatory cavities, it will come as no surprise that different vowels differ in their spect make-up because of varying combinations of the tongue height, advancement & lip rounding features.
- High vowels have lower F1 values than low vowels.
- I: + high + front, - rounded (I : involves tongue advancement and no lip rounding).
- i: has a relatively low F1 value (oral cavity is rather closed to the front).
- Front vowels have higher F2 values than back vowels.

Nasals' Acoustic Characteristics

- There are two features of importance:

• Reduction in intensity of F1 due to the damping (lessening) features of nasal cavity wall surface.

• The second, acoustic features are the presence of anti- resonance (sharp drop in intensity); this acoustic phenomenon occurs when a tube is coupled to a side-branching tube.

Spectral characteristics of nasals

• Nasals are usually easy to spot on spectrograms. Each nasal has a bar near the baseline indicating energy at around 200Hz.

• Because nasals have lower amplitude than vowels, their formants are often not fully visible on a spectrogram.

• Each nasal has distinct formants in the 1000 to 2000Hz range.

Laterals' Acoustic Characteristics

(L is a lateral sound because the tongue is raised at the alveolar ridge, but the sides of the tongue are down permitting air to escape over the sides of the tongue).

• From an acoustic point of view, laterals are like nasals in that they have formants with low amplitudes.

• The differences in the frequencies of F2 can be used to quantify the degree of velarization of the English laterals.

• E.g. the final "velaralized" lateral in "feel" has a low F2 at around

800Hz, whereas the so called "clear" lateral in "leaf" has a high F2 at around 1200Hz.

The vowels' main characteristics

. Vowels have a fully developed formant pattern.
. They can be classified on the basis of the first two formants.
. These resonant frequencies can approximately be associated with the size of the two cavities separated by a constriction in the oral tract.
. F1 is associated with the pharyngeal cavity and F2 with the oral cavity and F3 with the nasal cavity.

Let's compare the cardinal vowels to illustrate:

. i: front constriction, large pharyngeal cavity and small oral cavity.
. a: back constriction and thus a much smaller pharyngeal cavity and a relatively large oral cavity.

Acoustic cues of fricatives

- No clear formant pattern.
- No resonant, continuant sound.
- Airstream strong and constriction narrow making airflow turbulent and creating friction: a-periodic
- Voiced fricatives: periodic at the level of the vocal cords vibration but a-periodic at the level of the vocal tract vibration (Turbulent vibration).
- They are mixed because they are periodic and a-periodic; both of them have periodicality at the level of the vocal tract vibration but also at the level of the vocal cords vibration.
- Turbulence: noise.

Stops' Acoustic Characteristics

• The complete articulatory closure results in a period of silence, which shows up as a blank column on a spectrogram, followed by a brief burst of a-periodic noise when the closure is released.

- No-resonance, no formant structure.
- greatest degree of obstruction.
- Momentary cessation of air flow.

- complete occlusion of vocal tract, occlusion in oral cavity.
- increase in inter-oral pressure during the hold closure.
- Release of air pressure by releasing oral occlusion resulting in audible burst of noise.

Acoustic cues of stops

1. Silent gap it is the hold period in articulation (no flow of air out of the vocal tract).

- Voiceless stops: nothing visible on the spectrogram.
- Voiced stops: voice bar (A bar of low frequency, vocal tract vibration).

2. Noise burst: it is at the moment of release, very brief (10 to 35 ms).

- It appears as a vertical line in the spectrogram.
- It follows as a silent gap.
- This burst is seen in stops in the initial and medial position but not in final position e.g. cake.

3. Formant transition: right after occlusion, the rapid movement of articulation causes sudden change in the resonance peak of the vocal tract.

Co-articulation:

The articulatory influence of one phonetic element on the other.

1) Nasalization:

Vowels are nasalized before nasal consonants. E.g. run, tone,
king, fun…

The velum is lowered so that air escapes through the nasal cavity.

2) Labialization:

is concerned with lip rounding, when the rounding of the lips is involved in the articulation of the labial vowel following it e.g., too small.

3) Devoicing:

is the process whereby a voiced sound becomes voiceless because of adjacency to a voiceless sound.

e.g. she s so small. Who s speaking? It's so funny.

Corellation between acoustic phonetics and auditory phonetics:

- Acoustic phonetics: Auditory phonetics:

- Frequency : → Perceived as pitch.
  (measured in Hz).
- Amplitude : → Perceived as loudness.
  (measured in dB).
- Duration: → Perceived as speech tempo.
  (measured in time).

Summary

Acoustic phonetics: pertaining to the properties of sound waves, and
a sound wave without a repeating pattern is a-periodic.
The basic pitch of a voice is its F0.
Voicing appears on spectrogram as bars striations and stops appear on spectrogram as blank column; However, voiced plosive is represented in a spectrogram as a voicing bar.
Cycles per second are completed for a wave form of 200 Hz, Why?

200 cycles per second because each cycle equals one second.
A spectrum is the amplitude profile of the harmonics of a complex wave form, it depicts a sound energy at a specific point in time.
A spectrogram is a visual display of sound energy, showing how the spectrum changes over time and all natural-number multiples are called harmonics.