

Lesson-21 CONSONANTAL GESTURES - I

Topic-104: Consonantal Gestures

In phonetics and phonology, speech sounds (segments) using basic units of contrast are defined as gestures – they are treated as the abstract characterizations of articulatory events with an intrinsic time dimension. Thus sounds (segments) are used to describe the phonological structure of specific languages and account for phonological variation. In this type of description in phonetics and phonology, sounds are the underlying units which are represented by classes of functionally equivalent movement patterns (gestures).

Topic-108: Nasals

Nasal manners of articulation are commonly found in the languages of the world. Like stops, nasal can also occur voiced or voiceless (for example, in Burmese, Ukrainian and French) though in English and other most languages nasals are voiced. As voiceless nasals are comparatively rare, they are symbolized simply by adding the voiceless diacritic [̥] under the symbol for the voiced sound. There are no special symbols for voiceless nasals and it is written as /m̥/ - a combination of the letter for the voiced bilabial nasal and a diacritic indicating voicelessness.

Topic-109: Fricatives

Fricative as an articulatory gesture may be divided into voiced or voiceless sounds but we can also subdivide fricatives in accordance with other aspects of the gestures that produce them. For example, some authorities have divided fricatives into sounds such as [s], in which the tongue is grooved so that the airstream comes out through a narrow channel, and those such as [θ], in which the tongue is flat and forms a wide slit through which the air flows. On the other hand, a slightly better way of dividing fricatives is to separate them into groups on a purely auditory basis.

Lesson-22 CONSONANTAL GESTURES-II

Topic-111: Laterals

The only English lateral phoneme, at least in British English, is /l/ with allophones [l] as in led [lɛd] and [ɫ] as in bell [bɛɫ]. In most forms of American English, initial [l] has more velarization than is typically heard in British English initial [l]. In all forms of English, the air flows freely without audible friction, making this sound a voiced alveolar lateral approximant. It may be compared with the sound [ɹ] in red [rɛd], which is for many people a voiced alveolar central approximant. Laterals are usually presumed to be voiced approximants unless a specific statement to the contrary is made.

Lesson-23 ACOUSTIC PHONETICS-I

Topic-118: Source Filter Theory of Speech Production

Source-filter theory is an important concept in acoustic phonetics. It is a model of speech (e.g., vowel) production. According to this theory, source refers to the waveform of the vibrating larynx. Its spectrum is rich in harmonics, which gradually decrease in amplitude as their frequency increases. The various resonance chambers of the vocal tract, especially the movements of the tongue and lips, act on the laryngeal source in the manner of a filter (see filtered speech), reinforcing certain harmonics relative to others. Thus the combination of these two elements (larynx as source and cavity as filter) is known as the source-filter model of speech (e.g., vowel) production. We have already discussed that speech sounds can differ in pitch, loudness, and quality. Now if we understand the idea of source-filter we would be able to analyze these changes as possible variation in speech sounds. When discussing differences in quality, we noted that the quality of a vowel depends on its overtone structure (i.e., formants). Now putting this idea another way, we can say that a sound (e.g., vowel) contains a number of different pitches simultaneously. There is the pitch at which it is actually spoken, and there are the various overtone pitches that give it its distinctive quality. We distinguish one vowel from another by the differences in these overtones. The overtones are called formants, and the lowest three formants distinguish vowels from each other.

Topic-119: Explaining Source – Filter Mechanism

In this theory, the tract is represented using a source-filter model and several devices have been devised to synthesize speech in this way. The idea is that the air in the vocal tract acts like the air in an organ pipe, or in a bottle. Sound travels from a noise-making source (i.e., the vocal fold vibration) to the lips. Then, at the lips, most of the sound energy radiates away from the lips for a listener to hear, while some of the sound energy reflects back into the vocal tract. The addition of the reflected sound energy with the source energy tends to amplify energy at some frequencies and damp energy at others, depending on the length and shape of the vocal tract. The vocal folds (at larynx) are then a source of sound energy, and the cavity (vocal tract - due to the interaction of the reflected sound waves in it) is a frequency filter altering the timbre of the vocal fold sound. This idea can make it very easy for us to understand the formants of a vowel sound. Thus this same source-filter mechanism is at work in many musical instruments. In the brass instruments, for example, the noise source is the vibrating lips in the mouthpiece of the instrument, and the filter is provided by the long brass tube.

Lesson-24 ACOUSTIC PHONETICS-II

Topic-120: Tube Models

The formants that characterize different vowels are the result of the different shapes of the vocal tract. Any particle of air, such as that in the vocal tract or that in a bottle, will vibrate in a way that depends on its size and shape. Remember that the air in the vocal tract is set in vibration by the action of the vocal folds (in larynx). Every time the vocal folds open and close, there is a pulse of acoustic energy (activation). Irrespective of the rate of vibration at source (of the vocal folds), the air in the vocal tract will resonate at these frequencies as long as the position of the vocal organs remains the same.

Topic-121: Explaining the Tube Models

All voiced sounds are distinguishable from one another by their formant structure (frequencies). This idea could be understood by considering the vocal tract as a tube and thus the concept is when the vocal fold pulses have been produced at a steady rate, the "utterance" is on a monotone. In other words, what you hear as the changes in pitch are actually the changes in the overtones of this monotone "voice." These overtone pitch variations convey a great deal of the quality of the voiced sounds. The rhythm of the sentence is apparent because the overtone pitches occur only when the vocal folds would have been vibrating.

Topic-124: Explaining Acoustic Analysis (Vowels)

Using computer programs, we can analyze vowel sounds by showing their components through the display (spectrogram). In spectrograms, time runs from left to right, the frequency of the components is shown on the vertical scale, and the intensity of each component is shown by the degree of darkness. It is thus a display that shows, roughly speaking, dark bands for concentrations of energy at particular frequencies—showing the source and filter characteristics of speech. Remember that the traditional articulatory descriptions of vowels are related to the formant frequencies. The first two frequencies are important here. The first formant (F1) is inversely related to the height of a vowel whereas the second formant (F2) is related to the frontness of a vowel sound. When the first two formants are taken, the vowels of a language can be plotted on a chart and the structure is very much related to the traditional description of vowel sounds.

Topic-125: Acoustics of Consonants

The acoustic properties (structure) of consonantal sounds are usually more complicated than that of vowels. Usually, a consonant can be said to be a particular way of beginning or ending a vowel sound because during the production of a consonant there is no distinguishing feature prominently visible. There is virtually no difference in the sounds during the actual closures of voiced stops [b, d, g], and absolutely none during the closures of voiceless stops [p, t, k], because there is only silence at these points. Each of the stop sounds conveys its quality by its effect on the adjacent vowel. We have seen that during a vowel such as [u], there will be formants corresponding to the particular shape of the vocal tract. In the case of consonants, these changes are not really distinguishable (particularly for obstruents).

Lesson-25 ACOUSTIC PHONETICS-III

Topic-126: Explaining the Acoustics of Consonants

- ❖ **Voiced** - vertical striations corresponding to the vibrations of the vocal folds
- ❖ **Bilabial** - locus of both second and third formants comparatively low
- ❖ **Alveolar** - locus of second formant about 1700–1800 Hz.
- ❖ **Velar** - usually high locus of the second formant
- ❖ **Retroflex** - general lowering of the third and fourth formants
- ❖ **Stop** - gap in pattern (with burst for voiceless and sharp formant beginning for voiced stops)
- ❖ **Fricative** - random noise pattern in higher frequency regions
- ❖ **Nasal** - formant structure similar to that of vowels (with formants at 250, 2500, and 3250)
- ❖ **Lateral** - formant structure similar to that of vowels (with formants at 250, 1200, and 2400)
- ❖ **Approximant** - formant structure similar to that in vowels, usually changing.

Topic-127: Interpreting Spectrograms

1. Using Praat (or any other software) and spectrogram is particularly useful when a researcher is working on a problem related to the nature (physical properties) of a sound (e.g., is it a phoneme or allophone?).
2. It increases our understanding of the speech sounds and their behavior in different forms (in isolation or as the part of connected speech).
3. Practice on spectrogram gives us the opportunity to learn about the characteristics of speech sounds.
4. It is also important for experts who are working on phonetic aspects of speech as signal processing.
5. These are also used as the part of techniques in speech recognition.

Topic-130: Analyzing Individual Differences

A complete range of a speaker's vowel qualities may be considered as representative of the speaker's personal features which, in turn, may be compared with the formant frequency of each vowel (with the total range of that formant in that speaker's voice). But this is true that the phoneticians are still working with comparing the acoustic data of one individual with the other and improve further the system of speech recognition. Experts of applied phonetics and computer speech technology are trying to understand the complexity of speech – synthesis systems and improve it.

Lesson-26 VOWELS AND VOWEL-LIKE ARTICULATIONS-1

Topic-131: Vowels and Vowel-like Articulation

The fundamental distinction between consonant and vowel sounds is that vowels make the least obstruction to the flow of air. In addition to this, vowels are almost always found at the center of a syllable, and it is very rare to find any sound, other than a vowel which can stand alone as a whole syllable. Phonetically, each vowel has a number of features (properties) that distinguish it from other vowels. These include; firstly, the shape of the lips (lip-rounding), rounded (for sounds like /u:/ vowel), neutral (as for ə - schwa sound) or spread (as in /i:/ sound in word like sea or – when photographers traditionally ask you to say “cheese” /tʃi:z/ in order to make you look smiling. Secondly, part of the tongue - the front, the middle or the back of the tongue may be raised, giving different vowel qualities: compare /æ/ vowel (as in word ‘cat’) as a front vowel, with the /ɑ:/ vowel (as in ‘cart’) which is a back vowel. Thirdly, the tongue (and the lower jaw) may be raised ‘close’ to the roof of the mouth (for close vowels. e.g. /i:/ or /u:/), or the tongue may be left ‘low’ in the mouth with the jaw comparatively ‘open’ (as for open vowels e.g., /a:/ and /æ/. In British phonetics, terms such as ‘close’ and ‘open’ are used for vowels, whereas in American phonetics ‘high’ and ‘low’ are used for vowel description. So, generally, these three aspects are described in the case of vowels; lip-rounding, the part of the tongue and the height of the tongue. In addition to these three features, some other characteristics of vowels are also used in various languages of the world (e.g., nasality – whether a vowel is nasal or not).

Topic-132: Cardinal Vowels

In order to classify vowels (independent of the vowel system of a particular language), the English phonetician Daniel Jones introduced a system in early 20th century and worked out on a set of vowels called the “cardinal vowels” comprising of eight vowels to be used as reference points (so that other vowels could be related to them like the corners and sides of a map). Jones’ idea of cardinal vowels became a success and it is still used by

experts and students for vowel description. He was strongly influenced by the French phonetician Paul Passy, and it has been claimed that the set of 'cardinal vowels' is quite similar to the vowels of educated Parisian French of his time. Cardinal vowel system is a chart or four-sided figure (the exact shape of which has been changed from time to time), with eight corners as can be seen on the IPA chart from IPA website. It is a diagram to be used both for rounded and unrounded vowels, and Jones proposed that there should be a primary and a secondary set of cardinal vowels. The primary set includes eight vowels in total (from 1 to 8); the front unrounded vowels [i, e, ε, a], the back unrounded vowel [ɑ] and the rounded back vowels [ɔ, o, u].

Topic-133: Secondary Cardinal Vowels

The main difference between primary and secondary cardinal vowels is related to lip-rounding as in some languages the feature of lip-rounding is possible for front vowels. By reversing the lip position (in comparison with primary cardinal vowels), the secondary series of vowel types is produced (e.g., rounding the lips for the front vowels).

- ❖ Close (high) front rounded vowel [y]
- ❖ Close-mid front rounded vowel [ø]
- ❖ Open-mid front rounded vowel [œ]
- ❖ Open (low) front rounded vowel [ɶ]
- ❖ Open (low) back rounded vowel [ɒ]
- ❖ Open-mid back unrounded vowel [ʌ]
- ❖ Close-mid back unrounded vowel [ɜ]
- ❖ Close (high) back unrounded vowel [ʊ]

Lesson-27 VOWELS AND VOWEL-LIKE ARTICULATIONS-I

Topic-139: Rhotacized Vowels

In the description of vowel quality, rhotacization (or rhotacized vowel) is a term which is used in English phonology referring to dialects or accents where /r/ is pronounced following a vowel, as in words 'car' and 'cart'. Thus varieties of English are divided on the basis of this feature - varieties having this feature are rhotic (in which /r/ is found in all phonological contexts) while others (not having this feature) are non-rhotic (such as Received Pronunciation where /r/ is only found before vowels as in 'red' and 'around'). Similarly, vowels which occur after retroflex consonants are sometimes called rhotacized vowels (they display rhotacization). It is important to mention that while BBC pronunciation is nonrhotic, many accents of the British Isles are rhotic, including most of the south and west of England, much of Wales, and all of Scotland and Ireland. Most American English speakers speak with a rhotic accent, but there are non-rhotic areas (e.g., the Boston area, lower-class of New York and the Deep South).

Lesson-28 VOWELS AND VOWEL-LIKE ARTICULATIONS-II

Topic-141: Summary of Vowel Quality

There are two features of vowel quality (i.e., height and backness of the tongue) that are used to contrast one vowel with another in nearly all languages of the world. But there are four other features that are used less frequently and not all languages exhibit them. They include 'lip-rounding', rhotacization, nasalization and advanced tongue root (ATR). The following are the acoustic correlates of all these six features:

- ❖ **Height** - frequency of formant one (inversely related to F1)
- ❖ **Backness** - difference between frequencies of F2 and F1
- ❖ **Rhotacization** - frequency of formant three
- ❖ **Rounding** - lip position (rounded, half rounded or neutral)
- ❖ **ATR** - width of the pharynx (ATR or RTR)
- ❖ **Nasalization** - position of the soft palate

Topic-142: Semivowels

Most of the world languages contain a class of sounds that functions in a way similar to consonants but is phonetically similar to vowels (e.g., in English, /w/ and /j/ as in 'wet' and 'yet'). When they are used in the first part of syllables (at onset), they function as consonants. But if they are pronounced slowly, they resemble (in quality) with the vowels [u] and [i] respectively. These sounds are called semivowels which are also termed as approximants today. In French there are three semivowels (i.e., in addition to j and w there is another sound symbolized /ɥ/ and is found in initial position in the word like 'huit' /ɥit/ (eight) and in consonant clusters such as /fruɥ/ in /fruɥi/ ('fruit'). The IPA chart also lists a semivowel corresponding to the back close unrounded vowel /ɯ/. Like the others, this is classed as an approximant.

Topic-143: Secondary Articulatory Gestures (SAG)

'Secondary' articulation is an articulatory gesture with a lesser degree of closure occurring at approximately the same time as another (primary) gesture. It is different than co-articulation which is at the same time and of the same value (taking place as an equal level gesture)

Topic-145: Summary of the SAGs

The secondary gestures for vowel quality are hereby summarized for further clarification. A sound may or may not have any of the four secondary articulations such palatalization, velarization, pharyngealization and labialization. Labialization may also have (at the same time) any of the three secondary articulatory gestures (and even if the sound is itself labial such as [mʷ]). The main features of these secondary articulatory gestures for vowel sounds are briefly mentioned here for your understanding:

1. Palatalization [j] is the raising of the front of the tongue such as for /i/ vowel).
2. Velarization (written as [ɣ] and [ʁ]) is the raising of the back of the tongue (such as [u]-like sound).
3. Pharyngealization [ʕ] is the retracting of the root of the tongue.
4. Labialization [ʷ] is the rounding of the lips such as Arabic [sʷ] and [tʷ].

Lesson-29 SUPRASEGMENTAL FEATURES-I

Topic-146: Introduction to Suprasegmental (SS) Features

Supra means 'above' or 'beyond' and segments are sounds (phonemes). Suprasegmental is a term used in phonetics and phonology to refer to a vocal effect (such as tone, intonation, stress, etc.) which extends over

more than one sound (segment) in an utterance. Major suprasegmental features include pitch, stress, tone, intonation or juncture. Remember that these features are meaningful when they are applied above segmental level (on more than one segment). Phonological studies can be divided into two fields: segmental phonology and suprasegmental phonology. Suprasegmental features have been extensively explored in the recent decades and many theories have been constituted related to the application and description of these features.

Topic-147: Syllable

Syllables are the parts of word (in which a word is further divided into parts), for example, mi-ni-mi-za-tion or sup-reseg-men-tal. Phonetically, we can observe that the flow of speech typically consists of an alternation between vowel-like states (where the vocal tract is comparatively open and unobstructed) and consonantlike states where some obstruction to the airflow is made (thus altering speech between the two natural kinds of sounds). So, from the speech production point of view, a syllable consists of a movement from a constricted or silent state to a vowel-like state and then back to constricted or silent state. From the acoustic point of view, this means that the speech signal shows a series of peaks of energy corresponding to vowel-like states separated by troughs of lower energy (sonority).

Topic-148: Explaining Syllable

Syllable structure could be of three types: 'simple' (CV), 'moderate' (CVC) and 'complex' (with consonant clusters at edges) such as CCVCC and CCCVCC (where V means vowel and C stands for consonant). Moreover, words can have one syllable (monosyllabic), two syllables (bisyllabic or disyllabic), three syllables (trisyllabic) or many syllables (polysyllabic).

Topic-151: Lexical and Emphatic Stress

Sentence level stress, on the other hand, is applied on one word (rather than a syllable) in a sentence thus making that word more prominent (stressed) than the rest of the words in the sentence. This type of stress has its role in intonation patterns and rhythmic features of the language showing specific emphasis on the stressed word (which may be highlighting some information in the typical context).

Lesson-30 SUPRASEGMENTAL FEATURES-II

Topic-152: Stress Timed Languages

Languages of the world are; therefore, divided into two broad categories: stress timed language and syllable timed languages.

Topic-153: Explaining Stress Timed Languages

'Stress timed languages' is a very general phrase used in phonetics to characterize the pronunciation of languages displaying a particular type of rhythmic pattern that is opposed to that of syllable-timed languages. In stress-timed languages, it is claimed that the stressed syllables recur at regular intervals of time (stress-

timing) regardless of the number of intervening unstressed syllables as in English. This characteristic is sometimes also referred to as 'isochronism', or isochrony.

Topic-155: Explaining Syllable Timed Languages

Many phoneticians disagree with the basic idea of timing value. They are of the view that there are three dimensions: fixed word stress (mainly found in Romance languages), variable word stress (mainly found in languages such as English and German) and fixed phrase stress (phrase as a third possibility as exhibited by Japanese) and they want to categorize languages on the basis of these three patterns.

Topic-156: Pitch as a Suprasegmental Feature

As a suprasegmental feature, pitch is an auditory sensation - when we hear a regularly vibrating sound such as a note played on a musical instrument (or a vowel produced by the human voice), we hear a high pitch (when the rate of vibration is high) and a low pitch (when the rate of vibration is low). There are some speech sounds that are voiceless (e.g. /s/), and cannot give rise to a sensation of pitch in this way but the voiced sounds can. Thus the pitch sensation that we receive from a voiced sound corresponds quite closely to the frequency of vibration of the vocal folds. However, we usually refer to the vibration frequency as fundamental frequency in order to keep the two things distinct. In tonal languages, pitch is used as an essential component of the pronunciation of a word and a change of pitch may cause a change in meaning. In most languages (whether or not they are tone languages) pitch plays a central role in intonation. In very simple words, pitch is the variation in the vibration of vocal folds.

Lesson-3 1 SUPRASEGMENTAL FEATURES-III

Topic-157: Tone and Tonal Languages

Tone (in phonetics and phonology) as a suprasegmental feature refers to an identifiable movement (variation) or level of pitch that is used in a linguistically contrastive way. In tone (tonal) languages, the linguistic function of tone is to change the meaning of a word. For example, in Mandarin Chinese, [ma] said with a high pitch means 'mother' while [ma] said on a low rising tone means 'hemp'. In other (non-tonal) languages, tone forms the central part of intonation, and the difference between, for example, a rising and a falling tone on a particular word may cause a different interpretation of the sentence in which it occurs. In the case of tone languages, it is usual to identify tones as being a property of individual syllables, whereas an intonational tone may be spread over many syllables. In the analysis of English intonation, tone refers to one of the pitch possibilities for the tonic (or nuclear) syllable. For further analysis, a set of four types of tone is usually used (fall, rise, fall-rise and rise-fall) though others are also suggested by various experts.

Topic-158: Intonation as a Suprasegmental Feature

The three variables of pitch range, height and direction are generally distinguished.

Topic-159: Functions of Intonations

Intonation as a suprasegmental feature performs several functions in a language. Its most important function is to act as a signal of grammatical structure (e.g., creating patterns to distinguish among grammatical

categories), where it performs a role similar to punctuation (in written language). It may furnish far more contrasts (for conveying meaning). Intonation also gives an idea about the syntactic boundaries (sentence, clause and phrase level boundaries). It also provides the contrast between some grammatical structures (such as questions and statements). For example, the change in meaning illustrated by 'Are you asking me or telling me?' is regularly signaled by a contrast between rising and falling pitch. Note the role of intonation in sentences like 'He's going, isn't he?' (= I'm asking you) opposed to 'He's going, isn't he!' (= I'm telling you) (These examples are given by Peter Roach). The role of intonation in the communication is quite important as it also conveys personal attitude (e.g., sarcasm, puzzlement, anger, etc.). Finally, it can signal contrasts in pitch along with other prosodic and paralinguistic features. It can also bring variation in meaning and can prove an important signal of the social background of the speakers.

Lesson-32

LINGUISTIC PHONETICS-I

Topic-161: Linguistic Phonetics

Linguistic phonetics is an approach which is embodied in the principles of the International Phonetic Association (IPA) and in a hierarchical phonetic descriptive framework that provides certain basis for formal phonological theory. Speech, being very complex phenomena and having multiple levels of organization, needs to be explored from different angles. Linguistic phonetics answers a number of questions related to the possible ways of articulatory unified phonetics and phonology and from the perspective of cognitive phonetics focusing on speech production and perception and how they shape languages as a sound systems. The idea is mainly related to the overall ability of human beings to produce sounds (as a community and irrespective of their specific languages) and then the representation of their shared knowledge (as considered by the IPA in its charts) for formal phonetic and phonological theories.

Topic-163: Explaining Phonetics of the Community and of the Individual

The major reason why the phonetics of the community is considered for phonetic descriptions is that, firstly, individual speakers differ in interesting ways (two native speakers of a language will always speak with some variations). The description of the phonetics of the individual involves describing the phonetic knowledge and skills related to the performance of language. It is possible that certain aspects of the phonetics of the individual can be captured using IPA transcription but others are not compatible with it (such as his private knowledge and its performance and the role of memory and experience). Secondly, the phonetics of the individual is usually not the focus of the linguist in speech elicitation, and it is difficult to describe even with spectrograms of the person's speech. Although, the phonetics of the individual is the focus of much of the explanatory power of phonetic theory but for general phonetic description we need to focus on the phonetics of the community.

Topic-165: Explaining the IPA

One evidence that the IPA chart is based on linguistic phonetics is the description of the blank cells on the chart (those neither shaded nor containing a symbol) that indicate the combinations of categories that are humanly possible but have not been observed so far to be distinctive in any language (e.g., a voiceless retroflex lateral fricative is possible but has not been documented so far, so it is left blank). The shaded cells, on the other hand, exhibit the sounds not possible at these places. Further, below the consonant chart is a set of