

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 [æ]
- ❖ 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

symbols for consonants made with different airstream mechanisms (clicks, voiced implosives, and ejectives). All these descriptions reflect the potentialities of human speech sounds (as a linguistic community) not only showing the possible segments but also the suprasegmental features and points related to the possible airstream mechanisms and even the diacritics for various types coarticulations and secondary articulatory gestures. The IPA chart is carefully documented (by experts) and is continuously revised and updated.

Lesson-33

LINGUISTIC PHONETICS-II

Topic-166: Feature Hierarchy

Feature hierarchy is an important concept in phonetics and phonology which is based on the properties and features of sounds. In a very general sense, a feature may be tied to a particular articulatory maneuver or acoustic property.

Sounds are divided in terms of their supra-laryngeal and laryngeal characteristics, and their airstream mechanism. The supra-laryngeal characteristics can be further divided into those for place (of articulation), manner (of articulation), the possibility of nasality, and the possibility of being lateral. Thus, these features are used for classifying speech sounds and describing them formally.

Topic-167: Feature Hierarchy: Discussion

For dividing speech sounds through feature hierarchy, the first division is made on the basis of the major regions of the vocal tract, giving us the five features in total (i.e., Labial, Coronal, Dorsal, Radical, and Glottal). The first three of these features are related to tongue position whereas 'Radical' is a cover term for [pharyngeal] and [epiglottal] articulations made with the root of the tongue. The feature of 'Glottal', on the other hand, is based on being [glottal], to cover various articulations such as [h]. If we are to have a convenient grouping of the features for consonants, we have to recognize that SupraLaryngeal features must allow for the dual nature of the actions of the larynx and include Glottal as a place of articulation. Remember that a sound may be articulated at more than one of the regions Labial, Coronal, Dorsal, Radical, and Glottal. Within the five general regions, **'Coronal' articulations can be split into three mutually exclusive possibilities**: Laminal (i.e., blade of the tongue), Apical (i.e., tip of the tongue), and Sub-apical (i.e., the under part of the blade of the tongue). Thus the major regions may be subdivided into sub regions on the basis of their features.

Lesson-34

LINGUISTIC PHONETICS-III

Topic-172: Memory for Speech

Speech is quite diverse and complex particularly when it comes to the phonetics of individual. It is understandable that different speakers of the same language will have somewhat different productions of speech depending upon their vocal tract physiology and their own habits of speech motor coordination and more importantly due to their memory of speech. Sociolinguistic features also influence; we are exposed to a

variety of speech styles ranging from very careful pronunciations in various types of public speaking to the quite casual style that is typical between friends. All this leads to the lack of phonetic invariants (or the variability of invariability). This 'lack of phonetic invariance' provides us with many reasonable justifications as it has posed an important problem for phonetic theory as we try to reconcile the fact that shared phonetic knowledge can be described using the IPA symbols and phonological features with the fact that the individual phonetic forms that speakers produce and hear on a daily basis span a very great range (of varieties). This lack of invariance as a problem also has great practical significance for language engineers who try to get computers to produce and recognize speech.

Topic-173: Explaining Memory for Speech

- ❖ **Language universal features:** Broad phonetic classes (e.g., aspirated vs. unaspirated) derive from physiological constraints on speaking or hearing, but their detailed phonetic definitions are arbitrary—a matter of community norms.
- ❖ **Speaking styles:** No one style is basic (from which others are derived), because all are stored in memory. Bilingual speakers store two systems.
- ❖ **Generalization and productivity:** Exemplar theory says that generalization is also possible within productivity. Interestingly, productivity—the hallmark of linguistic knowledge in the phonetic implementation approach—is the least developed aspect of the exemplar theory.
- ❖ **Sound change:** Sound change is phonetically gradual and operates across the whole lexicon. It is a gradual shift as new instances keep on adding.

Topic-174: The Balance Between Phonetic Forces

In order to explain the sound patterns of a language, the views of both speaker and listener are considered. Both of them like to use the least possible articulatory effort (except when they are trying to produce very clear speech), and there are a large number of assimilations, with some segments left out, and other reduced to minimum. Thus a speaker uses language with an ease of articulation (e.g., coarticulation and secondary articulation). This tendency to use language sounds with maximum possible ease of articulation leads to change in the pronunciation of words.

Lesson-35 PHONOTACTICS AND SYLLABIC TEMPLATES

Topic-177: Explaining Syllabification

Consonant sequences are called clusters (e.g., CC – two consonants or CCC – three consonants). Most of the phonotactic analyses are based on the syllable structures and syllabic templates.

Topic-178: Phonotactics

The study of the phonemes and their order found in the syllables (the study of sound sequences) of a language is called the phonotactics. It has often been found that languages do not allow all phonemes to appear in any order (e.g., a native speaker of English can figure out fairly easily that the sequence of phonemes /strenθs/ makes an English word ('strengths') and that the sequence /bleidg/ would be acceptable as an English word

'blage', although that word does not happen to exist, but the sequence /lvm/ could not possibly be the part of an English word). Phonotactic analyses of English come up with some interesting findings. For example, why should 'bump', 'lump', 'hump', 'rump', 'mump(s)', 'clump' and others all be associated with large blunt shapes? Why should there be a whole family of words ending with a plosive and a syllabic /l/ all having meanings to do with clumsy, awkward or difficult action (e.g., 'muddle', 'fumble', 'straddle', 'cuddle', 'fiddle', 'buckle', 'struggle', 'wriggle')? Why can't English syllables begin with /pw/, /bw/, /tl/, /dl/ when /pl/, /bl/, /tw/, /dw/ are acceptable? All such discussion is called the phonotactics of the language.

Topic-179: Explaining Phonotactics

Phonotactics is a term used in phonology to refer to the order (sequential arrangements or tactic behavior) of segments (sounds or phonological units) which occur in a language. It shows us what counts as a phonologically well-formed structure of a word. The allowed sound patterns and restricted sound patterns of language are found through phonotactics. For example, in English, consonant sequences such as /fs/ and /spm/ do not occur initially in an English word, and there are many other restrictions on the possible consonant+vowel combinations which may occur. By thoroughly analyzing the data, the 'sequential constraints' of a language can be stated in terms of phonotactic rules. According to the Generative phonotactics, no phonological principles can refer to morphological structure; and phonological patterns which are sensitive to morphology (e.g. affixation, etc.) are represented only in the morphological component of the grammar (not in the phonology). Some examples from the English phonotactics are given for your understanding:

One phoneme pattern	V	I, oh, owe
Two phoneme pattern	CV	to, be, see
Three phoneme pattern	CVC	cat, dog, run
Four phoneme pattern	CCVC	stick, click, brick
Five phoneme pattern	CCVCC	brisk, treats, speaks
Six phoneme pattern	CCCVCC	streets, strand, strips
Seven phoneme pattern	CCCVCCC	strengths

Also possible: CCV (try) CCCVC (stroke), CCCV (straw), VCC (eggs) CVCC (risk), CVCCC (risks).

Lesson-36 USING PRAAT-1

Topic-180: Introduction to PRAAT

Praat is a computer program with which you can analyze, synthesize, and manipulate speech, and create high-quality pictures for your articles and thesis. You are advised to start going through the tutorial from its homepage.

Topic-183: Recording and Displaying

- ❖ Go to NEW > RECORD mono-sound (with sampling rate – 44100 Hz)
- ❖ Make sure the volume bar is fluctuating as you record – if it isn't, you're not recording; if you don't see the volume bar at all, you're not speaking loudly enough.
- ❖ Watch out for clipping. If your recording level is too high and you go into the red on the volume bar, you'll end up with what is called a "clipped" signal; this is very bad for speech analysis!
- ❖ Give the recording a name (in the box below "Save to list").
- ❖ Save to list.

Topic-184: Segmenting and Labeling

1. **Create a textgrid:** • In the Praat Objects window, highlight the subject (required) file. • Annotate > To TextGrid. • Create two tiers (this will be enough for our purposes). Write 'word segment' (these are two tiers) on the cell named 'All tier names' on the small window.
2. **Open the sound file and textgrid together:** • Hold down Ctrl and click on each file to highlight them both. • Edit (in your display you should now see the waveform (top), the spectrogram (middle) and the textgrid (bottom) corresponding to your sound file).
3. **Segment the file:** • Place the cursor at the beginning of the name on the spectrogram/waveform; a boundary line will show up. • Click in the little circle at the top of the word tier in the Textgrid to create a boundary. • To remove a boundary that you have made - Highlight the boundary - Go to Boundary > Remove OR click Alt+backspace.
4. **Label the intervals:** • Select/highlight the target interval by clicking between two boundaries; the selected interval should go yellow. • To input or change the text in an interval, edit in the Textbox above the spectrogram. • Give name to each interval you create ([first name] or [last name]).

Lesson-37 USING PRAAT-II

Topic-187: Measuring the Fundamental Frequency

- 1) **Displaying the pitch track and allowing Praat to measure the pitch automatically:** • Display the pitch track: Pitch > Show pitch. • Place your cursor in the middle – a stable portion of the vowel. • Go to Pitch > Get pitch – a box will appear with the pitch value in it (note it down)
- 2) **Displaying the pitch track and measuring pitch manually:** • Display the pitch track - Pitch > Show pitch. • Click on the blue pitch track in the middle of the vowel. • A red horizontal bar should appear with the pitch value (in dark blue) on the right side of the window (take the measurement from here).
- 3) **By looking at the waveform (top of the display):** • Zoom into a small piece of the waveform in the middle of the vowel and measure the period by highlighting one complete cycle and noting the time associated with it (in the panel above the waveform).

Topic-188: Measuring the Harmonics

Display a narrow-band spectrogram:

- ❖ Go to: Spectrum > Spectrogram settings.

- ❖ Change the window length to 0.025s – the default window length is 0.005s (wide-band spectrogram) - this changes the spectrogram dramatically!
- ❖ Looking at each vowel, notice the grey horizontal bands: these correspond to harmonics. For each vowel, measure the frequencies of the first 3 harmonics (H1-H3) and the 10th harmonic (H10).
- ❖ Click on the center (horizontally) of each harmonic in the center of each vowel.
- ❖ A red horizontal bar should appear with the frequency value on the left side of the window in red.

Topic-189: Measuring the Formants

Formants are the overtone resonances. Acoustically, in order to plot vowels on chart, F1-F2 are very important. By now, we know that the narrow bands spectrograms are required for measuring harmonics whereas we need the wide bands for measuring the formants (which are the important characteristics of sonorant speech sounds – vowels). On spectrogram, formants are thick bands (darkness corresponds to loudness; i.e. the darkest harmonics are the ones that are the most amplified). These amplified harmonics form the formants that are characteristic of sonorant speech sounds. Now, let's measure the first and second formants (F1 and F2) from the middle of each vowel using the three techniques outlined below and note down your measurements:

Displaying the formants (red dots on the spectrogram) automatically:

- ❖ Display the formant track: Formant > Show formants.
- ❖ Place your cursor in the middle, stable portion of the vowel.
- ❖ Go to Formant > Formant listing: a box will appear with the time point at which the measurement was taken, and the first four formants.

Topic-190: Relationship Between Harmonics and Formants

Captured in the source-filter model of the speech, it is clear now (from the comparison of the two values – for formants and harmonics) that harmonic numbers are different for one type of sounds but the formants are the same. Actually, the relationship between the harmonics and the formants is captured in the source-filter model of speech production. The point is that harmonics are related to the laryngeal activity (source) and formants are the output of the vocal tract (filter).

Lesson-38 USING PRAAT-III

Topic-191: Vowel Properties

For exploring the acoustics of vowels in this session, we need to record vowels and explore their properties. The eight vowels from American English (given in your book (Chapter 8) are to be recorded for the purpose (by now, you should know how to record them). These vowels are: heed, hid, head, had, hod, hawed, hood and who'd. When you are done with the recording, get ready for measuring the following three things: intrinsic pitch, spectral make up (formants) and plotting them in excel sheet (and finally exporting them to your Word document). Now, record yourself saying the words. Take a quick look at your vowels in the Edit window, and

make sure you can clearly see the vowel formants. If you have trouble seeing them, you can go back to the previous labs and learn it again. While doing this, please make a note of it on your worksheet.

Topic-194. Plotting Vowels on Chart

Finally, we are at the last step related to spectral make-up of vowel sounds. We have already taken the measurement of the first two formants and we are going to plot those values on a chart using the Excel spreadsheet. By putting F1 and F2 in separate columns, write the formant values associated with different vowels (giving vowels in the first column, the difference between F2 and F1 in the second column and F1 in the third). After putting the data in Excel sheet, we will use the Scatter chart from the same spreadsheet. Further in order to make it corresponding with the required values for F1 and F2, we will reverse the values for both formants (on both axis – Y and X). Now the zero for both F1 and F2 is at the right corner. Watch the video and you will find how F1 is inversely related to the height of the vowel and the difference between F2 and F1 to the frontness of the vowels. Once completed, export the chart to your Word document and give it the number and title accordingly.

Lesson-39 USING PRAAT – IV ✓

Topic-196: Nasal Formants

Formants for nasal sounds are also important for acoustic analysis. Measure the first three (F1, F2 and F3) formants of nasals from the file (use the already learnt way of measuring formants). Remember that nasals have very distinctive waveforms (different than that of vowels) as they have distinctive forms of anti-formants (bands of frequencies damped) and formant transition.

Topic-197: Glide and Their Formants

Glides are also the sonorants (vowel-like) sounds as they have similar patterns (have formants). Read from our recorded file and take the first three formants (F1, F2 and F3) from the middle of the sounds for glides (both for /w/ and /j/) and explore their acoustic correlates. Carefully judge the center of these sounds (the midpoint of [w] and [j]). Analyze that how similar is the formant structure of glides with vowels and nasals. Draw lines to indicate F1, F2, F3 and compare with vowels.

Lesson-40 USING PRAAT- ✓

Topic-198: Stop Voicing on Spectrograph

There are three important acoustic correlates of voicing in stops: the voice bar, VOT, and the duration of the preceding vowel. Record /apa/, /aba/, /ata/, /ada/, /apha/ and /atha/ and for each of the stops in the file, take the three measurements according to the following instructions: See the voicing or the voice bar by exploring features of stop. We can also explore the features related to the place of articulation (any bilabial feature for /p/ or /b/ in comparison with non-bilabial). Also check the duration of the preceding vowels.

Topic-199: Measuring Voice Onset Time (VOT)

To calculate the VOT: Record /apa/, /aba/, /ata/, /ada/, /apha/ and /atha/. Zoom in through your stop sounds so that you can analyze the patterns of the stop sounds and find the difference among the three types of VOT (negative, zero and positive). Measure the VOT of each stop and compare voiced/voiceless counterparts (p/b, t/d, k/g). Similarly, zoom in so that you can clearly see the stop closure followed by the beginning of the vowel. You can measure the time between the end of the stop closure (the beginning of the release burst) and the onset of voicing in the following vowel (the onset of regular pitch pulses in the waveform).

Lesson-41 FURTHER AREAS OF STUDY IN P&P

Topic-200: P&P Research as the Part of ELT

Phonetics and phonology is a very potential area for research to be carried out in Pakistani context. In applied phonology, many areas can be explored; for example, issues faced by Pakistani learners of English may be studied. Similarly, the pronunciation issues of Pakistani learners are potential area through which the difficulties faced by Pakistani students may be addressed. Also, researchers can explore and document the features of Pakistani English based on their phonological features in order to get the Pakistani variety of English recognized. Other problematic areas may also include: segmental and supra segmental features (such as stress placement, intonation patterns and syllabification and resyllabification of English words by Pakistani learners. Contrastive analysis (between English phonology and the sound systems of the regional languages of Pakistan (Urdu, Punjabi, Sindhi, Balochi and Pashto) can also be carried out by the researchers. We can also think about exploring the consonant clusters and interlanguage phonology from second language acquisition point of view. While focusing on ELT as the part of applied linguistics, studies may also be carried out on Pakistani variety of English (development of its corpora, deviation from the standard variety (RP), its specific features, etc.). Moreover, IPA resources and their application on ELT in Pakistani context can also be studied.

Topic-201: Current Trends in P&P Research

Pakistani regional languages are the part of the rich linguistic regions. (Himalaya Hindu Kush (HKH) region, one of the richest regions in the world linguistically and culturally) may be very potential area for research in the fields of areal and typological linguistics (description of linguistic features crosslinguistically). While working on Pakistani regional languages, one may apply for funding from international organizations (e.g., organization for endangered languages and UNISCO).

Topic-202: Distinctive Features

Three principles for feature analysis: contrastive function (how it is different), descriptive function (what it is) and classificatory function (based on broader classes of sounds). Features may also be studied further as a part of language universals and then their role as language specific sub sets.

Topic-203: Experimental Phonetics

In experimental phonetics and phonology, the studies of sounds include various latest experimental techniques and computer software that are used under carefully designed lab experimentation. It is an important aspect of the application of the latest technology by going beyond the simple acoustics and by working in sophisticated phonetic labs in order to discover the hidden aspects of human speech. For example, questions such as 'How speech is produced and processed?' are the focus of experimental phonetics (explore the speech chain as the beginning of experimental phonetics as mentioned in Chapter-20 by Peter Roach). The latest trends under experimental phonetics include brain functions in speech production and processing (by using the latest equipment – many special instruments such as x-ray techniques), speech errors, neurolinguistics and the topics related to the developments through computers – for speech analysis and synthesis.

Lesson-42

THE PEDAGOGY OF PHONETICS AND PHONOLOGY

Topic-206: Developing Relevant Material

Developing relevant material for the teaching of phonetics and phonology is an important task for aspiring teachers of English language. Remember the specific needs of ELT activities in your own context and explore already developed material available online from various sources (such as British Council and other teacher resource centers); however, you must also be able to develop your own material (as specifically required by your students). For example, you can develop your material related to the pronunciation teaching to the learners of English. You can incorporate material related to the IPA text – transcription of the audio (listening) based activities – by involving students on using dictionaries (ideally the phonetic dictionaries) in the classroom.

Topic-208: Making Research Accessible to Teachers

Good teachers are expected to be active researchers and therefore busy in updating themselves about the latest researches and teaching methodologies around the world. It is also a pedagogical challenge for teachers to keep themselves updated by exploring pedagogical and technological challenges for ELT experts (in their own contexts and internationally). For example, the aspects of Task Based Learning and Teaching (TBLT) as a golden method for second language acquisition (SLA) may be effective in Pakistani context if explored by ELT practitioners. Teachers as the agents of change and they must be reading research studies and carry out research by and explore their issues and solutions. A good way is to keep reading teachers' digests and journals and participate in the online discussions by teaching associations.

Topic-209: Facilitating Action Research

As already discussed, teachers are expected to facilitate action research which is the most rewarding and productive for their own profession. For example, the phonetics of phonological speech errors if explored and shared by teachers (by investigating their own practices) may lead to a very positive discussion in the academic circles (of research into ELT – SLA). Similarly, topics such as learners' performance and development (e.g., what do good speakers do?) may yield useful results for teachers' fraternity. Having said this, it is required from teachers (and student teachers) to facilitate action research related to reading/listening issues, English reading strategies (e.g., in primary schools) – (and their effectiveness), impact on pronunciation and many more. Research in the fields of phonetic theory and the description with phonological, typological and broader implication may also be included in phonetics and phonology specific action research.

More on ENG507

- ❖ **Tap:** Tap is up and down movement of the top of the tip of tongue. For example, pronouncing the middle sound in word 'pity' with typical American accent [ɾ]. It is very brief and is produced by a sharp upward throw of the tongue blade. In this sound, tongue makes a single tap against the alveolar ridge.
- ❖ **Flap:** Flap is front and back movement of tongue tip at the underside of tongue with curling behind. It is found in abundance in Indo-Aryan (IA) languages [ɾ]. Typical flap sounds found in IA languages is a retroflex sound and the examples are [ɽ], [ɽ] and [ɽ].
- ❖ **Trill:** In the production of trill the articulator is set in motion by the current of air [r]. It is a typical sound of Scottish English as in words like 'rye' and 'row'.
- ❖ **Bilabial:** This sound is made with two lips (for example, /p/ and /b/). The lips come together for these sounds.
- ❖ **Labiodental:** This sound is made when the lower lip is raised to touch the upper front teeth (for example, /f/ and /v/).
- ❖ **Dental:** This sound is made with the tongue tip or blade and upper front teeth. For example, say the words thigh, thy and you will find the first sound in each of these words to be dental.
- ❖ **Alveolar:** This sound is made with the tongue tip or blade and the alveolar ridge. You may pronounce words such as tie, die, nigh, sigh, zeal, lie using the tip of the tongue or the blade of the tongue for the first sound in each of these words (which are alveolar sounds).
- ❖ **Retroflex:** This sound is produced when the tongue tip curls against the back of the alveolar ridge. Many speakers of English do not use retroflex sounds at all but it is a common sound in Pakistani languages such as Urdu, Sindhi, Pashto, Balochi and Punjabi.
- ❖ **Palato-alveolar:** This sound is produced with the tongue blade and the back of the alveolar ridge (for example, first sound in each of words like shy, she, show)
- ❖ **Palatal:** This sound is produced with front of the tongue and the hard palate (such as the first sound in 'yes'.
- ❖ **Velar:** This sound is produced with back of the tongue and the soft palate (such as /k/ and /g/).