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Ministry of Higher Education and Scientific Research

University of Mohamed Boudiaf – M'sila

Faculty of Letters and Languages

Department of English Language and Letters

Handouts for Advanced Phonology and Phonetics:

A Course Packet

Teacher: Berrabah Imane

Level : Master one

Branch : Linguistics

Academic Year : 2025/2026

Module : Advanced Phonology and Phonetics

Nature	**One- semester course**
Level	**M1**
Abbreviation	**APaP**
VHS	**45 hours**
Weekly allotted time	**1 h30 m**
Evaluation mode	**TD 50%, and Exam 50%**
Coefficient	**2**
Credit	**4**
Pre-requisites	**Linguistics and Phonetics.**

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Preface

This Pedagogical handout has been carefully crafted to meet the explorative and educative needs of Master one students following the official curriculum of the Advanced Phonology and Phonetics module at the Department of English, University of M'sila.

As this area of study delves deeper into the sound systems of languages, it encompasses both theoretical frameworks and practical applications that serve to improve linguistic competence. Master's students find themselves at a crucial point where fundamental knowledge must be deepened and expanded, making a comprehensive understanding of phonology and phonetics imperative. After gaining introductory knowledge about Phonetics and speech sound system during the first and second year of their University studies, Master one students of English will find deeper assistance within this document that was intentionally designed based on a rich combination of scholarly resources namely, *Phonology in generative grammar* (Kenstowicz 1994), *English Phonetics and Phonology* (Roach 2009), and *Optimality theory* (Kager 1999). At its core, this pedagogical support enables students to delve deeper into the theoretical and practical growth of both Phonetics and Phonology.

The handout's trajectory begins with Preliminaries to Advanced Phonology and Phonetics, establishing the necessary theoretical and methodological groundwork which importantly includes a foundational overview of Historical Phonology and the mechanisms of Sound Change to contextualize the dynamic nature of linguistic systems. Next comes the lecture of the core principles of the framework Generative Phonology, where students are introduced in detail to the system of Distinctive Features as the universal primitives of sound structure that allows students to discover the underlying rules that dictate how phonemes interact across languages. This perspective not only broadens their theoretical knowledge, but also sharpens their

analytical skills, which are vital in any linguistic investigation. The ability to dissect sound patterns can illuminate broader syntactic and morphological structures, revealing intricate interdependencies that characterize linguistic systems.

Moving further in the curriculum, the students are equipped with the analytical tools to investigate various Phonological Processes such as assimilation, deletion, and insertion, ultimately culminating in intensive, practical problem-solving sessions that utilize real-world examples drawn from diverse languages to ensure students become not just passive receivers of information, but active researchers capable of formulating and testing hypotheses.

Turning attention to the practical applications of advanced phonology and phonetics, two to three sessions of intensive, practical problem-solving are dedicated to analyze complex phonological phenomena, and also to train their pronunciation skills. This intersection between theory and practice demonstrates how phonetics can be harnessed to improve language learning, subsequently preparing master's students for future teaching roles or clinical applications in linguistics.

Building upon this foundational skill set, the curriculum then advances to exploration of prosodic structures, introducing students to Syllable Structure and syllable-based processes before concluding with a phonological framework, systematically covering Autosegmental as a key model for analyzing phenomena beyond the segment groups. The aim is to ensure students become not just passive receivers of information, but active researchers capable of formulating and testing hypotheses across various theoretical models.

Crucially, throughout these lectures, numerous analytical tasks and theoretical debates will be posed with the focal purpose of boosting students' ability to think critically and evaluate competing phonological models from different perspectives. In opposition to the generally held idea about mastering linguistic modules through rote learning, this handout does not focus on the memorization of rules or blind rehearsal of feature specifications. On the contrary, the basic and focal aim behind the creation of this booklet specifically, and the teaching of Advanced Phonology and Phonetics

generally, is to train the student's mind on the correct methods of linguistic inquiry and analytical argumentation, saving them from being passive receivers of pre-established information. By following this method, where problem sets and real-world data are prioritized, students will be more actively involved in the classroom, and any apprehension regarding the module as one basically reliant on pure memorization will be gradually eradicated.

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Course Description

This course offers an in-depth exploration of the sound systems of human language, emphasizing the intricate relationship between phonetic realization and phonological organization. It builds on foundational linguistic knowledge to develop students' analytical and theoretical understanding of how speech sounds are produced, perceived, and systematically patterned across languages. The module engages students in a detailed examination of both phonetic principles, including articulatory, acoustic, and auditory aspects of speech, and phonological processes, such as assimilation, feature specification, syllable structure, and rule formation. Through this integrated approach, students will gain insight into how phonetic evidence informs phonological theory and how abstract representations shape spoken language.

Beyond theoretical grounding, the module provides a practical dimension, equipping students with analytical tools and transcription skills essential for linguistic research and advanced language study. By the end of the course, learners will be able to connect abstract phonological concepts with real-world phonetic phenomena, demonstrating both scientific rigor and linguistic sensitivity in their analyses.

Course Objectives

The course of **Advanced Phonology and Phonetics** aims at assisting students and providing them with the necessary theoretical, analytical, and computational knowledge about the sound structure of human language. Our main objectives for this course include :

- To achieve a clear, functional understanding of the boundary where physical sound production ends and the cognitive organization of sound systems begins.
- To analyze the theoretical architecture of Generative Phonology, specifically through the detailed exploration of Distinctive Feature Theory.
- To examine Syllable Structure and syllable-based process across languages.

- To Engage critically with major linear and non-linear theories

Skills to be Fostered

Along with the basic objective of introducing M1 students of English to the theoretical mechanisms governing linguistic sound systems, this course aims at boosting the students' critical thinking and analytic problem-solving skills. Basically, it wishes to :

- Develop formal analytical skills through the ability to formally prove the existence and relationship between phonemes and allophones using minimal pairs and distributional analysis.
- Develop the capacity to evaluate competing theoretical claims and manipulate advanced models to account for data, thereby facilitating the transition from linguistic observers to linguistic theorists.
- Encourage the development of abstract reasoning required to handle rule formalism, abstract representations.
- Improve the ability to articulate and defend complex phonological arguments in writing and presentations, using the specialized phonological language.

Course Duration

The teaching time is 45 hours devided over 15 weeks. Sessions weekly time is 3 hours (Cours+ TD) per week. The total 30 sessions, devoted for the first semester of master 1 in Linguistics, include a 2 sessions dedicated for a Test and examination administered at the end of the semester

Evaluation:

- Final semester exam (50%)
- Course work (TD) (50%)

Lecture one : Preliminaries to Advanced Phonology and Phonetics

Overview:

The current lecture serves as the essential conceptual foundation for the entire Advanced Phonology and Phonetics (APaP) module, designed to transition graduate students from descriptive observation to linguistic theory. The primary goal is to secure a solid conceptual footing before diving into advanced phonological frameworks**.**

Lecture Objectives:

By the end of this introductory lecture, students should achieve these essential goals that will anchor the rest of the course:

- To have a clear, functional understanding of the Phonetics/Phonology distinction.
- To recognize the three main branches of Phonetics.
- To ensure that they are masters of the core phonological units, primarily the phoneme and the allophone, understanding how to formally prove their existence and relationship.
- To review the articulatory foundation of consonants and vowels
- To prepare students for the advanced analytic focus of the course.

1. The Nature: Phonology vs. Phonetics

Phonology and phonetics are two fundamental branches of linguistics that are interrelated, but maintain distinct theoretical structures and applications. Although both fields are concerned with the sounds of human language, they differ significantly in their focus and the methodologies employed in their studies. Understanding these differences is crucial for linguists, language educators, and communications professionals in understanding how sounds work in linguistic systems.

Phonetics:

is the study of the physical properties of speech sounds, including their production, transmission, and perception. It deals with the articulation of sounds – how they are produced by the human vocal apparatus – and their acoustic properties – how they are transmitted through the air. Phonetics can be subdivided into three main areas: articulatory phonetics, which explores how speech sounds are produced; acoustic phonetics, which analyzes the physical properties of sound waves; and auditory phonetics, focusing on how sounds are perceived by the auditory system (Spencer, 1996). This physical orientation allows researchers to examine speech sounds in a concrete, empirical way, using instruments to measure frequencies, amplitudes, and other acoustic details.

Phonology

on the other hand, addresses how sounds are organized and function in specific languages and linguistic systems. Investigates the abstract and mental representations of sounds, focusing on the rules that govern sound patterns and the relationships between sounds in a given language (Spencer,1996). Phonology is concerned with concepts such as phonemes, which are the smallest units of sound that can distinguish meaning, and allophones, which are variations of phonemes that do not change meaning within a specific linguistic context. Phonological analysis is, therefore, fundamentally focused on the systemic relationships and distributions of sounds within languages (Carr, 2019).

2. The Importance of Phonetics and Phonology

The importance of phonetics in understanding human communication lies in its ability to provide insights into the actual sound patterns produced in speech. Phonetic analysis can help diagnose speech disorders, teach pronunciation in language learning, and aid speech recognition technology. For example, Speech-Language Pathologists (SLPs) rely on phonetic principles to assess and treat various speech sound disorders,

successfully applying knowledge about articulatory and acoustic phonetics in clinical practice (Yavas, 2020). Furthermore, the application of phonetics extends to several fields, such as forensic linguistics, where sound analysis can contribute to speaker identification, and the development of linguistic technologies, such as speech synthesis and recognition.

In contrast, the importance of phonology arises from its focus on understanding the mental structures and rules that underpin language use. Phonology is fundamental to discerning how different languages use sounds and how those sounds relate to meaning and structure. For example, minimal pairs, words that differ only by a single sound, can demonstrate how phonological contrasts can lead to different meanings (Roach, 2009). Understanding phonology allows linguists to characterize specific sound systems of a language and explore phenomena such as assimilation, elision, and syllable structures that are crucial to linguistic theory and language teaching.

A fundamental difference between phonetics and phonology concerns the level of abstraction. Although phonetics operates on a physical, observable level, phonological analysis requires a more abstract consideration of linguistic phenomena. Phonologists employ several theoretical frameworks, including generative grammar, to explain sound patterns across languages. This abstraction allows us to formulate phonological rules and restrictions that predict language behavior (Alduais, 2015). Furthermore, the relationship between these two fields extends to the dynamics of linguistic change. Phonetic changes can lead to phonological changes over time as language evolves. For example, a change in the pronunciation of a vowel can lead phonologists to reevaluate a language's phonemic inventory and how these sounds interact. In this sense, phonetics and phonology are intertwined, with changes in one potentially affecting the other.

In educational settings, the distinction between phonetics and phonology is essential for developing effective language teaching materials. Language teachers benefit from both fields as they design curricula that address both the mechanical aspects of sound production and the cognitive understanding of sound systems. For example, understanding phonetic variability in how certain sounds are pronounced between different speakers or dialects can improve teaching methods for second language acquisition (Davenport & Hannahs, 2020). The interaction between phonetics and phonology can also improve our understanding of communication systems beyond language. Sociophonetics research, which examines how social factors influence variation in speech sounds, reveals insights into identity, community, and cultural interactions through spoken language (Zsiga, 2024). This illustrates that phonological and phonetic research has pertinent implications for understanding the broader communicative contexts in which language operates.

In a nutshell, while phonetics focuses on the physical properties of speech sounds, phonology investigates the abstract rules and systems that govern the organization of sounds in languages. Both are essential for understanding language and human communication, offering nuanced insights into how individuals produce and interpret sounds. An appreciation of its distinct roles enriches our understanding of linguistic theory and practice, affirming the essential nature of sound in the structure of human interaction. As studies in these areas continue to evolve, their applications will undoubtedly broaden, further illuminating the complexities of language as a communication system and as a topic of academic research.

3. Core Units for the Phonological system

The phonological system constitutes a fundamental aspect of language structure, contributing significantly to how communication is achieved and understood. At the heart of this system are the core units of phonemes, syllables, and suprasegmental

features, each playing distinct but interdependent roles in the formation of linguistic structures.

a) Phonemes:

Phonemes are the smallest units of sound capable of differentiating meaning within a given language. They are abstract representations that, combined, create a variety of pronunciations and meanings. For example, the contrast between the sounds /p/ and /b/ in “pat” and “bat” highlights how simple changes in phonemic elements can lead to different lexical items. Analyzing phonemes and their patterns within a language allows linguists to understand the rules governing sound combinations, which are crucial for effective communication (Harris & Lindsey, 2014). As Blevins and Goldsmith (1995) point out, the meaning of phonemes transcends simple sound; they constitute the constituent elements of larger phonological structures.

The organization of phonemes into syllables adds an additional layer of complexity within the phonological system. Syllables facilitate the rhythmic and melodic properties of speech. They serve as a key organizing principle, structuring phonemes into manageable units that can be easily perceived and produced by speakers and listeners. The influence of the syllable on language is evident through its interaction with stress patterns and intonation, both of which are essential for conveying meaning beyond the level of the individual phoneme. Clements (1985) discusses phonological features, revealing how syllables can be viewed as geometric constructs that organize phonemes in ways that improve the clarity and coherence of spoken language.

b) Minimal pairs :

They are pairs of words that differ only by a single phoneme and that produce different meanings, such as "pat" and "bat."

That is to say, a minimal pair consists of **two words** in a language that meet two strict criteria:

1. They differ by only one sound (phone).
2. The one sound difference must occur in the exact same position within the word.
3. They must have different meanings.

The classic example is the contrast between /pɪn/ (pin) and /tɪn/ (tin). Because replacing the sound /p/ with the sound /t/ results in a totally different word with a different meaning, we can formally conclude that /p/ and /t/ are separate, contrasting phonemes in English. This method is the bedrock of establishing a language's entire functional sound inventory and is essential for all further phonological analysis

Examination of minimal pairs provides information about the phonemic inventory of a language, allowing linguists to identify which sounds are distinctive and can change the meaning of words. However, phonetic variation goes beyond mere contrasts manifested in minimal pairs; involves a more nuanced understanding of how allophones work within the sound system.

c) Allophones:

Allophones are contextually determined variants of a phoneme that do not change the meaning. For example, the English phoneme /t/ can be realized with different pronunciation depending on its phonetic environment. First, [t^h] aspirated, as in "tap". This version of /t/ is produced with a puff of air (aspiration) and occurs only at the beginning of a stressed syllable. Thus the word tap is transcribed as: tap →[t^hæp]. **Or**, [t] unaspirated, as in "stop. This version is produced without the puff of air and occurs only immediately following the phoneme /s/ e.g., stop →[stɑːp].

It is argued that these allophonic variations exist in **complementary distribution**, meaning, they occur in specific phonological contexts and do not overlap. That is to say, sound [A] and sound [B] never occur in the exact same phonetic environment. Instead, their environments are mutually exclusive, like two pieces of a puzzle:

- Sound [A] appears only in environment X such as syllable-initial position (aspirated [t^h])
- Sound [B] appears only in environment Y as in post-consonant position (unaspirated [t])

Because they never contrast in the same context, they cannot **create a minimal pair** or distinguish meaning. Therefore, a native speaker treats them as the same underlying unit. If two sounds are found to be in complementary distribution, they are classified **as allophones** of the same phoneme. Understanding the distribution of allophones is crucial to understanding the systematic nature of a language's phonetic behavior. By delineating the specific contexts in which allophones occur, linguists can elucidate the phonological rules that dictate such variation.

Finally, exploring the interaction between phonetic variation, allophones and minimal pairs sheds light on the systematicity of phonological structures in different languages. Hall (2013) emphasizes that such complexities underscore the sophisticated designs embedded in language systems. By understanding how distinct phonemes and their corresponding allophones function not only as discrete units but also as components of a broader phonological structure, linguists can more effectively understand the complexities inherent in the sound systems of different languages. This dynamic view of phonetic variation facilitates a deeper appreciation of the functional and structural aspects of language, reinforcing the need for a holistic approach to phonological investigation (Hall ,2013).

4. The Phonetic Basis: Articulation of Consonants and Vowels

Exploring the phonetic foundations of speech requires a deep understanding of the articulation processes underlying consonants and vowels. Phonetics, as a subfield of linguistics, delves into how sounds are produced, transmitted, and perceived. The articulation of speech sounds is fundamentally linked to the manipulation of airflow

through the vocal tract, which is structured from the lungs to the lips and includes various anatomical features such as the tongue, palate and glottis.

- **Consonants** are characterized by an obstruction of airflow, which can vary according to several articulatory characteristics: voicing, place of articulation, and manner of articulation. The expression voicing refers to whether or not the vocal cords vibrate during the production of a sound. Sounds are classified as **voiced** , e.g., /b/, /d/, /g/ when the vocal folds vibrate, while unvoiced sounds ,e.g., /p/, /t/, /k/ are produced without this vibration (Spencer, 1996). **Place of articulation** describes where in the vocal tract airflow is impeded. For example, bilabial consonants are produced with both lips (e.g., /p/, /b/), while alveolar consonants are produced on the alveolar ridge , e.g., /t/, /d/. The shape of joint pertains to **the type of constriction** or degree of closure that affects airflow. Consonants can be classified as stops with complete closure, e.g./p/, /t/, fricatives with partial closure causing turbulence as in /f/, /s/, or nasals allowing airflow through the nasal cavity : /m/, /n/.

- Vowels, in contrast, are typically produced with a more open configuration of the vocal tract, allowing for a continuous flow of air without significant obstructions. The characteristics of vocal articulation are mainly defined by the position of the tongue and the shape of the lips. Vowels can be classified according to their height (high, middle, low), back (front, center, back) and roundness. For example, the vowel sound /i/ as in "seat" is classified as a high front unrounded vowel, while /u/ as in "food" is classified as a high back rounded vowel. This classification not only highlights differences in tongue position but also correlates with the acoustic properties of the sounds produced.

The production and classification of consonants and vowels are not mere academic exercises; They are crucial for effective linguistic communication (Kenstowitcz,1994). Fundamentally involved in these articulatory processes are phonemes, which are the

smallest sound units that can differentiate meanings. Systematic variations in articulation contribute to the phonological systems of individual languages, allowing for distinct phonemic inventories across linguistic traditions. According to Ashby (2013), the interaction of sounds in speech acts as a vehicle to transmit meaning, forming the core of language as a communicative system.

In summary, insights into consonant and vowel articulation illuminate not only the technical aspects of speech production but also the broader implications for language comprehension and production, highlighting the essential role of phonetics in linguistic theory and practice., The analysis extends to the importance of these articulatory characteristics in linguistic contexts. Consonants and vowels constitute the fundamental elements of speech, exhibiting a variety of articulatory characteristics that directly influence linguistic structure and functionality. Different languages use consonant and vowel systems that reveal not only phonetic diversity but also functional elements of speech, demonstrating how articulation underpins effective communication.

In advanced phonology, we analyze **why** sound changes happen. This requires us to categorize entire **natural classes** of sound groups that behave alike in rules. for example, all stops or all fricatives. The only way to formally define a natural class is through shared articulatory features.

5. The Advanced Jump

Phonology and phonetics form the backbone of linguistic study, serving as the basis for understanding how language works sonically. The transition from preliminary concepts to advanced theories encompasses a crucial academic progression, whereby students must engage with a variety of models and methodologies to fully understand the complexities involved in audio systems. This module provides an analysis of this transition, highlighting the main theories and methodologies essential for effective learning in this field.

As students progress to more advanced concepts, the focus shifts to phonology, which studies abstract mental representations of sound patterns. Here the notion of phonemic and phonetic distinctions plays a central role. Phonemes are the smallest sound units that can change meaning, while allophones are different realizations of a phoneme that do not alter meaning. Recognizing this distinction is critical as students begin to engage with theoretical frameworks such as generative phonology, which postulates that phonological rules govern the systematic patterns observed in languages (Mees & Collins, 2013). Generative approaches encourage the analysis of sound systems as rule-governed, highlighting the cognitive processes involved in the production and perception of speech.

Another significant advance in the field is the exploration of phonological theories, as, autosegmental theory, optimality theory, and moraic theory. These approaches allow linguists to understand the variations and alternations observed in different languages while keeping in mind the interaction between conflicting constraints (Mees & Collins, 2013). Advanced study of phonological theories allows students to appreciate the competition between rules and constraints, marking a significant leap from traditional rule-based phonology to more dynamic modeling of sound patterns.

6. Reading and Preparation for the Next lecture (Distinctive Features)

The assignment for the next lecture is critical:

1. **Reading**: Search and read about **"Distinctive Feature Theory,"** focusing specifically on the **primary feature matrix** and the justification for using **binary values** (plus/minus).
2. **Preparation**: Be prepared to define and illustrate features of different sounds in English language

References :

1. Alduais, A. M. (2015). An account of phonetics and phonology as similar identical or different. The International Journal of Indian Psychology, 3(1), 157-165.

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2. Carr, P. (2019). English phonetics and phonology: An introduction. John Wiley & Sons.
3. Davenport, M., & Hannahs, S. J. (2020). Introducing phonetics and phonology. Routledge.
4. Hall, K. C. (2013). A typology of intermediate phonological relationships. The linguistic review, 30(2), 215-275.
5. Hawkins, P. (2018). Introducing phonology. Routledge.
6. Hayes, B. P. (2011). Introductory phonology. John Wiley & Sons.
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Lecture 02 : Distinctive Features

Overview

The second lecture on Distinctive Feature Theory (DFT) begins by tracing its theoretical root back to the pioneering efforts of the Prague School, particularly the foundational work of Nikolai Trubetzkoy (1930) and Roman Jakobson (1940). The, discussion wil be made upon the adaptation and formalization of this conceptual framework by Chomsky and Halle (1968). Their work resulted in a rigorous detailed system of Generative Phonology.

Objectives

By the end of this lecture, students should be able to:

1. Define the concept of *distinctive features* and explain their role in phonological theory.
2. Identif**y** the major *distinctive features* used to describe English sounds
3. Classify consonants and vowels based on their distinctive feature specifications.
4. Explain how *natural classes* are formed through shared distinctive features.
5. Use feature matrices to represent sounds.

1. The History and Development of the DFT

The history of distinctive feature theory represents a crucial evolution in phonology, moving from the idea of the indivisible phoneme to a more analytical and insightful perspective. The concept was fundamentally developed by the Prague Linguistic Circle in the 1930s, primarily through the work of Nikolai Trubetzkoy, who established the importance of phonological opposition in distinguishing meaning, and his colleague, Roman Jakobson. Jakobson formalized the theory beginning in the 1940s, proposing that all contrasts between sounds could be described using a limited, universal set of binary features—a sound either possesses a feature ([+]) or it does not ([−]) which he initially defined primarily in acoustic terms.

This early system was then revised and popularized within the framework of Generative Phonology by Noam Chomsky and Morris Halle in their highly influential 1968 work, *The Sound Pattern of English* (SPE). The SPE system retained the binary nature but shifted the definitions from acoustic to largely articulatory terms such as [+coronal], [+high], allowing for a more systematic and concise description of the natural classes of sounds that undergo similar phonological rules. While the SPE model provided the basis for decades of subsequent research, later theories, such as Feature Geometry, introduced a hierarchical structure for features to better account for assimilation processes, and some modern approaches have explored the use of privative (single-valued) features, demonstrating that the effort to find the most fundamental, universal building blocks of speech continues to this day.

2. Key concepts

Binary nature:

Features are typically expressed in a binary (+/-) system, such as [+voice] for voiced sounds and [-voice] for voiceless sounds. (JaKobson, 1942). In order to distinguish between meanings, what counts is either the presence or absence of a given feature. For example :

[+voice]	[-voice]
bet	pet
zeal	seal

Universal set:

The same set of features is used to describe the sounds of all languages, even though different languages use them to create different contrasts.

Classification

Features can be used to group sounds into classes.

3. Categories of DFT

The set of features are categorized into groups based on the type of articulatory or acoustic property they describe. The main categories typically include:

3.1. Major Class Features

Major class features in phonology are fundamental binary properties that distinguish between the primary natural classes of sounds, namely, vowels, consonants, and glides. They are related to the basic physical manner and place of articulation. The main major class features are **[± syllabic]**, **[± sonorant** , and **[± consonantal]**.

a) Syllabic [± syllabic]

This feature determines a sound's ability to form the **nucleus of a syllable**.

Feature	**Description**	**Examples**
+ syllabic	Sounds that function as a **syllable peak** (nucleus). These are typically the most	All **Vowels** (e.g., /a/, /u/, /i/), and sometimes **Liquids** (/l/, /r/) or **Nasals** (/m/, /n/) when they form a syllable

	prominent or loud sounds in a syllable	peak in words like *bottl***e** or *butt***on**.
[-syllabic]	Sounds that do **not** function as a syllable peak. They form the onset or coda of a syllable.	All **Consonants** (e.g., /p/, /t/, /s/, /m/, /l/, /r/) and **Glides** (e.g., /w/, /j/).

b. **Sonorant [± sonorant]**

This feature distinguishes sounds produced with a relatively **open vocal or nasal tract**, allowing air to flow freely without significant turbulence or pressure build-up. All sounds that are spontaneously voiced are sonorants.

Feature	**Description**	**Examples**
[+sonorant]	Sounds produced with minimal obstruction in the vocal tract. These include soun s that are generally louder and can sustain voicing.	**Vowels** (/a/, /i/), **Glides** (/w/, /j/), **Liquids** (/l/, /r/), and **Nasals** (/m/, /n/).
[-sonorant]	Sounds produced with a significant obstruction that creates high pressure or turbulence. These are often referred to as **obstruents**.	**Stops** (/p/, /t/, /k/), **Fricatives** (/f/, /s/, /z/), and **Affricates** (/tʃ/, /dʒ/).

c. Consonantal [± consonantal]

This feature distinguishes sounds produced with a **radical obstruction** in the midline of the vocal tract. It fundamentally separates true consonants from vowels and glides.

Feature	Description	Example
[+consonantal]	Sounds that involve a significant obstruction (a narrowing or closure) in the vocal tract that is as narrow as or narrower than that for the production of glides. They are typically produced with a contact or near-contact of articulators.	All **Stops** (/p/, /t/), **Fricatives** (/s/, /z/), **Affricates** (/tʃ/, /dʒ/), **Nasals** (/m/, /n/), and liquids.
[-consonantal]	Sounds produced with a relatively unobstructed vocal tract, allowing air to flow freely. This class includes the most vowel-like sounds.	All **Vowels** (/a/, /i/, /u/) and **Glides** (/w/, /j/).

In some books and articles, we can find:

d. Approximant [± approximant]

The feature **[± approximant]** is used to group sounds that are produced with an approximation between articulators, but without the friction of a fricative. It's often used to separate liquids and glides from true stops and fricatives.

Feature	**Description**	**Examples**
[+approximant]	Produced with a gentle narrowing of the vocal tract, but not enough to create turbulence.	**Glides** (/w/, /j/) and **Liquids** (/l/, /r/).
[-approximant]	Sounds that are either true vowels (which are more open) or true obstruents (which have too much obstruction).	**Vowels** and **Obstruents** (Stops, Fricatives, Affricates).

The table below brings together the information from the previous tables to offer a comparative overview of the major class features. It illustrates key distinctions for each feature, emphasizing points of convergence and divergence among them.

Sound class	**[+/- consonantal]**	**[-/+ sonorants]**	**Key distinction**
Vowels	**[−]** (Unobstructed)	**[+]** (Always voiced)	They are the least obstructed and always voiced.
Glides	**[−]** (Unobstructed)	**[+]** (Always voiced)	They are vowel-like in obstruction but cannot form a syllable nucleus.
Nasals and liquids	**[+]** (Significant obstruction)	**[+]** (Always voiced)	They are **consonants** (due

			to obstruction) but are **sonorous** (due to continuous voicing and air flow, often through a side path like the nose or sides of the tongue).
Obstruent	**[+]** (Significant obstruction)	**[−]** (Not spontaneously voiced)	They are the most obstructed and lack the spontaneous voicing of sounds.

3.2. Place of Articulation Features

These features describe where in the vocal tract a sound is produced and which articulators are involved. Understanding place features is essential for analyzing how consonants (and some vowels) are distinguished and patterned in the world's languages.

The place features are grouped according to the **primary articulator** involved in sound production. Below is an overview of the most widely used system (after Chomsky & Halle, 1968).

Feature	Primary articulation	Description	Examples

[±labial]	Lips	Sounds made with one or both lips	**+labial:** /p, b, m, f, v/ **–labial:** /t, d, s, z/
[±coronal]	Tongue tip/blade	Sounds produced with the tongue tip or blade raised toward the upper teeth or alveolar ridge.	**+coronal:** /t, d, n, s, z, θ, ð, ʃ, ʒ/ **–coronal:** /p, k, g/
[±anterior]	Front of oral cavity	Specifies whether the sound is articulated at or in front of the alveolar ridge.	**+anterior:** /p, b, m, f, v, θ, ð, t, d, n/ **–anterior:** /ʃ, ʒ, tʃ, dʒ/
[±dorsal]	Tongue body	Sounds made by raising the tongue body toward the soft palate (velum) or hard palate.	**+dorsal:** /k, g, ŋ, j/ **–dorsal:** /t, d, s/
[±high]	Tongue height (vowels & dorsals)	Specifies whether the tongue body is raised close to the palate.	**+high:** /i, u, k, g/ **–high:** /a, ɔ, ɑ/
[±back]	Tongue position (front–back)	Indicates whether the tongue body is retracted toward the back of the mouth.	**+back:** /u, o, k, g/ **–back:** /i, e, t, d/

[±low]	Tongue height (vowels)	Specifies whether the tongue body is lowered toward the open vowel position.	**+low:** /a, ɑ/ **–low:** /i, e, o/

As shown in the above description, the place of articulation functions to systematically classify speech sounds according to their articulatory properties. By representing these contrasts through binary features, phonologists can account for the organization of sounds into natural classes and explain recurrent phonological patterns, such as assimilation or neutralization. The classification thus serves not only as a descriptive tool but also as a theoretical framework that links phonetic realization to underlying phonological structure. table

***NOTE*:** [+round] sounds are also [+labial]; however, not all [+labial] sounds are [+round]. e.g., /p/, /f/ can be articulated without lip rounding.

3.3. **Manner of Articulation Features**

Manner of articulation features specify the configuration and movement of the articulators and the airflow mechanism during speech production. They capture distinctions such as:

- Whether the airflow is completely blocked or partially restricted,
- Whether the sound involves nasal resonance or lateral airflow,
- Whether the articulators vibrate or remain stationary.

These features allow us to represent sounds **hierarchically and systematically**, showing how phonemes group into classes such as *stops*, *fricatives*, *affricates*, or *nasals*.

Feature	**Definition**	**Description/phonetic effect**	**Examples**
[±continuant]	Continuity of airflow through cavities	[+continuant]: Airflow continues through the oral cavity. [–continuant]: Airflow completely blocked at some point.	**+continuant:** /f, s, z, ʃ, v/ **–continuant:** /p, b, t, d, k, g/
[±nasal]	Use of nasal resonance	[+nasal]: Air passes through the nasal cavity due to lowered velum. [–nasal]: Velum raised, airflow through oral cavity only.	**+nasal:** /m, n, ŋ/ **–nasal:** /p, t, k, s/
[±lateral]	Airflow direction	[+lateral]: Air passes along the sides of the tongue. [–lateral]: Air passes through the center of the oral cavity.	**+lateral:**/l/ **–lateral:** /r, n, s/
[±delayed release]	Type of air release in affricates	[+delayed release]: Constriction released gradually (affricates). [–delayed release]: Instantaneous release (stops)	**+delayed release:** /tʃ, dʒ/ **–delayed release:** /p, t, k/

[±strident]	Intensity/noisiness of airflow	[+strident]: Greater turbulence or high-frequency noise. [–strident]: Softer or less turbulent airflow.	**+strident:** /s, z, ʃ, ʒ/ **–strident:** /θ, ð, f, v/

In summary, the table demonstrates how manner of articulation features classify speech sounds according to the degree and nature of constriction within the vocal tract. These binary distinctions make it possible to describe and compare a wide range of sounds systematically, revealing the structural relationships among stops, fricatives, affricates, and nasals. By organizing sounds in this way, phonologists can account for both cross-linguistic regularities and the patterned behavior of sounds within individual languages.

4. Illustrative Examples of Feature Matrices

Having outlined the major class, place, and manner of articulation features, we can now apply this framework to the analysis of individual sounds. The following examples demonstrate how these features combine to form a *feature matrix* for a given segment. Each matrix represents the distinctive feature composition of a sound, capturing its phonological identity within the system and illustrating how features interact to define natural classes.

A feature matrix displays the articulatory and auditory characteristics of a specific segment (phoneme) within the phonological system, highlighting the distinguishing characteristics that define it. A binary value is used to represent each feature: [+feature] for properties that are present, or [–feature] for those that are not.

❖ Example 1: /p/

Phonetic Description: voiceless bilabial plosive

Feature Type	Feature	Value	Explanation
Major Class	[sonorant]	–	Airflow completely blocked; not sonorous
	[consonantal]	+	Produced with oral constriction
Manner	[continuant]	–	Complete closure during articulation
	[nasal]	–	Oral, not nasalized
	[delayed release]	–	Instant release (not affricate)
Place	[labial]	+	Articulated with the lips
	[coronal]	–	No tongue blade involvement
	[dorsal]	–	Tongue body not active
Laryngeal	[voice]	–	Vocal folds do not vibrate

- **Summary:** /p/ is characterized as a [–sonorant, +consonantal, –continuant, -nasal, +labial, -coronal, - dorsal, –voice, -delayed release] sound.

❖ **Example 2: /n/**

Phonetic Description: voiced alveolar nasal

Feature Type	Feature	Value	Explanation
Major Class	[sonorant]	+	Continuous airflow (via nasal cavity)
	[consonantal]	+	Produced with significant oral constriction
Manner	[continuant]	–	Airflow blocked in oral cavity
	[nasal]	+	Air passes through nasal cavity
	[lateral]	–	Air does not flow along tongue sides

Feature Type	Feature	Value	Explanation
Place	[coronal]	+	Tongue tip/blade contact with alveolar ridge
	[anterior]	+	Articulation in front part of oral cavity
	[labial]	–	Not produced with lips
Laryngeal	[voice]	+	Vocal folds vibrate

- **Summary:** /n/ is [+sonorant, +consonantal, +nasal, +coronal, +anterior, - labial, lateral, +voice].

❖ **Example 3: /s/**

Phonetic Description: voiceless alveolar fricative

Feature Type	Feature	Value	Explanation
Major Class	[sonorant]	–	Turbulent airflow, not sonorous
	[consonantal]	+	Significant oral constriction
Manner	[continuant]	+	Airflow maintained through constriction
	[strident]	+	High-intensity noise
	[nasal]	–	Oral airflow only
Place	[coronal]	+	Tongue tip/blade at alveolar ridge
	[anterior]	+	Articulation at the front of the oral cavity
Laryngeal	[voice]	–	No vocal fold vibration

- **Summary:** /s/ is [–sonorant, +consonantal, +continuant, +strident, - nasal, +coronal, +anterior, –voice].

These examples show how unique characteristics work together to determine a sound's phonological identity. A structured collection of articulatory and acoustic characteristics that collectively define how a sound is produced and interpreted is represented by each feature matrix. This method also makes it possible to identify natural classes, or groups of sounds that have similar feature specifications and are thus subject to the same rules, like voicing alternation or assimilation. Furthermore, feature matrices facilitate the methodical connection of abstract representations to perceptible speech patterns, acting as a link between phonological theory and phonetic actuality. This analytical approach reduces the complexity of speech sounds to a predictive and cost-effective system of attributes that captures both language-specific differences and universal tendencies.

Having examined the major class, place, and manner of articulation features in the preceding tables, we can now consider how these features function together to define the identity of individual sounds. The tables provide a systematic representation of the binary properties that distinguish phonemes, highlighting both contrasts and natural classes. Building on this foundation, we can use **feature matrices** to capture the full profile of a sound, showing how multiple features interact to specify its phonological identity. At the same time, it is important to recognize that not all features need to be independently specified: some are **redundant**.

5. Redundancy

In phonology, the term **redundancy** refers to features of a sound that are **predictable or automatically determined** from other features, rather than being contrastive. Redundant features do not need to be specified independently in a feature matrix because they follow systematically from other features. For example, in English, all [+nasal] consonants are also [+sonorant]; thus, specifying [+nasal] automatically implies [+sonorant], making the sonorant feature **redundant** in this context. Recognizing redundancy allows phonologists to **simplify feature representations**,

focus on the distinctive properties that actually differentiate sounds, and understand how certain phonological patterns are universally constrained by the relationships among features. In essence, redundancy highlights the **economy and predictability** within sound systems and helps explain why not every articulatory detail needs to be explicitly listed in a phonological description.

To put differently, Redundant features mean that they are predictable from other features and do not contribute to phonemic contrasts. Understanding redundancy allows us to simplify feature representations, focus on the truly distinctive properties that differentiate sounds, and reveal the inherent economy and structure within phonological systems.

6. Practice

Activity 1 :

Instructions: For each of the following sounds, indicate whether it is

[-/+continuant], **[+/-nasal]**, **[+/-lateral]**, or **[+/-strident]**.

Sounds: /s/, /l/, /m/, /p/, /v/

Activity 2: Using the tables for major class, place, and manner, construct a feature matrix for the following sounds. Include the **laryngeal feature [+/-voice]**.

Sounds: /b/, /n/, /θ/

Activity 3: Compare the feature matrices of /p/, /t/, and /k/ then answer the following questions :

1. Which features are shared by all three sounds?
2. Which features differ ?
3. Are there any redundant features that can be predicted from others?
4. What natural class do these sounds form based on the shared features?

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Lecture 03: Phonological Processes and Rules Formalism

Overview

In this lecture we will extend the knowledge on phonological processes and explores how distinctive features interact dynamically through phonological processes. Furthermore, it exposes students to the methodical ways that sounds interact and alter in particular language contexts. Students will examine the types of processes that take place in different languages and how phonological rules codify these patterns. The lecture is divided into two sections: section one is devoted to phonological processes. Whereas section two is dedicated to discuss phonological rules formalism and the use of distinctive features.

Objectives

By the end of this lecture, students should be able to:

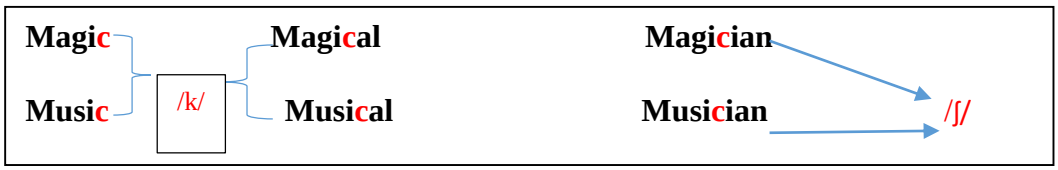
1. Define phonological processes
2. Differentiate between *phonetic variation* and *phonological alternation*.
3. Identify and classify common phonological processes in English and other languages.
4. Formulate phonological rules using distinctive features.
5. Analyze examples of natural data to derive underlying forms and corresponding rules.

Section 1: Phonological Processes

1.1 . Introduction

Human speech is a fundamental concern for phonologists and linguists in general. Part of our linguistic competence in any given language involves knowledge of its phonology. Specifically, the sound system and the ways in which sounds are organized and combined in speech. One of the central issues in phonological study concerns the rules and processes that govern how sounds interact when they occur together. The relationship between the **phonemic representation**, the abstract mental forms of sounds, and the **phonetic representation**—their actual spoken realizations—is governed by phonological rules that arise from systematic phonological processes.

Consider the following examples from the English Language:



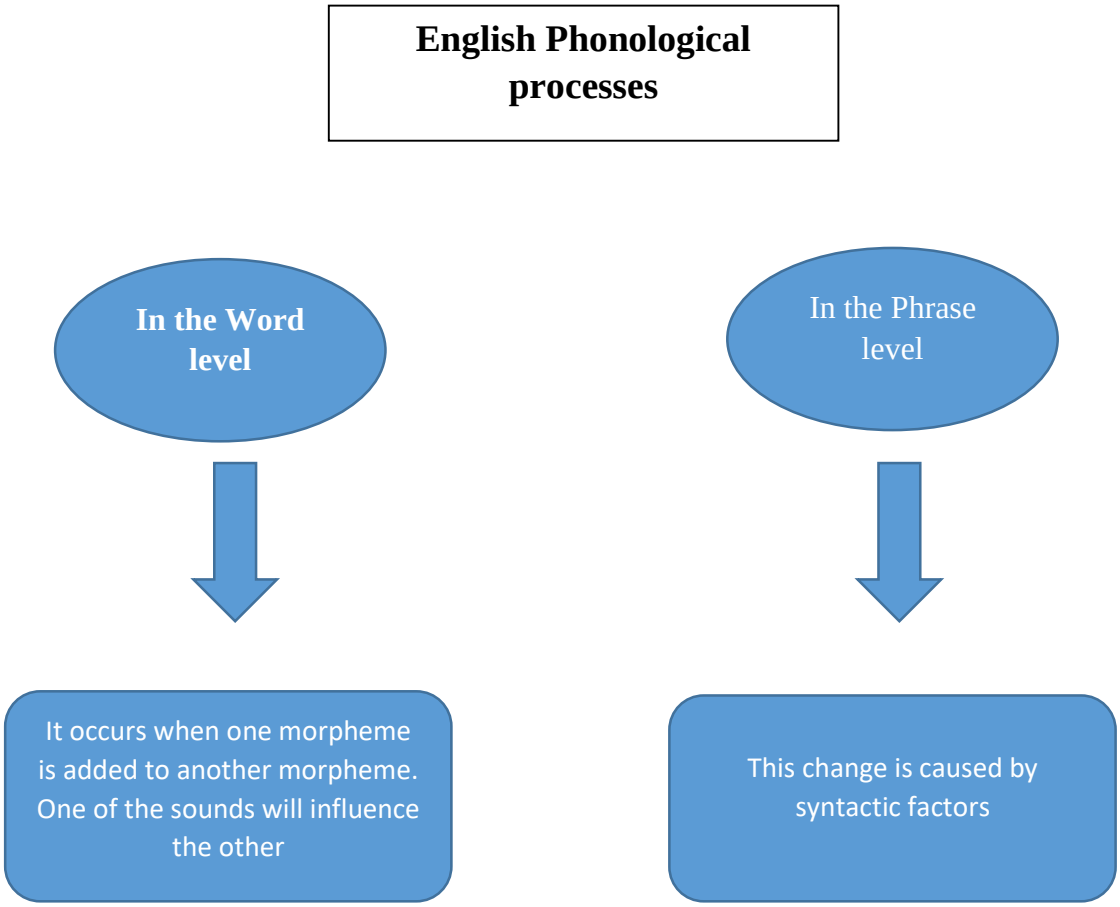
In the examples provided, we can observe how the pronunciation of certain sounds changes when forming new word derivatives in English. In the case of *magic* /ˈmædʒɪk/ → *magical* /ˈmædʒɪkəl/ → *magician* /məˈdʒɪʃən/, the final /k/ sound in the base word remains in the adjective but transforms into /ʃ/ in the noun, accompanied by a shift in stress from the first to the second syllable. A similar pattern occurs with *music* /ˈmjuːzɪk/ → *musical* /ˈmjuːzɪkəl/ → *musician* /mjuːˈzɪʃən/, where the /k/ changes to /ʃ/ in the noun form, and the stress moves to accommodate the morphological change. These changes reflect a combination of **phonological processes**, notably palatalization of /k/ before certain sounds.

By definition, **phonological processes** refer to the systematic changes that occur in the pronunciation of sounds when morphemes are combined to form words (Spencer, 1996). These processes are not random but follow regular and predictable patterns

governed by the phonological rules of a language. They explain how underlying or abstract forms—stored in the speaker's mental lexicon—are transformed into actual spoken forms in natural speech. Phonological processes may occur not only at morpheme boundaries, where affixes are attached to roots, but also in other phonetic environments such as word-initial, medial, and final positions. Such changes can involve the modification, addition, deletion, or reordering of sounds, ensuring that the resulting forms conform to the phonotactic and articulatory constraints of the language.

The English phonological processes occurred upon two levels:

1. In word level
2. Phrase level



The diagram illustrates that phonological processes in English function at both the word and phrase levels, each contributing to the natural flow and organization of

speech. At the **word level**, these processes operate within the boundaries of individual words, shaping how morphemes combine and how sounds adjust to fit the phonological structure of the language. At the **phrase level**, however, the focus shifts to connected speech, where words influence one another through processes such as assimilation, elision, and linking. Together, these two levels demonstrate that sound changes in English are not isolated phenomena but part of a broader, rule-governed system that ensures speech remains fluid, efficient, and natural in real communication.

1.2. Categories of Phonological Processes

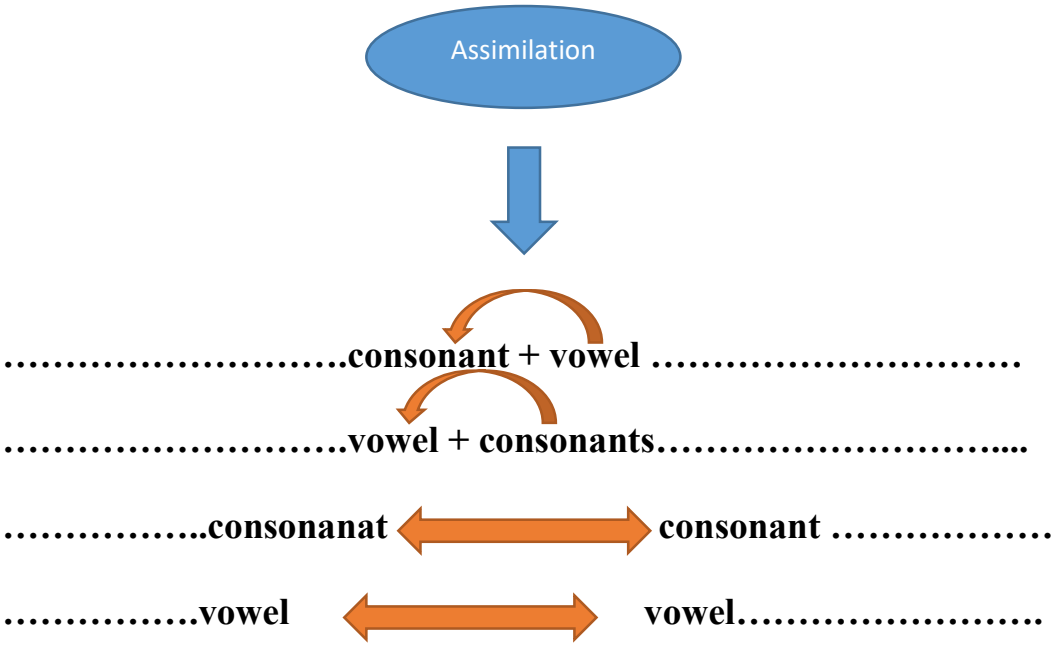
Phonological processes in English can be grouped into several major categories, depending on how and why the sounds change. These categories reflect the systematic patterns speakers use to produce speech that is easier and more natural. The main categories include assimilatory processes ,Syllable structure processes **,** and Neutralization.

Assimilatory Processes

Assimilatory processes occur when one sound becomes more similar to a neighboring sound in terms of one or more phonetic features, such as place of articulation**,** manner of articulation, or voicing. Assimilation helps speakers transition smoothly between sounds.
Examples include:

- Place assimilation**:** /n/ → [m] before bilabials as in *input* → [ˈɪmpʊt]
- Voicing assimilation**:** /s/ → [z] in plural forms as in *dogs* → [dɒgz]
- Manner assimilation *that side* → [ðæs saɪd], the alveolar stop /t/ becomes a fricative [s] resulting in a fricative manner assimilation in rapid speech.

Assimilation can occur within words (word-level) or across word boundaries (phrase-level), reflecting how connected speech naturally adjusts sound sequences for ease of articulation. Consider the following figure:



The figure above demonstrates the main **sound environments** in which phonological processes typically occur in English. These environments such as consonant followed by vowel (C + V), vowel followed by consonant (V + C), consonant followed by consonant (C + C), and vowel followed by vowel (V + V)—represent the points of contact where sounds interact and influence one another. Such interactions often lead to changes in pronunciation, including assimilation, elision, insertion, or linking.

This can be clearly observed in the above example *music* /ˈmjuːzɪk/, *musical* /ˈmjuːzɪkəl/, and *musician* /mjuːˈzɪʃən/. When the suffix **–ian** is added, the sequence of consonant and vowel sounds (C + V) triggers a **phonological adjustment**, causing the /k/ sound to change into /ʃ/ before the high front vowel /I/ in *musician*. This process, known as **palatalization**, occurs to make articulation smoother and maintain the natural flow of speech. Thus, the diagram highlights how specific sound environments, such as consonant–vowel contact, can give rise to systematic sound changes in English word formation. Understanding these environments helps explain why phonological processes are not random but occur systematically depending on the **position and relationship of sounds** within or across words.

Labialization

Labialization occurs when a sound, typically a consonant, is produced with additional lip rounding because of the influence of a nearby rounded sound, such as /w/, /uː/, or /ʊ/. The rounding feature spreads from one sound to another, giving the affected consonant a secondary articulation at the lips. It occurs when a sound, typically a consonant, is produced with additional lip rounding because of the influence of a nearby rounded sound, such as /w/, /uː/, or /ʊ/. The rounding feature spreads from one sound to another, giving the affected consonant a secondary articulation at the lips. **Labialization** is illustrated by examples from NUPE language, a western African language, in which native speakers add secondary articulation, lip rounding, to consonant sound as in:

egu [eg^{w}u] " mud"

ego [eg^{w}o] "grass"

It may occur across different places of articulation, notably, velar, alveolar, bilabial, resulting in pairs of consonants such as /k/ vs. /k^{w}/, or /s/ vs. /s^{w}/. These contrasts can signal different lexical items, meaning that the presence or absence of labialization changes the word's meaning.

Nasalization

Nasalization is another assimilatory process when a vowel takes the features of consonant. It is when a feature of a consonant is super-imposed on into a vowel. In this type of assimilation, the modification of the vowel is usually allophonic. Then, the nazal consonant affect the vowel and makes it nasalized. Consider the following example from the English Language:

man [mæn] → [mæ̃n]

sing [sɪŋ] → [sĩŋ]

hand [hænd] → [hæ̃nd]

Nasalization demonstrates the interaction between articulatory organs during speech production and shows how phonetic context influences sound quality. It is a clear example of how speech sounds overlap in time, creating smooth and efficient transitions between nasal and oral sounds.

Devoicing

Devoicing is a phonological process in which a **voiced sound**, notably a sound produced with vibration of the vocal cords, becomes **voiceless** under specific phonetic conditions. This change usually occurs to make articulation easier or to maintain consistency within a phonological environment. In CHATINO, a language spoken in Mexico, unstressed vowels are devoiced when they are between two voiceless consonants:

[tiye] "lime" [t̥hi] "hard"

[kino] "sandal" [ki̥su] "avocado"

[ku̥ta] "you will give

[ki̥ta] "you will wait"

Vowel Harmony

Vowel harmony in another assimilation phonological process in which one vowel assimilates to another vowel. To illustrate, the below examples are taken from the Turkish language:

[kol] arm [kolum] "my arm"

[ev] "house" [evler] "houses"

[gül] *"rose"* [gülüm] *" my rose"*

In Turkish, vowel harmony operates mainly through two interacting processes:

- **<u>Backness harmony</u>** ensures that all vowels in a word agree in terms of their position in the mouth—either **front** or **back**. When the root contains

a front vowel such as *e, i, ö, ü*, any vowel added through a suffix must also be front, as in *ev – evler* ("house – houses"). Conversely, if the root contains a back vowel (such as *a, ıu, o, u*), the suffix vowel will also be back, as in *kapı – kapılar* ("door – doors"). This creates a consistent articulatory pattern across the word.

- **Rounding harmony**, on the other hand, affects the shape of the lips and typically applies to high vowels in suffixes. If the last vowel in the root is rounded (*o, ö, u, ü*), the following suffix vowel will also be rounded; if it is unrounded (*a, e, ıu, i*), the suffix vowel remains unrounded. For example, *gül – gülüm* ("rose – my rose") shows rounding harmony.

Together, these two harmonies give Turkish its smooth, rhythmic sound and reflect the language's strong preference for phonological regularity.

1.3. Types of Assimilation

Assimilation can be divided into two main types: regressive assimilation and progressive assimilation**.**

Regressive assimilation

occurs when the change of one sound into another sound is influenced by a following sound.

Progressive assimilation:

happens when the change of the sound into another sound is affected by the preceding sound

In both cases, the change is governed by shared or transferred distinctive features, illustrating how speech sounds interact dynamically to maintain ease and fluidity in pronunciation.

1.4. Other Phonological Processes

Insertion

Insertion, also called **epenthesis**, is a phonological process where a sound either a vowel or a consonant is added to a word to make pronunciation easier or to conform to the phonotactic rules of a language., It helps to avoid difficult consonant clusters or awkward transitions between sounds., Often occurs for ease of articulation or to maintain syllable structure.

Examples:

- **English:**

  athlete → [æθəˌlit] insertion of schwa /ə/

  film → [fɪləm] in some English dialects.

- **Japanese:**

  Christmas → [kurisumasu] vowel inserted to break clusters.

Deletion

Deletion, or **elision**, is a process where a sound that is present in the underlying form is omitted in the surface pronunciation. It simplifies pronunciation by reducing complex clusters or unstressed syllables. Common in fast or casual speech.

Examples:

- **English:**

  friendship → [frɛnʃɪp] deletion of /d/.

  camera → [kæmrə].

- **French:**

petit ami → [ptitami] "boyfriend" – deletion of schwa.

- **Spanish:**

para esto → [paɾesto] deletion of unstressed vowel.

Both insertion and deletion show how languages adjust their sound patterns for articulatory ease and phonotactic regularity. These processes, along with assimilation and vowel harmony, illustrate the dynamic nature of phonological systems governed by distinctive features and phonological rules.

Section 2: Phonological Rules

2.1. **Definition**

Phonological processes and alternation in English are foundational topics in phonological theory, as they illuminate the dynamic relationship between underlying phonemic representations and their surface realizations in spoken language. Linguists such as Chomsky and Halle (1968) have argued that phonological processes are governed by systematic rules that operate within the mental grammar of speakers, reflecting universal principles of language organization and efficiency. These processes ensure that language adheres to constraints of articulatory ease and perceptual clarity, while simultaneously conforming to phonotactic rules and prosodic structures specific to each language. From a generative perspective, phonological alternations are not random but are deeply rooted in the abstract representation of sounds, with rules that apply hierarchically to derive surface forms.

Phonological rules describe how phonemes are realized as their allophones in a given environment. The latter typically in phonology refers to adjacent phonemes. According to Goldensmith (1995) phonological rules are defined as the alternation between two different levels of sound representation. Moreover, Hayes (2009) describes phonological rules as "generalizations" about the different ways a sound can

be pronounced in different environments. That is to say, phonological rules describe how a speaker moves from the abstract representation or the mental knowledge stored in his/her brain, to the actual sound they articulate when they speak which is the surface form.

In general, phonological rules start with the underlying representation of a sound (the phoneme that is stored in the speaker's mind) and yield the final surface form, or what the speaker actually pronounces. For example, the English plural -s may be pronounced as[s] (in "cats" , [z] in "beds", or as [iz] in "societies"; these forms are all stored mentally as the same plural morpheme /s/, but the surface pronunciations which are derived through a phonological rule are different. Phonological rules apply at multiple levels of speech, impacting both segmental (individual sounds) and suprasegmental (stress, intonation, and rhythm) elements of language. These rules are often formulated in terms of phonological processes, which can result in changes such as assimilation, deletion, insertion, and alternation of sounds. The rules often operate to simplify articulation, accommodate ease of speech, or comply with the phonotactic constraints of the language.

2.2. Key Concepts

A. **Underlying Form:** Underlying forms represent the mental or abstract representation of a word or sound..

B. Surface Form: surface forms represent how the word is actually pronounced. See the following figure:

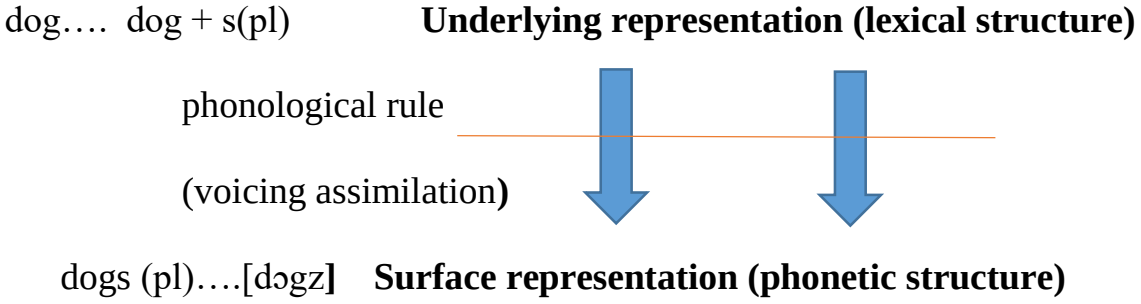


Figure 4: UR/SR in English language

The figure above illustrates the distinction between underlying and surface representations in the phonological component of the English language. In this framework, the underlying representation (UR) reflects how words and morphemes are stored mentally in their most abstract form, before any phonological rules are applied. The surface representation (SR), on the other hand, shows how these forms are actually pronounced after undergoing rule-governed changes.

For example, in the English word "*dog…..dogs"*, the plural morpheme is mentally represented as /-s/. However, when it follows the voiced consonant /g/ in *dogs*, a voicing assimilation rule applies, changing the voiceless /s/ into the voiced [z]. As a result, the surface form is [dɔgz], not [dɔgs].

2.3. Phonological Rules Formalism

The previous discussion demonstrates how phonological rules bridge the gap between these two levels, showing how abstract phonemes are transformed based on their phonetic or phonological context. A single underlying phoneme might have multiple allophonic realizations depending on its position in a word or the surrounding sounds. Chomsky and Halle (1968), in The Sound Pattern of English, introduced the idea that these rules are part of a speaker's mental grammar, systematically applied to ensure consistency in how sounds are produced.

Furthermore, phonological rules act as a bridge between abstract mental forms and concrete spoken output. Such representations are best analyzed in terms of distinctive features, which allow linguists to describe these transformations more systematically.

Phonological rules can be formally expressed using a generative approach, often written in a format like:

A → B / X _ Y

A → B / X _

A → B / _ Y

The above illustration indicates that sound A becomes sound B in the context where it is preceded by X and/or followed by Y. These rules account for systematic variations across contexts and demonstrate the predictive nature of phonology. Chomsky and Hall (1968) introduced the "# " symbol in their generative phonology framework to represent the boundaries between words in connected speech, providing a way to show how phonological rules apply across different segments of speech. The idea was to distinguish between different levels of phonological representation. Consider the following example:

A type of assimilation that happens frequently in English is **voicing assimilation**. A voiceless consonant can become voiced if it is adjacent to a voiced sound:

/s/ → [z] / __ [b, d, g, v, ð, z]

The above rule states that /s/ is voiced to [z] when it occurs before voiced sounds like /b/, /d/, /g/, etc. This is a process of regressive assimilation, where the following sound influences the preceding sound.

It is of great importance to recognize that rules can also be formulated at a **more abstract and systematic level** using **distinctive features**. While phoneme-based rules describe changes between specific sounds as in the example of /s/ → [z], feature-based rules capture the **shared properties** that underlie such changes. This approach allows linguists to generalize across broader classes of sounds and to explain why certain patterns recur across languages. That is to say, by referring to **features such as [+voice]**, **[−nasal]**, or **[+continuant]**, rules become not only more economical but also

more explanatory, as they reflect the internal organization of the sound system. Let's have the example of voicing assimilation in English language:

To formulate a rule for voicing assimilation using distinctive features, we will break down the features involved in this process. In distinctive feature theory, phonemes are analyzed in terms of binary features as [+voice] and [-voice], as well as [+nasal], [+continuant], and so on. Hence, in voicing assimilation we focus primarily on the [+voice] and [-voice] features of consonants.

Voicing assimilation rules:: /s/ → [z] / __ [b, d, g, v, ð, z]

Within the distinctive feature theory:

[−voice] → [+voice] / __ [+voice]

Breakdown of Features:

/s/ is [-voice] (voiceless), and /z/ is [+voice] (voiced).

[b, d, g, v, ð, z] are all [+voice] sounds (voiced).

The rule states that a voiceless sound [−voice] becomes voiced [+voice] when it occurs before another voiced sound [+voice].

Features:

- /s/ sound has the distinctive features:[−voice] (voiceless)[+coronal] (produced with the tongue tip)[−sonorant] (obstruent)
- /z/ has the distinctive features: [+voice] (voiced)[+coronal] (produced with the tongue tip) −sonorant] (obstruent)

Full Distinctive Features Representation:

/s/ → [z] / __ [+voice]

[−voice, +coronal, −sonorant] → [+voice, +coronal, −sonorant] / __ [+voice]

Another clear example illustrating how phonological rules operate across languages can be drawn from **French vowel nasalization**. In French, certain vowels become **nasalized** when they occur before a nasal consonant is deleted in the surface form.

a. Segmental rule:

/V/ → [Ṽ] / __ [n, m, ŋ]

Where:

- /V/ represents the underlying oral vowel.
- [Ṽ] represents the surface nasalized vowel denoted by a tilde (diacritic), indicating nasalization.
- nasal consonants like /m/, /n/, /ŋ/, which trigger the nasalization of the vowel when they appear in the environment around it.

Secondary rule:

/n,m, ŋ/ → ∅ / Ṽ __ #.

That is, the nasal consonant is deleted when it follows a nasalized vowel and occurs in word-final position. Together, these rules explain alternations such as:

/bɔn/ → [bɔ̃] ‘good’

/fin/ → [fɛ̃] ‘fine’

b. **Feature-based Rule**:

[±high] [±low] [±back] [±round] → [+nasal] / __ [+nas]

In the Example of : "bon" [bɔ̃] “good)”

/ɔ/ has the features matrix [+open, -high, -back, -round].

[ɔ̃] becomes [+open, -high, -back, -round, +nasal]

So,

Underlying form: /bɔn/

when applying the nasalization process then the deletion process, respectively

Surface form → [bɔ̃]

This process demonstrates how phonological rules can interact, one rule introducing a feature, nasality, and another deleting the triggering consonant, resulting in a systematic alternation between oral and nasal vowels.

Practice

Read each example carefully. Identify the **phonological process** illustrated in each case. e.g., assimilation, insertion, deletion, devoicing, nasalization….. Then, briefly explain what happens in terms of **distinctive features** if possible.

Underlying Form	Surface Form	Process	Explanation
/in+possible/	[ɪmpɒsɪbəl]		
/hænd+bæg/	[hæmbæg]		
/dɒg+s/	[dɔgz]		
/tɛn+θ/	[tɛ̃nθ]		
/film/	[fɪləm]		
/bɛd/	[bɛt] (in certain dialects)		
Japanese: /desu/ → [des] (in fast speech)			

Activity 2: **Writing Phonological Rules**

Write the formal phonological rule that derives the surface form from the underlying representation. Use either segment symbols or distinctive features.

Example:

- *English plural allomorphy:*
  /s/ → [z] / [+voice] __
  → voiced assimilation rule (progressive assimilation)

Now, write the rules for the following:

1. /in+possible/ → [ɪmpɒsɪbəl]
   → _____
2. /tɛn+θ/ → [tɛ̃nθ]
   → _____

3. /film/ → [fɪləm]
   → _____
4. /dog+s/ → [dɔgz]
   → _____

Activity 3 : Derivation Practice

Show the step-by-step derivation from the underlying form (UR) to the surface form (SR) using phonological rules.

Example :

Underlying form: /in+correct/

1. Place /n/ before /k/
2. Assimilation rule: /n/ → [ŋ] / __ [+velar]
3. Surface form: [ɪŋkərekt]

Do the following :

1. /in+possible/ → [ɪmpɒsɪbəl]
   Steps:
   a. _____
   b. _____
   c. Surface form: _____
2. /dog+s/ → [dɔgz]
   Steps:
   a. _____
   b. _____
   c. Surface form: _____
3. /film/ → [fɪləm]
   Steps:
   a. _____
   b. _____
   c. Surface form: _____

4. **Rule Ordering and Interaction**

Consider the following data and determine the correct **rule order**:

Underlying Form	Surface Form
/tɔp+z/	[tɔps]
/dɔg+z/	[dɔgz]
/bʌs+z/	[bʌsɪz]

1. What are the two rules involved?
   - Rule 1: _____
   - Rule 2: _____
2. Which rule must apply **first**, and why?

……
……
……
……
…….

Activity 5: Distinctive Feature Practice

Use distinctive features to express the following rules:

1. **Final devoicing** as in German, Dutch, or some English dialects:
   [+voice] → [−voice] / ___ #
2. **Nasal assimilation:**
   [+nasal] → [αplace] / ___ [αplace]
3. **Progressive voicing assimilation:**
   [−voice] → [+voice] / [+voice] ___

Now, write the feature-based rule for labial assimilation in the word *impossible* from /in+possible/:
→……
……
…….

Discuss the Following Questions:

1. Why are **phonological rules** essential for explaining variation between underlying and surface forms?
2. How do **distinctive features** make phonological rules more general and powerful?
3. In what ways can **rule ordering** affect the surface form of words?

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Lecture 04: Syllable Structure

Overview

The present lecture introduces the concept of syllable structure, a fundamental unit of phonological organization that links segmental sounds to rhythmic patterns in speech. Understanding the internal structure of the syllable is essential for analyzing how sounds combine and how syllable boundaries are determined across languages. The discussion will explore key principles governing syllable formation, including the Sonority Principle and the Maximal Onset Principle.

Objectives

By the end of this lecture, students should be able to:

1. Define the concept of the syllable and describe its internal structure
2. Explain the Sonority Principle. and its role in determining permissible sound sequences within a syllable.
3. Apply the Maximal Onset Principle to correctly assign syllable boundaries in different linguistic contexts.
4. Analyze examples of syllable-based phonological processes

1. The Syllable

Sounds in natural languages constitute a hierarchical structure called the syllable. Kahn (1968: 20) defines the syllable as "*a unit of perception and production larger than the segment and smaller than the word".* In other words, the syllable referred to the smallest phonological unit found in languages. Moreover, kreidler (1976) put that the syllable is a group of segments or phonemes that occupies a certain position in the syllable. In that, it arranges consonants and vowels into units. The core of the syllable is the nucleus; it is most often a vowel or a combination of two vowels. To illustrate, the word "dinner" in the English language is composed of two syllables: 'di' and 'nə'.

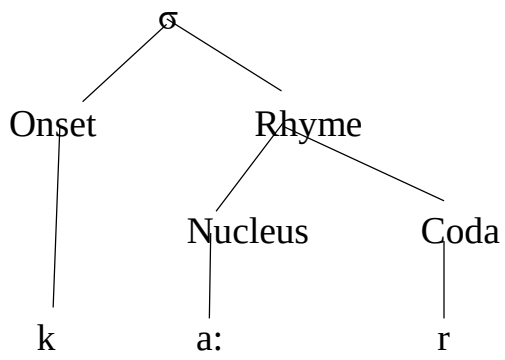
The syllable is a central concept **in phonology**, serving as a key unit in the organization of speech sounds. While its definition and role are debated among linguists, it is broadly understood as a grouping of sounds centered around a sonority peak, typically a vowel (Kenstowicz, 1994). The study of syllables sheds light on

linguistic universals and cross-linguistic variation, as well as phonotactic constraints that shape word structures.

From a **phonetic point of view**, syllables are usually described as consisting of a center which has little or no obstruction to airflow and which sounds comparatively loud; before and after the center, there will be greater obstruction to airflow and/or less loud sound.

2. The Internal Structure of the Syllable

The internal structure of the syllable is binary branching (Kiparsky, 1980; Spencer, 1996; Prince and Smolensky, 2004). The syllable is presented by the node **σ** and consists of an onset and a rhyme. The rhyme branches into nucleus and a coda whereby the nucleus is more often occupied by vowels and are accordingly peaks or nuclei. On the other hand, onsets and coda are associated with consonants. Noteworthy, the onset and coda might be attached with more than one consonant, yielding a cluster. By way of illustration, in the word ‘car’ [ka:r] from the English language, [k] is the syllable onset, [a:] is the nucleus, and [t] the coda. It’s syllable structure has the following tree:



The onset-rhyme model shown in the syllable tree was suggested by Selkrik (1978, 1982) and then adopted by other phonologist as a linguistic universal model to account for the syllable structure in languages. To sum up:

- The obligatory vowel within the syllable structure, The core and most sonorous part of the syllable = **Nucleus** (N) / peak (center)
- The optional consonant(s) that can precede the nucleus = **onset** (O)
- The optional consonant(s) that can follow the nucleus = **coda** (C)
- The Rhyme (or Rime) is the combination of the nucleus and coda.

To make generalizations when we describe syllable shapes, it is useful to represent consonant sounds with a capital "C" and vowel sounds with capital "V.", the syllable structure in the English word "cat" is represented as CVC.

The sonority hierarchy principle, the Maximal onset principle and the phonotactic constraints (Katamba, 1993:154) restrict the arrangement of consonants within a syllable into onset and rhyme across langauges.

3. The Sonority Hierarchy Principle (SSP)

Sievers (1893) is the first linguist who introduced the term sonority in linguistics. He stated that sonority referred to the loudness of speech sounds in languages. That is, sounds in all languages are produced with different degrees of vibration whereby sounds with great vibration are more sonorous than sounds with less vibration (Sievers 1893). In this regard, segments are ranked within the syllable according to their level of sonority. Vowels are the most sonorous segments in the syllable whereas the consonants are less sonorous. For instance, much effort is needed in the production of the vowel [i] than in the production of the stop [k]. Therefore, the vowel [i] would be

place higher than [k] on the sonority scale. Sonority serves as a crucial organizing principle in phonology, particularly in the analysis of syllable structure, as it helps predict the preferred arrangement of sounds within syllables.

3.1. Definition of Sonority

In its most general sense, sonority is a measure of the acoustic energy, loudness, or resonance of a sound relative to others. More precisely, it refers to the degree of openness of the vocal tract and the intensity of airflow during the production of a given sound (Kenstowicz, 1994). Sounds with a greater degree of vocal tract openness, such as vowels, are considered more sonorous than sounds produced with greater constriction, such as stops.

3.2. The Sonority Hierarchy

The Sonority Hierarchy, also known as **the Sonority Scale**, is a ranking of speech sounds based on their relative sonority. While minor variations exist in its formulation across languages and linguistic traditions, the most widely accepted scale is as follows (Selkirk, 1984):

1. Vowels: Most sonorous due to the complete lack of constriction in the vocal tract.

2. Glides: /j/ and /w/, which are similar to vowels in their articulation but involve more constriction.

3. Liquids: /l/ and /r/, which allow significant airflow but involve some constriction.

4. Nasals: /m/, /n/, /ŋ/, which involve airflow through the nasal cavity while the oral cavity is obstructed.

5. Fricatives: /s/, /z/, /f/, /ʃ/, characterized by turbulent airflow through a narrow constriction.

6. Stops: /p/, /t/, /k/, /b/, /d/, /g/, which involve complete closure of the vocal tract and, thus, minimal sonority.

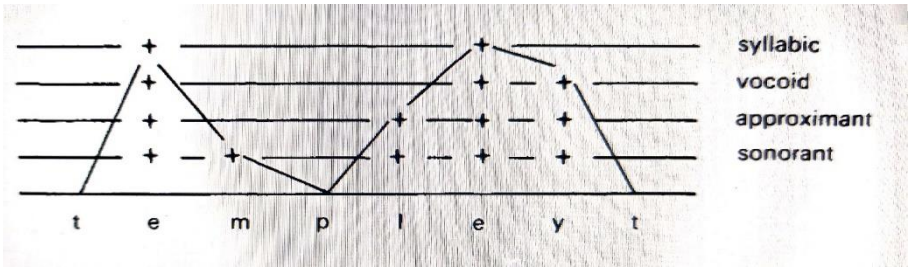
The hierarchy or the sonority scale dictates that speech sounds are scaled from the most to least sonorous whereby onsets rise in sonority towards the nucleus and coda fall in sonority from the nucleus. Different scales of sonority hierarchy were suggested (Blevins 1995; Hooper 1976; Selkirk, 1984; Ohala, 1990a, 1990b; Parker, 2008). Phonologists confirmed that speech sounds are ranked along the sonority scale according to their natural classes. Katamba (1980) proposed the following scale hierarchy scale where '>' means 'has greater sonority than:

1. Vowels >Glides > Liquids > Nasals > obstruent. (Katamba, 1980: 158)

Natural classes in (1) motivates the ranking of sounds' sonority and facilitate the employment of the sonority principle and it is easier to derive the sonority scale from phonological features. For example, [liquids] are more sonorous than [nasals], and [glides] are more sonorous than [liquids]. Nonetheless, within a syllable, the most sonorous sounds are vowels and they should associate the nucleus. They are called also the peak. By adopting the SSP and the hierarchy in (1), hypothetical syllables in [ma], [du], [bin], and [fænt] are well formed. Their sonority slope ascends from the right edge (onset) of the syllable to the nuclear vowel and descends from the nucleus to the left margin (coda) of the syllable. Conversely, syllables containing sonority reversals such as [rna] and [iml] violate the sonority principle and are prohibited in most languages. Parker (2008:60) model provided more details on natural classes of sounds as follows:

Vowels>glides>liquids>nasals>voiced-fricatives>voiced-affricates>voiced-stops>voiceless- fricatives>voiceless affricates>voiceless stops.

In a nutshell, the Sonority Sequencing Principle (SSP) is a universal linguistic principle that governs how sounds are ordered within syllables based on their relative sonority. Clements (1990) argued that in any given syllable, sounds should rise in sonority from the onset to the nucleus and decrease in sonority from the nucleus to the coda.



Sonority Cycle (in Clements, 1990: 300)

In the above sonority cycle, the sonority rises toward the peak of the syllable and descends in the margins. In this respect, Clements (1990) stated that syllable are created by following three main steps. First, we need to determine the syllabic segments as known in the language that we are interested in and associate it to the syllable node. Furthermore, other segments which are [-syllabic] are positioned to the left side of the previously mentioned syllabic peak and then apply the same operation to the unsyllabified segments on the right side. Noteworthy, marginal segments have lower sonority values.

4. The Maximal Onset Principle

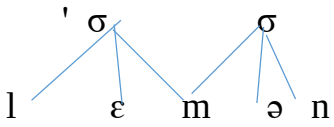
The maximal onset principle also determines the underlying syllable division. Pulgram (1970) suggested that intervocalic consonants should be syllabified as the onset of the following vowel as far as possible. Furthermore, consonantal segments between two vocalic segments are associated with the onset of the nucleus as long as there is no violation of the SSP. As a case in point, the following words from the English language are syllabified in accordance with the maximal onset principle as follows:

[ka.ri] ‘carry’ *[kar.i] because [r-] is a possible onset

[ha.pi] ‘happy’ *[hap.i] because [p-] is a possible onset

As illustrated in the above examples, the consonants [r] and [p], stand between vowels, which make it difficult to assign such consonants to the first syllable or to the other. To account for such a problem, Clements and Keyser (1983) suggest referring to the maximal onset principle and syllabifying CVCV syllable type as CV.CV. Accordingly, the consonants [r], [p], are associated to the following syllable node.

Yet, the maximal onset principle did not account for issues related to stress rules. For example, in ['lɛ.mən] ‘lemon’ the stress falls on the first syllable which ends in [ɛ]. To solve such problem, Kahn (1976) suggested that in syllable of the type VCV, if the first V is lax and stressed, the syllabification is realized as VCV, where C belonging to both the first and the second syllables. The main concept is that some consonants may belong to more than one syllable at a time. These consonants are called **“ambisyllabic”** (Hayes, 2009: 04). **The ambisyllabic consonants** are dominated by two syllable (σ) nodes as shown in :



5. Types of Syllables

- **Monosyllable**

A word that consists of a single syllable is called a monosyllable and is said to be monosyllabic like: Bear ,can, dish , deal , Ball , bat

- **Disyllable**

It is for a word of two syllables as in ; Contact , Rocket ,Chicken , Pillow.

- **Trisyllable**

It is for a word of three syllables; Beautiful ,Terrible ,Horrible , carefully

- **Polysyllable**

which may refer either to a word of more than three syllables **or** to any word of more than one syllable.

Practical Activities:

- **Activity 1: Syllabification and Internal Structure**

Syllabify the following words and identify the **onset (O)**, **nucleus (N)**, and **coda (C)** of each syllable.

1. problem
2. teacher
3. extra

- **Activity 2: Application of Syllable Principles**

Read the following items and answer the questions.

a) Syllabify the word **/əˈprəʊʧ/** (*approach*) according to the **Maximal Onset Principle**.

b) Briefly explain how the **Sonority Principle** helps justify your syllabification.

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Lecture 05: Syllable-Based Processes

Overview

Lecture Five explores syllable-based phonological processes, which are sound changes that occur due to the structure and organization of syllables within words. Understanding these processes is essential for analyzing how syllables influence pronunciation, rhythm, and speech patterns across languages. The lecture examines key phenomena such as **epenthesis, deletion, and resyllabification**, emphasizing how speakers adjust syllable structures to maintain ease of articulation and phonotactic balance.

Objectives

By the end of this lecture, students should be able to:

1. Define and describe major syllable-based phonological processes and their linguistic significance.
2. Identify examples of syllable restructuring such as epenthesis, deletion, and resyllabification in various languages.

3. Apply knowledge of syllable-based processes to explain pronunciation variations in English and other languages.

Introduction

The dynamic field of phonological studies, which is constantly evolving, has reached a consensus on the pivotal role of the syllable in phonological analysis. Indeed, processes that are based on syllables occur within them and traverse syllable boundaries. The process of syllabification, along with the arrangement of syllables into words and sentences, initiates phonological processes. Furthermore, the phonotactic constraints of languages dictate the sequence of words within syllables, ensuring they adhere to the acceptable order of sounds in the language (Crystal, 1997).

Syllable-based processes, also known as repair strategies, re-syllabify elements (consonants and vowels) within a syllable. This complex array of phonological processes involves the deletion or insertion of elements to maintain the permissible syllable structure of a given word in languages. A significant number of phonological repair strategies, such as assimilation, syncope, epenthesis, weak or unstressed vowel deletion, metathesis, final consonant deletion, and vowel shortening, showcase the intriguing complexity of phonological processes with a direct reference to the syllable (Azieb and Mahadin, 2018).

5.1. Vowel Epenthesis

Vowel epenthesis is , as defined by Hall (2011: 123), is a key concept in linguistics. It refers to any process where a vowel is added to an utterance, activated to satisfy language-specific constraints and create well-formed syllables. For instance, Abdul-Karim's (1980) investigation into vowel epenthesis in Lebanese Arabic is a significant contribution to our understanding of this process. His findings, such as the insertion of the vowel[i] to avoid the violation of the SSP in the CC final cluster, are engaging. Consider the following. Consider the following example: (Abdul-Karim ,1980:180)

a. /?ism/ [?isim] ‘name’ b. /kibʃ/ kibʃ ~ kibʃ ‘ram’

/?ibn/ [?ibin] ‘son’ /sabt/ sabt ~ sabit ‘Saturday’

/ʃ i ɣ il/ [ʃ i ɣ il] ‘work’ /nafs/ nafs ~ nafis ‘self’

In a similar fashion, most of Libyan Arabic dialects prohibits consonant clusters in word final domain As in words like /ʒɪb-t/ ‘I brought’ which surfaces as /ʒɪbɪt/ (Huwaidi, 2016: 117) It is assumed that a vowel is inserted to break the final /bt/cluster, creating /ʒɪbɪt/ where /b/ constitutes the onset of the first syllable and /t/ constitutes the coda of the new syllable.

One may claim that vowel epenthesis in the mentioned examples targets the form of the syllable CVCC and changes it to a bi-syllabic form as /CVCVC/. Yet, the motivation behind such process differs from one dialect to another. As seen in

Lebanese Arabic, the epenthesis targeted CC clusters that present sonority reversals whilst in Libyan Arabic the epenthesis targeted any CC cluster word-finally.

5.2. Deletion

The deletion process, a complex and intriguing linguistic phenomenon, involves omitting a consonant or a vowel within a word to satisfy the syllable requirement in a specific language or dialect. Azieb and Mahadin (2018) found that normal Algerian children speaking the Jijilian dialect account for several syllable-based processes in their speech. One example is the deletion of weak and unstressed syllables. They stated that weak syllables are omitted in words consisting of two or more syllables, highlighting the intricate nature of language evolution and the challenges it presents to researchers. Consider the following illustration in:

Adult Form	**Child Form**	**Gloss**
[də'bana]	[bana]	'fly'
[ʒə'dɪ]	['dɪ]	'grandfather'
[sən'dala]	[dala]	' sandal’

5.3. Metathesis

Metathesis is another syllable-based process. It is defined as *“ the order of sounds and the syllable boundary make inconvenience”* Granmot (1985: 239) . It causes a group of sounds to be placed to be easier for the speaker. That is to say, syllables in a certain language are organized according to its phonotactic constraints to be well formed and

in some cases violation of syllable template might be captured by metathesis. Moreover, metathesis serves a phonological purpose in different languages to build a more acceptable structure. For example, in Judeo-Spanish syllable of CVC1C2 structures, whereby the two adjacent consonants are identical in place, manner and voicing are prohibited. They might be subject for metathesis creating the output CVC2C1.

To conclude, successive research studies, researchers, including, Kahn (1976) and McCarthy (1979a, 1979b) argued for the important role of syllable in analyzing phonological issue in different languages.

Practical Activities: Syllable Structure

- **Activity 1: Syllable Identification and Structure Analysis**

Syllabify the following words and identify the **onset (O)**, **nucleus (N)**, and **coda (C)** of each syllable.

1. extra
2. computer
3. strength

- **Activity 2: Application of the Sonority and Maximal Onset Principles**

Consider the word **/əˈnɑːlɪsɪs/** .

a) Syllabify the word according to the **Maximal Onset Principle**.
b) Explain briefly how the **Sonority Principle** supports your syllabification.

- **Activity 3: Syllable-Based Phonological Processes**

Identify the syllable-based phonological process involved in each example and explain its function.

1. *camera* → [ˈkæmrə]
2. *handbag* → [ˈhæmbæg]
3. *athlete* → [ˈæθəliːt]

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Lecture 06: An Introduction to Autosegmental Theory

Overview

This lecture introduces students to the fundamental principles of Autosegmental Phonology, with a particular focus on the X-skeleton representation. The session will explain how this model moves beyond traditional linear approaches by representing phonological features and timing units on separate but connected tiers. Students will explore how the X-tier provides an abstract framework for organizing segments according to their position and timing within a word, allowing for a clearer understanding of processes such as segment insertion, deletion, and compensatory lengthening. Through visual diagrams and examples, the lecture will demonstrate how the X-skeleton captures the hierarchical and non-linear nature of phonological structure.

Objectives

At the end of this lecture, students will be expected to:

1. Explain the main principles of Autosegmental Phonology.

2. Describe the structure and function of the X-skeleton (CV-tier) as a representation of segmental timing.
3. Demonstrate how the X-skeleton accounts for the process compensatory lengthening.

1. Introduction

In previous lectures, we examined how phonological rules and representations are typically described in linear models as distinctive features, where sounds are arranged in a one-dimensional sequence or group of segments. While such models effectively describe segmental alternations, they often fail to represent non-linear relationshi**ps**, such as when certain features or structures extend across multiple segments. To overcome these limitations, Autosegmental Phonology was developed as a non-linear model that allows multiple levels or tiers to represent different aspects of phonological structure.

2. Definition of Autosegmental Theory

Leben (1973) proposed the Autosegmental theory (AT) as a collaborative effort to solve the puzzle of tone independence from segmental systems. This theory, which has since been expanded to analyze a wide range of phonological problems, including vowel harmony (Clement and Sezar, 1983), has been the subject of numerous research studies aiming to propose a more reliable and satisfactory approach to tonal representation and analysis. Goldsmith (1976) further developed the autosegmental model, suggesting that the underlying representation is multi-tiered rather than a linear string of segments. In essence, the theory posits that autosegments appear at different levels, called tiers, and that a new mechanism of association between the tiers is adopted.

The new convention in the autosegmental framework on the derivation form suggested by Goldsmith (1976) and adopted by McCarthy (1979) is called ‘the **Well-**

Formedness Condition' (henceforth, WFC). The WFC is a set of rules that determine the validity of a phonological structure, ensuring that it adheres to the principles of the autosegmental theory.

works at deleting or adding association lines at any step throughout the derivation process. The WFC dictates that:

a) All vowels are associated with at least one tone; all tones are associated with at least one vowel (as in c).

(b) Associated lines do not cross (as in d).

By a way of illustration, consider the hypothetical tonal representation in (c and d):

c. Segmental tier ta ta ta

Melody tier L H L

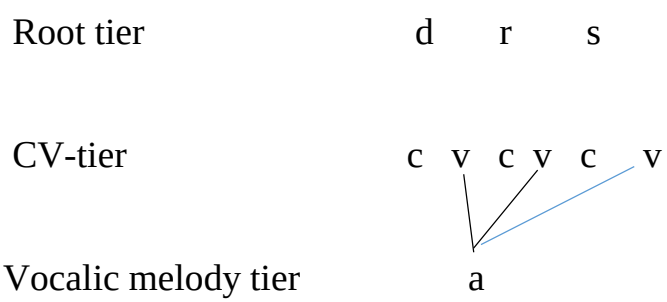
d. Segmental tier * ta ta ta

Melody tier L H L

The crossed associated lines are unaccepted in (d) and hence the well-formed alignment is represented in (c).

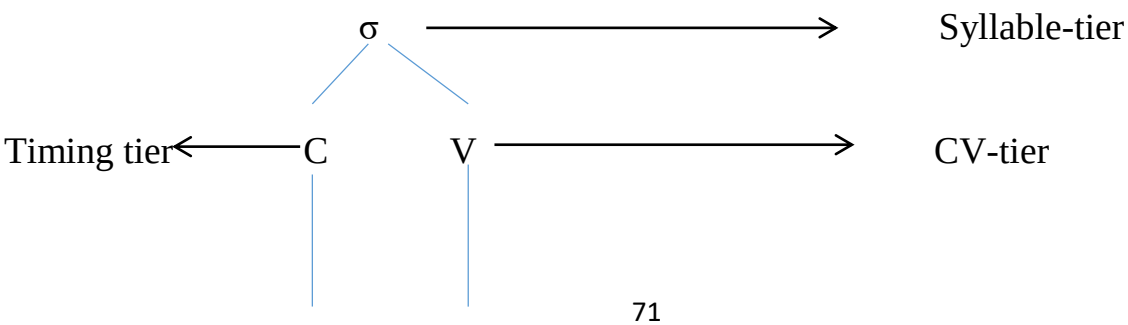
The recent version of autosegmental theory is adopted in McCarthy (1979a). McCarthy (1979a), among others, extended autosegmental model to the verbal derivation of the Arabic language. He stated that form of Arabic verbs are derived from a consonantal root in which consonants and vowels belong to separate morphologically

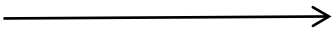
defined tiers; That is, root tier , the segment tier and the vocalic tier. The segment tier or the CV-tier is encoded as a string of C's and V's. By way of example, the tri-consonantal verb [darasa] 'he studied' in Arabic is represented in terms of three separated and independent tiers as in the following example:



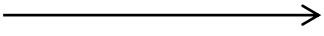
/darasa/ 'he studied"

The approach is grounded on a hierarchical order of linguistic elements rather than a linear one; segments are autonomous or independent from each other and phonological processes are described in terms of spreading feature rather than copying. In this regard, syllable is delineated through a hierarchical representation known as tiers. They are as the following: the syllable node/ tier (σ), the CV-tier that consists of the [C] and the [V], and the melody tier. The consonants and vowel segments dominate the CV-tier while the melody tier consists of bundles of distinctive features that represent consonant and vowel segments. Consider the following example:



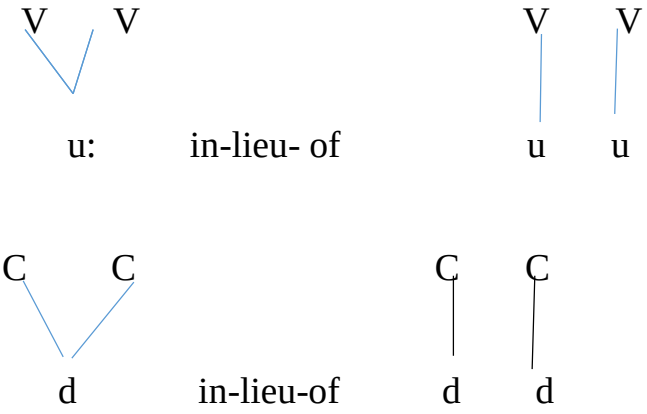


Association lines

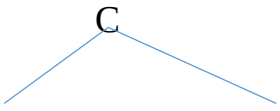
Melody tier  [k] [u]  Segmental tier

The above diagram shows that the [v] element of the CV-tier represents the peak of sonority (nucleus) while the [C] element represents the syllable onset and coda (also known as the margins). These elements show immediate constituent structure; that is, the syllabic node immediately dominates the CV-tier and the segmental tier are all immediately dominated by the CV-tier. This representation show: one-to-many, many-to-one and one-to-one associations (Mahadin, 1994: 49-51):

One-to-many is displayed in the representation of long vowels and geminate consonants:



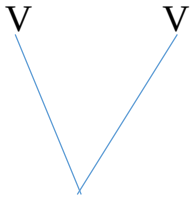
Many-to-one is depicted in the representation of affricates:



t ʃ

One-to-one is represented in the following example:

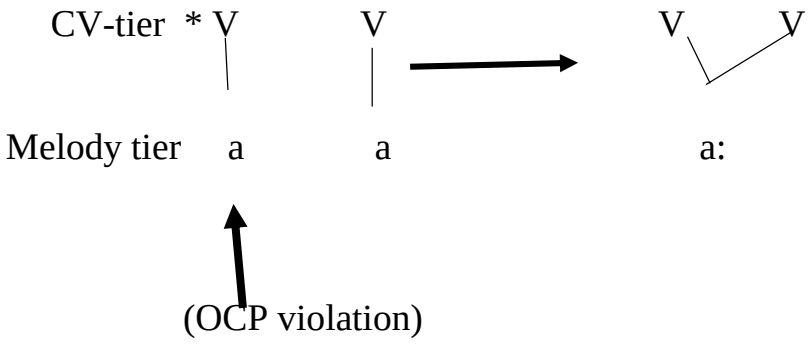
In addition, an important motivation to adhere to the autosegmental approach is the aptitude to address the omission of the feature [long]. Long vowels in autosegmental model are represented as sequences of two VV on the CV-tier associated to one feature matrix. The autosegmental theory proposes that long segments are treated as a single melodic element. They attached to two V positions in line with the Obligatory Contour Principle as in :



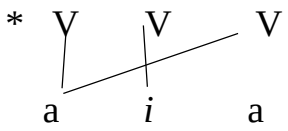
[i] = [i:]

3. The Obligatory Contour Principle

This is the second important principle in the autosegmental phonology. The OCP was first suggested in Leben (1973) and then revised in Goldsmith (1976). The principle was proposed to account for the nature of tones of underlying segments in the African tonal languages. He stated that identical tones at the melody tier are not sanctioned. Later, it was expanded to include some distributional constraints in Arabic. According to him, the OCP dictates that at the melodic level, adjacent identical elements are prohibited and segments of the same nature are not allowed at the melody tier (McCarthy 1986:209). He added that OCP acts as a universal constraint that can mark the ill-formed representation in the derivation process. By way of illustration, McCarthy (1986) contended that we can observe the OCP in long segments such as the [a:] in [ka:tib] 'a writer' in Arabic (1.19) whereby the single vocalic segment in the melody tier is associated to two V slots in the CV-tier:



Noteworthy, the long vowels cannot be separated by inserting a vocalic segment between the two V slots. The reason is that the epenthesis would invoke the violation of the WFC condition mentioned above.



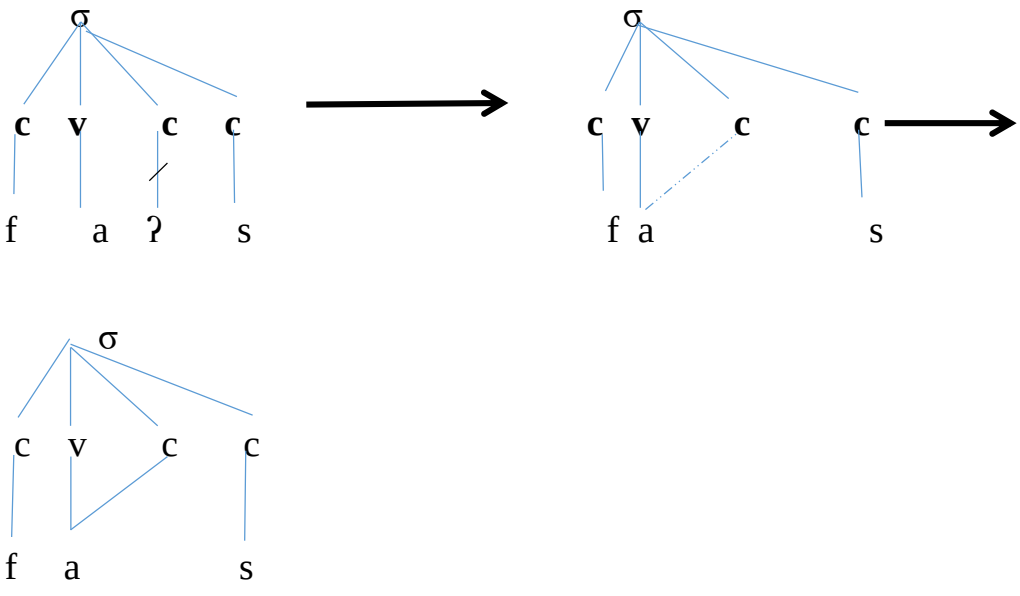
(a*i*a)

4. Compensatory Lengthening

Another substantial profit in the use of the autosegmental approach is the analysis of the compensatory lengthening process whereby one segment, usually a vowel, is associated or linked to a timing unit. i.e V or C-position on the CV-tier. The latter was left empty by de-association or delinking of neighboring segments.

As an exemplar, in the Standard Arabic, the word /faʔs/ ‘ax’ is realized as [fa:s] in Bechar Arabic (Benyagoub 2017). The glottal stop [ʔ] was deleted and hence the C-position associated to it was left empty. The letter is allied to the neighboring vowel in the melody tier, Vis [a], creating a long vowel [a:]. In conformity with the autosegmental approach, compensatory lengthening is presented as follow:

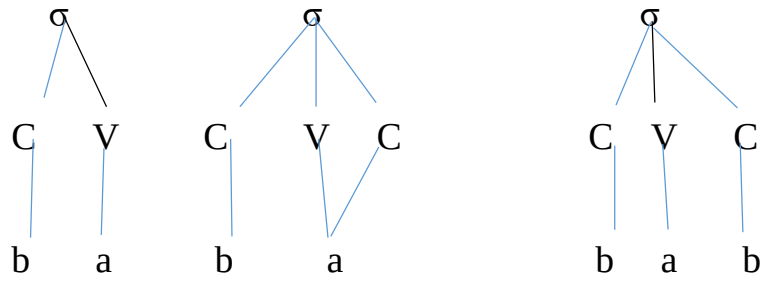
(Benyagoub 2017:45)

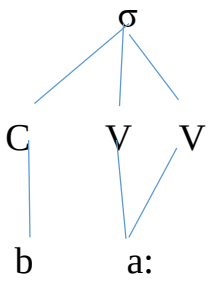


One problem with the CV-model proposed by McCarthy (1986a) is that it does not provide a reliable explanation for V-lengthening process. The latter attests that a [-syllabic] element in the CV-tier is associated to a [+syllabic] segment in the segmental tier. In consequence, another model of the skeletal tier was proposed, namely, the X-slot model.

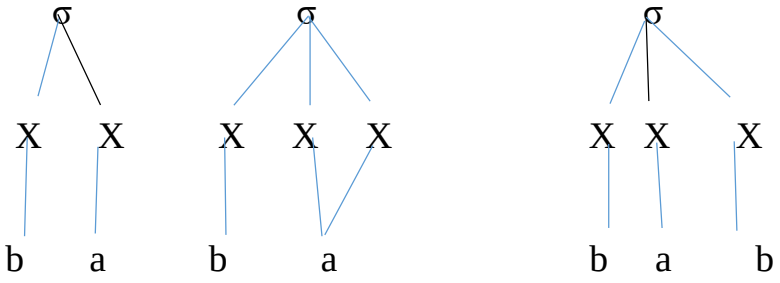
5. X-skeleton

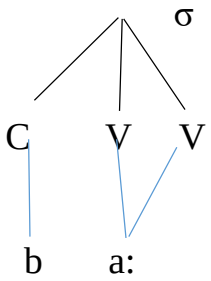
Levin (1985) proposed new modification to the framework of autosegmental. He argued that the CV model is not a well establishing representative that can be applicable for several phonological phenomena. Henceforth, they replaced the C and V by one uniform sequence of Xs and it was called the X-Skeleton Slot. One advantage of the X-Slot is related to the notion of syllabicity [± syllabic] in which the /V/ is [+syllabic] linked to the nucleus and the /C/ is [-syllabic] linked to the margins of the syllable. To eliminate this feature, Levin (1985) suggested replacing the CV-tier by the SKLETON slot to represent the timing units without vocalic or consonantal specifications, as shown in : CV-model





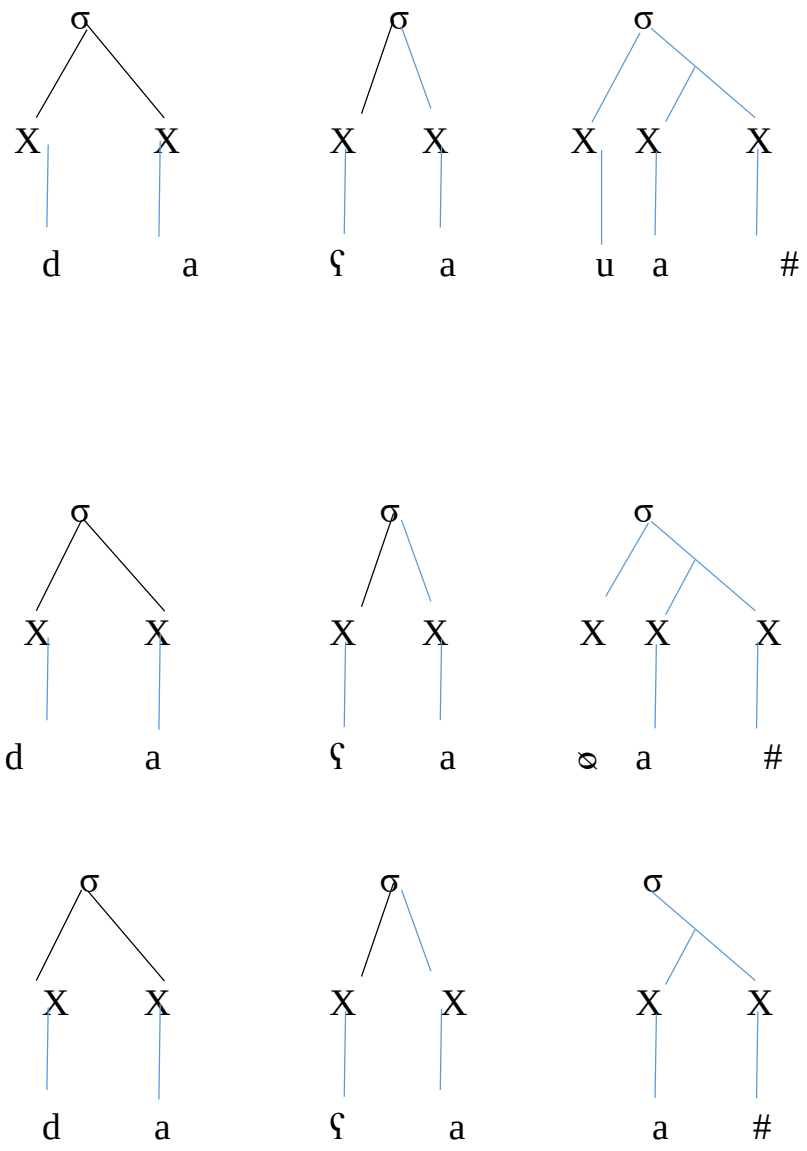
X-skeleton model



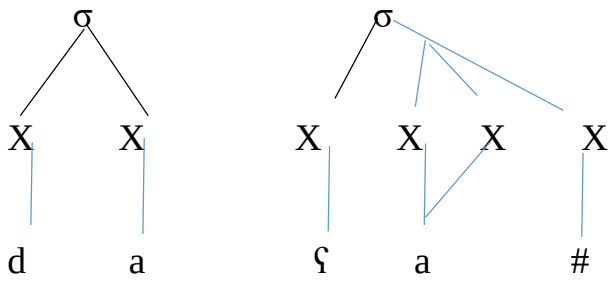


One piece of evidence to endorse the X-skeletal model is discussed in Mahadin's (1994) analysis of weak verbs in the Arabic language. He argued that the X-Skeleton analysis unravel the issue of the underlying representation of weak verbs. He stated that weak verbs 'show only two consonants in some of the forms because of the deletion of glide in intervocalic position' (Mahadin, 1994).

For example the verbs [da?awa] and [ramaja] are realized as [da?a:] and [rama:]. The underlying representation of verbs such as [da?a:] and [rama:] are alike to strong verbs. As an exemplification, [da?a:] is presented as follow: (Mahadin, 1994: 61)



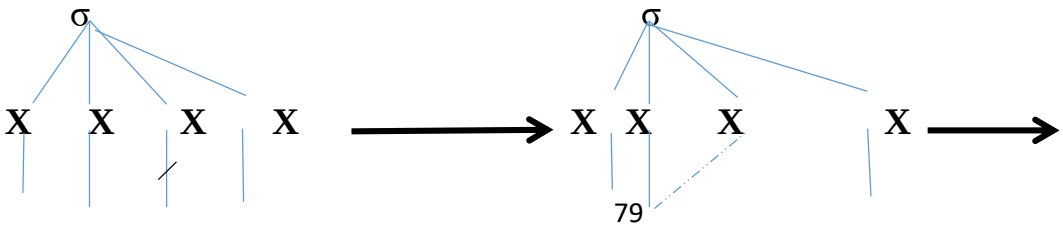
Reassociation Principle (surface representation)



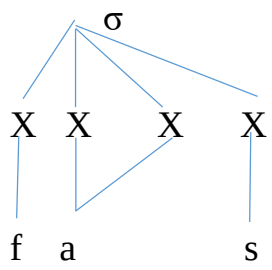
As clearly shown in the above example, the underlying representation and the surface representation are distinct. The (X) skeleton related to [u] is deleted , and then the stranded vowel is also omitted . The yielded output violates the syllable structure of having an onset as well as the OCP (Mahadin, 1994: 63). Therefore, he assumed that a reassociation principle works at merging the two syllable nodes yielding in surface representation.

Another piece of evidence to adopt the X-skeleton model is withdrawn from the Greek lengthening cases. Broselow (1983) asserted that certain slots seem not to differentiate between vowels and consonants as potential suppliers of articulatory material. This is notably perceptible in compensatory lengthening, which frequently consists of deletion of a consonant followed by lengthening of a vowel (Goldsmith, 1995).

In line with the X-skeleton model, compensatory lengthening in the previous title is presented as follows:



f a ʔ s f a s



To sum up, the autosegmental framework is considered as an appropriate model to represent and to handle, easily, insoluble questions in previous traditional phonology. As discussed in the above sections, the current model analyzes the internal structure of the syllable, the compensatory lengthening process and the elimination of the feature long and many other phonological aspects in a flexible and more adequate system.

6. **Practice**

Class Discussion

Answer the following short questions to check your understanding of the key concepts introduced in the lecture.

1. What is the main difference between linear and autosegmental representations of phonological structure?
2. What does an **association line** represent in an autosegmental diagram?
3. How does the X-tier help explain timing phenomena such as compensatory lengthening.

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5. Mahadin, R. (1994), An X-skeleton Analysis of some Phonological Processes in Arabic. **Al-Abhath**, XLII: 49-95.

6. McCarthy, J. (1979), On stress and syllabification. **Linguistic Inquiry**, 10 (3), 443- 465.

Answer Keys

Chapter one : guidelines

Distinctive Feature Theory

- Describes speech sounds using **binary features** (+/-) instead of whole units.
- **Primary feature matrix**: rows = sounds, columns = features.
- **Why binary?**
    1. Simplifies sound description.
    2. Highlights contrasts that change meaning.
    3. Predicts phonological patterns.
    4. Works across languages.

Chapter Two

Activity 1: Identify features

Sound	[+/- continuant]	[+/- nasal]	[+/- lateral]	[+/- strident]
/s/	+	-	-	+
/l/	-	-	+	-
/m/	-	+	-	-
/p/	-	-	-	-
/v/	+	-	-	+

Notes:

- Continuant: airflow is continuous (+) or blocked (-).
- Nasal: air escapes through the nose (+) or not (-).
- Lateral: airflow goes around the sides of the tongue (+) or not (-).
- Strident: noisy, high-frequency fricatives (+) or not (-).

Activity 2: Feature matrix

We include **major class, place, manner, and laryngeal feature**.

Feature	/b/	/n/	/θ/
Sonorant	-	+	-
Consonantal	+	+	+

Feature	/b/	/n/	/θ/
Vocalic	-	-	-
Nasal	-	+	-
Lateral	-	-	-
Continuant	-	-	+
Voice	+	+	-
Place	bilabial	alveolar	Dental
Manner	stop	Nasal	fricative

Activity 3: Compare /p/, /t/, /k/

Step 1: Feature matrix

Feature	/p/	/t/	/k/
Consonantal	+	+	+
Sonorant	-	-	-
Vocalic	-	-	-
Nasal	-	-	-
Lateral	-	-	-
Continuant	-	-	-
Voice	-	-	-

Answer questions

1. **Shared features**:
    - [Consonantal: +]
    - [Sonorant: -]
    - [Vocalic: -]
    - [Nasal: -]
    - [Lateral: -]
    - [Continuant: -]
    - [Voice: -]

2. **Features that differ**:
   - Place of articulation: /p/ = bilabial, /t/ = alveolar, /k/ = velar
3. **Redundant features**:
   - Features like **sonorant , continuant** can predict others like **obstruent**, since all stops are [-sonorant, -continuant].
4. **Natural class**:
   - **Voiceless stops** or **oral stops** (excluding nasals and fricatives)

Chapter Three

Activity 1: Identifying Phonological Processes

Underlying Form	Surface Form	Process	Explanation
/in+possible/	[ɪmpɒsɪbəl]	**Assimilation (nasal place assimilation)**	/n/ becomes [m] before the bilabial stop /p/. The nasal assimilates to the place of articulation of the following consonant: [+nasal, +alveolar] → [+nasal, +bilabial].
/hænd+bæg/	[hæmbæg]	**Assimilation (nasal place assimilation)**	/n/ changes to [m] before the bilabial /b/ due to progressive assimilation in place of articulation.
/dog+s/	[dɔgz]	**Voicing assimilation**	The plural morpheme /s/ becomes [z] after the voiced consonant /g/. The fricative assimilates the feature [+voice].
/tɛn+θ/	[tɛ̃nθ]	**Nasalization**	The vowel /ɛ/ becomes nasalized due to the influence of the following nasal consonant /n/.
/film/	[fɪləm]	**Epenthesis (insertion)**	A schwa [ə] is inserted to break up a difficult consonant cluster and improve syllable structure.
/bɛd/	[bɛt]	**Final devoicing**	The voiced stop /d/ becomes voiceless [t] in word-final position in certain dialects.
Japanese /desu/	[des]	**Deletion (vowel deletion)**	The high vowel /u/ is deleted in fast or casual speech, a common phonological reduction process.

Activity 2: Writing Phonological Rules

1. **/in+possible/ → [ɪmpɒsɪbəl]**
   /n/ → [m] / __ [+bilabial]
   (Alveolar nasal becomes bilabial before a bilabial consonant.)

2. **/tɛn+θ/ → [tɛ̃nθ]**
   V → [+nasal] / __ [+nasal]
   (Vowels become nasalized before nasal consonants.)
3. **/film/ → [fɪləm]**
   Ø → [ə] / l __ m
   (Schwa insertion between /l/ and /m/ to simplify the cluster.)
4. **/dog+s/ → [dɔgz]**
   /s/ → [z] / [+voice] _
   (Voicing assimilation of the plural morpheme.)

Activity 3: Derivation Practice

1. /in+possible/ → [ɪmpɒsɪbəl]

a. Prefixation: /in+possible/
b. Nasal place assimilation: /n/ → [m] / __ p
c. Surface form: **[ɪmpɒsɪbəl]**

2. /dog+s/ → [dɔgz]

a. Morpheme combination: /dog+s/
b. Voicing assimilation: /s/ → [z] after voiced /g/
c. Surface form: **[dɔgz]**

3. /film/ → [fɪləm]

a. Underlying form: /film/
b. Schwa epenthesis to break consonant cluster
c. Surface form: **[fɪləm]**

Rule Ordering and Interaction

1. What are the two rules involved?

Rule 1: Voicing assimilation (progressive)
/z/ → [s] / [−voice] ___
(The plural morpheme /z/ becomes voiceless after a voiceless consonant.)

Rule 2: Epenthesis (schwa insertion)
Ø → [ɪ] / s ___ z
(A vowel is inserted to break up an illicit sibilant cluster.)

2. Which rule must apply first, and why?

Voicing assimilation must apply first, followed by **epenthesis**.

Explanation:
Voicing assimilation determines whether the plural morpheme surfaces as [s] or [z] based on the voicing of the preceding consonant. If epenthesis were to apply first, the environment for voicing assimilation would be disrupted, and incorrect surface forms would result. Therefore, assimilation must precede insertion to allow the correct voicing agreement to take place.

Activity 5: Distinctive Feature Practice

Feature-Based Rules (Model Answers)

1. **Final devoicing**
   [+voice] → [−voice] / ___ #
2. **Nasal assimilation**
   [+nasal] → [αplace] / ___ [αplace]
3. **Progressive voicing assimilation**
   [−voice] → [+voice] / [+voice] ___

Feature-Based Rule for *impossible* (/in+possible/)

[+nasal, +alveolar] → [+nasal, +bilabial] / ___ [+bilabial]

(or more generally)

[+nasal] → [αplace] / ___ [αplace, +bilabial]

Discussion Questions (Suggested Answers)

❖ **1. Why are phonological rules essential for explaining variation between underlying and surface forms?**

Phonological rules explain how abstract underlying representations are systematically transformed into surface forms. They account for regular sound patterns and variations that cannot be captured by listing surface forms alone, allowing linguists to explain why different pronunciations occur in predictable environments.

2**. How do distinctive features make phonological rules more general and powerful?**

Distinctive features allow phonological rules to apply to **natural classes** of sounds rather than individual segments. This increases the explanatory power of rules by capturing generalizations across multiple sounds that share phonetic or phonological properties.

3. In what ways can rule ordering affect the surface form of words?

Rule ordering determines the sequence in which phonological processes apply. If rules are applied in an incorrect order, they may fail to apply or produce incorrect surface forms. Proper rule ordering ensures that phonological processes interact correctly to yield the attested surface forms.

Chapter Four

❖ Activity 1

1. *problem* → /ˈprɒ.bləm/
   - Syllable 1: O = /pr/, N = /ɒ/, C = Ø
   - Syllable 2: O = /bl/, N = /ə/, C = /m/
2. *teacher* → /ˈtiː.tʃər/
   - Syllable 1: O = /t/, N = /iː/, C = Ø
   - Syllable 2: O =/ tʃ/, N = /ə/, C =/ r/
3. *extra* → /ˈek.strə/
   - Syllable 1: O = Ø, N = /e/, C = /k/
   - Syllable 2: O = /str/, N = /ə/, C = Ø

❖ Activity 2

a) Correct syllabification:
/əˈprəʊtʃ/

b) Explanation:
The **Maximal Onset Principle** assigns as many consonants as possible to the onset of the following syllable, provided they form a permissible onset in the language. The **Sonority Principle** supports this division by ensuring that sonority rises toward the nucleus and decreases toward the syllable edges.

Chapter Five

❖ Activity 1

1. *extra* → /ˈek.strə/
   - Syllable 1: O = Ø, N = /e/, C = /k/
   - Syllable 2: O = /str/ , N = /ə/, C = Ø
2. *computer* → /kəmˈpjuː.tər/
   - Syllable 1: O = /k/, N =/ə/, C = /m/
   - Syllable 2: O = /pj/, N =/ uː/ , C = Ø
   - Syllable 3: O = /t/, N = /ə/, C = /r/
3. *strength* → /streŋθ/
   - Monosyllabic
   - O = /str/, N = /e/, C = /ŋθ/

❖ **Activity 2**

a) Correct syllabification:
/əˈnɑː.lɪ.sɪs/

b) Explanation:
The **Maximal Onset Principle** assigns consonants to the onset of the following syllable whenever phonotactically possible. The **Sonority Principle** requires that sonority rises toward the nucleus and falls toward the coda, which supports the placement of /l/ and /s/ in onsets rather than codas.

❖ **Activity 3**

1. *camera* → [ˈkæmrə]
    - **Deletion (syncope)**: deletion of an unstressed vowel to simplify syllable structure.
2. *handbag* → [ˈhæmbæg]
    - **Resyllabification** (with assimilation): consonants reorganized to create a preferred syllable pattern.
3. *athlete* → [ˈæθəliːt]
    - **Epenthesis**: insertion of a vowel to break up an illicit consonant cluster.

Chapter Six : Answer Guidelines

Question 1: Difference between linear and autosegmental representations

A correct answer should explain that **linear representations** arrange speech sounds in a single sequence where each segment is represented on one line, while **autosegmental representations** use multiple tiers to represent different phonological features independently. It should mention that autosegmental phonology allows features (such as tone or vowel length) to associate with more than one segment, which cannot be adequately represented in linear models.

Question 2: Function of an association line

A correct answer should state that an **association line** shows the relationship between elements on different tiers in an autosegmental diagram. It indicates how a feature (such as tone, length, or nasality) is linked to one or more segments or timing units, making it possible to represent spreading, delinking, or reassociation processes.

Question 3: Role of the X-tier in explaining compensatory lengthening

A correct answer should explain that the **X-tier** (or timing tier) represents abstract timing units that are independent of segmental content. In compensatory lengthening, when a segment is deleted, its timing unit may remain and reassociate with a neighboring segment, resulting in increased length. The answer should show that the X-tier helps explain why length is preserved even when a segment is lost.

Exam Question Samples

Mohamed Boudiaf University of M'sila **Level:**

M1 Department of ENGLISH

Full Name: …….. **Group:**

First semester Exam in Advanced Phonetics and Phonology

Activity one: Consider the sounds **[t]** and **[tʃ]** in the following Japanese data and answer the questions:

Japanese language	**Translation in English**
1. /tatami/	"mat"
2. /tegami/	"letter"
3. /tʃitʃi /	"father"
4. /shita/	"under"
5. /tʃizu:/	"map"
6. /koto/	"fact"
7. /utʃi/	"house"
8. /te/	"hand"
9. /degu:tʃi/	"exit"

Questions:

1. Are the two sounds [t] and [tʃ] allophones of the same phoneme, or minimal pairs? Argue for your answer.
2. Draw the general rule.

3. Describe the distinctive features of both sounds

Activity two: Identify and explain the phonological process in each of the following examples:

a) English: "input" pronounced as **[ɪnpʊt] → [ɪmpʊt]**

b) French: "bien" pronounced as **[bjɛ̃]**

Activity three: Provide a clear and concise definition for each of the following terms and illustrate with one example for each:

Phonology - The syllable - Distinctive Features - Maximal Onset principle

Appendices

Appendix A

Manner of Articulation	Place of Articulation: Bilabial		Labio dental		Inter dental		Alveolar		Alveo-palatal		Palatal		Velar		Glottal	
Stop	p	b					t	d					k	g	ʔ	
Fricative			f	v	θ	ð	s	z	ʃ	ʒ					h	
Affricate									tʃ	dʒ						
Nasal		m						n						ŋ		
Lateral Approximant								l								
Retroflex Approximant								ɹ								
Glide	ʍ	w										j				

State of the Glottis

Voiceless	Voiced

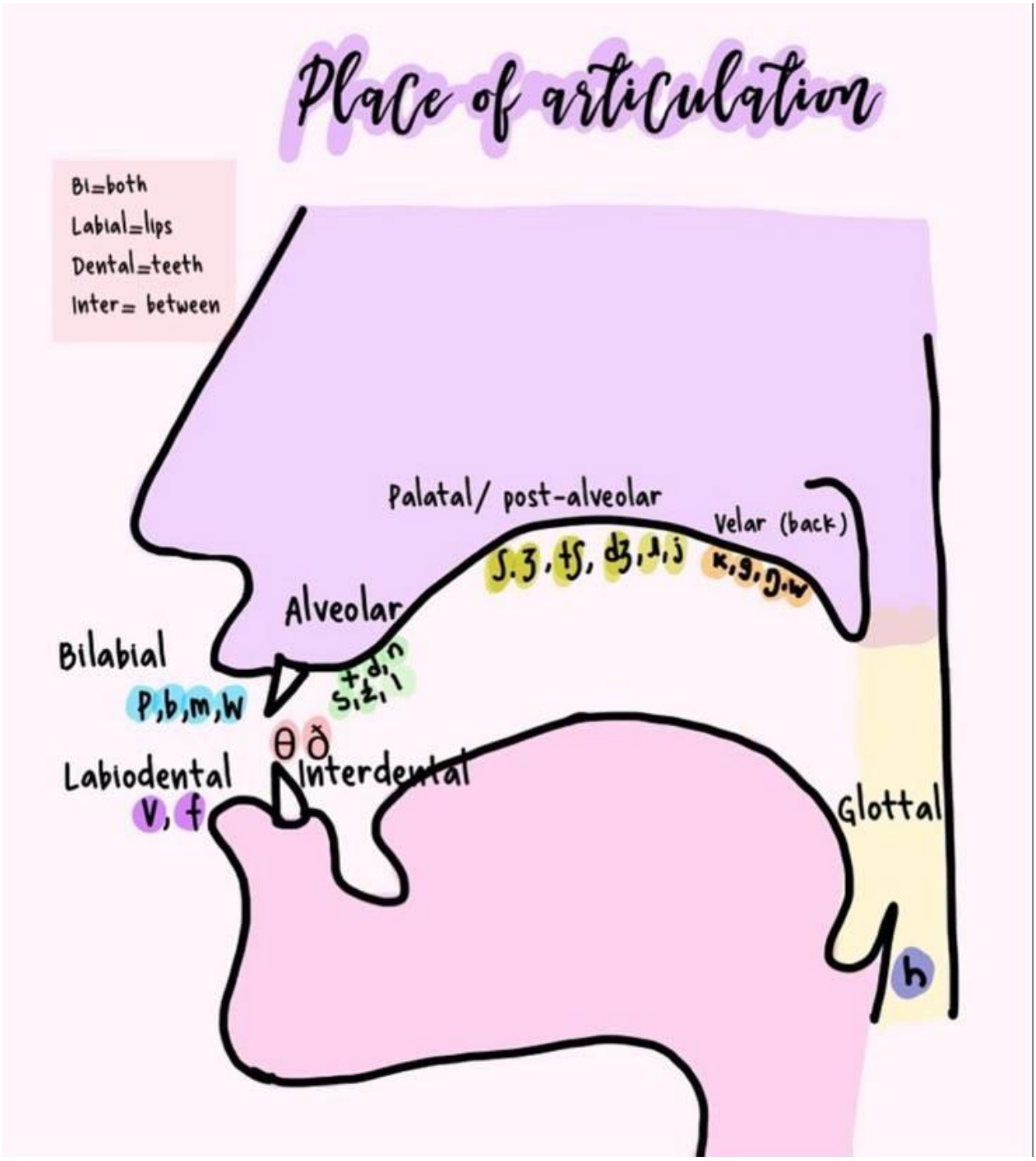
	MANNER	PLACE: Bilabial	Labio-dental	Lingua-dental	Alveolar	Post-alveolar	Palatal	Velar	Glottal
	Stop	p, **b**			t, **d**			k, **g**	
	Fricative		f, **v**	θ, **ð**	s, **z**	ʃ, **ʒ**			h
	Affricate					ʧ, **ʤ**			
	Nasal	m			n			ŋ	
Approximates	Liquid (Lateral)				l				
	Liquid (Rhotic)				ɹ				
	Glide	w					j	w	

***Bolded** symbol is the voiced sound

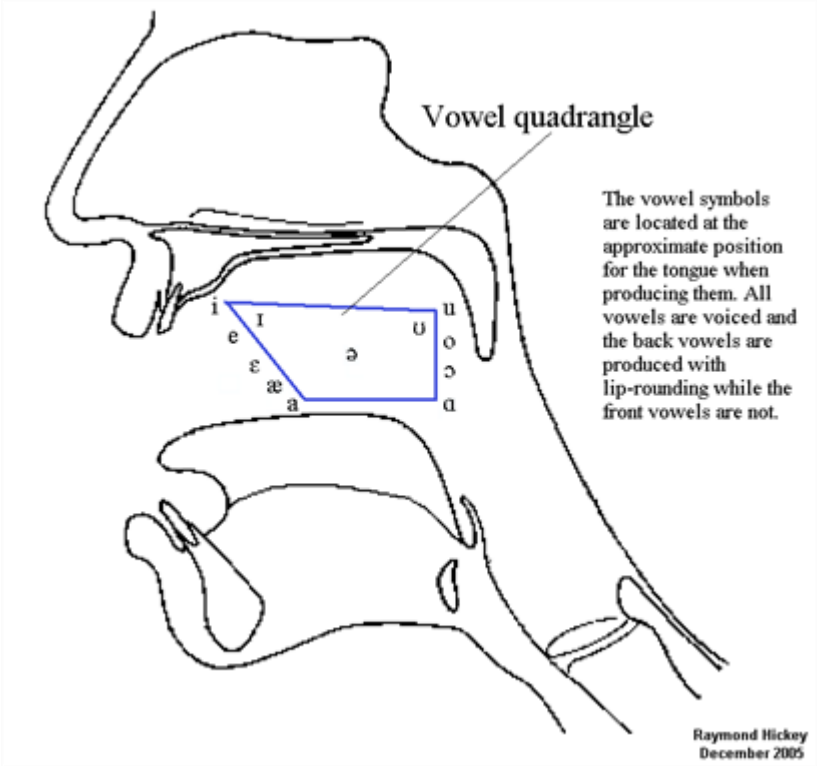
Diacritics

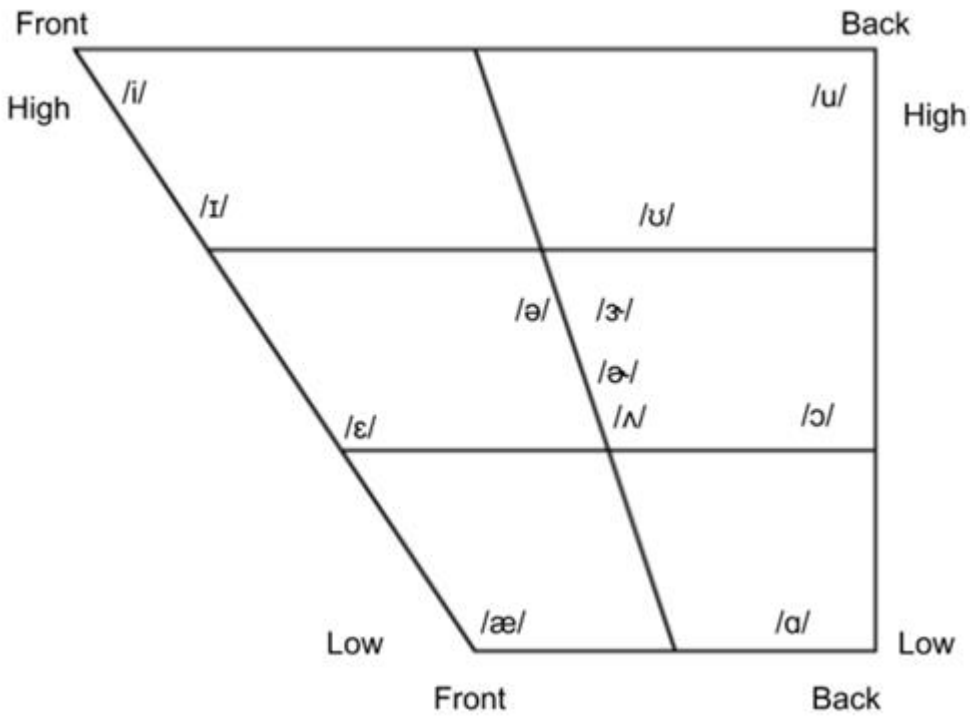
n̥ d̥	Voiceless	tˠ dˠ	Velarized	dˀ	No audible release	e̙	Retracted tongue root
s̬ d̬	Voiced	tˤ dˤ	Pharyngealized	n̩	Syllabic	o͈	More rounded
tʰ dʰ	Aspirated	b̤ a̤	Breathy voiced	ẽ	Nasalized	o͉	Less rounded
t̪ d̪	Dental	b̰ a̰	Creaky voiced	ɚ	Rhoticity	u̟	Advanced
t̺ d̺	Apical	t̼ d̼	Linguolabial	e̯	Non-Syllabic	e̠	Retracted
t̻ d̻	Laminal	ɬ	Velarized / pharyngealized	e̝	Raised	ë	Centralized
tʷ dʷ	Labialized	dⁿ	Nasal release	e̞	Lowered	e̽	Mid-centralized
tʲ dʲ	Palatalized	dˡ	Lateral release	e̘	Advanced tongue root		

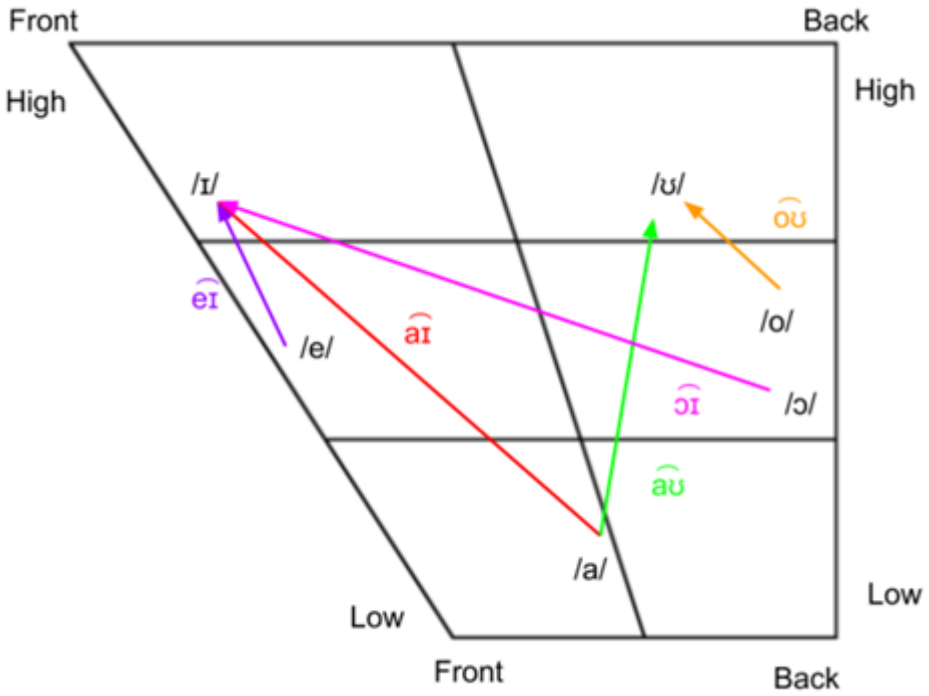
Appendix B


Place of articulation
Bi=both
Labial=lips
Dental=teeth
Inter= between
Palatal/ post-alveolar
Velar (back)
ʃ,ʒ, tʃ, dʒ, ɹ, j
k, g, ŋ, w
Alveolar
Bilabial
p, b, m, w
t, d, n
s, z, l
θ ð
Labiodental
v, f
Interdental
Glottal
h

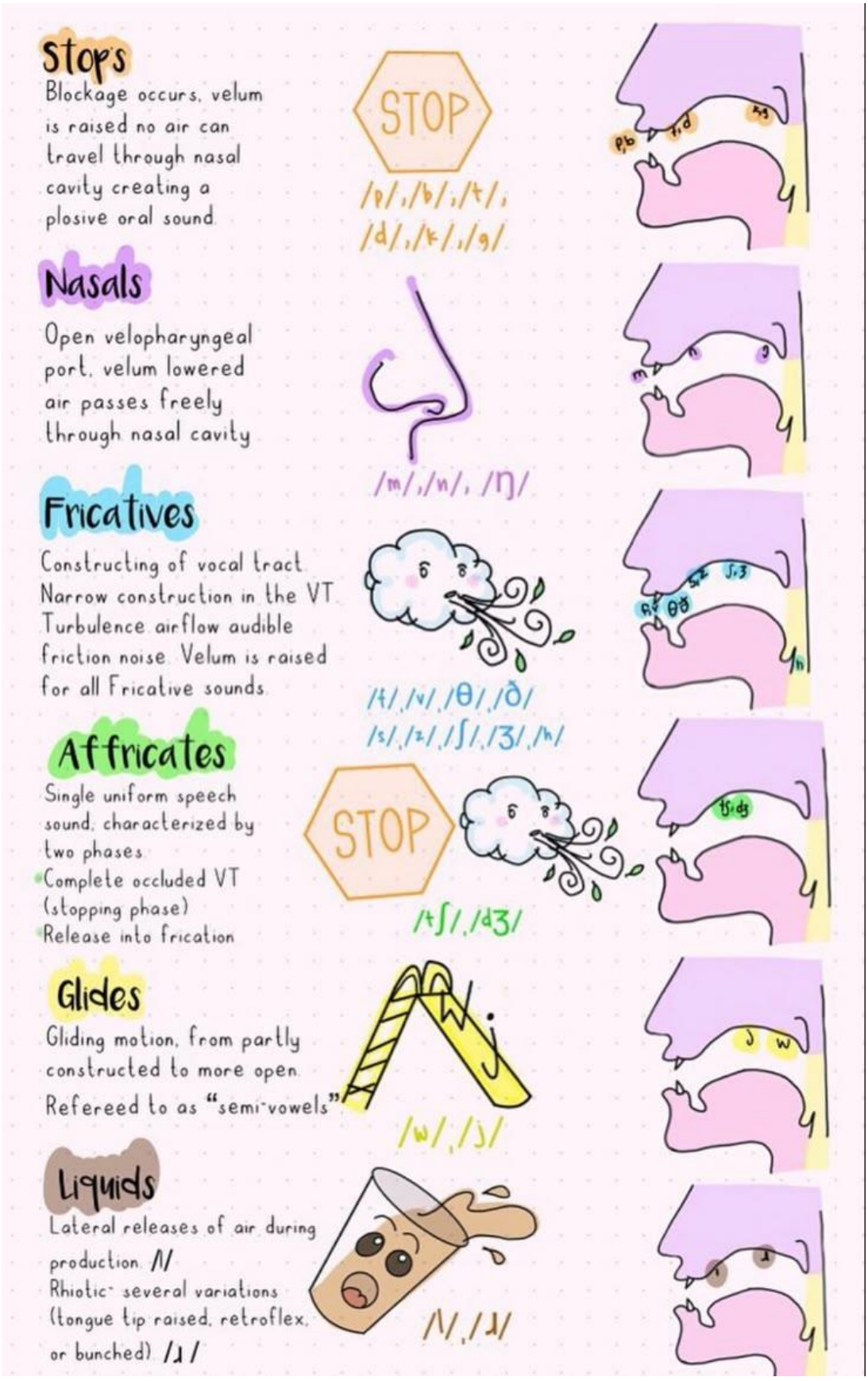
Appendix C


Vowel quadrangle
The vowel symbols are located at the approximate position for the tongue when producing them. All vowels are voiced and the back vowels are produced with lip-rounding while the front vowels are not.
i
ɪ
e
ʊ
u
o
ɛ
ə
ɔ
æ
ɑ
a
Raymond Hickey
December 2005


Front
Back
High
/i/
/u/
High
/ɪ/
/ʊ/
/ə/
/ɜ/
/ɚ/
/ɛ/
/ʌ/
/ɔ/
/æ/
/ɑ/
Low
Low
Front
Back



Appendix D : English Diphthongs


Stops
Blockage occurs, velum is raised no air can travel through nasal cavity creating a plosive oral sound
STOP
/p/,/b/,/t/, /d/,/k/,/g/
Nasals
Open velopharyngeal port, velum lowered air passes freely through nasal cavity
/m/,/n/, /ŋ/
Fricatives
Constructing of vocal tract Narrow construction in the VT Turbulence airflow audible friction noise Velum is raised for all Fricative sounds
/f/,/v/,/θ/,/ð/ /s/,/z/,/ʃ/,/ʒ/,/h/
Affricates
Single uniform speech sound, characterized by two phases
Complete occluded VT (stopping phase)
Release into frication
STOP
/tʃ/,/dʒ/
Glides
Gliding motion, from partly constructed to more open
Refereed to as "semi-vowels"
/w/,/j/
Liquids
Lateral releases of air during production /l/
Rhiotic- several variations (tongue tip raised, retroflex, or bunched) /ɹ/
/l/,/ɹ/

Appendix E

Sound	Voice	Sonorant	Continuant	Nasal	Labial	Coronal	Anterior	Strident	Dorsal	High	Low	Back
/p/	–	–	–	–	+	–	+	–	–	–	–	–
/b/	+	–	–	–	+	–	+	–	–	–	–	–
/t/	–	–	–	–	–	+	+	–	–	–	–	–
/d/	+	–	–	–	–	+	+	–	–	–	–	–
/k/	–	–	–	–	–	–	–	–	+	+	–	+
/g/	+	–	–	–	–	–	–	–	+	+	–	+
/f/	–	–	+	–	+	–	+	+	–	–	–	–
/v/	+	–	+	–	+	–	+	+	–	–	–	–
/θ/	–	–	+	–	–	+	+	–	–	–	–	–
/ð/	+	–	+	–	–	+	+	–	–	–	–	–
/s/	–	–	+	–	–	+	+	+	–	–	–	–
/z/	+	–	+	–	–	+	+	+	–	–	–	–
/ʃ/	–	–	+	–	–	+	–	+	+	+	–	–
/ʒ/	+	–	+	–	–	+	–	+	+	+	–	–
/h/	–	–	+	–	–	–	–	–	+	+	–	+
/tʃ/	–	–	–/+	–	–	+	–	+	+	+	–	–
/dʒ/	+	–	–/+	–	–	+	–	+	+	+	–	–
/m/	+	+	–	+	+	–	+	–	–	–	–	–
/n/	+	+	–	+	–	+	+	–	–	–	–	–
/ŋ/	+	+	–	+	–	–	–	–	+	+	–	+
/l/	+	+	+	–	–	+	+	–	–	–	–	–
/r/	+	+	+	–	–	+	–	–	–	–	–	–
/w/	+	+	+	–	+	–	–	–	+	+	–	+
/j/	+	+	+	–	–	+	–	–	+	+	–	–

Vowel	High	Mid	Low	Front	Back	Central	Round	Tense
/**i**/ (as in *beet*)	+	–	–	+	–	–	–	+
/**ɪ**/ (as in *bit*)	+	–	–	+	–	–	–	–
/ **eɪ**/ (as in *bait*)	–	+	–	+	–	–	–	+
/**ɛ**/ (as in *bet*)	–	+	–	+	–	–	–	–
/**æ**/ (as in *bat*)	–	–	+	+	–	–	–	–
/**ʌ**/ (as in *sofa, cup*)	–	+	–	–	–	+	–	–
/**ɑ**:/ (as in *father*)	–	–	+	–	+	–	–	+
/**ɒ**/ (as in *lot*, BrE)	–	–	+	–	+	–	+	–
/**ɔ**:/ (as in *thought*)	–	+	–	–	+	–	+	+
/**ʊ**/ (as in *put*)	+	–	–	–	+	–	+	–
/**u**:/ (as in *goose*)	+	–	–	–	+	–	+	+
/**ɜ**:/ (as in *bird*)	–	+	–	–	–	+	–	+

Find more details about English sounds on the following link:

https://www.youtube.com/playlist?list=PLOZUTLsJbEAjW-Z9Bou0fPvPs8zdF79pJ