1. Phonotactic Constraints and Foreign Accents

*Phonotactic constraints:* Restrictions on possible combinations of sounds - languages generally prefer syllables made up of, first, a consonant (C) and then a vowel (V), but some languages have different allowances (for example, English allows up to three consonants to start a word, as long as the first is /s/, the second is /p/, /t/, or /k/, and the third is /l/, /j/, /w/ or /ɹ/).

In English, any consonant may begin at the start of a word except for [ʒ] and [ŋ]-a number of two-consonant combinations also occur word-initially, with a stop or fricative being followed by a liquid or a glide.

In ASL, a monosyllable sign cannot consist of just one handshape, location, and orientation - at least one of these things is required to change - and handshape changes may always occur during movement.

If a sign involves movement, the handshape change must occur during the movement - this constraint is merely an arbitrary rule built into the phonology of ASL. A signer may be right-hand dominant or left-hand dominant, and the dominant hand is the hand the signer will use for all one-handed signs - but no signer switches back and forth between hands during normal conversation. There are very specific restrictions as to what the non-dominant hand may do in any given two-handed sign - the non-dominant hand must have the same handshape and orientation as the dominant hand in a sign including movement (don't pat your head and rub your belly).

The non-dominant hand may, however, remain stationary while the dominant hand moves.

In Signed Mandarin, certain signs have been introduced by hearing instructors at deaf schools that allow both hands to move without having the same handshape, orientation, and movement. Similar attempts have been made with Taiwan Sign Language, but the reaction among native speakers was that those signs were grammatically incorrect.

When borrowing a foreign word from another language, speakers pronounce the words so that they conform to their languages phonotactic restrictions - for example, in English, two stops cannot come at the beginning of words, nor can stop and nasal combinations, so to pronounce Ptolemy or gnostic the first consonant is dropped - a vowel may also be inserted between the two consonants.

There are two ways that consonant clusters are changed in a new language: the first is to delete one of the consonants, and the other is to insert a vowel - every language has its own preference (Finnish deletes the first consonant, while Japanese inserts vowels into the cluster).
Sound substitution: Another contributor to foreign accents, this is when a sound existing in a known language is used to replace a sound not in the new language (for example, this into zis and thin into sin by French speakers)

2. Implicational Laws

Observations about more common and less common speech sounds

If a language uses a less common sound, one of its more common counterparts will also be used (the sounds in a languages inventory of phonemes, meaning that the sound is distinctive relative to other sounds in the language)

For each less common sound in the inventory, there tends to be a more common sound in the inventory which is just like the less common sound except for one or two phonetic features (the more common counterpart of a voiceless vowel is a voiced vowel, the more common counterpart of a voiceless pharyngeal fricative is a voiceless velar fricative)

Commonness is relative - one sound is more common compared to another, and less common compared to yet another

This is an implicational law - the presence of the less common sound implies that the more common sound will also be used, but this implication does not go the other way

Implicational laws also apply to natural classes (a language using voiced stops will also use voiceless ones, the presence of fricatives in a language implies a stop with the same place of articulation)

The commonness of a sound also applies to its range and distribution - even if a less common sound is used in a language, it will be used less often than its more common counterpart (a common sound will have a wider distribution in the language and appear in more phonetic environments than the less common one)

Children learning a language will acquire the use of more common sounds earlier in their lives, and the acquisition of a relatively less common sound implies that its more common counterpart has already been acquired

For example, when a child says [dɪs] instead of [ðɪs], it is because they have yet to acquire [ð], but they do know [d], which is the more common counterpart of [ð]

More common sounds tend to be more stable and resist change, compared to less common ones - if any sound is going to be lost in language change, it is more likely to be a less common one (for example, Old English had the voiceless velar fricative [x], corresponding to the letters <gh>, and this sound was lost - English speakers stopped using velar fricatives altogether)

When people use a language, their goal is usually to communicate - to transmit a message from a speaker to a hearer

If a sound is difficult to produce, speakers will be inconsistent in pronouncing it, and this could confuse the hearer - to avoid being misunderstood, difficult sounds may be avoided, and it may disappear from the language entirely if enough speakers avoid it
It is often the case that if sound X is easier to pronounce than sound Y, it will be more common (alveolar fricatives are more common than pharyngeal fricatives because the tip of the tongue is more agile than the back of the tongue, hence, they are easier to produce)

If a sound blends into the surrounding sounds too much, its distinctive quality may be difficult to hear - for this reason, consonants and vowels are most usable when they are quite different from each other (the consonants and vowels are maximally distant - they share very few qualities)

Voiceless consonants are more common than voiced ones, because they have less in common with vowels - voiceless consonants are more noticeable than voiced ones when near vowels

Consonants are made by obstructing the vocal tract in some way, so a vowel pronounced with the mouth wide open will be more distinct from surrounding consonants

3. How to Solve Phonology Problems
Phonemes are psychological units of linguistic structure, and are not physically present in a stream of speech
They make distinctions in meaning - if two sounds are members of separate phonemes, minimal pairs can almost always be found (if two sounds are allophones of the same phoneme, minimal pairs differing only in those sounds will not exist)
Allophones of a phoneme are not a random collection of sounds but are a set of sound that have the same psychological function - they are systematically related to each other, by phonetic properties, and it is possible to predict which will appear in a word based on phonological rules

Strategies for phonemic analysis
Distribution: The set of phonetic environments in which a sound can occur - its environment, or the sounds that immediately precede and follow it within the word
The easiest way to start a phonemic analysis is to determine whether the sounds are in contrastive distribution, looking first for minimal pairs
Example of how to list a sound’s phonetic environment (# indicates a word boundary):
[
[i] [i ]
[g_e] [p^h_e]
[a_#] [k^h_a]
[b_o] [f_e]
[#_i] [f_i]
]

Once you’ve collected the list of phonetic environments for a sound, follow these steps:
1. Look at the environments to find natural classes: [i] is preceded by [p^h], [k^h], [f], and [j], all of which are voiceless consonants - this allows us to describe its environment as “appears after voiceless consonants”
   Only [i] can occur word-finally, but either can appear before a vowel - this means that the environment following them can be the same, meaning it does not help to distinguish between them
2. Look for complementary gaps in the environment: [ɹ] does not appear in the same environments as [ɻ] (after voiceless consonants), and there is no [ɻ] after voiced consonants or beginning/end of words - these are systematic and complementary gaps, meaning they are in complementary distribution.

3. State a generalization about the distribution of each of the sounds: Write a rule that will make predictions about where each of the sounds can occur, in this case, the end result is:

- [ɹ] appears following voiceless consonants
- [ɻ] appears everywhere else

4. Determine the identity of the phoneme and its allophones: One of the sounds is the basic allophone, while the other is the restricted allophone ([ɻ] is restricted to a very specific environment, while [ɹ] may appear anywhere else - this makes [ɻ] the basic allophone, as it can be used in a wider variety of contexts).

The basic allophone is the closest approximation of the mental "sound" that speakers store in their memory, and in choosing a name for the phoneme, we are making the leap from observable phonetic reality to unobservable psychological reality.

The final version of a rule shows the process of going from the phoneme to each of the allophones, so:

/ɹ/ → [ɹ] / after voiceless consonants
/ɻ/ → [ɻ] / elsewhere

Because /ɹ/ becomes more like a preceding sound (voicelessness), we can conclude that assimilation is involved in this phonological rule.

More complicated phonemic analysis:

It's necessary to show that sounds are in complementary distribution, even if no minimal pairs exist for two sounds, in order to conclude that they are allophones of the same phoneme.

When no generalization can be made about where a group of sounds can occur, it is possible to conclude that they are members of separate phonemes.

Near-minimal pairs: Words that are ALMOST identical except for one sound, for example, [hɹd] and [bɹt] for [h] and [b] - no conceivable phonological rule could determine this.

When identifying conditioning environments, some strategies can speed up the process:

Formulate hypotheses about the allophones: if a less common sound appears in a language, it is probably a restricted allophone, so looking at its environment can provide clues.

Keep in mind that allophonic variations result from the application of phonological rules: these usually involve some phonological process, such as assimilation or deletion - check the environment for evidence that a phonological process has been applied.

4. Assimilation

The process of assimilation is one by which the features of a segment or suprasegment spreads to surrounding segments. Since it involves just one feature of a segment, it is called partial assimilation. In full assimilation, the segment assimilates all the features of the other.
5. Deletion

The process of deletion involves the loss of a sound segment or suprasegment when morphemes or words are combined together. The deletion process occurs in English and many Nigerian languages.

6. Epenthesis

The process of epenthesis is one by which sound segments are inserted into a word to make the structure of the word conform with the language’s syllable structure. In many Nigerian languages, epenthesis is employed when words are borrowed from other languages. For languages that do not permit consonant clusters, a vowel segment will be inserted to break the cluster.

7. Nasalisation

The process of nasalization involves an oral phoneme becoming nasalized in the environment of a nasal segment. We have already seen in earlier example from English how an oral vowel became nasalized in the environment of a nasal consonant.

8. **Assimilation**-Cause a sound or gesture to become more like a neighbouring sound or gesture -the segment affected takes on a property from a nearby segment (alveolar stop assimilation (English): alveolar stops assimilate to the place of articulation of a following consonant)

9. **Dissimilation**-Causes two close sounds to become less alike with respect to some property (manner dissimilation (Greek): a stop becomes a fricative when followed by another stop)

10. **Insertion**-Cause a segment not present at the phonemic level to be added to the phonetic form of a word (voiceless stop insertion (English): between a nasal consonant and a voiceless fricative, a voiceless stop with the same place of articulation as the nasal is included -causes dance /dæns/ -> [dænts])

11. **Deletion**-Cause a sound present at the phonemic level to be eliminated -applies more frequently to unstressed syllables because it saves time and articulatory effort, and not much information is sacrificed (/h/-deleted (English): /h/ may be deleted in an unstressed syllable)

12. **Metathesis**-Change the order of sounds in order to make words easier to pronounce or understand (CV metathesis (Leti): when three consecutive consonants occur, the first consonant trades place with the preceding vowel)
Can also occur in sign language—for example, several ASL signs are articulated with a movement from just beneath the ear forward to the side of the mouth, but many speakers will produce them from the mouth back to the ear.

13. **Strengthening**—Also called *fortition*, these rules make sounds stronger.

   - (aspiration (English): voiceless stops become aspirated when they occur at the beginning of a stressed syllable—aspirated stops are considered to be stronger sounds than unaspirated ones because the duration of voicelessness is much longer)

14. **Phonological features**

14.1. Major class features

   - [consonantal]: sound produced with a radical obstruction in the vocal tract
   - [sonorant]: sound whose phonetic content is predominantly made up of the sound waves associated with voicing (high energy output relative to effort)
   - [continuant]: sound during whose production the air stream is not blocked in the oral cavity

14.2. Vowel features

   - **Tongue-body features:**
     - [back]: body of the tongue is retracted from neutral position
     - [high]: body of the tongue is raised above neutral position
     - [low]: body of the tongue is lowered below neutral position

   - **Lip feature:**
     - [round]: the lip orifice is rounded

   - **General vocal tract setting feature:**
     - [tense]: deliberate, accurate, maximally distinct gesture with relatively high muscular effort

   - **Quantity feature:**
     - [long]: long duration

   - **Redundancy rule in RP and GA:** [+tense] [+long]; [-tense] [-long]

14.3. **Consonant features**
• use of major class features
• reduction of the excess of place features
• compatibility with vowel features

Place features:
• [anterior]: obstruction in front of the palato-alveolar region
• [coronal]: blade of the tongue raised above its neutral position

Acoustic feature:
• [strident]: relatively noisy sound

Original vowel features (largely redundant):
• [round] also covers /w/ and /ȝ/, distinguishes them from /j/, /x/ or /h/
• [back], [high], [low]: redundant, except to distinguish /x/ and /h/

Obstruent features:
• [voice]: glottal setting consistent with vocal fold vibration
• [voice]: glottal setting consistent with vocal fold vibration
• [tense]: competes with [voice], would help distinguish fortis/lenis differences in

only potentially voiced obstruents ([+ tense] [- voice]; [- tense] [+ voice]);
problem: /x ȝ h/ have to be classified as [+tense] (phonetically untenable)

More redundant features:
• [+ sonorant, - continuant] [+ nasal]
• [+ son, + cont, + ant, + cor] [+] lateral

14.4 Phonological vs. phonetic feature

distinctive features:
• unpredictable from phonological context
• distinguish words, morphemes, phonemes (many morphemes differ in just one

feature,
e.g. place features labial, coronal, velar in English stops: pin, tin, kin, bun, done, gun)

- these features must be learned/memorized in the course of language development

redundant features:

- for any given sound of a language these features are predictable by rule from the phonological environment

- speaker learns the rule, not the feature as part of the phoneme; the grammar does not list the feature value individually for each lexical item

- often the source of persistent foreign accent

- e.g., English speakers apply the rule that syllable-initial voiceless stops are aspirated when speaking French, although this rule does not apply in that language system ("tas" as [thæ] instead of [ta])

15. Syllables

The idea that one of the natural units of speech is a syllable is familiar from traditional grammars and dictionary entries, and we have already referred to syllables in trying to formulate our phonological rules precisely. It is traditionally assumed that a syllable is formed from zero or more consonants, followed by a vowel, and ending with another, usually shorter, sequence of zero or more consonants. These three parts of a syllable are called the onset (O), the nucleus (N) and the coda (C), respectively, with the nucleus as the only obligatory part, and with the tree structure:

```
syllable σ
   /\         /
  O  R
 /\   /\    /\      /
 p N C
 /\  /\    /\      /
 æ n
```

Here the syllable “σ” is called the root node of the tree – so the root is upside-down, the way family trees often are. In this upside-down tree, the root has two parts, the onset and the rime. Why assume that the elements of the syllable group in this way, as [onset [nucleus coda]] rather than as [[onset nucleus] coda]? Well, one kind of argument comes from the fact that it is quite easy to divide syllables at the onset-rime boundary.

Vowels are Nucelar (English) A nucleus can only contain a vowel or a diphthong.

Within a syllable the sonoricty strictly increases and then decreases
- **Maximise Onset**  Put as many consonants into the onset as possible
- **Legitimate Onsets**  An sequence of sounds is a legitimate onset if and only if it is the onset of the first syllable of an English word.
- **The Voice Agreement Principle:** Obstruent sequences at the end of an English word cannot differ with respect to voicing.
- **The Not-Too-Similar Principle:** Obstruent sequences cannot differ only in voicing.
- **Sonority principle (SP):** Onsets usually rise in sonority towards the nucleus, and codas fall in sonority away from the nucleus.

16. General aims of phonology
- looking for regularities that help to define a language’s inventory of phonological elements (vowels, consonants, syllables, tones)
- determining patterns in the distribution of these elements in the language’s representations
- may they appear in or are they banned from initial, medial, final
- investigating alternations in the shapes of morphemes composed of these
- investigating alternations in the shapes of morphemes composed of these elements within the word and variant pronunciations of words within the sentence
- discovered regularities are assumed to be the joint product of the principles and parameters of Universal Grammar and the rules and representations that develop through the course of language acquisition