UINT TWO
SPEECH SOUNDS
# UNIT CONTENT

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## Introduction

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1. Phonetics (The Study of Sounds)

### 2. Articulatory phonetics

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## Overview

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References
Dear learner,
Welcome to UINT TWO in this course ‘An Introduction to Linguistics’. This unit attempts to provide you with the study of the production and perception of speech sounds. This unit consists of three sections, each one is more than one sub-section.

1- Phonetics (The study of sounds)
2- Articulatory phonetics
3- Phonology
Both exercises and self-assessment questions (SAOs) are used to ensure the necessary practice needed to reinforce the material already discussed.
UNIT OBJECTIVES

Dear learner, upon completing this unit you are expected to be able to:

1. recognize that there are certain ways and places for producing speech sounds.
2. discover that there are three sub-disciplines of phonetics,
3. understand and use the basic terminology of phonetics,
4. define the terms of phonetics,
5. explain the characteristics of speech sounds,
6. and differentiate between consonants and vowels.
7. recognize that there are certain patterns of sound in a language.
8. discover how sounds are organized in a language,
9. understand and use the basic terminology of phonology,
10. define the terms of phonology,
11. explain the function of sounds within a language,
12. and differentiate between consonants and vowels.
1. Phonetics (The Study of Speech Sounds)

Dear learner, have you come across the term phonetics? Did you ask yourself about the definition of phonetics? To answer these questions, let’s concentrate on this part of the unit.

Phonetics is the study of the production and perception of speech sounds. It is concerned with the sounds of language, how these sounds are articulated and how the hearer perceives them.

Phonetics is a branch of linguistics that studies the material aspects of speech sounds. It is related to the science of acoustics in that it uses much the same techniques in the analysis of sound that acoustics does. There are three sub-disciplines of phonetics:

- **Articulatory Phonetics**: the production of speech sounds. Articulatory phonetics researches where and how sounds are originated and thus carries out physiological studies of the respiratory tract, trying to locate precisely at which location and in which manner a sound is produced.
- **Acoustic Phonetics**: the study of the physical production and transmission of speech sounds. Acoustic phonetics examines the length, frequency and pitch of sounds. Special instruments are required to measure and analyze the sounds while they travel via the channel.
- **Auditory Phonetics**: the study of the perception of speech sounds. Auditory phonetics studies what happens inside the ear and brain when sounds are finally received. It is also interested in our ability to identify and differentiate sounds.
2. **Articulatory phonetics**

In this part, we will concentrate on articulatory phonetics, which also happens to be what modern linguistics has traditionally focused on. Our notion of the typical, classical linguist, zealously studying speech sounds, such as the famous Dr. Higgins from George Bernard Shaw's Pygmalion, is derived from this stage in the discipline.

Any speech sound is caused by a stream of air that originates in our vocal apparatus, escapes through our mouth or nose. The
various sounds all differ according to the voicing, place and manner of their articulation. A minor change of any of these three factors may alter a sound significantly. For example, if a stream of air leaves the vocal tract unhindered, the result is a vowel. If the stream of air is obstructed in any way, the result is a consonant.

SAQs

1. What is articulatory phonetics?
2. Define the term ‘vowel sound’.
3. What is a consonant sound?

2.1 Voicing

Try to utter two long consonants, first [z], then [s], continually: "zzzzzzzzsssssssssssssszzzzzzz". Hold your fingertip to your larynx (Adam's apple) and try to notice what happens. You will feel come vibration. This is caused by a stream of air that is being pressed through a narrow aperture, called glottis, between the vocal cords. It is the pressure of the air on the walls of the glottis that causes the vibration of the cords. We are able to produce two different sets of sounds, which are otherwise identical: voiced and voiceless sounds, by this small change of the glottis. There are many consonants which are differentiated in this way, like [f]-[v], [t]-[d], or [g]-[k].

SAQs

1. What is vibration?
2. What causes the vibration of the vocal cords?
2.2 Manner of Articulation

Dear Learner, please, before going deeply in this part, try to think of the meaning of the words ‘Manner’ and ‘Articulation’. What is meant by manner of articulation? To answer this question, let’s concentrate on the following two parts:

a. Plosives and Continuants

Another fundamental distinction of consonants is made between the so-called plosives and continuants. Plosives are consonants that are brought about by an explosive release of air from the mouth, e.g. [t]. They are also called stops, or oral stops. If the air is released through the nose, we call the resulting consonant a nasal plosive, as in [m] or [n], which is also called nasal stop since the mouth is kept closed for the most part.

If the air continues to be released after the articulation of the consonant, the sound is a continuant. If we let out air continuously through a space behind the upper teeth, the so-called alveolar ridge, we produce a type of continuant sound called fricative, e.g., [f]. Affricates are produced by a plosive and a fricative continuant following immediately thereafter, as in [ʧ], e.g., in the word "chair". Fricatives and affricates with a hissing sound, as [z] in "zip", or [(ʒ)] in "measure" are also called sibilants. Oral stops, i.e. nonnasal plosives, and fricative and affricative continuants all have in common that the air is not let out through the nose; consonants produced in this way are called obstruents. If air is released also through the nose, these consonants are called sonorants. The sounds [l] and [ɹ] are called liquids.
Exercise (2)

Write about the pronunciation of the English plural.

SAQs

1. What are plosive consonants?
2. If we let out air continuously through a space behind the upper teeth, we produce….

b. Aspiration

A further manner of articulating a sound is by either aspirating or not aspirating the sound. Try to pronounce these: [pit] - [spit]. You will notice that while saying the word 'pit', a stream of air evades your mouth, whereas when saying 'spit', your glottis starts to vibrate immediately after the pronunciation of [sp]. Hence, we may call the [p] aspirated when saying 'pit', while it is unaspirated when saying 'spit'. This distinction results from the glottis remaining open after certain occasions of a sound, namely in the case of aspirated ones. This aspiration is shown by putting a small (h) above the /p/.

Exercise (3)

Write about doing phonology problems.

SAQs

1- How can we make distinction between consonants?
2- Define the terms plosives and continuants, and give examples.
2.3 Consonant Sounds

Dear learner, have you ever thought of how consonants are distinguished? What do we mean by place of articulation? With the help of the following information we can answer these questions.

Consonants are distinguished also according to the location of their production, that is, after the various organs of the vocal tract.

- **Labials**
  - consonants that are articulated by use of the lips. Some of these are created by bringing the lips together, like \[ m \]. These are called [bilabials]. Other consonants are brought about by bringing the bottom lip to the upper teeth. These are called [labiodental], e.g., \[ f \].

- **Alveolars**
  - These are articulated by raising the tip of the tongue to the **alveolar ridge**, like \[ d \].

- **Velars**
  - If you raise the back of your tongue to the soft **velum**, velars are produced. An example is \[ g \].

- **Interdentals**
Are the sounds at the beginning of "thin" and "then", in IPA: \[\mathbf{\tilde{e}}\] and \[\mathbf{\tilde{e}}\]. In order to articulate these, you have to press the tongue between the teeth. Again you can see that the difference is voicing.

- **Palatals (or Alveopalatals)**
  As in the middle of the word "measure" are produced by the contact of the front part of the tongue with the hard palate just behind the alveolar ridge.

  With the help of this detailed information we can now refer to every consonant by its location and manner of articulation; \[\mathbf{\tilde{e}}\], for example, is a voiceless, labiodental fricative.

**Exercise (4)**

Why do we need the IPA?

**SAQs**

1- What is meant by place of articulation?
2- Define the term ‘labiodentals’ and give examples.
3- Give examples of the following samples: alveolar, velars, and inter-dentals.

**2.4 Vowel Sounds**

Dear learner, have you ever come across articulatory phonetics? In contrast to consonants, where voice, manner and place of articulation serve as descriptive categories, **vowels are differentiated by their position of the tongue and the lips**. These categories are indicative of the different ways in which the two
sounds are produced - while consonants are produced with the help of many organs, vowels depend on the position of the tongue and the lips. The positioning of the tongue and the lips allow for a great amount of variation, enabling us to voice many more vowels than the familiar five vowels a, e, i, o, u. English has more than a dozen different vowels. Also, in English we find several diphthongs.

Vowels can be produced by raising the tongue high, keeping it in the middle, or low in the mouth; also, the tongue can be moved to the front, center or back. The lips can be rounded or non-rounded. If you try to articulate while moving your lips and your tongue around, you will notice how manifold the resulting vowel-like sounds are. A general chart of the vowels of English looks as follows:

This chart is a rough sketch of the mouth. It is similar to a coordinate system, with the positions high, middle, and low representing one axis, and the positions front, central, and back representing the other axis. The only position not used in English for the pronunciation of vowels is the high central point.

**Exercise (5)**

Draw a table of vowels
Dear learner, can you differentiate between the terms phonetics and phonology? So, what is phonology?

**Phonology** is the study of the sound patterns of language. It is concerned with how sounds are organized in a language. **Phonology examines what occurs to speech sounds when they are combined to form a word and how these speech sounds interact with each other.** It endeavors to explain what these phonological processes are in terms of formal rules. **Phonology deals with the function of sounds within a language.** Let us have a close look at these functions. Every language has a precisely defined set of sounds. This set consists of the so-called distinctive sounds. The system of the speech sounds and their usage is defined as duality of patterning; with a given set of components, we may construct an unlimited number of new arrangements of the components. In other words:

> Our language provides us with a limited set of sounds, but we can arrange these to ever-new utterances.

**SAQs**

1- What is phonology?
2- Phonology examines …
3- Phonology deals with ….
4- What do we call the set of sounds of any language?
5- Define the system of the speech sounds and their usage.
6- With a given set of components, we may construct an unlimited number of new arrangements of the components, what does that mean?
3.1 Phonemes and allophones

Dear learner, have you ever heard about these two terms: phonemes and allophones? By calling a sound distinctive, we refer to its capability of changing the meaning of a word. Naturally, single sounds cannot carry any meaning. "B" or "P", for example, are meaningless utterances. But when several distinct sounds are assembled to a word, each of them suddenly contributes to a meaning. And by exchanging individual distinct sounds, we may change this meaning. We call these sounds phonemes, the smallest distinctive elements of a language. They are easy to discern.

Compare two words, which differ only by one sound, e.g., "pin" and "bin". By replacing the beginning consonants, the meaning of the word changes. We call such pairs minimal pairs. The test we just performed to locate the phonemes is called Commutation Test. The phonemes thereby discerned are then put within dashes, such as /p/, /b/, for phonological transcription. These are, of course, ideal units of the sound system of a language. They should not be confused with the sounds of actual utterances examined by phonetics. Phonetics tries to differentiate among the sounds with the highest possible degree of accuracy. It does so without regard for the influence a sound may have on the meaning of an utterance. These phonetic units are put in brackets, as you can see in the unit on phonetics.

Not all sounds of a language are necessarily distinctive sounds. Compare the English and American pronunciations of "dance": [dænz] versus [dænz]. Although there are different sounds in the pair, the meaning does not change. Thus, [æ] and [ə] are not
phonemes in this case. We call this phenomenon free variation. The two sounds can be referred to as allophones. These sounds are merely variations in pronunciation of the same phoneme and do not change the meaning of the word. Free variation can be found in various dialects of the same language. In this case, the different pronunciations of words throughout a country do not change the meaning of those words.

Other examples of sounds, which are not phonemes, are those, which occur, in complementary distribution. This means that where one sound of the pair occurs, the other does not. Examples for complementary distribution are the aspirated and unaspirated allophones of /p/. The initial consonant as in "pill" is aspirated. The consonant after /s/ in "sprint" is unaspirated. The respective transcriptions would be [pʰi:l] and [spraɪnt], where [ʰ] indicates aspiration. Aspirated [pʰ], as you can see in this example, occurs only at the beginning of words. [pʰ] and [p] are only allophones of the same phoneme /p/.

**SAQs**

| 1- | Dear learner, by calling a sound distinctive, we refer to its capability of changing the meaning of a word. Explain, what does that mean to you. |
| 2- | Define the term ‘phoneme’. |
| 3- | What do we mean by minimal pairs? |
| 4- | What is the purpose of the Commutation Test? |
| 5- | Write what you know about complementary distribution. |

**3.2 Distinctive features**

From our studies of phonetics, we know how to describe the features of sounds. The same techniques apply for the description of phonemes. In the pair "vault" and "fault", for example, the difference lies in the voicing of the first phonemes: /v/ versus /f/, the first
representing a voiced consonant [\+voiced], the second an unvoiced consonant [-voiced]. Voicing is of great importance in the English sound system. Therefore, we call it a distinct feature. Other distinctive features are [\±nasal] (for consonants only) or [\±consonantal], etc.

Every feature has two values, the positive value '+' contrasting the negative value '-'.

SAQs

1- What do you mean by a distinctive sound?
2- What do we call the single sound that cannot carry any meaning?
3- What is the distinctive feature?

3.3 Redundant features

Dear learner. Let’s think of the term ‘Redundant features’. Some features of sounds may be redundant in a language. This means that these sounds have a specific feature, but do not constitute minimal pairs. An example for such a redundant feature is [\±nasal] of vowels in English. You have already seen that phonetics treats consonants as nasal or non-nasal only. Still, vowels can be positive nasal [+nasal] or negative nasal [-nasal]. This does not make them into phonemes; they are merely allophones of the same vowel. In the English language the redundant feature of nasality is found to abide to a general rule: Vowels that are [+nasal] are always followed by consonants that are also [+nasals]. Likewise, Consonants that are [+nasal] are always preceded by vowels that are also [+nasal]. For example, the vowel in "band" is [+nasal], while in "bar", it is [-nasal]. Still, nasality is a distinctive feature in English consonants. In languages other than English, nasality of vowels may well not be a redundant feature. The general rule stated above says that nasality in English vowels is predictable, because you can tell if a vowel is nasal or not by looking at the consonant following it.

SAQs
Dear learner, I would like you to make sure that you one day have come across the idea that says, phonology has certain rules. What are these rules? Certain laws that are peculiar to that particular language determine the sequences of phonemes. The English language, for example, does not allow consonants such as /ʒ/ or /ʃ/ to be followed by a consonant similar to it. The phoneme sequence */bgliz/*, to give another example, is not permitted in English due to the consonant cluster /bg/ at the beginning. The following rules have been found to apply to the assembly of phoneme sequences in the English language.

**SAQs**

1- Nasality in English vowels is predictive. Why?
2- Write three examples of allophones.
3- Nasality is a distinctive feature in English. Elaborate into more details.

### 3.4 Rules of Phonology

There are many instances in which we try to ease articulation and the easiest way of doing this is to simplify articulation by assimilating sounds. The assimilation rule also reflects a phenomenon called *co-articulation*. According to this principle,
features of phonemes spread in anticipation of sounds or perseveration of articulatory processes.

Examples: ten men → tem men

good girl → goog girl

3.4.2 Feature addition rules

Sometimes, features are added to phonemes when they occur in a specific phonetic context. We have already looked at aspirated and unaspirated occurrences of stops like /p/. At the beginnings of words as in pill, /p/ is aspirated. The feature of aspiration is hence added because /p/ is a sound at the beginning of a word. In other phonetic contexts, the feature of aspiration is not added. Pen /pʰen/, please /pʰl iːz/, But it the /p/ is not in initial position, it is not aspirated. E.g tap napkin.
Exercises (6)

1. Consider the distribution of [r] and [l] in Korean in the following words. Some additional details of Korean pronunciation which are not indicated in the book are given here.

rubi 'ruby'
kiri 'road'
saram 'person'
irumi 'name'
radio 'radio'
mul 'water'
pal 'big'
soul 'Seoul'
ilgop 'seven'
ipalsa 'barber'

Are [r] and [l] allophones of one or two phonemes? (That is, are these sounds stored differently in the memory of Korean speakers?) State your reasons, and give the rule to derive the surface phones if you conclude that they are allophonic.

2. Do [s] and [z] represent different phonemes? (Do Finnish speakers use both /s/ and /z/ to store words in their memories?)

3. Do [d] and [t] represent different phonemes? (Do Finnish speakers use both /d/ and /t/ to store words in their memories?)

4. Are [b] and [v] allophones of one phoneme? (Are [b] and [v] memorized as separate sounds, or are they stored in memory as the same sound?) (Hint: Are they in complementary distribution? Do the environments overlap? Can you predict which will occur?) Does the same rule that describes the distribution of [b] and [v] apply to [p] and [f]?
3.4.3 Segment-deletion and addition rules

Phonological rules of a language may result in the addition or deletion of segments from a phoneme sequence. A good example for this rule is French, where word-final consonants are *deleted* when a consonant follows. But they are maintained when the following word starts with a vowel or a glide:

<table>
<thead>
<tr>
<th>Before a consonant:</th>
<th>peɪt tableu</th>
<th>[pəɪt ˈtæblə]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before a vowel:</td>
<td>peɪt ami</td>
<td>[pəɪt ʌmi]</td>
</tr>
</tbody>
</table>

3.4.4 Movement (metathesis) rules

In some languages, and in some English dialects, phonemes are rearranged. Consider the example "ask". In some English dialects, it is pronounced [æks]. Historically, "ask" derived from Old English "aksian"; a metathesis rule changed it in most English dialects to the form commonly known today, whereas in others, the old form is kept.
Overview

Dear learner, by the end of this unit, I think you have covered the elaborated objectives, and made sure that the self-assessment questions, exercises, and activities are thoroughly answered. As mentioned earlier this unit is of three sections that cover certain areas of introducing the sounds of language. These sections are fully detailed to you to:

1- recognize that there are certain ways and places for producing speech sounds.
2- discover that there are three sub-disciplines of phonetics,
3- understand and use the basic terminology of phonetics,
4- define the terms of phonetics,
5- explain the characteristics of speech sounds, and
6- differentiate between consonants and vowels.

We hope that you have mastered this unit for it is of certain importance to understand the coming units of this course.

Preview

Dear learner, after having finished studying Unit One and learning the principles of speech sounds which are considered the basic of unit two. In unit three, you are going to note that there three are sections. Section one deals with types of morphemes, grammatical classification, morphological classification, morph, morpheme and allomorph. Section two introduces morphology and word-formation, inflection, word-formation, derivation, compounding. Section three explores word classes and sentences functions. All these sections cover what is called morphology, which is the study of word structure. Please, before starting unit two, make sure you have mastered unit one.
ANSWERS KEY

Exercise (1)

Larynx: voiceless or voiced
The larynx is located in the throat. It is an intricate combination of muscles and cartilage. Although it is capable of a number of different movements we will only consider two.
Voiceless: The vocal cords are pulled apart, so that they do not vibrate.
Voiced: The vocal cords are pressed lightly together, so that they do vibrate.
You can feel whether or not your vocal cords are vibrating by placing your hand against your throat while making a speech sound. Do not whisper, though, whispered sounds are all voiceless.

Nose: oral or nasal?
The soft palate (or velum) at the back of the throat can be moved like a valve to open or close the opening to the nose. It is normally open when breathing, but is closed for many speech sounds.
Oral: The velum is closed.
Nasal: The velum is open

Place: Bilabial, Labiodental, Interdental, Alveolar, Lateral, Palatal, Velar or Glottal?
The mouth can be narrowed in many places by the lips and tongue. The place of a speech sound describes where the mouth is narrowest.
Bilabial: The lips are moved together.
Labiodental: The bottom lip is moved toward the upper teeth.
Interdental: The tongue is moved toward the upper teeth.
Alveolar: The tip of the tongue is moved toward the the alveolar ridge (the ridge behind the upper teeth).
Lateral: As for alveolar, but with the sides of the tongue down, so that air flows around the tongue.
Palatal: The blade of the tongue is moved toward the hard palate.
Velar: The body of the tongue is moved toward the soft palate.
Glottal: The vocal folds are moved together.
Closure: Stop, Fricative, Affricate, or Approximant (liquid or glide)?
The degree of narrowing of the mouth can vary. We recognize the following possibilities:
Stop: The mouth is closed completely.
Fricative: The mouth is nearly closed, so that the air flows turbulently through the channel.
Affricate: A stop is followed immediately by a fricative.
Approximant: The mouth is fairly open.
English consonants cannot have all values of all parameters. Nasals, liquids and some glides are usually voiced.
<table>
<thead>
<tr>
<th></th>
<th>Bilabial</th>
<th>Labiodental</th>
<th>Interdental</th>
<th>Alveolar</th>
<th>Lateral</th>
<th>Palatal</th>
<th>Velar</th>
<th>Glottal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stop</strong></td>
<td>voiceless nasal</td>
<td>p</td>
<td>b</td>
<td>m</td>
<td>t</td>
<td>d</td>
<td>n</td>
<td>k</td>
</tr>
<tr>
<td><strong>Fricative</strong></td>
<td>voiceless voiced</td>
<td>f</td>
<td>v</td>
<td>θ</td>
<td>δ</td>
<td>s</td>
<td>z</td>
<td>f</td>
</tr>
<tr>
<td><strong>Affricate</strong></td>
<td>voiceless voiced</td>
<td>M</td>
<td>W</td>
<td>r</td>
<td>l</td>
<td>j</td>
<td>h</td>
<td>Č</td>
</tr>
<tr>
<td><strong>Approximant</strong></td>
<td>voiceless voiced</td>
<td>M</td>
<td>W</td>
<td>r</td>
<td>l</td>
<td>j</td>
<td>h</td>
<td></td>
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</tbody>
</table>
Describing consonants
Each consonant in the table can be uniquely described by answering the four questions. You should be able to go back and forth with these descriptions. For example:

- \([m]\) = voiced nasal bilabial stop
- \([l]\) = voiced oral lateral approximant
- \([k]\) = voiceless oral velar stop

Vowels
Four questions for English vowels
- Height: high, mid or low?
- Place: front, central or back?
- Lips: rounded or unrounded
- Tongue Root: advanced (= ATR, tense) or plain (= lax)

Exercise (2)
The plural marker in English has several different pronunciations:

- \([\emptyset]\) (zero): [dir], [jɪp], [fɪʃ], etc.
- \([\ddot{a}\n]\): [ɑksən], etc.
- \([s]\): [kæts], [pæts], [sæks], etc.
- \([z]\): [daːɡz], [ɾɪbz], [bænz], etc.
- \([əz]\): [bʊʃəz], [roʊəz], etc.

The choice of zero or \([\ddot{a}\n]\) is handled in the Morphology, because it is **not** predictable from the speech sounds. The choice of \([s]\), \([z]\) or \([əz]\) is handled in the Phonology, because it is **predictable** from the speech sounds.

Exercise (3)
The basic steps in doing phonology problems are:
1. Look for minimal pairs (If yes, then both sounds are phonemes)
2. Look for alternations in the pronunciation of one morpheme
3. List the environments for the different pronunciations
4. Find the part of the environment that predicts the change in pronunciation
5. Make a mind and mouth diagram
6. Write the rule (in words, then in symbols)
7. Check to see that the rule works.

**Exercise (4)**
We need a system for recording speech sounds accurately.

**Exercise (5)**

<table>
<thead>
<tr>
<th></th>
<th>Front</th>
<th>Central</th>
<th>Back</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unrounded</td>
<td>Unrounded</td>
<td>Unrounded</td>
</tr>
<tr>
<td>High</td>
<td>tense lax</td>
<td>i</td>
<td>I</td>
</tr>
<tr>
<td></td>
<td>lax</td>
<td>i</td>
<td></td>
</tr>
<tr>
<td>Mid</td>
<td>tense lax</td>
<td>e</td>
<td>e</td>
</tr>
<tr>
<td></td>
<td>lax</td>
<td>æ</td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>lax</td>
<td>æ</td>
<td></td>
</tr>
</tbody>
</table>

**Describing vowels**
As for consonants, the vowels can be described by answering the four questions for vowels. For example:

- [u]: high back rounded tense
- [æ]: low front unrounded lax
- [ɛ]: mid front unrounded lax

**Height: high, mid or low**
The body of the tongue can be moved up or down within the mouth.
- High: The body of the tongue is moved up.
- Mid: The resting position for the body of the tongue.
- Low: The body of the tongue is moved down.

**Place: front, central or back**
The body of the tongue can also be moved toward the front or back of the mouth.
Front: The body of the tongue is moved forward.
Central: The resting position for the body of the tongue.
Back: The body of the tongue is moved backward.

**Lips: Unrounded or rounded**
The lips can be moved independently of the tongue. This is not exploited very much in English; German and French have a wider array of rounded vowels.
Unrounded: The lips are not rounded. The resting position for the lips.
Rounded: The lips are rounded.

**Tongue Root: advanced or plain**
This is the most difficult vowel feature to feel, due to the lack of appropriate nerves in the root of the tongue and throat. The tongue root can be advanced, making the throat wider. It can also be retracted, narrowing the throat, this is used in Arabic for instance, and in the production of [r] and [ɔ] for many speakers of English.
ATR/tense: The tongue root is advanced. This sounds very similar to a small increase in vowel height.
Plain/lax: The resting position for the tongue root.

**Schwa**
Each of the vowel features is defined as a deflection from the resting position of the lips and tongue.
The vowels [ʌ] and [ə] share the resting position features: mid, central, unrounded and plain. They are distinguished in English transcriptions by stress. [ʌ] is used for stressed vowels, as in [bʌt] "but". [ə] is used for unstressed vowels, as in [bətwin] "between".
The International Phonetics Association designed an alphabet in which each letter indicates one unique sound. It is designed to be able to transcribe the speech sounds of any human language.

**Exercise (6)**
1. Look for minimal pairs
   There are none. Therefore, probably allophones of one phoneme. Two sounds in the mouth, one sound in the mind.

2. Look for morphemes with changing pronunciation
   There are none.

3. List the environments for the sounds
   (Zoom in on the things of interest. Get rid of extraneous information.) Work from the things closest to the sounds of interest.

<table>
<thead>
<tr>
<th></th>
<th>[r] sounds immediately before</th>
<th>sounds immediately after</th>
<th>[l] sounds immediately before</th>
<th>sounds immediately after</th>
</tr>
</thead>
<tbody>
<tr>
<td># (beginning of word), i, a</td>
<td>u, i, a, u</td>
<td>u, a, i</td>
<td># (end of word), k, s</td>
<td></td>
</tr>
</tbody>
</table>

4. Find the part of the environment that predicts the change in pronunciation
   Does the "before" environment predict which sound? NO! The sounds [i] and [a] occur before both [r] and [l]. Therefore, we cannot predict [r] versus [l] on the basis of the immediately preceding sound. In the case of [i] or [a] both [r] and [l] can occur.
   Does the "after" environment predict [r] versus [l]? YES! The "after" environments do not overlap!
   What is the difference between the two environments? [r] occurs only when a vowel follows; [l] occurs when either a consonant follows or when nothing follows (i.e. at the end of the word).
   Which is the simpler one to predict? [r], "vowel" is simpler than "consonant or nothing". Therefore, the [r] is predictable, and /l/ (the unpredictable one) must be the phoneme.

5. Make a mind and mouth diagram
6. Mind: /l/
8. Write the rule (in words, then in symbols)
9. Koreans pronounce /l/ as [r] when a vowel immediately follows.
10. /l/ → [r] / [vowel]

Can we do better? What's the difference between [l] and [r]?
[l] is [lateral]; [r] is [alveolar].
[ku:zi] and f. [ku:si] differ minimally in pronunciation in the right way: a. has [z] and f. has [s].

**BUT** they both have the same meaning: 'six'. Because the difference in pronunciation does **NOT** cause a change in meaning, this is **not** a minimal pair. Therefore these two words do not establish a mental memorized distinction between [s] and [z].


b. List the environments for the different pronunciations

<table>
<thead>
<tr>
<th></th>
<th>[s]</th>
<th>[z]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>sounds immediately before</strong></td>
<td><strong>sounds immediately after</strong></td>
</tr>
<tr>
<td>u:, i:, a</td>
<td>i, a, # (end of word)</td>
<td>u:, i:</td>
</tr>
<tr>
<td>i, a</td>
<td>i, a</td>
<td>i, a</td>
</tr>
</tbody>
</table>

c. Find the part of the environment that **predicts** the change in pronunciation.

Can we predict [s] versus [z] from the "before" environment? NO! The "before" environments overlap, both [s] and [z] can occur when the immediately preceding sound is [u:] or [i:]. Therefore, knowing the immediately preceding sound won't predict which of [s] or [z] we get.
Can we predict [s] versus [z] from the "after" environment? NO! The "after" environments overlap, both [s] and [z] can occur when the immediately following sound is [i] or [a]. Therefore, knowing the immediately following sound won't predict which of [s] or [z] we get. Moreover, in the cases of the false minimal pairs, a. [ku:zi] and f. [ku:si] 'six'
g. [li:sa] and k. [li:za] 'Lisa'
the environments are exactly the same. (They look like minimal pairs, but they aren't because the change in pronunciation doesn't cause a change in meaning.) Since the environments are exactly the same in these alternative pronunciations of 'Lisa' and 'six', nothing in the speech sounds themselves can predict which one of [s] or [z] will be used. This case is not phonologically predictable. It might be the case that looking at social or dialect factors would tell us how Finnish speakers choose between [s] and [z]. At this point all we know is that they don't make the choice between [s] and [z] based on the surrounding sounds. However, we can notice that [s] occurs in more environments than [z] does. For example, j. [ratas] 'whell' has an [s] at the end of the word. We don't see any words ending in [z]. So, it would be best to memorize the sound as /s/, and then sometimes pronounce /s/ as [z]. For this case we just can't predict exactly when /s/ is pronounced as [z].

d. Make a mind and mouth diagram
e. Mind: /s/
f. Mouth: [s] [z]
g. Overlapping environments--unpredictable
h. Write the rule (first in words, then in symbols)
i. /s/ becomes [z] unpredictably
j. /s/ → [z] unpredictably
k. /s/ → [voiced] unpredictably
[s] and [z] are in free variation
1. Look for minimal pairs (If yes, then both sounds are phonemes)
   There are minimal pairs:
   - h. [madon] 'of a worm'
   - i. [maton] 'of a rug'
   [madon] and [maton] differ minimally in their pronunciation, AND this change in pronunciation goes along with a change in meaning: [madon] means 'of a worm' and [maton] means 'of a rug'. Because we found minimal pairs, both sounds are phonemes.

2. Look for alternations in the pronunciation of one morpheme
   There are no alternations for [t] and [d].

3. List the environments for the different pronunciations
   Because they are both phonemes (both used in memory) and there are no alternations, we do not need to calculate the environment, because there is nothing to predict.
   In Finnish, /t/ is pronounced as [t] and /d/ is pronounced as [d].

4. Find the part of the environment that predicts the change in pronunciation
   There is nothing to predict here. Both /t/ and /d/ are phonemes, and they maintain separate pronunciations (there are no alternations).

5. Make a mind and mouth diagram

6. Mind: /t/ /d/

7. Mouth: [t] [d]

8. Write the rule
   No rule here, they're both phonemes with no alternations.

   a. Look for minimal pairs (If yes, then both sounds are phonemes)
      There are no minimal pairs for [b] versus [v].

   b. Look for alternations in the pronunciation of one morpheme
      The morpheme for 'broke' shows different pronunciations for the masculine and the feminine: [javar] 'broke masculine' and [javra] 'broke feminine'. But these two forms do not illustrate a
[b]-[v] change. Therefore, they don't immediately let us figure out what causes either [b] or [v] to occur. So we have to go on to listing the environments.

c. List the environments for the different pronunciations

<table>
<thead>
<tr>
<th></th>
<th>[b]</th>
<th>[v]</th>
</tr>
</thead>
<tbody>
<tr>
<td>sounds immediately before</td>
<td>sounds immediately after</td>
<td>sounds Immediately before</td>
</tr>
<tr>
<td># (beginning of word), g</td>
<td>i, a</td>
<td>a, e</td>
</tr>
<tr>
<td></td>
<td></td>
<td>a, r, # (end of word)</td>
</tr>
</tbody>
</table>

d. Find the part of the environment that **predicts** the change in pronunciation.

The "after" environments overlap. The sound [a] can come immediately after both [v] and [b]. Therefore, we cannot predict which of [v] or [b] would occur just given the information about what sound comes immediately after. The "before" environments do not overlap. Therefore, the before environment is sufficient to predict which of [b] or [v] will occur. Therefore, for speakers of Hebrew, [b] and [v] are stored as one sound.

But **which** sound do you store in memory? We figure this out by asking which environment is **harder** to predict. In this data, [v] only occurs after **vowels**. [b] never occurs after vowels. [b] only occurs after consonants, or at the beginning of the word. The environment "after vowels" is simpler than "after consonants or at the beginning of the word", so the environment for [b] is **harder** to predict. Therefore, for
Hebrew speakers [b] and [v] are different pronunciations of the memorized sound /b/.

e. Make a mind and mouth diagram

f. Mind: 
   /b/

g. Mouth: [b] / Elsewhere [v] / [vowel] _

h. Write the rule (in words, then in symbols)
i. /b/ becomes [v] when there is a vowel immediately before it

j. /b/ → [v] / [vowel] __

1. [voiced oral bilabial stop] → [fricative] / [vowel] __

2. What do we want to compare? [b] with [p] or [b] with [f]? We want to compare stops with stops and fricatives with fricatives. Therefore, we want to compare [b] with [p]. Therefore, we are considering whether the rule should be extended to include:


   How would we know? The rule says that we get [f] if and only if it is preceded by a vowel. Therefore, there can be two kinds of counter examples:

a. [f] preceded by something other than a vowel (consonant or at the beginning of the word -- the undergeneration case)

b. [p] preceded by a vowel (the overgeneration case)

   So we look. All [f]'s are immediately preceded by vowels. No [p] is immediately preceded by a vowel. Therefore, the rule works here too.

   Now we need to write one rule that covers both cases. What characteristics do [p] and [b] share? They're both labial stops. Therefore, the rule must be:

   A labial oral stop becomes a fricative when a vowel comes immediately before it.

   [labial oral stop] → [fricative] / [vowel] __

1. What determines the choice of [b, p] versus [v, f]? The sound immediately before. What sound is immediately before the blank? [d]. What kind of sound is [d]? A consonant. So fricatives cannot appear here, because fricatives only appear when there is a vowel immediately before them.
So "(1) [b] but not [v] could occur in the empty slot" is the only correct statement.

1. No vowel preceding, so fricatives cannot occur in this position.
   So "(2) [p] but not [f] could occur in the empty slot" is the only correct statement.

1. laval
2. surva
3. labal
4. palar
5. falu
6. razif
7. If these words actually occurred in Hebrew would they:
   1. Force you to revise the conclusions about the distribution of labial stops and fricatives you reached on the basis of the first group of words given above.
   2. Support your original conclusions?
   3. Neither support nor disprove your original conclusions.
      Let's check to see if we need to rethink anything.

4. Look for minimal pairs (If yes, then both sounds are phonemes)
   The new data introduces a minimal pair: [laval] versus [labal].
   This would lead us to conclude that the distinction between [b] and [v] is significant, because it goes along with a change in meaning. Then we would conclude that Hebrew speakers memorize both [b] and [v], giving two phonemes /b/ and /v/.
   This is clearly a different conclusion than what we came up with, so if the right answer is (1), we would be forced to revise our conclusions.
Terms

1) **Vowel:** a speech sound in which the airstream from the lungs is not blocked in any way in the mouth or throat, and which is usually pronounced with vibration of the vocal cords. The type of vowel sound which is produced depends largely on the position of the tongue:
   (a) which part of the tongue is raised.
   (b) How far the tongue is raised.

2) **Consonant:** a speech sound where the airstream from the lungs is either completely blocked (stop), partially blocked (lateral), or where the opening is so narrow that the air escapes with audible friction (fricative). With some consonants (nasal) the airstream is blocked in the mouth but allowed to escape through the nose.

3) **IPA:** an abbreviation for:
   (1) International Phonetic Association.
   (2) International Phonetic Alphabet.
   Assimilation: When a speech sound changes, and becomes more like another sound which follows it or preceded it.
REFERENCES


