PHONEMIC ANALYSIS

A phonemic analysis tries to answer the question:
What is a permissible (phonological) word in a particular language?

A 'classical' phonemic analysis consists of:
i. an inventory of phonemes
ii. a list of allophonic rules (including allophones of course)
iii. a statement of phonotactics (environments) — which phonemes go where
These three steps provide an answer to the first question.

A phonemic analysis will reveal if the studied phonemes / allophones of the particular language are in:
– complimentary distribution
– contrastive distribution
– free variation

complimentary distribution: phonemes are said to be in complementary distribution if they never occur in the same phonetic environment

contrastive distribution: phonemes occur in the same phonetic environment where the distinction in meaning is due to the particular phoneme (form minimal pairs)

free variation: phonemes are said to be in free variation if they do not affect the meaning of the word

The full method of phonemic analysis can be broken down as follows:

1. Do an inventory of phones (transcribed sounds)

2. Identify phonetically similar ('suspicious') pairs

3. Compare the distributions of suspicious pairs, looking for complementary or contrasting distribution in terms of:
– neighbouring segments
– syllable and word structure
– stress
– non-neighbouring segments

4. Group complementary suspicious pairs (or triplets, etc) into phonemes

5. Do an inventory of phonemes

6. Describe allophonic variation in terms of rules

7. Describe the phonotactics of phonemes (including syllable and word structures

8. In choosing an allophone to name the phoneme after, ie its basic allophone or basic variant, choose the one with the broadest range of occurrence that allows for the simplest allophonic statement. If this is not clear, choose the one that occurs word-initially.

9. Notation for statements of allophonic variation:

Phonetic vs phonemic inventories

In my first year "Sounds of Language" class, one of the things we do is look at phonetic vs phonemic inventories. I've just had a question about this on the discussion board for the module so I thought I may as well post my response, in case anyone is interested.

Sounds pattern differently in different languages. Speakers of two languages may produce exactly the same set of speech sounds - or phones (phonetics) - when talking, but the languages may use those sounds differently to create meaning. Once we're talking about meaning, we are considering phonemes.

Say, for example, there are two languages whose speakers produce the consonant sounds [p] and [b] and have one vowel, [a]. In both cases, the phonetic inventory contains [p], [b] and [a]. We put the sounds in [] brackets to indicate we are just talking about how the sound is produced at the moment.

The only thing which is different between [p] and [b] is voicing; [p] is voiceless and [b] is voiced. Otherwise, they are both bilabial plosives.

In language A, [bapa] and [baba] mean different things - [bapa] means "red" and [baba] means "yellow". [bapa] and [baba] constitute a MINIMAL PAIR, as only one sound differs between the two and it changes the meaning of the word. We can therefore say that /p/ and /b/ are phonemes - meaning units - because of this change in meaning, and we now put them in // brackets. There are TWO consonant phonemes. Thus, the phonemic inventory is /p/, /b/ and /a/.

In language B, however, [baba] and [bapa] both mean the same thing - they both mean "car". This means that it doesn't matter whether the consonant is voiced in language B. As there is no change in meaning when one substitutes [p] for [b], they are NOT different phonemes but belong to the same single phoneme.

What we have to do for language B is decide which sound represents the phoneme, and we often choose the one which occurs in most environments. As we don't have a lot of data here, let's go with the phoneme being /b/ (as there are more of them). That phoneme contains the two sounds [p] and [b], which are ALLOPHONES (phonetic variants) of /b/. Thus, the phonemic inventory is /b/ and /a/.

This is a very limited set of data, however!

4.2 ALLOPHONES AND PREDICTABLE VARIATION

Within a phoneme category, speech sounds vary, usually in predictable ways. The variants within a phoneme category are called allophones. Allophones usually appear in complementary distribution, that is, a given allophone of one phoneme appears in one predictable environment, but the other allophones of that phoneme never appear in that environment.

CHECK YOURSELF

1. Remember that in English, voiceless stops are aspirated at the beginning of a word and the beginning of a stressed syllable, but never in the middle of a word nor at the end of a word. Which term best describes this pattern?

- Phonemic contrast.
- Minimal pair.
- Complementary distribution.

2. The symbol [ɬ] represents a velarized [l]. Looking at the following set of transcribed English words, what can you conclude about [l] and [ɬ] in English?

leaf [lif] fall [fɑɬ]

luck [lʌk] spill [spɪɬ]

lemon [lɛmən] wolf [wʊɬf]

- [l] and [ɬ] are phonemically contrastive in English.
- [l] and [ɬ] are in complementary distribution in English.

3. Remembering that the alveolar flap [ɾ] appears in a predictable environment in English (see Section 3.9), which statement is true for English?

- The segments [t] and [ɾ] are two different phonemes in English.
- The segments [t] and [ɾ] are allophones of the same phoneme in English.

VIDEO SCRIPT

In our last unit, we learned about the notion of a **phoneme**. Remember that a phoneme is something that exists in your mind: it's like a shopping bag in which your mind stores memories of examples of phonetically similar sounds that are all members of one category. Not all the sounds that you store in one phoneme category have to be identical; in fact, your mental category has room for a lot of **variation**. Any variants that are not contrastive, that don't lead to a meaning change, are members of that same phoneme category and are called **allophones**.

We've already seen some examples of allophones of English phonemes as we've been learning to transcribe sounds. We know that the alveolar lateral approximant [l] has a voiceless variant [l̥] and a syllabic variant [l̩], but our minds categorize all of them as members of the same phoneme. This shopping-bag metaphor is going to get a little unwieldy, so let's look at another notation that we can use to represent this phoneme category.

We say that /l/ is the label for the phoneme category itself, it's the most general form of the phoneme. Notice that instead of using square brackets, for the symbol that represents the whole category we use slashes. In any given word, the phoneme /l/ might get spoken as any one of its allophones, each of which gets represented in square brackets. But where does each allophone appear? Which allophones do we use in which words? One of the big things that phonology is concerned with is the **distribution** of allophones: that is, what phonetic environments each allophone appears in. The distribution of allophones is a key part of the mental grammar of each language — it's something that all speakers know unconsciously.

Some allophones appear in **free variation**, which means that it's pretty much random which variant appears in any environment. But most allophones are entirely **predictable**: linguists say that allophonic variation is **phonetically conditioned** because it depends on what other sounds are nearby within the word.

Let's start by looking at free variation because it's the simpler case. Take our phoneme /l/, as in the words *lucky* and *lunch*. Most of the time you pronounce these words with a plain old ordinary voiced alveolar lateral approximant. But sometimes you might be speaking extra clearly — maybe you're trying to talk to a relative who's hard of hearing, or maybe you're concentrating on teaching some speech sounds to a language learner. So instead of making the /l/ sound at the alveolar ridge, you stick your tongue right out between your teeth and say *lucky* or *lunch*. Now you're making a dental [l̪], not an alveolar [l], but it's still a member of the phoneme category for /l/ — it doesn't change the meaning of the word so this phonetic difference is not contrastive. It's just free variation within the category.

But most allophonic variation is predictable: different allophones show up in different **environments**. Let's look at a few words. If we look at this set of words: *plow*, *clap*, *clear*, *play*, we can see that whenever /l/ follows a [p] or [k], it is **devoiced**. But now look at this other set of words *(blue, gleam, leaf, fall, silly*), when /l/ appears in any other environment, like following a voiced stop, or at the beginning of a word, at the end of a word, or in the middle of a word, it's the ordinary [l]. If we looked at a whole lot more words and recorded a lot of English speakers, we'd find that whenever /l/ is in a consonant cluster following a voiceless aspirated stop, it also becomes voiceless, but when /l/ is in other environments, it stays voiced. We never find voiceless [l̥] in other environments, and we almost never find voiced [l] following a voiceless stop. That pattern is called **complementary distribution**.

That's an important phrase, and it's going to come up a lot in the next few units. It means that there's no overlap in where we find the allophones: We see voiceless [l̥] following voiceless stops, but never anywhere else, and we never see voiced [l] in that environment. Likewise, we see voiced [l] in lots of different environments, but we never see voiceless [l̥] in any of those places. When we see complementary distribution, that's good evidence that the two segments we're considering are allophones of one phoneme. Can you think of any other examples of English phonetic segments that are in complementary distribution? Think about what happens when you're transcribing voiceless stops.

So let's sum up. If we have two phonetic segments that are related but different from each other, and we find some **minimal pairs** to show that this phonetic difference is **contrastive**, then we conclude that those two segments are **two different phonemes**.

And if we have two phonetic segments that are related but different, and they're not contrastive, then we look to see what the **distribution** of these segments is, that is, what **environments** we see them in. If they're not contrastive and they're in **complementary distribution**, then we conclude that they're **allophones of the same phoneme**.

Minimal pair

In phonology, **minimal pairs** are pairs of words or phrases in a particular language, spoken or signed, that differ in only one phonological element, such as a phoneme, toneme or chroneme,[1] and have distinct meanings. They are used to demonstrate that two phones are two separate phonemes in the language.
Many phonologists in the middle part of the 20th century had a strong interest in developing techniques for discovering the phonemes of unknown languages, and in some cases, they set up writing systems for the languages. The major work of Kenneth Pike on the subject is *Phonemics: a technique for reducing languages to writing*.[2] The minimal pair was an essential tool in the discovery process and was found by **substitution** or **commutation** tests.[3]
As an example for English vowels, the pair "l**e**t" + "l**i**t" can be used to demonstrate that the phones [ɛ] (in l**e**t) and [ɪ] (in l**i**t) actually represent distinct phonemes /ɛ/ and /ɪ/.
An example for English consonants is the minimal pair of "**p**at" + "**b**at". The following table shows other pairs demonstrating the existence of various distinct phonemes in English. All of the possible minimal pairs for any language may be set out in the same way.

word 1	word 2	IPA 1	IPA 2	note
pin	bin	/pɪn/	/bɪn/	
rot	lot	/rɒt/	/lɒt/	initial consonant
thigh	thy	/θaɪ/	/ðaɪ/	
seal	zeal	/siːl/	/ziːl/	
bin	bean	/bɪn/	/biːn/	vowel
pen	pan	/pɛn/	/pæn/	

cook	kook	/kʊk/	/kuːk/	
hat	had	/hæt/	/hæd/	final
mean	meme	/miːn/	/miːm/	consonant

Phonemic differentiation may vary between different dialects of a language so a particular minimal pair in one accent may be a pair of homophones in another. That means not that one of the phonemes is absent in the homonym accent but only that it is not contrastive in the same range of contexts.

Minimal set

The principle of a simple binary opposition between the two members of a minimal pair may be extended to cover a **minimal set** in which a number of words differ from one another in terms of one phone in a particular position in the word.[10] For example, the vowels /a/, /e/, /i/, /o/, /u/ of Swahili are shown to be distinct by the following set of words: *pata* 'hinge', *peta* 'bend', *pita* 'pass', *pota* 'twist', *puta* 'thrash'.[11] However, establishing such sets is not always straightforward[12] and may require very complex study of multiple oppositions as expounded by, for example, Nikolai Trubetzkoy.[1

Contrastive distribution

Contrastive distribution in linguistics, as opposed to complementary distribution or free variation, is the relationship between two different elements in which both elements are found in the same environment with a change in meaning.

PhonologyEdit

In phonology, two sounds of a language are said to be in contrastive distribution if replacing one with the other in the same phonological environment results in a change in meaning. If a sound is in contrastive distribution, it is considered a phoneme in that language.

For example, in English, the sounds [p] and [b] can both occur word-initially, as in the words *pat* and *bat* (minimal pairs), which are distinct morphemes.

Therefore, [p] and [b] are in contrastive distribution and so are phonemes of English.

Note that two sounds that are in contrastive distribution in one language can be in complementary distribution or free variation in another. These sounds occur in English, as in the word *team* [t^hiːm] and *steam* [stiːm], but their occurrence is purely dependent upon phonological context. Therefore, in English, [t^h] and [t] are not in contrastive distribution but in complementary distribution.

Complementary distribution and Free variation

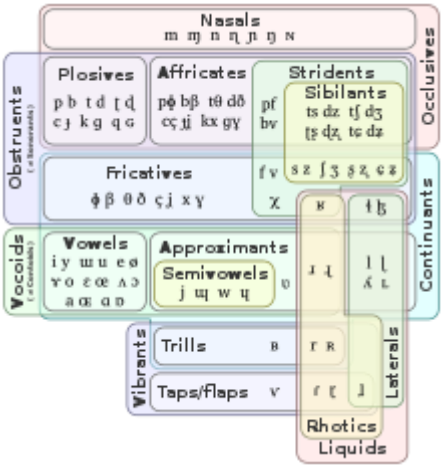
Not all sounds of a language are necessarily distinctive sounds. Compare the English and American pronunciations of "dance". Although there are different sounds in the pair, the meaning does not change. Thus, [**a** as in barn] and [**a** as in pat] are not phonemes in this case. We call this phenomenon **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.
Another example 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.
Consider the following words with respect to the plosive sounds p,t, and k. Put your hand in front of your mouth and pronounce the words. Do you feel a difference?
pill s**p**ill **t**ill s**t**ill **k**ill s**k**ill
Did you realize, that there is a burst or puff of air after the /p/ in *pill, till,* and *kill*, that is absent in *spill, still,* and *skill*? The feature that makes the difference between the plosive sounds in pill, till, kill and spill, still, skill is called **aspiration** (the period between the release of the closure of a consonant and the start of the vocal cord activity for the vowel that comes after it. This period is usually felt as a puff of air.)
Aspirated and unaspirated allophones are one example of complementary distribution: where the one (e.g. the aspirated p) occurs, the other cannot occur. Aspirated [aspirated p], as you can see in this example, occurs only at the beginning of words. [aspirated p] and [p as in pit] are only allophones of the same phoneme /p/.
The word “complementary” actually refers to the fact that the contexts in which the allophones of a phoneme appear can never be the same and they cover the whole range of possible environments in which the sound can occur (for an analogous situation think of complementary angles in geometry). In other words, in a given context X only a certain allophone will occur, while in another context Y, another allophone is expected to occur and X and Y are the only contexts in which the allophones can occur.
It follows from this that the occurrence of allophones is always predictable since in a certain context we can only expect one and only one realization of the phoneme. In the context of the word *pill* for example – the voiceless plosive /p/ is followed by a stressed vowel and is in syllable-initial position – we can safely say that the aspirated allophone [ph] will come up. If, on the other hand, p is not syllable-initial and is preceded by s as in spill, we can safely predict that the unaspirated variant of p will occur.
The occurrence of different phonemes is, on the contrary, totally unpredictable since it is the very fundamental characteristic of phonemes that they are contrasted in one and the same context. There is no way in which we can predict therefore that in the context -il we will have *pill, nil, chill, fill, gill, Jill, sill, kill, mill, hill, dill* or *till* (the list can continue). Any two words – such as *pill* and *bill*, mentioned above, or *kill* and *hill*, etc. – that help us discover which sounds have a contrastive value in a given language are said to form, just to remind you, a **minimal pair**.
The following criteria must be met by the two words in order that they form a minimal pair: they should have the same number of sounds, and these sounds should be identical, with the only exception of the contrasting sound that should be distributed in the same context in both words; the words must also have different meanings.

Distinctive feature

In linguistics, a **distinctive feature** is the most basic unit of phonological structure that may be analyzed in phonological theory.
Distinctive features are grouped into categories according to the natural classes of segments they describe: major class features, laryngeal features, manner features, and place features. These feature categories in turn are further specified on the basis of the phonetic properties of the segments in question.[1]

Since the inception of the phonological analysis of distinctive features in the 1950s, features traditionally have been specified by binary values to signify whether a segment is described by the feature; a positive value, [+], denotes the presence of a feature, while a negative value, [−], indicates its absence. In addition, a phoneme may be unmarked with respect to a feature. It is also possible for certain phonemes to have different features across languages. For example, [l] could be classified as a continuant or not in a given language depending on how it patterns with other consonants.[2]
In recent developments[*when?*] to the theory of distinctive features, phonologists have proposed the existence of single-valued features. These features, called univalent or privative features, can only describe the classes of segments that are said to possess those features, and not the classes that are without them.[3]
List



Euler diagram showing a typical classification of sounds (in IPA) and their manners of articulation and distinctive features

This section lists and describes the features.[4]

Major class

Major class features: The features that represent the major classes of sounds.

1. [+/− syllabic][*citation needed*] Syllabic segments may function as the nucleus of a syllable, while their counterparts, the [−syll] segments, may not. Except in the case of syllabic consonants, [+syllabic] designates all vowels, while [−syllabic] designates all consonants (including glides).
2. [+/− consonantal] Consonantal segments are produced with an audible constriction in the vocal tract, such as obstruents, nasals, liquids, and trills. Vowels, glides and laryngeal segments are not consonantal.
3. [+/− approximant] Approximant segments include vowels, glides, and liquids while excluding nasals and obstruents.
4. [+/− sonorant] This feature describes the type of oral constriction that can occur in the vocal tract. [+son] designates the vowels and sonorant consonants (namely glides, liquids, and nasals) that are produced without an imbalance of air pressure in the vocal tract that might cause turbulence. [−son] describes the obstruents, articulated with a noticeable turbulence caused by an imbalance of air pressure in the vocal tract.

LaryngealEdit

Laryngeal features: The features that specify the glottal states of sounds.

1. [+/− voice] This feature indicates whether vibration of the vocal folds occurs with the articulation of the segment.
2. [+/− spread glottis] Used to indicate the aspiration of a segment, this feature denotes the openness of the glottis. For [+sg], the vocal folds are spread apart widely enough for frication to occur; for [−sg], there is not the same friction-inducing spreading.
3. [+/− constricted glottis] The constricted glottis features denotes the degree of closure of the glottis. [+cg] implies that the vocal folds are held closely together, enough so that air cannot pass through momentarily, while [−cg] implies the opposite.

MannerEdit

Manner features: The features that specify the manner of articulation.

1. [+/− continuant] This feature describes the passage of air through the vocal tract. [+cont] segments are produced without any significant obstruction in the tract, allowing air to pass through in a continuous stream. [−cont] segments, on the other hand, have such an obstruction, and so occlude the air flow at some point of articulation.
2. [+/− nasal] This feature describes the position of the velum. [+nas] segments are produced by lowering the velum so that air can pass through the nasal tract. [−nas] segments conversely are produced with a raised velum, blocking the passage of air to the nasal tract and shunting it to the oral tract.
3. [+/− strident] The strident feature applies to obstruents only and refers to a type of friction that is noisier than usual. This is caused by high energy white noise.
4. [+/− lateral] This feature designates the shape and positioning of the tongue with respect to the oral tract. [+lat] segments are produced as the center of the tongue rises to contact the roof of the mouth, thereby blocking air from flowing centrally through the oral tract and instead forcing more lateral flow along the lowered side(s) of the tongue.
5. [+/− delayed release][*citation needed*] This feature distinguishes stops from affricates. Affricates are designated [+del rel]

PlaceEdit

Place features: The features that specify the place of articulation.

- [LABIAL] Labial segments are articulated with the lips. As consonants, these include bilabial and labiodental consonants.

1. [+/− round]: [+round] are produced with lip rounding, while [−round] are not.

- [CORONAL] Coronal sounds are articulated with the tip and/or blade of the tongue. These include a large number of consonants, which can be made with the tip, blade or underside of the tongue (apical, laminal, or subapical consonant, respectively), making contact with the upper lip (linguolabial), between the teeth (interdental), with the back of the teeth (dental), with the alveolar ridge (alveolar), behind the alveolar ridge (postalveolar), or on or in front of the hard palate ((pre)palatal).
  With postalveolar sibilants, additional tongue shapes need to be distinguished, i.e. "domed" or slightly palatalized ("hushing" or "palato-alveolar"), palatalized (alveolopalatal), and "closed" ("hissing-hushing").

1. [+/− anterior]: Anterior segments are articulated with the tip or blade of the tongue at or in front of the alveolar ridge. Dental consonants are [+ant], postalveolar and retroflex ones are [−ant].
2. [+/− distributed]: For [+dist] segments the tongue is extended for some distance in the mouth. In other words, laminal dental and postalveolar consonants are marked as [+dist], while apical alveolar and retroflex consonants are [−dist].

- [DORSAL] Dorsal sounds are articulated by raising the dorsum of the tongue. All vowels are dorsal sounds. Dorsal consonants include palatal, velar and uvular consonants.

1. [+/− high]: [+high] segments raise the dorsum close to the palate. [−high] segments do not.
2. [+/− low]: [+low] segments bunch the dorsum to a position low in the mouth.
3. [+/− back]: [+back] segments are produced with the tongue dorsum bunched and retracted slightly to the back of the mouth. [−back] segments are bunched and extended slightly forward.
4. [+/− tense]: This feature (mainly) applies to the position of the root of the tongue when articulating vowels. [+tense] vowels have an advanced tongue root. In fact, this feature is often referred to as advanced tongue root (ATR), although there is a debate on whether tense and ATR are the same or different features.

- [RADICAL] Radical sounds are articulated with the root of the tongue. These include epiglottal consonants.

1. [+/− advanced tongue root]: [+ATR] segments advance the root of the tongue.
2. [+/− retracted tongue root]: [+RTR] segments bunch the root of the tongue towards the pharyngeal wall and activate the pharyngeal constrictor muscles

- [GLOTTAL][*citation needed*] Purely glottal sounds do not involve the tongue at all. These are the glottal consonants.

Vowel spaceEdit

Vowels are distinguished by

1. [+/− back] (back vowels)
2. [+/− high] (close vowels)
3. [+/− low] (low vowels)
4. [+/− tense] (tense vowels)

However, laryngoscopic studies suggest[*citation needed*] the features are

1. [+/− front] (front vowels)
2. [+/− raised] (raised vowels)
3. [+/− retracted] (retracted vowels)
4. [+/− round] (round vowels)

Jakobsonian system[Edit]

This system is given by Jakobson & Halle (1971, 3.6, 3.7).

Sonority[Edit]

- [+/− vocalic] vocalic, non-vocalic
- [+/− consonantal] consonantal, non-consonantal
- [+/− nasal] nasal, oral
- [+/− compact] forward-flanged: velar and palatal consonant, wide vowel[*clarification needed*]
- [+/− diffuse] backward-flanged: labial and coronal, narrow vowel[*clarification needed*]
- [+/− abrupt]
- [+/− strident] strident, mellow
- [+/− checked]

Protensity[Edit]

- [+/− tense]

Tonality[Edit]

- [+/− grave] peripheral consonant, back vowel
- [+/− acute]
- [+/− medial] coronal or palatal consonant, front vowel
- [+/− flat] narrowed slit, wider slit
- [+/− sharp] widened slit, narrower slit

Phonemic contrast refers to a minimal phonetic difference, that is, small differences in speech sounds, that makes a difference in how the sound is perceived by listeners, and can therefore lead to different mental lexical entries for words. For example, whether a sound is voiced or unvoiced (consider /b/ and /p/ in English) matters for how a sound is perceived in many languages, such that changing this phonetic feature can yield a different word (consider *bat* and *pat* in English); see Phoneme. Other examples in English of a phonemic contrast would be the difference between *leak* and *league;* the minimal difference of voicing between [k] and [g] does lead to the two utterances being perceived as different words. On the other hand, an example that is not a phonemic contrast in English is the difference between [sit] and [siːt].[1] In this case the minimal difference of vowel length is not a contrast in English and so those two forms would be perceived as different pronunciations of the same word *seat*. The core principle in phonology is the idea of **contrast**. Say we have two sounds that are different from each other. If the difference between those two sounds leads to a

difference in meaning in a given language, then we say that those two sounds contrast in that language.

So for example, the difference between *fan* and *van* is a phonetic difference in voicing. That phonetic difference leads to a substantial difference in meaning in English, so we say that /f/ and /v/ are **contrastive** in English. And if two sounds are contrastive in a given language, then those two sounds are considered two different phonemes in that language.

So here's a new term in linguistics. What is a **phoneme**? A phoneme is something that exists in your mind. It's a mental category, into which your mind groups sounds that are phonetically similar and gives them all the same label. That mental category contains memories of every time you've heard a given sound and labelled it as a member of that category. You could think of a phoneme like a shopping bag in your mind. Every time you hear the segment [f], your mental grammar categorizes it by putting it in bag labelled /f/. /v/ contrasts with /f/ — it's a different phoneme, so every time you hear that [v], your mind puts it in a different bag, one labelled /v/.

If we look inside that shopping bag, inside the mental category, we might find some phonetic **variation**. But if the variation is not meaningful, not contrastive, our mental grammar does not treat those different segments as different phonemes. In English, we have a phonemic category for /l/, so whenever we hear the segment [l] we store it in our memory as that phoneme. But voiceless [l̥] is not contrastive: it doesn't change the meaning of a word, so when we hear voiceless [l̥] we also put it in the same category in our mind. And when we hear a syllabic [l̩], that's not contrastive either, so we put that in the same category. All of those [l]s are a little different from each other, phonetically, but those phonetic differences are not contrastive because they don't lead to a change in meaning, so all of those [l]s are members of a single phoneme category in English.

Now, as a linguist, I can tell you that voiceless [f] and voiced [v] are two different phonemes in English, while voiceless [l̥] and voiced [l] are both different members of the same phoneme category in English. But as part of

your developing skills in linguistics, you want to be able to figure these things out for yourself. Our question now is, how can we tell if two phonetically different sounds are phonemically contrastive? What evidence would we need? Remember that mental grammar is in the mind — we can't observe it directly. So what evidence would we want to observe in the language that will allow us to draw conclusions about the mental grammar?

If we observe that a difference between two sounds — a phonetic difference — also leads to a difference in meaning, then we can conclude that the phonetic difference is also a phonemic difference in that language. So our question really is, how do we find differences in meaning?

What we do is look for a **minimal pair**. We want to find two words that are identical in every way except for the two segments that we're considering. So the two words are minimally different: the only phonetic difference between them is the difference that we're interested in. If we can find such a pair, where the minimal phonetic difference leads to a difference in meaning, it's contrastive, then we can conclude that the phonetic difference between them is a phonemic difference.

We've already seen one example of a minimal pair: *fan* and *van* are identical in every way except for the first segment. The phonetic difference between [f] and [v] is contrastive; it changes the meaning of the word, so we conclude that /f/ and /v/ are two different phonemes. Can you think of other minimal pairs that give evidence for the phonemic contrast between /f/ and /v/? Take a minute, pause the video, and try to think of some.

Here are some more minimal pairs that I thought of for /f/ and /v/: *vine* and *fine*, *veal* and *feel*. Minimal pairs don't have to have the segments that we're considering at the beginning of the word. Here are some pairs that contrast at the end of the word: *have* and *half*, *serve* and *surf*. Or the contrast can occur in the middle of the word, like in *reviews* and *refuse*. What's important is that the two words are minimally different: they are the same in all their segments except for the two that we're considering. And it's also

important to notice that the minimal difference is in the IPA transcription of the word, not in its spelling.

So we've got plenty of evidence from all these minimal pairs in English that the phonetic difference between /f/ and /v/ leads to a meaning difference in English, so we can conclude that, in English, /f/ and /v/ are two different phonemes.

Phonotactics (from Ancient Greek *phōnḗ* "voice, sound" and *tacticós, also spelled/known as taktikós* "having to do with arranging")[1] is a branch of phonology that deals with restrictions in a language on the permissible combinations of phonemes. Phonotactics defines permissible syllable structure, consonant clusters and vowel sequences by means of *phonotactic constraints*.
Phonotactic constraints are highly language-specific. For example, in Japanese, consonant clusters like /st/ do not occur. Similarly, the clusters /kn/ and /gn/ are not permitted at the beginning of a word in Modern English but are in German and Dutch (in which the latter appears as /ɣn/) and were permitted in Old and Middle English. In contrast, in some Slavic languages /l/ and /r/ are used alongside vowels as syllable nuclei.

Syllables have the following internal segmental structure:

- Onset (optional)
- Rhyme (obligatory, comprises nucleus and coda):
    - Nucleus (obligatory)
    - Coda (optional)

Both onset and coda may be empty, forming a vowel-only syllable, or alternatively, the nucleus can be occupied by a syllabic consonant. Phonotactics is known to affect second language vocabulary acquisition.[2]
English phonotacticsEdit

Main article: English phonology § Phonotactics

The English syllable (and word) *twelfths* /twɛlfθs/ is divided into the onset /tw/, the nucleus /ɛ/ and the coda /lfθs/; thus, it can be described as CCVCCCC (C = consonant, V = vowel). On this basis it is possible to form rules for which representations of phoneme classes may fill the cluster. For instance, English allows at most three consonants in an onset, but among native words under standard accents (and excluding a few obscure loanwords such as *sphragistics*), phonemes in a three-consonantal onset are limited to the following scheme:[3]

/s/ + stop + approximant:

- /s/ + /t/ + /ɹ/
- *stream*

- /s/ + /t/ + /j/ (not in most accents of American English)

- *stew*

- /s/ + /p/ + /j ɹ l/

- *sputum*
- *sprawl*
- *splat*

- /s/ + /k/ + /j ɹ l w/

- *skew*
- *scream*
- *sclerosis*
- *squirrel*

This constraint can be observed in the pronunciation of the word *blue*: originally, the vowel of *bl**ue*** was identical to the vowel of ***c**ue*, approximately [iw]. In most dialects of English, [iw] shifted to [juː]. Theoretically, this would produce *[bljuː]. The cluster [blj], however, infringes the constraint for three-consonantal onsets in English. Therefore, the pronunciation has been reduced to [bluː] by elision of the [j] in what is known as yod-dropping.
Not all languages have this constraint;
compare Spanish ***pli**egue* ['pljeɣe] or French ***plu**ie* [plɥi].
Constraints on English phonotactics include:[4]

- All syllables have a nucleus
- No geminate consonants
- No onset /ŋ/
- No /h/ in the syllable coda (except in Hiberno-English)
- No affricates or /h/ in complex onsets
- The first consonant in a complex onset must be an obstruent (e.g. ***st**op*; combinations such as **__nt__at* or **__rk__oop*, with a sonorant, are not allowed)
- The second consonant in a complex onset must not be a voiced obstruent (e.g. **__zd__op* does not occur)
- If the first consonant in a complex onset is not /s/, the second must be a liquid or a glide
- Every subsequence contained within a sequence of consonants must obey all the relevant phonotactic rules (the substring principle rule)

- No glides in syllable codas (excluding the offglides of diphthongs)
- The second consonant in a complex coda must not be /r/, /ŋ/, /ʒ/, or /ð/ (compare *asthma*, typically pronounced /ˈæzmə/ or /ˈæsmə/, but rarely /ˈæzðmə/)
- If the second consonant in a complex coda is voiced, so is the first

- An obstruent following /m/ or /ŋ/ in a coda must be homorganic with the nasal
- Two obstruents in the same coda must share voicing (compare *ki**ds*** /kɪdz/ with *ki**ts*** /kɪts/)
- linguistics, a **consonant cluster**, **consonant sequence** or **consonant compound**, is a group of consonants which have no intervening vowel. In English, for example, the groups /spl/ and /ts/ are consonant clusters in the word *splits*.

- Some linguists[*who?*] argue that the term can be properly applied only to those consonant clusters that occur within one syllable. Others claim that the concept is more useful when it includes consonant sequences across syllable boundaries. According to the former definition, the longest consonant clusters in the word *extra* would be /ks/ and /tr/,[1] whereas the latter allows /kstr/, which is phonetically [kstɻ̊ʲʷ] in some accents.
- PhonotacticsEdit

- Languages' phonotactics differ as to what consonant clusters they permit.
- Many languages are more restrictive than English in terms of consonant clusters. Many languages forbid consonant clusters entirely. Hawaiian, like most Malayo-Polynesian languages, is of this sort. Japanese is almost as strict, but allows a sequence of a nasal or approximant, plus another consonant, as in *Honshū* [hoˈũɕɯː] (the name of the largest island of Japan), and *Tōkyō* [toːkʲoː]. Standard Arabic forbids initial consonant clusters and more than two consecutive consonants in other positions. So do most other Semitic languages, although Modern Israeli Hebrew permits initial two-consonant clusters (e.g. *pkak* "cap"; *dlaat* "pumpkin"), and Moroccan Arabic, under Berber influence, allows strings of several consonants.[a] Like most Mon–Khmer languages, Khmer permits only initial consonant clusters with up to three consonants in a row per syllable. Finnish has initial consonant clusters natively only on South-Western dialects and on foreign loans, and only clusters of three inside the word are allowed. Most spoken languages and dialects, however, are more permissive. In Burmese, consonant clusters of only up to three consonants (the initial and two medials—two written forms of /-j-/, /-w-/) at the initial onset are allowed in writing and only two (the initial and one medial) are pronounced. These clusters are restricted to certain letters. Some Burmese dialects allow for clusters of up to four consonants (with the addition of the /-l-/ medial, which can combine with the above-mentioned medials.
- At the other end of the scale,[2] the Kartvelian languages of Georgia are drastically more permissive of consonant clustering. Clusters in Georgian of four, five or six consonants are not unusual—for instance, /brtʼqʼɛli/ (*flat*), /mt͡sʼvrtnɛli/ (*trainer*) and /prt͡ʂkvna/ (*peeling*)—and if grammatical affixes are used, it allows an eight-consonant cluster: /gvbrdɣvnis/ (*he's plucking us*). Consonants cannot appear as syllable nuclei in Georgian, so this syllable is analysed as CCCCCCCCVC. Many Slavic languages may manifest almost as formidable numbers of consecutive consonants, such as in the Slovak words *štvrť* /ʃtvrʲt̬ʲ/ ("quarter"), and *žblnknutie* /ʒbl̩ŋknutje/ ("clunk"; "flop") and the Slovene word *skrbstvo* /skrbstʊo/ ("welfare"). However, the liquid consonants /r/ and /l/ can form syllable nuclei in West and South Slavic languages and behave phonologically as vowels in this case. An example of a true initial cluster is the Polish word *wszczniesz* (/fʂt͡ʂɲɛʂ/ ("you will initiate"). In the Serbo-Croatian word *opskrbljivanje* /ɔpskr̩bʎivaɲɛ/ ("victualling") the ⟨lj⟩ and ⟨nj⟩ are digraphs representing single consonants: [ʎ] and [ɲ], respectively. In Dutch, clusters of six or even seven consonants are possible (e.g. *angstschreeuw* ("a scream of fear"), *slechtstschrijvend* ("writing the worst") and *zachtstschrijdend* ("treading

the most softly")). Some Salishan languages exhibit long words with no vowels at all, such as the Nuxálk word /xɬpʼχʷɬtʰɬpʰɬːskʷʰt͡sʼ/: *he had had in his possession a bunchberry plant*. It is extremely difficult to accurately classify which of these consonants may be acting as the syllable nucleus, and these languages challenge classical notions of exactly what constitutes a syllable. The same problem is encountered in the Northern Berber languages.

- There has been a trend to reduce and simplify consonant clusters in East Asian languages, such as Chinese and Vietnamese. Old Chinese was known to contain additional medials such as /r/ and/or /l/, which yielded retroflexion in Middle Chinese and today's Mandarin Chinese. The word 江, read /tɕiɑŋ˥/ in Mandarin and /kɔːŋ˧˥/in Cantonese, is reconstructed as **klong* or **krung* in Old Chinese by Sinologists like Zhengzhang Shangfang, William H. Baxter, and Laurent Sagart. Additionally, initial clusters such as "tk" and "sn" were analysed in recent reconstructions of Old Chinese, and some were developed as palatalised sibilants. Another element of consonant clusters in Old Chinese were analysed in coda and post-coda position. Some "departing tone" syllables have cognates in the "entering tone" syllables, which feature a -p, -t, -k in Middle Chinese and Southern Chinese varieties. The departing tone was analysed to feature a post-coda sibilant, "s". Clusters of -ps, -ts, -ks, were then formed at the end of syllables. These clusters eventually collapsed into "-ts" or "-s", before disappearing altogether, leaving elements of diphthongisation in more modern varieties. Old Vietnamese also had a rich inventory of initial clusters, but these were slowly merged with plain initials during Middle Vietnamese, and some have developed into the palatal nasal.
- LoanwordsEdit

- Consonant clusters occurring in loanwords do not necessarily follow the cluster limits set by the borrowing language's phonotactics. These limits are called restraints or constraints (see also optimality theory). A loanword from Adyghe in the extinct Ubykh language, *psta* ('to well up'), violates Ubykh's limit of two initial consonants. Also, the English words *sphere* /ˈsfɪər/ and *sphinx* /ˈsfɪŋks/, Greek loanwords, violate the rule that two fricatives may not appear adjacently word-initially.[*citation needed*]
- EnglishEdit

- In English, the longest possible initial cluster is three consonants, as in *split* /ˈsplɪt/, *strudel* /ˈʃtruːdəl/, *strengths* /ˈstrɛŋkθs/, and "squirrel" /ˈskwɪrəl/, all beginning with /s/ or /ʃ/ and ending with /l/, /r/, or /w/[b] and the second one is /p/, /t/ or /k/; the longest possible final cluster is five consonants, as in *angsts* in some dialects /ˈæŋksts/, though that is rare (perhaps owing to the fact that it is a derivative of a recent German loanword[3]). However, the /k/ can also be considered epenthetic; for many speakers, nasal-sibilant sequences in the coda require insertion of a voiceless stop homorganic to the nasal. For speakers without this feature, the word is pronounced without the /k/. Final clusters of four consonants, as in *sixths* /ˈsɪksθs/, *twelfths* /ˈtwɛlfθs/, *bursts* /ˈbɜːrsts/ (in rhotic accents) and *glimpsed* /ˈglɪmpst/, are more common. Within compound words, clusters of five consonants or more are possible (if cross-syllabic clusters are

accepted), as in *handspring* /ˈhændspriŋ/ and in the Yorkshire place-name of *Hampsthwaite* /hæmpsθweɪt/.

- It is important to distinguish clusters and digraphs. Clusters are made of two or more consonant *sounds*, while a digraph is a group of two consonant *letters* standing for a single sound. For example, in the word *ship*, the two letters of the digraph ⟨sh⟩ together represent the single consonant [ʃ]. Conversely, the letter ⟨x⟩ can produce the consonant clusters /ks/ (annex), /gz/ (exist), /kʃ/ (sexual), or /gʒ/ (some pronunciations of "luxury"). It is worth noting that ⟨x⟩ often produces sounds in two different syllables (following the general principle of saturating the subsequent syllable before assigning sounds to the preceding syllable). Also note a combination digraph and cluster as seen in *length* with two digraphs ⟨ng⟩, ⟨th⟩ representing a cluster of two consonants: /ŋθ/ (although it may be pronounced /ŋkθ/ instead, as ⟨ng⟩ followed by a voiceless consonant in the same syllable often does); *lights* with a silent digraph ⟨gh⟩ followed by a cluster ⟨t⟩, ⟨s⟩: /ts/; and compound words such as *sightscreen* /ˈsaɪtskriːn/ or *catchphrase* /ˈkætʃfreɪz/.[*citation needed*]
- Korean
- Frequency of clustersEdit

- Not all consonant clusters are distributed equally among the languages of the world. Consonant clusters have a tendency to fall under patterns such as the sonority sequencing principle (SSP), wherein the closer a consonant in a cluster is from the syllable's vowel, the more sonorous the consonant is. Among the most common types of clusters are initial stop-liquid sequences, such as in Thai (e.g. /pʰl/, /tr/, and /kl/). Other common ones include initial stop-approximant (e.g. Thai /kw/) and initial fricative-liquid (e.g. English /sl/) sequences. More rare are sequences which defy the SSP such as Proto-Indo-European /st/ and /spl/ (which many of its descendants have, including English). Certain consonants are more or less likely to appear in consonant clusters, especially in certain positions. The Tsou language of Taiwan has initial clusters such as /tf/, which doesn't violate the SSP, but nonetheless is unusual in having the labio-dental /f/ in the second position. The cluster /mx/ is also rare, but occurs in Russian words such as мха (/mxa/).
- Consonant clusters at the ends of syllables are less common, but follow the same principles. The cluster is more likely to begin with a liquid, approximant, or nasal and end with a fricative, affricate, or stop, such as in English "world" /wə(ɹ)ld/. Yet again, there are exceptions, such as English "lapse" /læps/.
- See also

Generative Phonology

Definition:

Generative phonology is a component of generative grammar that assigns the correct phonetic representations to utterances in such a way as to reflect a native speaker's internalized grammar.

Discussion:

The following are crucial components of generative phonology:

- **Levels of phonological representation**
  - Generative phonology posits two levels of phonological representation:
    - An underlying representation is the most basic form of a word before any phonological rules have been applied to it. Underlying representations show what a native speaker knows about the abstract underlying phonology of the language.
    - A phonetic representation is the form of a word that is spoken and heard.
- **Phonological rules**
  - Phonological rules map underlying representations onto phonological representations. They delete, insert, or change segments, or change the features of segments.
- **Derivations**
- **Distinctive features**
  - Distinctive features make it possible to capture the generalities of phonological rules.
- **Linearity**
  - A stream of speech is portrayed as a sequence of discrete sound segments. Each segment is composed of simultaneously occurring features.

Rule OrderingEdit

According to Jensen, when the application of one particular rule generates a phonological or morphological form that triggers an altogether different rule, resulting in an incorrect surface form, rule ordering is required.[13]

Types of Rule OrderingEdit

Given two rules, A and B, if we assume that both are equally valid rules, then their ordering will fall into one of the following categories:[14]

- **Feeding:** the application of A creates the opportunity for B to apply.
- **Bleeding:** the application of A prevents B from being able to apply.
- **Counterfeeding:** the application of B creates the opportunity for A
- **Counterbleeding:** the application of B prevents A from being able to apply.

DerivationsEdit

When a distinct order between two rules is required, a derivation must be shown. The derivation must consist of a correct application of rule ordering that proves the phonetic representation to be possible as well as a counterexample that proves, given the opposite ordering, an incorrect phonetic representation will be generated.[15][13]

*Example Derivation**Edit***

Below is an example of a derivation of rule ordering in Russian as presented by Jensen:[13] Given the following rules with rule 1 applying before rule 2:

1. ___# (l-Deletion)[13]
2. ___ # (Final Devoicing)[16]

Correct Derivation:[13]Edit

1. /#greb+l#/ *(Underlying Representation)*
    - greb *(Application of l-Deletion)*
    - grep *(Application of Final Devoicing)*
2. [grep*=] *(Correct Phonetic Representation)*

Incorrect Derivation:[13]Edit

1. /#greb+l#/ *(Underlying Representation)*
    - ------ *(Application of Final Devoicing)*
    - greb *(Application of l-Deletion)*
2. *[greb] *(Incorrect Phonetic Representation)*

Expanded NotationEdit

On their own, phonological rules are intended to be comprehensive statements about sound changes in a language. However, languages are rarely uniform in the way they change these sounds. For a formal analysis, it is often required to implement notation conventions in addition to those previously introduced to account for the variety of changes that occur as simply as possible.[17]

- **Subscripts:** Indicate the number of occurrences of a phoneme type.[17]
    - indicates that or more consonants occur, where .
    - indicates that or more vowels occur, where .
- **Word Boundaries:** indicate the left and right boundaries that, between them contain a complete string, represented with a hashtag symbol.[17] For example, the word "cat".
    - #cat#, the beginning and end hashtags indicate the respective beginning and end of the word "cat".
- **{ } (Curly Braces):** Indicate a logical-disjunction relationship of two expressions.[18] For example,
    - The two expressions, ABD and AED and be written with curly braces as:
        - , A is followed by either B or E and then D.
- **( ) (Parenthesis):** Indicate a logical-disjunction relationship of two expressions and an abbreviated version of the curly braces notation,[17] while maintaining the same disjunctive relationship function. For example,
    - The two expressions, ABD and AD and be written with parentheses as:
        - , B is optionally permitted to come between A and D.
- **< > (Angled Brackets):** Indicate a conditional relationship within a set.[13][18] For example, vowel harmony in Turkish,
    - __ , All vowels will take on the [+/- back] value of the vowel that precedes it, regardless of the number of intervening consonants. If a vowel is [+ high], it will also take on the [+/- round] value of the preceding vowel, regardless of the number of intervening consonants.

Lexical Phonology

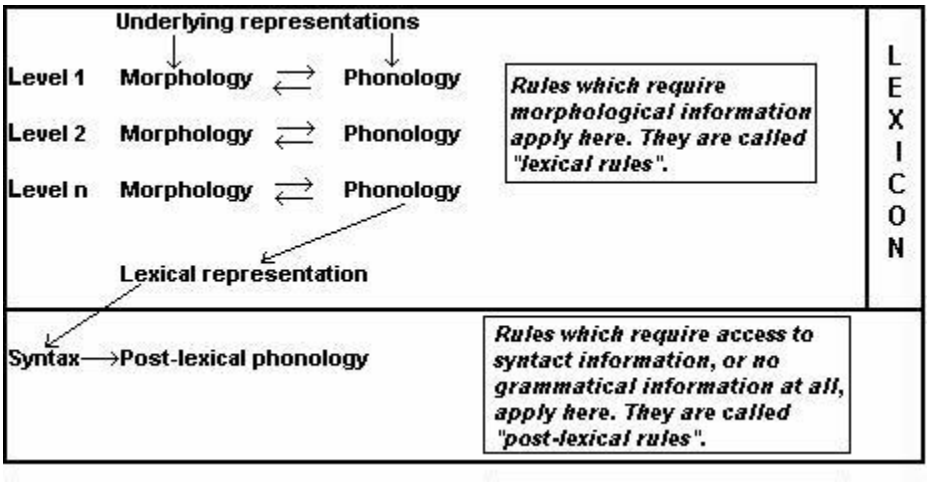
Definition:

Lexical phonology is an approach to phonology that accounts for the interactions of morphology and phonology in the word building process.

The lexicon plays a central, productive role in the theory. It consists of ordered levels, which are the domain for certain phonological or morphological processes.

Discussion:

Here is a diagram of the overall structure of the lexical phonology model:

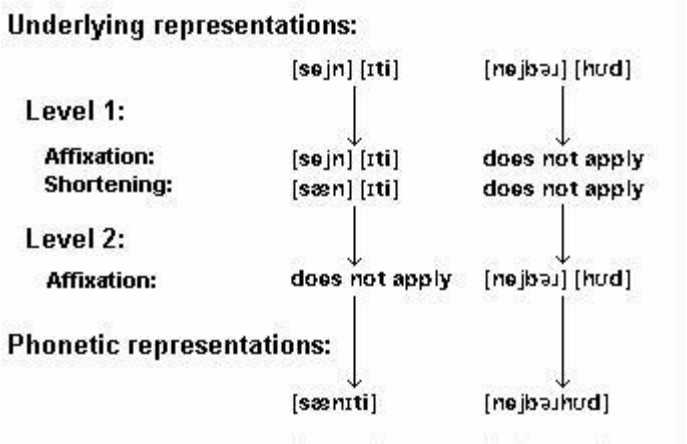


Examples:

(English)

Here is an example of an application of lexical phonology:

- Here are the words to be considered in this example:
  - sane [sejn] / sanity [sQnIti]
  - neighbor [nejb«&u0279;] / neighborhood [nejb«&u0279;hUd] *[nQb«&u0279;hUd]
- The following rule applies across level 1 morpheme boundaries:
  - A tense vowel becomes lax when a short word is lengthened by adding a suffix, so that the words ends up having at least three syllables.
- This derivation demonstrates affixation in lexical phonology accompanied by the application of a phonological rule, trisyllabic shortening.



- anguage Acquisition.
- One part of linguistics called phonology, which is included into the study of linguistics as mentioned above, comprises the *theory of lexical phonology*.

3. Lexical Phonology

- The theory of *lexical phonology* is a major contemporary theory of phonology developed in the early 1980s by K. P. Mohanan, Paul Kiparsky and Steven Strauss. This theory is the one most similar to classical generative phonology.
- UpWith the emphasis on morphophonology, it is a theory in which morphological and phonological rules are brought together within a single framework. It is an approach to phonology that accounts for the interactions of morphology and phonology in the word building process and the approach is based on the insight that much of the phonology operates together with the word formation rules in a cyclic fashion to define the class of lexical items in a language. Word formation rules relate to the formation of words. These rules combine morphemes to form new words and are also called morphological rules.
- The lexicon plays a central, productive role in the *theory of lexical phonology*. It consists of ordered levels, which are the domain for certain phonological or morphological processes. In addition, the lexicon is a term whose scope varies enormously from one theory to another. The lexicon is that aspect of language or of a linguist's account of a language that is centred on individual words or units. The term lexicon means simply 'dictionary', but in linguistic meaning the lexicon also represents information about pronunciation, meaning, morphological and syntactic properties so that it could be called a 'mental lexicon'. In lexical phonology, the lexicon is seen as being more than just an appendix to the grammar, containing unpredictable idiosyncratic phonological, grammatical, semantic and lexical information about morphemes and lexical items. The inner structure of the lexicon is assumed to be hierarchical. This aspect is discussed in detail in 3.3, Lexical Phonology and Morphology.

3.1 Historical Background

- As mentioned in 3., the theory was developed in the early 1980s by Kiparsky (1982, 1985), Halle and Mohanan (1985), Mohanan (1985), Kaisse and Shaw (1985) and further linguists. Before *the theory of lexical phonology* was developed, another theory was current in the study of linguistics called *generative phonology*.
- Chomsky and Halle´s *Sound Pattern of English* (1968), also abbreviated as SPE[1], established the basis of a phonological theory that recapitulates the syntactic model.
- The theory has its roots in the tradition of both SPE phonology and classical phonemics. The classical account of Chomsky and Halle was criticized from the early 1970s, because this theory was not seen as a theory to solve particular phonological problems and seemed not to be sufficient for several linguistic issues.
- From the 1970s on, the mainstream of phonological work shifted to more formal analytic considerations. The linguists Goldsmith (1976), Siegel (1974) and Pulleyblank (1983) worked out this theory and particular dimensions were added to generative phonology and they restructurated the old fashioned theory.
- Mohanan (1982) and Kiparsky (1982) led to *the theory of lexical phonology* which has been followed by several studies proposing applications, modifications and extensions.
- The early stages of generative linguistics had no provision for morphology and that is the central distinction between generative and lexical phonology. The current theory also contents morphology and the lexicon, whereas the term “lexicon” is understood in its linguistic way, that means not only the dictionary but the mental lexicon in the head of a human.

3.2 Lexical Phonology and Generative Phonology

- As seen in two paragraphs before, lexical phonology is the continued study of what was developed by Chomsky and Halle (1968) in classical generative phonology. The *theory of generative phonology* was first developed by Chomsky and Halle in 1968. It is the basis for further work in this study.
- The theory developed by Kiparsky in 1985 draws a connection between phonology and morphology. To explain the relationship between phonology and morphology, generative and lexical phonology, Kiparsky found the following words:
- *“It is tempting but unfair merely to dismiss lexical phonology as the generativists’ rediscovery of phonemics. Lexical Phonology is clearly generative in its style of theoretical modelling and its commitment to rule- based description including even the principle of cyclic rule application […]. Lexical Phonology continues to grapple with the problems of describing English morphology and morphophonemics […]”*[2]

3.3 Lexical Phonology and Morphology

- In this connection features of both approaches are combined so that lexical phonology includes morphological issues.
- Under assumption that the lexicon is a component of grammar which also contains regular word formation rules and phonological rules it is assumed that word formation rules of morphology are paired with phonological rules.

- So there is a relationship between the rules that build the morphological structure of a word and the phonological rules which are responsible for how a word is pronounced.
- These rules which can be found in the lexicon appear in blocks which are called levels or layer or strata[3]. This is figured in the following diagram by Kiparsky (1982a):
- illustration not visible in this excerpt
- Lexical phonology model
- The diagram shows that the different stages of morphology and phonology are organized in levels, they are level- ordered, so the derivational and inflectional processes of a language appear in a series of levels (or strata).
- **[...]**

Phoneme, in linguistics, smallest unit of speech distinguishing one word (or word element) from another, as the element *p* in “tap,” which separates that word from “tab,” “tag,” and “tan.” A phoneme may have more than one variant, called an allophone (*q.v.*), which functions as a single sound; for example, the *p*’s of “pat,” “spat,” and “tap” differ slightly phonetically, but that difference, determined by context, has no significance in English. In some languages, where the variant sounds of *p* can change meaning, they are classified as separate phonemes—*e.g.,* in Thai the aspirated *p* (pronounced with an accompanying puff of air) and unaspirated *p* are distinguished one from the other. Phonemes are based on spoken language and may be recorded with special symbols, such as those of the International Phonetic Alphabet. In transcription, linguists conventionally place symbols for phonemes between slash marks: /p/. The term *phoneme* is usually restricted to vowels and consonants, but some linguists extend its application to cover phonologically relevant differences of pitch, stress, and rhythm. Nowadays the phoneme often has a less central place in phonological theory than it used to have, especially in American linguistics. Many linguists regard the phoneme as a set of simultaneous distinctive features rather than as an unanalyzable unit.