جامعة نيويورك أبوظبي

NYU | ABU DHABI

PSYCH-UH 2218: Language Science

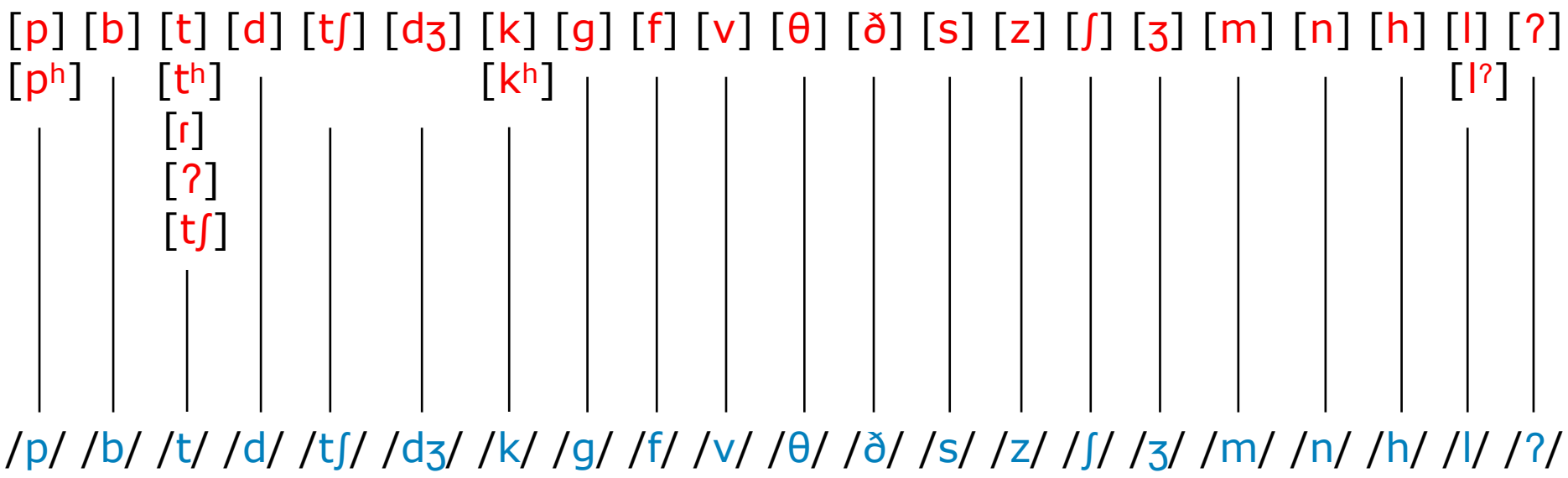
Class 6: Phonological rules

Prof. Jon Sprouse
Psychology

The big idea

The big idea is that there are two levels of analysis for speech sounds - the underlying form (phonemes) and the surface form (allophones). Any given phoneme could have multiple allophones!

allophones: This is the surface form. This is what we hear in speech. We only ever hear allophones! Every phoneme has at least one allophone - typically itself. It may also have others, like /t/ in English.

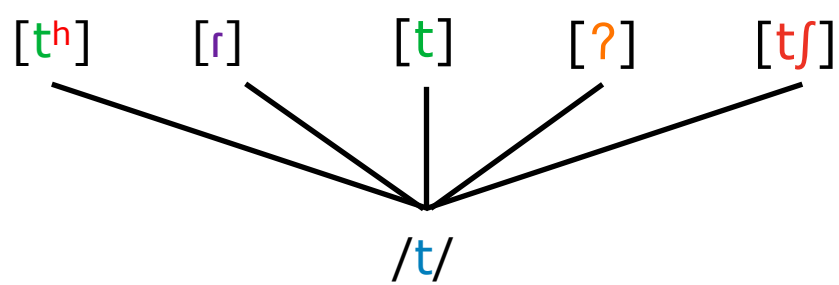


phonemes: This is the underlying form. You don't ever see these in speech. You have to infer them from the pattern of allophones that we see in the language. We will do this now!

Some phonemes have multiple allophones

The big idea is that there are two levels of analysis for speech sounds - the underlying form (phonemes) and the surface form (allophones). Any given phoneme could have multiple allophones!

allophone: These are sometimes called "variants" of the phoneme. They are the sounds that are actually produced.



The phoneme /t/ has a quite a large number of allophones in English - at least 5!

phoneme: The underlying form of segments. (This is typically what we think of when we think of speech sounds.)

All but 1 allophone will have a predictable environment based on a natural class

The big idea is that there are two levels of analysis for speech sounds - the underlying form (phonemes) and the surface form (allophones). Any given phoneme could have multiple allophones!

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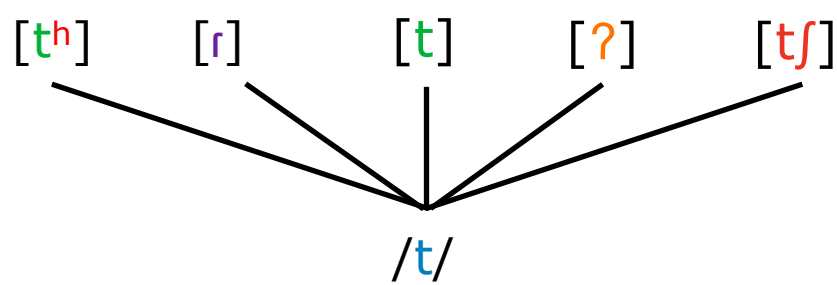

[tʰ]: #_

[ɾ]: _ [ɾ̩] or [l̩]

[ʔ]: _ [n̩]

[tʃ]: _ [r]

[t]: everywhere else

phoneme: The underlying form of sounds. (This is typically what we think of when we think of speech sounds.)

A more complicated example for identifying natural classes

Another example: non-nasal and nasal vowels

Here is a set of words in English. The tilde over a vowel means it has the feature [nasal]. [i] and [ĩ] are allophones of the same phoneme /i/. They are not contrastive in English.

word	IPA
dean	dĩn
lean	lĩn
mean	mĩn
team	tĩm
seam	sĩm
deed	did
leap	lip
mere	miɹ
tea	ti
seek	sik

[i]

before		after
d	_	d
l	_	p
m	_	ɹ
t	_	#
s	_	k

[ĩ]

before		after
d	_	n
l	_	n
m	_	n
t	_	m
s	_	m

Step 1 in analyzing these is to list all of the environments for each allophone. I have already done that here. But be sure you can see how each row in these tables maps back to a word in the list!

Another example: non-nasal and nasal vowels

Here is a set of words in English. The tilde over a vowel means it has the feature [nasal]. [i] and [ĩ] are allophones of the same phoneme /i/. They are not contrastive in English.

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mere	miɹ
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seek	sik

[i]

before		after
d	_	d
l	_	p
m	_	ɹ
t	_	#
s	_	k

[ĩ]

before		after
d	_	n
l	_	n
m	_	n
t	_	m
s	_	m

Step 2 is to look at each column in the table, and see if the sounds in the column form a natural class based on articulatory features.

Another example: non-nasal and nasal vowels

Let's look at the "before" environment for [i]. I have circled each of the sounds in the consonant chart.

before	i	after
d	_	d
l	_	p
m	_	ɹ
t	_	#
s	_	k

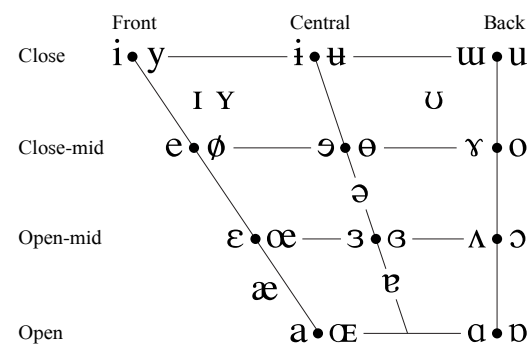
THE INTERNATIONAL PHONETIC ALPHABET (revised to 2015)

CONSONANTS (PULMONIC) © 2015 IPA

	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Glottal
Plosive	p b			t d		ʈ ɖ	c ɟ	k g	q ɢ		ʔ
Nasal	m	ɱ		n		ɳ	ɲ	ŋ	ɴ		
Trill	ʙ			r					ʀ		
Tap or Flap		ⱱ		ɾ		ɽ					
Fricative	ɸ β	f v	θ ð	s z	ʃ ʒ	ʂ ʐ	ç ʝ	x ɣ	χ ʁ	ħ ʕ	h ɦ
Lateral fricative				ɬ ɮ							
Approximant		ʋ		ɹ		ɻ	j	ɰ			
Lateral approximant				l		ɭ	ʎ	ʟ			

Symbols to the right in a cell are voiced, to the left are voiceless. Shaded areas denote articulations judged impossible.

VOWELS



Where symbols appear in pairs, the one to the right represents a rounded vowel.

Do these three sounds share a common feature?

No! They show up on different rows, so they don't share a manner feature. They show up in different columns (m is the outlier!), so they don't share a place feature. And they show up on both sides of the cell, so they don't share a voicing feature.

Another example: non-nasal and nasal vowels

Now let's look at the "after" environment for [i]. I have circled each of the sounds in the consonant chart.

before	i	after
d	_	d
l	_	p
m	_	ɹ
t	_	#
s	_	k

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Nasal	m	ɱ		n		ɳ	ɲ	ŋ	ɴ		
Trill	ʙ			r					ʀ		
Tap or Flap		ⱱ		ɾ		ɽ					
Fricative	ɸ β	f v	θ ð	s z	ʃ ʒ	ʂ ʐ	ç ʝ	x ɣ	χ ʁ	ħ ʕ	h ɦ
Lateral fricative				ɬ ɮ							
Approximant		ʋ		ɹ		ɻ	j	ɰ			
Lateral approximant				l		ɭ	ʎ	ʟ			

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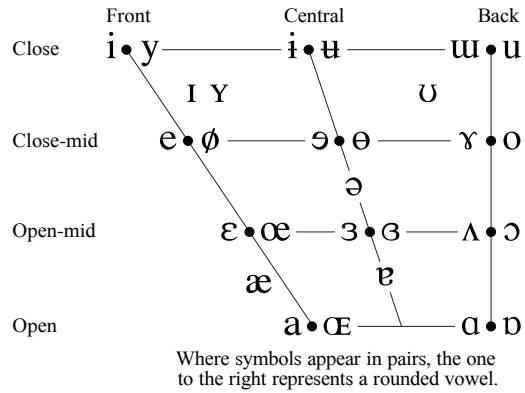
VOWELS



Where symbols appear in pairs, the one to the right represents a rounded vowel.

Do these three sounds share a common feature?

No! This is easy because # never forms a natural class with sounds.

Another example: non-nasal and nasal vowels

Now let's look at the "before" environment for [ĩ]. I have circled each of the sounds in the consonant chart.

before	ĩ	after
d	_	n
l	_	n
m	_	n
t	_	m
s	_	m

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Nasal	m	ɱ		n		ɳ	ɲ	ŋ	ɴ		
Trill	ʙ			r					ʀ		
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Fricative	ɸ β	f v	θ ð	s z	ʃ ʒ	ʂ ʐ	ç ʝ	x ɣ	χ ʁ	ħ ʕ	h ɦ
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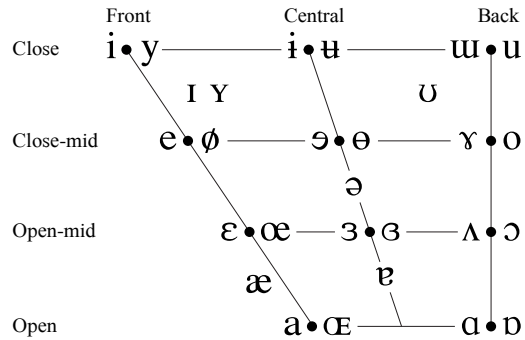
VOWELS



Where symbols appear in pairs, the one to the right represents a rounded vowel.

Do these three sounds share a common feature?

No! Also notice that these are exactly the same sounds that we saw for the "before" environment for [i]. This is another shortcut. When two allophones have an environment that overlaps (shows the same sounds), we know that is not the critical environment.

Another example: non-nasal and nasal vowels

Now let's look at the "after" environment for [ĩ]. I have circled each of the sounds in the consonant chart.

before	ĩ	after
d	_	n
l	_	n
m	_	n
t	_	m
s	_	m

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	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Glottal
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Fricative	ɸ β	f v	θ ð	s z	ʃ ʒ	ʂ ʐ	ç ʝ	x ɣ	χ ʁ	ħ ʕ	h ɦ
Lateral fricative				ɬ ɮ							
Approximant		ʋ		ɹ		ɻ	j	ɰ			
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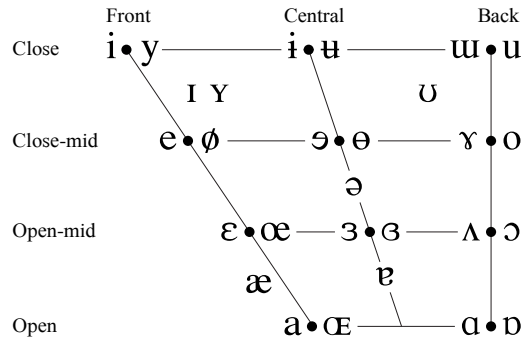
VOWELS



Do these three sounds share a common feature?

Yes! They are both on the same row, which means that they share a manner feature. In this case, it is [nasal].

Another example: non-nasal and nasal vowels

This is interesting. We can now say that [ĩ] is the allophone that appears when a nasal consonant comes after it, and [i] is the allophone that appears when any other sound (or word boundary) appears after it.

word	IPA
dean	dĩn
lean	lĩn
mean	mĩn
team	tĩm
seam	sĩm
deed	did
leap	lip
mere	miɹ
tea	ti
seek	sik

[i]

before		after
d	_	d
l	_	p
m	_	ɹ
t	_	#
s	_	k

[ĩ]

before		after
d	_	n
l	_	n
m	_	n
t	_	m
s	_	m

This makes some sense. [ĩ] is a nasal vowel and it appears next to nasal consonants! This is our first hint that there is something deeper happening! There is a logic dictating the choice between allophones. We want to uncover that logic!

How do we select the allophone in a given phonological environment?

Phonological Rules!

Phonological rules - Step 1 - use IPA

We capture the choice of allophone with **phonological rules**. Phonological rules have a special notation, and are written in features to reveal the natural classes and underlying logic of the rule.

But it is easiest to see the shape of rules by first writing them in IPA. **THIS IS NOT ULTIMATELY CORRECT because it is not in features**. But it is a good first step when trying to figure out a rule. Here is how we might write the rules for the [i]/[ĩ] example from last class in IPA.

/i/ ⟶ [ĩ] / __ [n] or [m]

/i/ ⟶ [i] / __ elsewhere

There is a lot going on here, so let's unpack it:

We use // to indicate a phoneme, and [] to indicate an allophone.

We use ⟶ to indicate the change. It is sometimes read as "rewrites as".

We use / to indicate that what follows is the environment of the change.

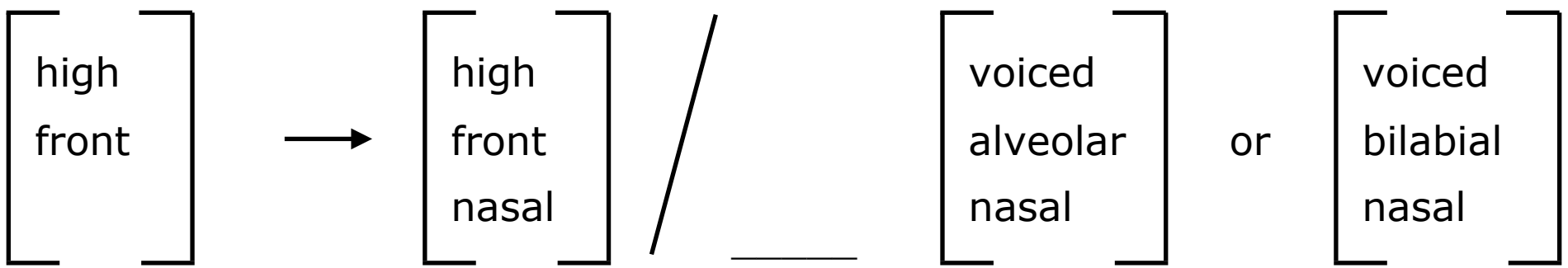
We use __ to indicate the location of the allophone in the environment.

Step 2 - convert to features

Though a helpful first step of writing a rule is to use IPA symbols, once you have a candidate rule, it is more revealing to write the rule in features.

/i/ → [ĩ] / __ [n] or [m]

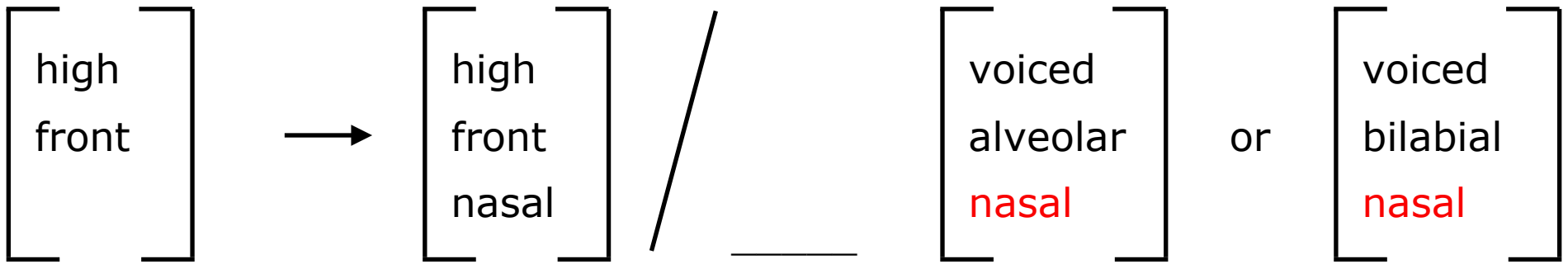
We convert each IPA symbol to features: the phoneme, the allophone, and the context:



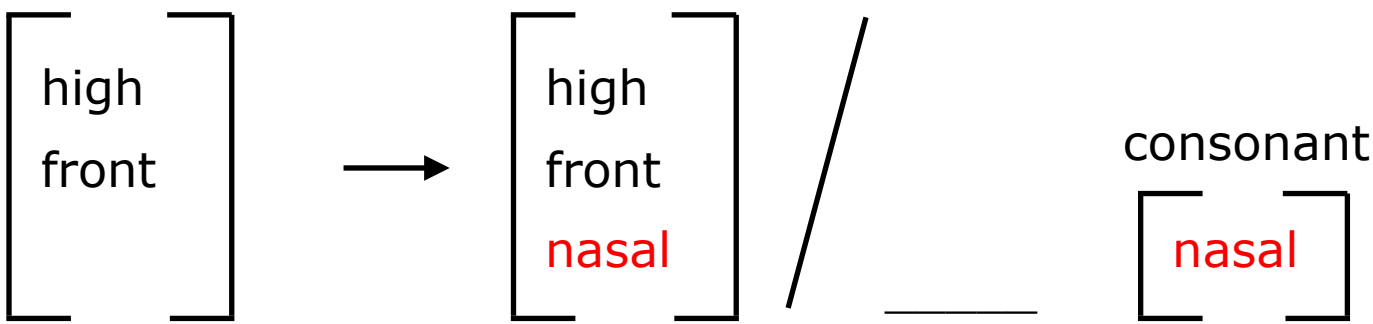
Using features will reveal more information than using IPA symbols. For example, using features here lets us see that the "or" is not necessary. In fact, we should **never have an "or" in a rule**. Remember, we need to look for a single natural classes. That means looking for a feature (or features) that defines a single class, without an "or".

Step 3 - figure out the natural class

Here is our rule with an "or". We know this is incorrect. But we can see that there is a shared feature in the environment: nasal.



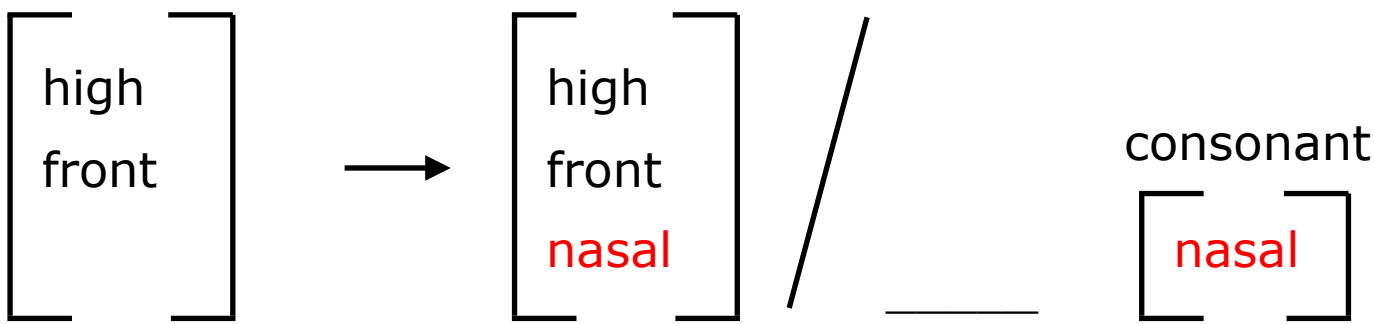
So, let's rewrite the rule using this natural class. So, we say that the environment is [nasa]. Because nasal can be a feature of both vowels and consonants, I have labeled the sound here as a consonant for clarity.



Step 4 - checking for predictions of the natural class

Here is a fact about natural classes that we have not discussed before — the class must contain all of the sounds that have the relevant feature (or features)!

So, if we say this rule is about nasal consonants in English, then it should apply for all nasal consonants in English.

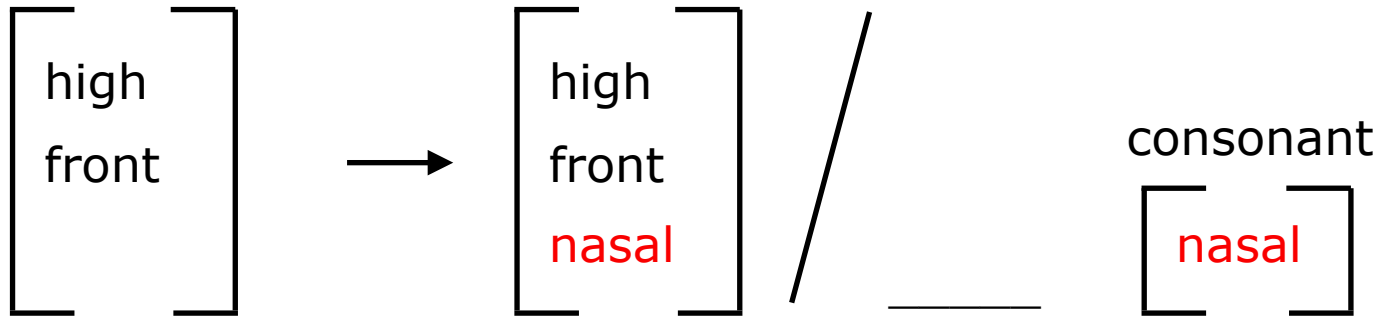


We have already seen that this rule holds for [n] or [m], but there is a third nasal consonant in English: [ŋ]. So this rule says that /i/ will become [ĩ] before [ŋ]. This seems to be true, but I can only test it with non-words because there are no existing English words with [ĩŋ].

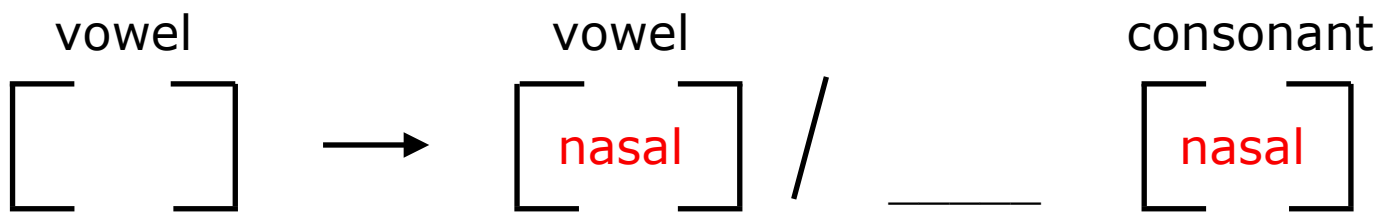
	Bilabial	Labio-dental	Dental	Alveolar	Post-alveolar	Retroflex	Palatal	Velar	Uvular	Glottal
Plosive	p b			t d				k g		
Nasal	m			n				ŋ		
Tap or flap										
Fricative		f v	θ ð	s z	ʃ ʒ					h
Affricate				t͡s d͡z	t͡ʃ d͡ʒ					
Approximant				ɹ			j			
Lateral approximant				l						

Step 5 - testing if the rule generalizes to other phonemes

Sometimes, the rule we find for one phoneme to select among its allophones actually holds for other phonemes too! So, the same way that we tried to simplify the environment of the change (to the right of the slash) to make predictions about the natural class, we can try to simplify the features that are relevant for the phoneme and allophone (to the left of the slash).

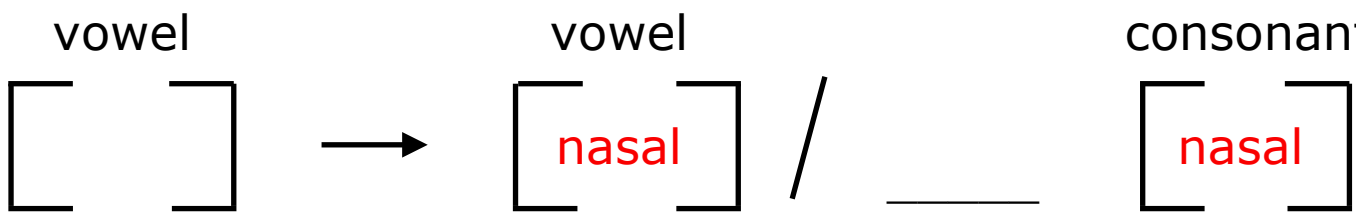


One question we can ask is if the rule affects all vowels in English, not just /i/. To do that, we simply remove all of the features from the specification, except the critical one [nasa]. And we add the specification that this is about vowels:



Step 5 - testing if the rule generalizes to other phonemes

This rule would predict that all vowels in English become nasal before a nasal consonant.



We can test this by looking at other vowels (with different features), and seeing if they become nasalized when they appear before nasal consonants:

high, back		low, front		low, back	
word	IPA	word	IPA	word	IPA
tune	tũn	hand	hæ̃nd	con	cɑ̃n
fume	fũm	ram	ɹæ̃m	bomb	bɑ̃m
toot	tut	had	hæd	cot	cɑt
fuel	fyul	rack	ræk	bob	bɑb

And it looks like they do! So we have a general rule applying to all vowels!

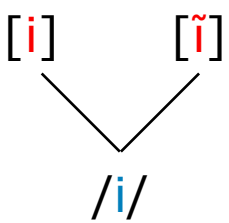
Choosing the correct rule when there are two options

Two (or more) options for underlying representations

One tricky part of formulating phonological rules is choosing the correct direction of the rule.

For a phoneme with two allophones, there are two options:

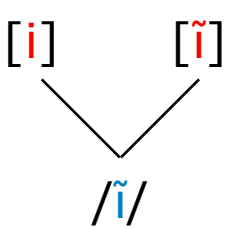
Option 1: /i/ is underlying. This means [ĩ] will occur due to a rule, and [i] will occur everywhere else



/i/ → [ĩ] / ___ [n] or [m] or [ŋ]

/i/ → [i] elsewhere

Option 2: /ĩ/ is underlying. This means [i] will occur due to a rule, and [ĩ] will occur everywhere else



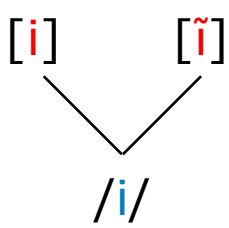
/ĩ/ → [i] / ___ [d] or [p] or [ɹ] or [k] or [#]

/ĩ/ → [ĩ] elsewhere

How do we choose? Natural classes.

The heuristic that we use is to choose the rule with a context that forms a **natural class**. A natural class is a set of segments that share a set of one or more features (usually articulatory features, but also word boundaries, syllable boundaries etc).

Option 1: /i/ is underlying. This means [ĩ] will occur due to a rule, and [i] will occur everywhere else

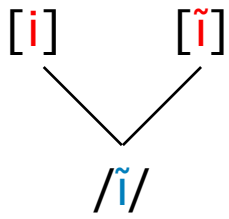


/i/ → [ĩ] / __ [n] or [m] or [ŋ]

voiced	voiced	voiced
alveolar	bilabial	velar
nasal	nasal	nasal

natural class

Option 2: /ĩ/ is underlying. This means [i] will occur due to a rule, and [ĩ] will occur everywhere else



/ĩ/ → [i] / [d] or [p] or [ɹ] or [k] or [#]

No natural class

voiced	voiceless	voiceless	voiced	
alveolar	bilabial	palatal	velar	word boundary
stop	stop	liquid	stop	

Remember our two shortcuts to rule out natural classes

When you are looking for natural classes, remember that there are two shortcuts that you can use to quickly see that **there is no natural class!**

Shortcut 1: word boundaries <u>cannot</u> form a natural class with sounds.

/ĩ/ ⟶ [i] / [d] or [p] or [ɹ] or [k] or [#]

[d]	[p]	[ɹ]	[k]	[#]
voiced alveolar stop	voiceless bilabial stop	voiceless palatal liquid	voiced velar stop	word boundary

This one helps us immediately with this rule. But also, we can see that there is no shared feature in the consonants either.

Shortcut 2: Consonants and vowels <u>cannot</u> form a natural class together.

This is because they use different features. I suppose one could imagine a natural class of "any speech sound whatsoever", but that is basically an empty claim. It does no work for us, so it is not a scientific theory!

A quick aside: allophones in free variation will have no rule

Though most allophones show up with predictable environments such that their environments don't overlap, it is also possible for allophones to show up in an overlapping distribution. When this happens, we can identify them as allophones because they are not contrastive. The two allophones don't change the word. In other words, the choice of allophone is completely optional. We say these allophones are in free variation. **In this case, there will be no rule to select them.**

word	IPA
leap	liˈp
soap	soʊp
troop	tɹup
leap	liˈpʰ
soap	soʊˈpʰ
troop	tɹupʰ

The segment [pʰ] is an unreleased stop - it is sort of an unfinished [p]. It is easy to see that these two segments show up in exactly the same environments. They are not contrastive, so they are allophones of the same phoneme.

We won't focus on these in this course because they do not require a phonological rule, and therefore there is a limit to what we can learn from them for our cognitive theory of language. But you should know that they exist in case you encounter one in your own language.

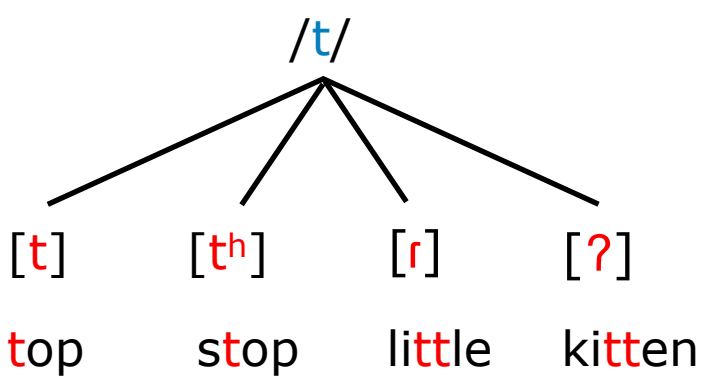
What are phonemes and allophones in our cognitive theory? Categories and members

Phonemes are categories

The way to think about phonemes and allophones is that speech segments are not individual things, they are categories. /t/ is a category. There are members of that category, called allophones, that actually arise in speech:

phoneme: An abstract category of speech segment.

This is the same idea of category as you are familiar with from life!



allophone: A member of the abstract category phoneme.

This is the same idea of member as you are familiar with from life!

Under this conception, the phonological rule selects which member of the category should arise in a given context.

Some worked out examples to see our analysis process

Tohono O’odham [t] and [tʃ]

Tohono O’odham is a Native American language. The Tohono O’odham live in the southwest US (primarily in Arizona). In Tohono O’odham there is no contrast between [t] and [tʃ]. Let’s look at their distribution in a data set:

dʒisk	“aunt”	dɔʔaʔk	“mountain”
tʃuːl̥	“corner”	tʃɯwaʔgi̥	“clouds”
wahtʃum̥	“drown”	taht	“foot”
dʒɯwɯhkɔh	“cut hair”	ʔahidaʔk	“year”
tɔnɔm̥	“be thirsty”	hɯhtahpsptʃu̥	“make it 5”
hɯdʒɯli	“self”	tʃihkpan̥	“work”
stahtɔnɔmːah	“thirsty times”	ʔiːdḁ	“this”
mɯdɯdam̥	“runner”	tɔhntɔ̥	“degenerate”
tɔdsid	“frighten”	tʃɯpɔsid	“brand”
gahtwi̥	“to shoot”	tʃɯhtʃi̥	“name”
gɯʔɯdtḁ	“get big”	dʒumali̥	“low”
tobidk	“white clay”	waʔdʒiwih	“swim”
spadmahkam̥	“lazy one”	dʒuːʔw̥	“rabbits”

Tohono O’odham [t] and [tʃ]

dʒisk	dɔʔaʔk
tʃu:liˌ	tʃɯwaʔgiˌ
wahtʃumˌ	taht
dʒɯwɯhkɔh	ʔahidaʔk
tɔnɔmˌ	hɯhtahpsptʃuˌ
hɯdʒɯli	tʃihkpanˌ
stahtɔnɔm:ah	ʔi:daˌ
mɯdɯdamˌ	tɔhntɔˌ
tɔdsid	tʃɯpɔsid
gahtwiˌ	tʃɯhtʃiˌ
gɯʔɯdtaˌ	dʒumaliˌ
tobidk	waʔdʒiwih
spadmahkamˌ	dʒu:ʔwˌ

Here I have deleted the translations for space reasons. And I have worked through the data set listing the environments for the two allophones.

before	tʃ	after
#	_	u
h	_	u
#	_	ɯ
#	_	i
h	_	i

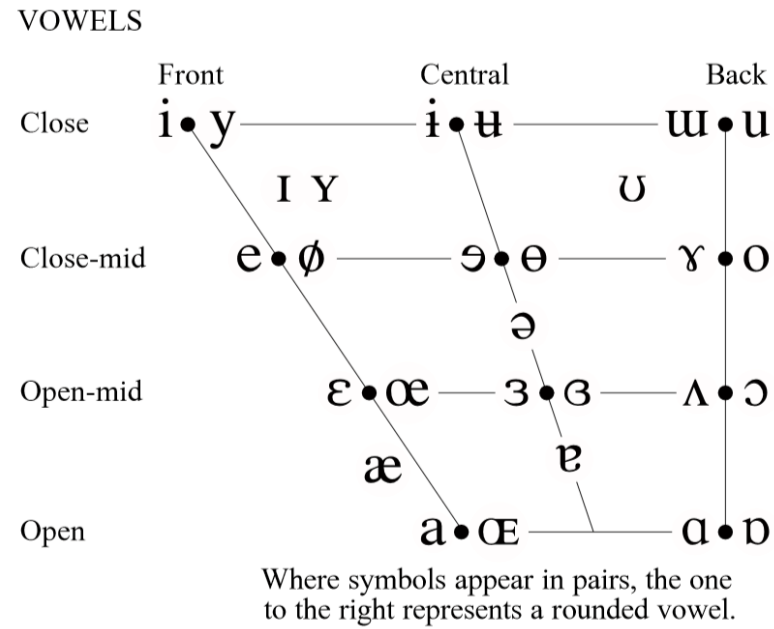
before	t	after
#	_	ɔ
s	_	a
h	_	ɔ
h	_	w
d	_	a
#	_	o
#	_	a
h	_	#
h	_	a

Tohono O'odham [t] and [tʃ]

Next we can look at each column one at a time to see if we notice any natural classes:

before	t	after
#	_	ɔ
s	_	a
h	_	ɔ
h	_	w
d	_	a
#	_	o
#	_	a
h	_	#
h	_	a

before	tʃ	after
#	_	u
h	_	u
#	_	ɯ
#	_	i
h	_	i



The "before" environment for [t] is not a natural class because it mixes # with other sounds. The same is true for the "after" environment.

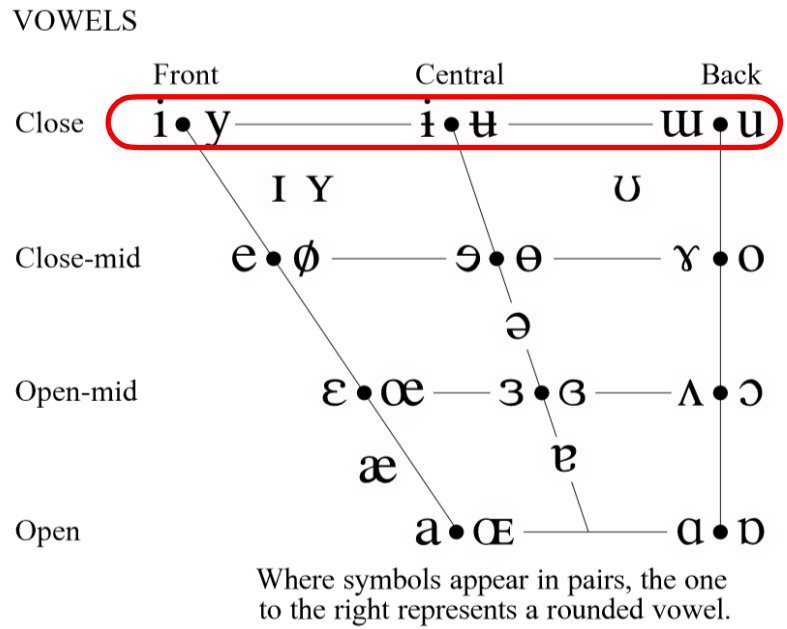
The "before" environment for [tʃ] is not a natural class because it mixes # with other sounds. But the "after environment is all vowels. Do they share a feature? I have added the vowel chart so we can look…

Tohono O'odham [t] and [tʃ]

Next we can look at each column one at a time to see if we notice any natural classes:

before	t	after
#	_	ɔ
s	_	a
h	_	ɔ
h	_	w
d	_	a
#	_	o
#	_	a
h	_	#
h	_	a

before	tʃ	after
#	_	u
h	_	u
#	_	ɯ
#	_	i
h	_	i



It looks like the natural close is high (or close) vowels! So we can first write our rules in IPA like this:

/t/ → [tʃ] / __ [high or close]

/t/ → [t] / __ elsewhere

Tohono O'odham [t] and [tʃ]

Next, we can write the phoneme to allophone part of the rule in features:

/t/ → [tʃ] / __ [high or close]

/t/	[tʃ]
voiceless alveolar stop	voiceless palatal fricative

Now, the next step is a bit of a logical leap for us at this point, but it is often the case that a rule that applies to a voiceless phoneme will also apply to the voiced counterpart of that phoneme. So we can check this by looking at [d] and [dʒ]. The hypothesis is that there may be a more general rule like this:

alveolar stop → palatal fricative / __ [high vowel]

dʒisk	dɔʔaʔk
tʃuːlˌ	tʃɯwaʔgˌ
wahtʃumˌ	taht
dʒɯwɯhkɔh	ʔahidaʔk
tɔnɔmˌ	hɯhtahpsptʃuˌ
hɯdʒɯli	tʃihkpanˌ
stahtɔnɔmːah	ʔiːdą
mɯdɯdamˌ	tɔhntɔˌ
tɔdsid	tʃɯpɔsid
gahtwˌ	tʃɯhtʃˌ
gɯʔɯdtą	dʒumalˌ
tobidk	waʔdʒiwih
spadmahkamˌ	dʒuːʔwˌ

Tohono O’odham [d] and [ʤ]

ʤisk	dɔʔaʔk
tʃu:lˌ	tʃɯwaʔgˌ
wahtʃuˌm	taht
ʤɯwɯhkɔh	ʔahidaʔk
tɔnɔˌm	hɯhtahpsptʃuˌ
hɯdʒɯli	tʃihkpanˌ
stahtɔnɔm:ah	ʔi:dˌa
mɯdɯdaˌm	tɔhntɔˌ
tɔdsid	tʃɯpɔsid
gahtwˌi	tʃɯhtʃˌi
gɯʔɯdtˌa	ʤumalˌi
tobidk	waʔʤiwih
spadmahkaˌm	ʤu:ʔwˌ

before	d	after
ɯ	_	ɯ
ɯ	_	a
ɔ	_	s
i	_	#
ɯ	_	t
i	_	k
a	_	m
#	_	ɔ
i	_	a

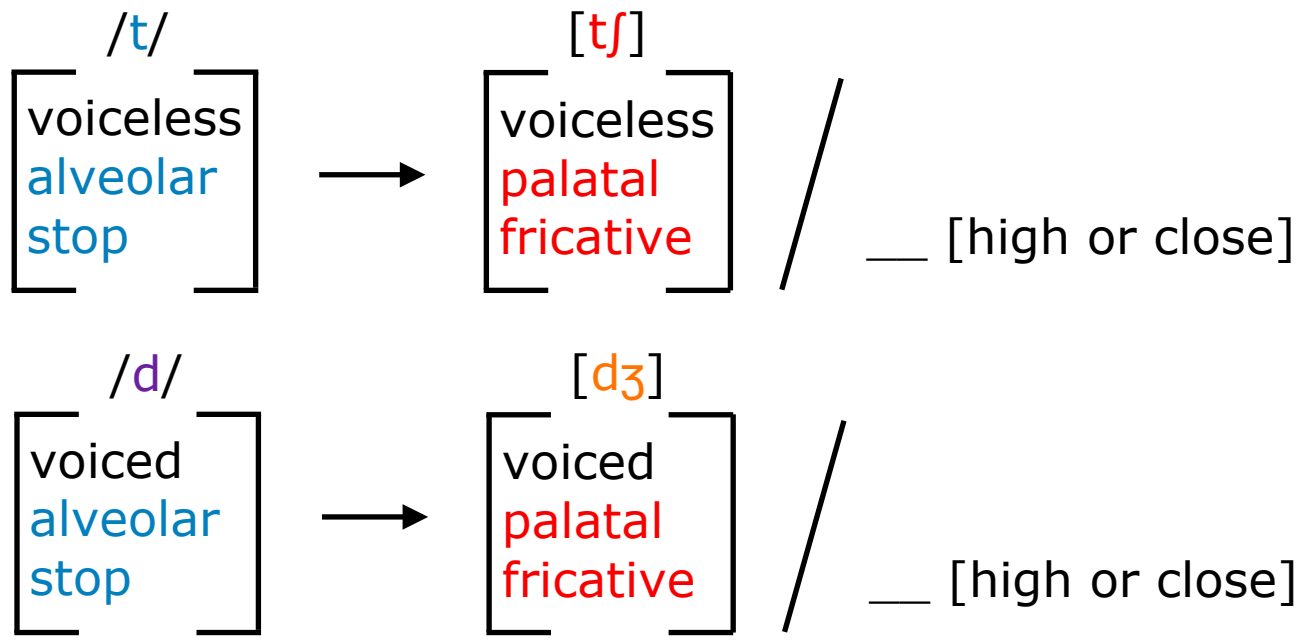
before	ʤ	after
#	_	i
#	_	ɯ
#	_	u
ʔ	_	i

The “before” environment for [d] is not a natural class because it mixes # with other sounds. The same is true for the “after” environment.

The “before” environment for [ʤ] is not a natural class because it mixes # with at least one other sound. But the “after environment is all high vowels. So it is the same as what we saw for the voiceless phoneme!

Tohono O'odham palatalization

So, instead of two rules like this:



We instead say that there is a single rule that applies to all alveolar stops, regardless of the voicing. We can write the rule like this:

This is described as "palatalization" or a "palatalization rule" because the place of articulation is moving back from the alveolar ridge to the palate.

And now the big question:
How many different kinds of phonological rules are there?

We want a constrained theory

The idea of having rules that let an underlying form change into a surface room is potentially very powerful. What I mean by that is it could make lots of things happen. For example, it could allow a /b/ to turn into a random other sound, like /k/. We probably don't want that.

When we look at all of the phonological rules that seem to occur in languages, we quickly see that they fall into just 7 types. And each of these types is a relatively small change (usually just 1 feature) and usually driven by the way articulation works! Here are the types of rules:

assimilation: The segment becomes more like to a nearby segment.

dissimilation: The segment becomes less similar to a nearby segment.

fortition: The segment becomes "stronger".

lenition: The segment becomes "weaker".

epenthesis: A new segment is inserted into the sequence.

elision: A segment is deleted from the sequence.

metathesis: The order of segments is changed.

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changes the segment

epenthesis:	A new segment is inserted into the sequence.
elision:	A segment is deleted from the sequence.
metathesis:	The order of segments is changed.

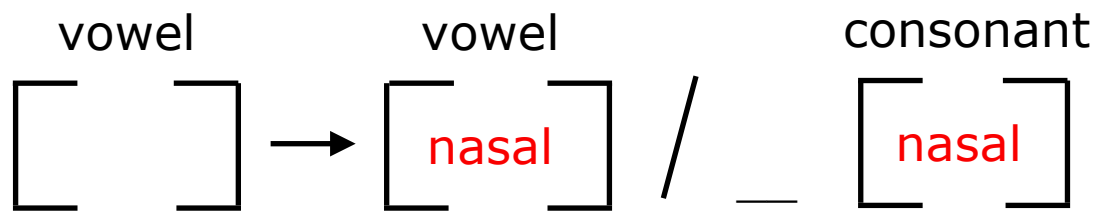
changes the sequence

Examples of each rule

assimilation: The segment becomes more similar to a nearby segment.

English nasal vowels

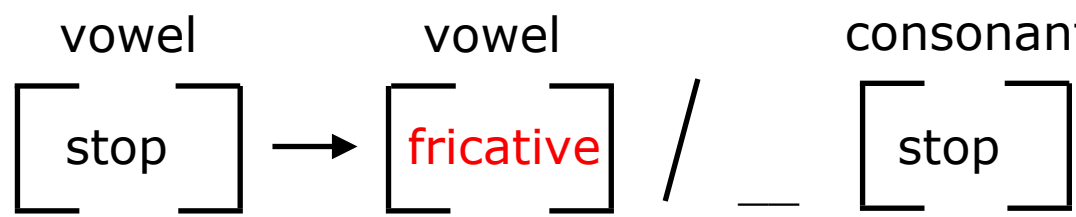
word	IPA
dean	dĩn
mean	mĩm
deed	did
leap	lip



dissimilation: The segment becomes less similar to a nearby segment.

Greek stops become fricatives

underlying	surface	meaning
epta	efta	"seven"
ktizma	xtizma	"building"



Examples of each rule

fortition: The segment becomes "stronger". Strong is metaphorical. It usually refers to some phonetic property "increasing".

word	IPA
tooth	tʰuwθ
tin	tʰɪn
stool	stuwl
sat	sæt

Aspiration in English is fortition. The length of the voicelessness is longer.

/t/ ⟶ [tʰ] / [$_{syll}$ ___]

lenition: The segment becomes "weaker". Weak is metaphorical. It usually refers to some phonetic property "decreasing".

word	IPA
water	wáɾɻ
atom	æɾaṃ
hit	hɪt
put	pʊt

Flapping in English is lenition. The duration of the [ɾ] segment is shorter than [t] or [d].

/t/ ⟶ [ɾ] / [V] ___ [V]

Examples of each rule

epenthesis: A new segment is inserted into the sequence.

Epenthesis is about the sequence. It occurs when a sequence wouldn't satisfy the phonotactic constraints. This is a common process when a language borrows a word from another language. For example, Japanese, which only allows CV syllables, borrowed English words with more complex syllables. Japanese inserts vowels to create CV syllables:

beer (bir)	→	biru	post	→	posuto
CVC		CV.CV	CVCC		CV.CV.CV

Examples of each rule

elision: A segment is deleted from the sequence.

Elision is about the sequence. It occurs when a sequence wouldn't satisfy the phonotactic constraints. We already saw an example with borrowing - when English borrows words from Greek with certain onset sequences.

gnostic → nɑstɪk

pneumonia → numoʊnyə

metathesis The order of segments is changed.

Metathesis is about the sequence. It occurs when a sequence wouldn't satisfy the phonotactic constraints. Classic examples will take some morphology to explain, so I don't want to that today. But there is some mild metathesis in all languages, particularly around sequences that would be difficult to pronounce:

comfortable → cʌmftɹbl̩

Notice the [ɹ] and [t] have switched order.