LING 1010

Language and Mind

Prof. Jon Sprouse

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Sequences of sounds

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So far, we've been talking about phonemes in isolation. But language is actually sequences of phonemes. So what do we find when we look at sequences of phonemes?

You might think that any sound can appear next to any other sound. But this isn't true. There are patterns in the sequences that we use. Here is a concrete example (that you probably never noticed before):

What is this thing?

Does the word have a "t" in it?

This is a **TEE**

Sure, right here.

What is this thing?

Does the word have a "t" in it?

This is a **TREE**

Sure, right here.

Or does it? Try saying this word. Does it really have a "t"?

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This is a **TEE**
In IPA it is [ti]

But this is a **CHREE**
In IPA it is [tʃri]

This forms a regular pattern

Is this a **TREE** or a **CHREE**?

Is this a **TRAIN** or a **CHRAIN**?

Is this a **TRUCK** or a **CHRUCK**?

Is this a **TRANSFORMER** or a **CHRANSFORMER**?

We call this a gap in the paradigm

Lots of consonants can appear before [r], but for some reason, [t] cannot. There is no word in English that has the sequence [tr] at the beginning of a syllable.

chr	sr
br	shr
fr	pr
gr	*tr
kr	vr

We use an asterisk to indicate that something never happens.

In fact, if you create novel words and ask English speakers to pronounce them, even if you spell them with a [t], they will pronounce it [tʃ]. **Try it!**

tronk	trimp
trallo	trulip

So this isn't an accident. It looks like English prohibits the sequence [tr], even for new words!

A different kind of gap

There are lots of gaps like the [tr] gap. I want to show you one more because it is a little different, and therefore will give a good perspective on how to look for patterns in sequences of phonemes.

You probably remember from grammar school that the plural marker is “s”. (And sometimes “es”, but let’s set that aside for now and focus on “s”.)

Try pronouncing all of these plural nouns and pay attention to the plural marker “s”:

trips	knobs
cats	lids
snacks	tags

What do you notice about the way the “s” is pronounced in the two columns?

A different kind of gap

The plural marker in the two columns is pronounced differently:

[s]	[z]
trips	knobs
cats	lids
snacks	tags

Do you notice a pattern?

The pattern is based on the consonant before the plural marker:

When the consonant before is voiceless, the plural marker is an [s].

When the consonant before is voiced, the plural marker is an [z].

This is another gap in the paradigm. Both [s] and [z] exist, but you will never find a plural [s] after a voiced consonant, and you will never find a plural [z] after a voiceless consonant. Go ahead and try to make up new words to test it!

Phonological Rules

Phonological Rules

So what we want to do now is come up with a theory that explains patterns (or gaps) like these.

We call the study of the patterns of sequences of sounds in language **phonology**. The resulting theory is called **phonological theory**.

We can build a theory of phonology that captures these patterns by postulating three components:

1. An underlying representation
2. A surface representation
3. A rule that maps from an underlying representation to the surface representation

Here is an example:

surface:	chree	chrain	chruck	chransformer
rule:	if an "r" follows a "t", change the "t" into a "ch"			
underlying:	tree	train	truck	transformer

Looking at the rule more closely

Most English speakers, even illiterate ones, "feel" as though there is a "t" in these words. The theory of underlying representations + rules can capture this intuition.

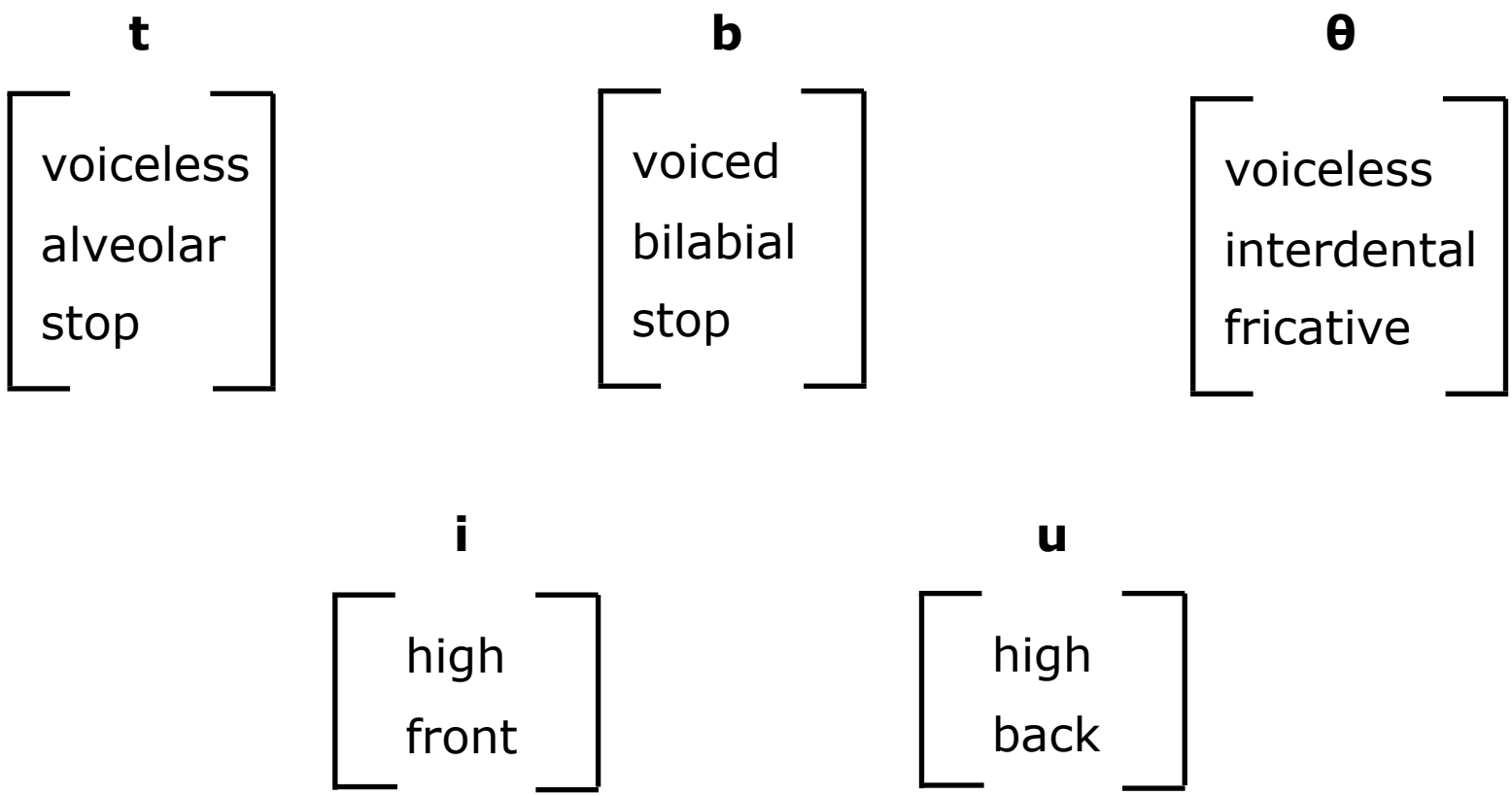
surface:	chree	chrain	chruck	chransformer
rule:	if an "r" follows a "t", change the "t" into a "ch"			
underlying:	tree	train	truck	transformer

The insight here is that it is only t's that precede r's that change into ch's. If you look at words that don't have r's, the surface form still has a t because the rule doesn't apply to them:

surface:	tee	tame	tuck
rule:	if an "r" follows a "t", change the "t" into a "ch"		
underlying:	tee	tame	tuck

Converting rules to articulatory features

We can still use the IPA symbols as labels for each speech sound. But each label really stands for a cluster of articulatory features:



Converting rules to articulatory features

The first step is to convert our rules from English orthography to IPA symbols. That way we can look those symbols up in our charts to find their features.

surface:	chree	chrain	chruck	chransformer
rule:	if an "r" follows a "t", change the "t" into a "ch"			
underlying:	tree	train	truck	transformer

Here is the rule in IPA symbols, and in a special shorthand for writing rules:

$$t \rightarrow t\int \; / \; \_ \; r$$

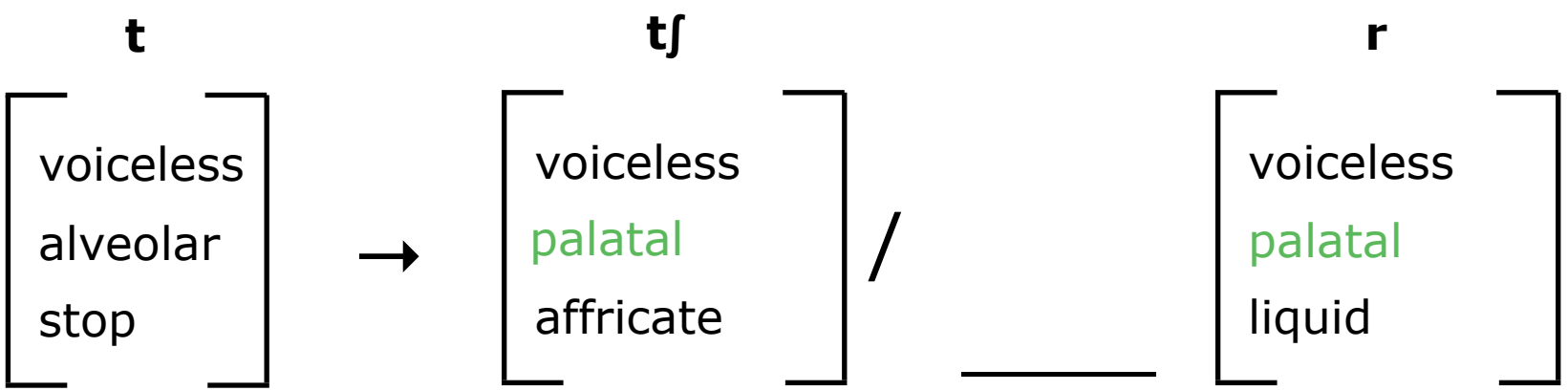
Here is how you read this rule:

1. The part before the slash says "t rewrites to tʃ"
2. The slash means "in the following context"
3. The underscore represents the location of the t, so here it is preceding an r

Converting rules to articulatory features

When the rule is written in IPA, it seems pretty arbitrary. But when you rewrite the rule using articulatory features, it starts to make more sense (that is, it looks less arbitrary, and seems to capture a deeper generalization):

t → tʃ / _ r



Can you see the deeper generalization? It is the fact that the [r] is **palatal**. It makes the [t] palatal too, which changes it from a [t] to a [tʃ].

Articulatory features and generalizations

We can also go a step further. We can look to see if there are other rules that seem similar, and see if we can state **one** general rule that captures both rules!

t → tʃ / _ r

As we've already seen, this rule explains why **train** is pronounced **"chrain"**.

d → dʒ / _ r

Well, it is also the case that **drain** is pronounced **"jrain"**, and **drum** is pronounced **"jrum"!**

The only differences between t and d is voicing: t is voiceless, and d is voiced. So the rule for these two are very similar. They only differ in voicing.

Here is a general rule that captures both of these rules in one. It doesn't refer to voicing at all, so that it can capture both rules above in one general rule!

$$\begin{bmatrix}\text{alveolar}\\ \text{stop}\end{bmatrix} \rightarrow \begin{bmatrix}\text{palatal}\\ \text{affricate}\end{bmatrix} \;/\; \underline{\qquad} \begin{bmatrix}\text{palatal}\\ \text{liquid}\end{bmatrix}$$

There can be any number of rules

Here is an example with multiple rules

Here are two english words that are distinct: writer and rider.

What is interesting about this pair is that we think the middle consonant is different: writer has a t, and rider has a d.

But in fact, that middle consonant is identical. Go ahead and **say them both** for yourself several times. Can you start to feel how they are actually the same?

We call that consonant a flap, and can symbolize it with a ɾ: wriɾer and riɾer.

https://www.seeingspeech.ac.uk/ipa-charts/?chart=1

The puzzle here is that even though we pronounce the two consonants the same (they are both ɾ), we perceive them as different.

As you can probably guess, we can demystify this puzzle using phonological rules!

Wriɾer vs Riɾer

So let's use our underlying/surface distinction to get at this.

Step 1: What is the rule for the flap (ɾ)?

surface:	riɾer	riɾer	laɾer	laɾer
rule:	if an er follows a t or d, change the t or d into a ɾ			
underlying:	riter	rider	later	lader
	writer	rider	latter	ladder

Step 2: What is the surface difference between writer and rider that makes us think we hear a t/d instead of D?

There is a difference in the length (in time) that the vowel is pronounced. The vowel in write is shorter, and the vowel in ride is longer. We use a **colon** to indicate longer vowels. We see this in writer and rider too!

short	**long**
write	ri:de
writer	ri:der

So we need two rules

Let's combine the vowel length facts with the flap facts and see what happens:

surface:	riɾer	ri:ɾer
rule:	if an er follows a t or d, change the t or d into a ɾ	
intermediate:	riter	ri:der
rule:	if a vowel is before d, make it longer	
underlying:	riter	rider
	writer	rider

Here's the cool part: the fact that the vowel in rider is longer is a **subconscious cue** that the consonant after it was a d (because that is the only way the rule would work). So even though there is no d in the surface form (there is a flap instead), you think you hear a d because the long vowel tells you that there was a d in the underlying form.

Phonology is structure

We aren’t conscious of words having underlying forms, surface forms, and rules to link them.

But even once you are aware of them, you can’t stop using them. If you are given a novel word with a [tr], or a novel word with a plural, you will pronounce them according to the rules!

This is structure in the mind!

That being said, we do have some intuitions about underlying forms. That is why sometimes it “feels” like there is a different letter there. In fact, this is partially to blame for the way that our writing system doesn’t really tell us how words are actually pronounced. In our writing system, we tend to write letters that represent the underlying forms rather than the surface forms.

Some conclusions

When we look at sequences of sounds in any language (although we focused on English), we see patterns. These patterns often arise as gaps in a paradigm.

We call the study of the patterns of sequences of sounds in language **phonology**. The resulting theory is called **phonological theory**.

We can build a theory of phonology that captures these patterns by postulating three components: an underlying form that is stored in the mind, a rule that is stored in the mind, and a surface form that is derived from the underlying form and the rule (the surface form is not stored in the mind).

We can create general rules using articulatory features that can explain multiple different patterns.

There can be any number of rules linking an underlying form and a surface form.

These rules help capture our intuitions about the sounds in words.