Phonology II: derivations, rules, phonotactics

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LING 20001

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Outline

American structuralism

- **Phonemic analysis**: categorizing sounds (**phones**) into **phonemes** and **allophones**

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- The intellectual cornerstone of **American Structuralism** (Leonard Bloomfield & co.)
- At its core, an empirical, positivist pursuit

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“Speech acts”

> Suppose that Jack and Jill are walking down a lane. Jill is hungry. She sees an apple in a tree. She makes a noise with her larynx, tongue, and lips. Jack vaults the fence, climbs the tree, takes the apple, brings it to Jill, and places it in her hand. Jill eats the apple ... the incident consists of three parts, in order of time:
>
> A. Practical events preceding the act of speech.
>
> B. Speech.
>
> C. Practical events following the act of speech.

(Bloomfield, 1933/1961, pp. 22-23)

Anti-mentalism

> [Paul] accompanies his statements about language with a paraphrase in terms of mental processes which the speakers are supposed to have undergone. The only evidence for these mental processes is the linguistic process; they add nothing to the discussion, but only obscure it.

(Bloomfield, 1933/1961, p.17)

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- However, in the 1950s people started noticing some problems with the concept of "phoneme"
- Most of those people were Morris Halle $\longrightarrow$

(I hired Chomsky!)

(b. Latvia, 1923; MA U of C,

Trouble in paradise

- Consider the prenasal neutralization of /ɪ/ ∼ /ɛ/ in some dialects of American English:

[pɪt]	‘pit’	[pɛt]	‘pet’
[pɛ̃n]	‘pin’	[pɛ̃n]	‘pen’
[tɪt]	‘tit’	[tɛt]	‘tet’
[tɛ̃n]	‘tin’	[tɛ̃n]	‘ten’
[kɪt]	‘kit’	[kɛt̩l]	‘kettle’
[kɛ̃n]	‘kin’	[kɛ̃n]	‘Ken’

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- ...so, which one is the phoneme?

Generative phonology

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- The generativists conceived of the phonological enterprise slightly differently
- Instead of worrying strictly about contrastiveness (a distributional notion), the core distinction for the generativists was one of **redundancy**

Generative phonology

underlying representations (URs): input

constraints/rules

surface representations (SRs): output

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- Given rules & URs, the grammar **generates** SRs

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- The idea is that this makes the grammar "simpler": you can state the generalization more succinctly
- At one time, this meant literally with fewer symbols: the less stuff on the page, the more elegant your generalization (and the higher the probability that it is correct: truth is beauty, beauty truth and all that)
- In reality, it is often a little more complicated than that, but the general heuristic still applies.

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- A "good grammar" is the one that captures the most generalizations.
- However, despite all of this anti-Structuralist rhetoric, we will still use the terms *phoneme* and *allophone* as synonyms for contrastive (unpredictable) and non-contrastive (predictable) representations, respectively

Outline

Phonological derivations

- In generative phonology, phonological rules operate on URs to generate SRs

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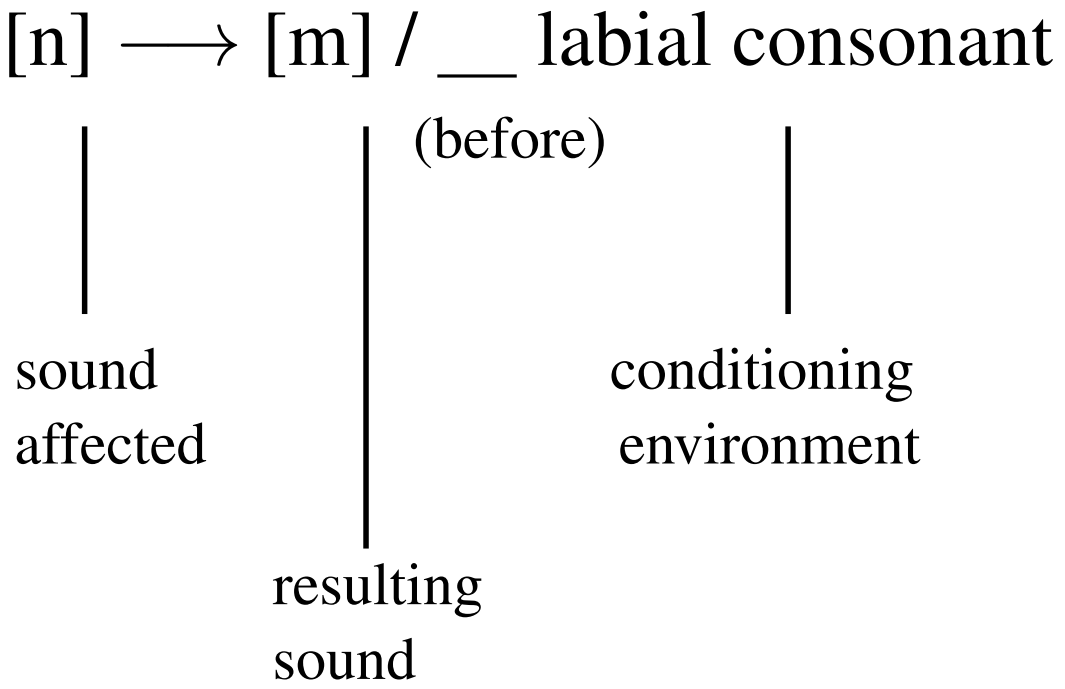
- In generative phonology, phonological rules operate on URs to generate SRs
- This operation is called a **derivation**, because we **derive** SRs from URs

URs:	phonological knowledge
rules:	allophonic processes
SRs:	phonetic implementation

Phonological rule format



“[n] becomes [m] before a labial consonant”

Doing phonology the generative way

The basic steps in doing phonology problems are:

1. Look for minimal pairs (phonemes).

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3. State the environment where each allophone occurs.
4. Determine the underlying representation.
5. Write the rule that derives the surface forms.

Doing phonology: Korean

- Consider the distribution of [ɾ] and [l] in the following examples from Korean:

[talda]	‘sweet’	[kɔːɾi]	‘distance’
[ɔːlmana]	‘how much’	[noɾɛ]	‘song’
[sɔlhwa]	‘legend’	[puɾida]	‘to use’
[pulgogi]	‘barbecued meat’	[saɾam]	‘person’
[tal]	‘moon’	[iɾɯm]	‘name’
[sul]	‘water’	[kɯːɾida]	‘to draw’

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- Are [ɾ] and [l] allophones of one or two phonemes?

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- No minimal pairs...
- Probably two allophones of a single phoneme

Doing phonology: Korean

Step 2: Organize the forms by alternant.

[l]			[ɾ]		
ta	l	da	kɔː	ɾ	i
ɔː	l	mana	no	ɾ	ɛ
sɔ	l	hwa	pu	ɾ	ida
pu	l	gogi	sa	ɾ	am
ta	l	#	i	ɾ	um
su	l	#	kɯː	ɾ	ida

- [ɾ] and [l] are in complementary distribution

Doing phonology: Korean

Step 3: find the conditioning environment.

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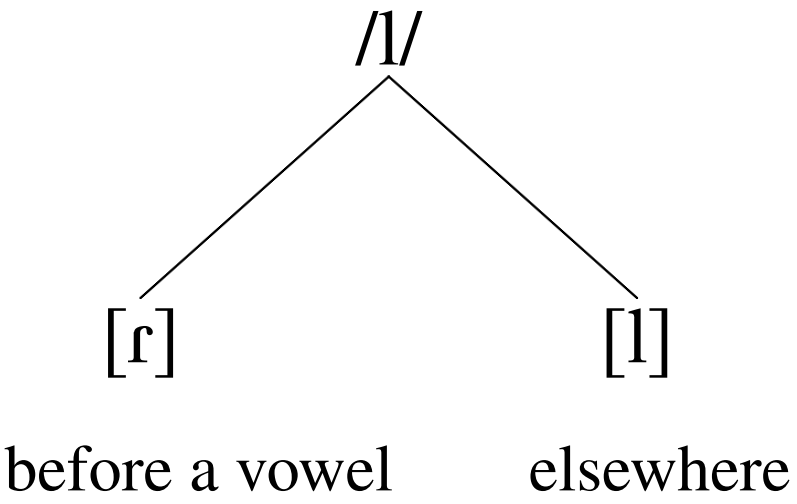
- [ɾ] only occurs **before a vowel**
- [l] occurs **everywhere else**

Doing phonology: Korean

Step 4: determine the underlying representation.



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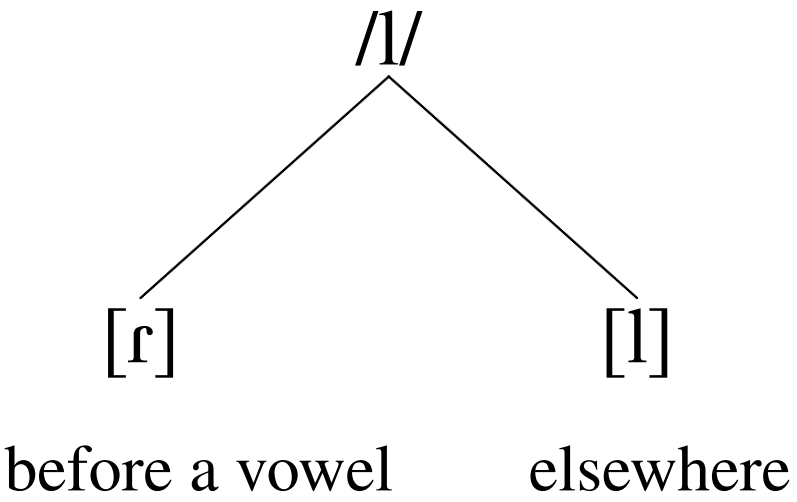

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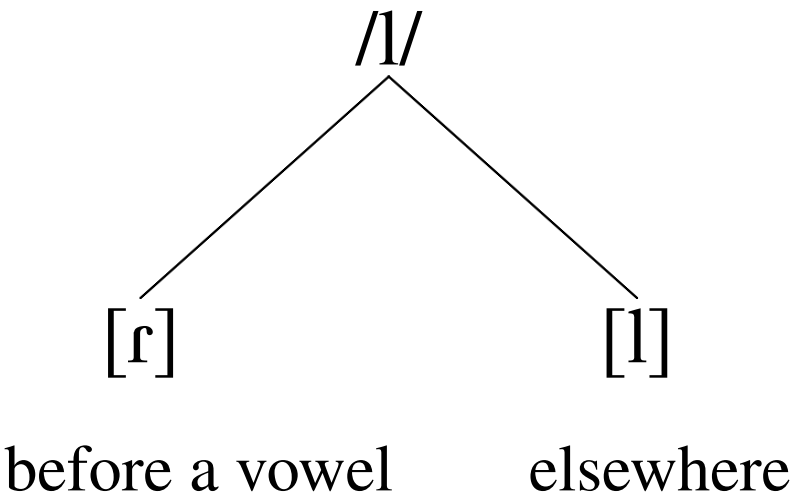

- Usually, we select one allophone as basic
- In most cases, this is the **elsewhere variant** (why?)

Doing phonology: Korean

Step 5: write the rule, and check that it applies.

$$/l/ \rightarrow [ɾ] \; / \; \_\_ \; V$$

UR	/#sul#/	/#salam#/
/l/ → [ɾ] / ___ V	-	saɾam
SR	[sul]	[saɾam]
UR	/#pulgogi#/	/#pulida#/
/l/ → [ɾ] / ___ V	-	purida
SR	[pulgogi]	[purida]

Outline

1 Generative phonology

2 Derivations

3 Alternations and rule ordering

4 Phonotactics and syllable structure

Some useful notation

UR	Underlying representation
SR	Surface representation
#	Word boundary
σ	Syllable ($\_\_\_]_\sigma$ = coda, $_\sigma[\_\_\_$ = onset)
A $\rightarrow$ B	A becomes B...
C ___ D	...in the environment of C and D
C	Consonant
V	Vowel

Alternations

- We've seen that phonemes can be realized in different ways depending on context – position in a word, other sounds they are next to, etc.

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- We've seen that phonemes can be realized in different ways depending on context – position in a word, other sounds they are next to, etc.
- This can change the shape of words (or parts of words, called **morphemes**, which we'll get to later this week) in various (predictable) ways.

Alternations in English

[ɪn]	[ɪm]	[ɪŋ]
inappropriate	*impossible*	*incoherent*
intolerant	*imbalance*	*inglorious*
indecent		

- This is an example of **assimilation**
- Can target manner as well as place:

[s]	[z]	[əz]
rocks	*tabs*	*kisses*
sonorants	*derivations*	*churches*
obstruents	*eyes*	*judges*
births	*cars*	*wishes*

Two rules of English

[p^{h}e͡jːn]	*pain*	[spe͡jːn]	*Spain*
[t^{h}æk]	*tack*	[stæk]	*stack*
[k^{h}æt]	*cat*	[skæt]	*scat*

$$\begin{bmatrix} -\text{spr glottis} \\ -\text{continuant} \\ -\text{voice} \end{bmatrix} \longrightarrow [+\text{spr glottis}] \,/\, \#\_\_$$

- In prose:

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- In prose:
- “Voiceless stops are aspirated in initial position”

Two rules of English

[pʰːæd]	*pad*	[pʰæt]	*pat*
[tʰiːð]	*teeth* (v.)	[tʰiθ]	*teeth* (n.)
[slæːb]	*slab*	[slæp]	*slap*

$$\mathrm{V} \longrightarrow [+\mathrm{long}] \,/\_\_ \begin{bmatrix} +\mathrm{cons} \\ +\mathrm{voice} \end{bmatrix}$$

- In prose:

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$$\mathrm{V} \longrightarrow [+\mathrm{long}] \,/\_\_ \begin{bmatrix} +\mathrm{cons} \\ +\mathrm{voice} \end{bmatrix}$$

- In prose:
- “Vowels lengthen when followed by a voiced consonant”

Rule application and ordering

UR	/#slæp#/	/#pat#/	/#pad#/
Aspiration	–	p^hæt	p^hæd
V-length	–	–	p^hæːd
SR	[slæp]	[p^hæt]	[p^hæːd]

- Here, more than one rule can apply in the derivation

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- Here, more than one rule can apply in the derivation
- How do rules interact with one another?
- Does the **order** in which the rules are applied matter?

Rule ordering: Kpelle

UR	*SR*	gloss
/N-polu/	[mbolu]	‘my back’
/N-tia/	[ndia]	‘my taboo’
/N-fela/	[mvela]	‘my waged’
/N-kɔɔ/	[ŋgɔɔ]	‘my foot’

Kpelle is a Mande language spoken in Guinea and Liberia.

/N/ is a [+nasal] segment, unspecified for place

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voicing assimilation: $C \rightarrow [+\text{voice}] / [+\text{nasal}]\ \_\_\_$

place assimilation: $[+\text{nasal}] \rightarrow [\alpha\text{place}] / \_\_\_\ [\alpha\text{place}]$

Rule ordering: Kpelle

Sometimes, rules can apply in any order:

UR	/#N-polu#/	/#N-kɔɔ#/
place assimilation	mpolu	ŋkɔɔ
voicing assimilation	mbolu	ŋgɔɔ
SR	[mbolu]	[ŋgɔɔ]
UR	/#N-polu#/	/#N-kɔɔ#/
voicing assimilation	Nbolu	Ngɔɔ
place assimilation	mbolu	ŋgɔɔ
SR	[mbolu]	[ŋgɔɔ]

Rule ordering: Kpelle

...but what if there were a third rule?

UR	*SR*	gloss
/N-polu/	[mbolu]	'my back'
/N-tia/	[ndia]	'my taboo'
/N-fela/	[mvela]	'my waged'
/N-kɔɔ/	**[ŋɔɔ]**	'my foot'

voicing assimilation:	$[-\text{voice}] \rightarrow [+\text{voice}] \,/\, [+\text{voice}]\ \_\_\_$
place assimilation:	$[+\text{cons}] \rightarrow [\alpha\text{place}] \,/\, \_\_\_\ [\alpha\text{place}]$
g-deletion:	$\text{g} \rightarrow \varnothing \,/\, [+\text{nasal}]\ \_\_\_$

Rule ordering: Kpelle

UR	/#N-polu#/	/#N-kɔɔ#/
place assimilation	mpolu	ŋkɔɔ
g-deletion	–	–
voicing assimilation	mbolu	ŋgɔɔ
SR	[mbolu]	[ŋgɔɔ] ŋɔɔ

Rule ordering: Kpelle

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g-deletion	–	–
place assimilation	mpolu	ŋkɔɔ
voicing assimilation	mbolu	ŋgɔɔ
SR	[mbolu]	[ŋgɔɔ] ŋɔɔ

Great success!

UR	/#N-polu#/	/#N-kɔɔ#/
place assimilation	mpolu	ŋkɔɔ
voicing assimilation	mbolu	ŋgɔɔ
g-deletion	–	ŋɔɔ
SR	[mbolu]	ŋɔɔ Hurrah!

Rule ordering: Kpelle

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voicing assimilation	mbolu	Ngɔɔ
g-deletion	–	Nɔɔ
place assimilation	mpolu	Nɔɔ
SR	[mbolu]	?[nɔɔ] ŋɔɔ

Rule ordering: Polish

sg	*pl*	gloss	*sg*	*pl*	gloss
klup	klubɨ	‘club’	ʒwup	ʒwobɨ	‘crib’
trup	trupɨ	‘corpse’	dom	domɨ	‘house’
snop	snopɨ	‘sheaf’	koʃ	koʃe	‘basket’
trut	trudɨ	‘labor’	wuk	wugɨ	‘lye’
nos	nosɨ	‘nose’	ruk	rogɨ	‘horn’
vus	vozɨ	‘cart’	wuk	wukɨ	‘bow’
lut	lodɨ	‘ice’	ul	ule	‘beehive’
nuʃ	noʒe	‘knife’	kot	kotɨ	‘cat’
grus	gruzɨ	‘rubble’	ʃum	ʃumɨ	‘noise’
ʒur	ʒurɨ	‘soup’	dzvon	dzvonɨ	‘bell’

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lut	lodʲ	‘ice’	ul	ule	‘beehive’
kot	kotʲ	‘cat’	nuʃ	noʒe	‘knife’
grus	gruzʲ	‘rubble’	ʃum	ʃumʲ	‘noise’
ʒur	ʒurʲ	‘soup’	dzvon	dzvonʲ	‘bell’

- Final obstruents are **always** voiceless in the singular

Rule ordering: Polish

sg	*pl*	gloss	*sg*	*pl*	gloss
klup	klubɨ	‘club’	ʒwup	ʒwobɨ	‘crib’
trup	trupɨ	‘corpse’	dom	domɨ	‘house’
snop	snopɨ	‘sheaf’	koʃ	koʃe	‘basket’
trut	trudɨ	‘labor’	wuk	wugɨ	‘lye’
nos	nosɨ	‘nose’	ruk	rogɨ	‘horn’
vos	vozɨ	‘cart’	wuk	wukɨ	‘bow’
lut	lodɨ	‘ice’	ul	ule	‘beehive’
kot	kotɨ	‘cat’	nuʃ	noʒe	‘knife’
grus	gruzɨ	‘rubble’	ʃum	ʃumɨ	‘noise’
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- Final obstruents are **always** voiceless in the singular
- Same obstruents **sometimes** voiceless in the plural

Which rule is better?

sg	*pl*	gloss	*sg*	*pl*	gloss
klup	klubɨ	‘club’	ʒwup	ʒwobɨ	‘crib’
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trut	trudɨ	‘labor’	wuk	wugɨ	‘lye’
nos	nosɨ	‘nose’	ruk	rogɨ	‘horn’
vos	vozɨ	‘cart’	wuk	wukɨ	‘bow’
lut	lodɨ	‘ice’	ul	ule	‘beehive’
nuʃ	noʒe	‘knife’	kot	kotɨ	‘cat’
grus	gruzɨ	‘rubble’	ʃum	ʃumɨ	‘noise’
ʒur	ʒurɨ	‘soup’	dzvon	dzvonɨ	‘bell’

- [−sonorant] → [+voice] / V ___ V
- [−sonorant] → [−voice] / ___ #

Which rule is better?

$$[-\text{sonorant}] \rightarrow [+\text{voice}] \text{ / V \_\_ V}$$

(Targets [−voice] obstruents)

UR	/#klup + ɨ#/	/#truP+ ɨ#/
voicing	klubɨ	trupɨ
SR	[klubɨ]	[trupɨ]
UR	/#wuk + ɨ#/	/#wuK + ɨ#/
voicing	wugɨ	wukɨ
SR	[wugɨ]	[wukɨ]

All obstruents are underlyingly voiceless, but only some undergo intervocalic voicing

Which rule is better?

$$[-\text{sonorant}] \rightarrow [-\text{voice}] \; / \; \_\_ \; \#$$

(Targets [+voice] obstruents)

UR	/#klub#/	/#trup#/
devoicing	klup	–
SR	[klup]	[trup]
UR	/#wug#/	/#wuk#/
devoicing	wuk	–
SR	[wuk]	[wuk]

Obstruents are underlyingly specified for voicing

Which rule is better?

$$[-\text{sonorant}] \rightarrow [-\text{voice}] \; / \; \_\_ \; \#$$

sg	*pl*	gloss	*sg*	*pl*	gloss
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grus	gruzɨ	‘rubble’	ʃum	ʃumɨ	‘noise’
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....for two reasons:

Which rule is better?

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1. The existence of non-alternating stems: why have two types of underlyingly voiceless segment?

Which rule is better?

$$[-\text{sonorant}] \rightarrow [-\text{voice}] \; / \; \_\_ \; \#$$

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grus	gruzɨ	‘rubble’	ʃum	ʃumɨ	‘noise’
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2. The non-existence of [+voice] obstruents stem-finally: why should this be an accident?

But wait a second

Something else is going on here...

sg	*pl*	gloss	*sg*	*pl*	gloss
klup	klubɨ	‘club’	ʒwup	ʒwobɨ	‘crib’
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Another problem

/u/ → [o] / plural forms?

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But then why *ʒur, ʒurɨ* ‘soup’, *ul, ule* ‘beehive’?

Another problem

/o/ → [u] / singular forms?

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ʒur	ʒurɨ	‘soup’	dzvon	dzvonɨ	‘bell’

But then why *snop, snopɨ* ‘sheaf’, *kot, kotɨ* ‘cat’?

Vowel raising comes first...

$$\begin{bmatrix} -\text{cons} \\ +\text{back} \\ -\text{high} \end{bmatrix} \longrightarrow [+\text{high}] \,/\_\_ \begin{bmatrix} +\text{voice} \\ -\text{nasal} \end{bmatrix} \#$$

UR	/#ʒwob#/	/#snop#/
***o*-raising**	**ʒwub**	**–**
devoicing		
SR	[ʒwup]	[snop]
UR	/#ʒwob+ɨ#/	/#snop+ɨ#/
***o*-raising**	**ʒwubɨ**	**–**
devoicing		
SR	[ʒwubɨ]	[snopɨ]

...followed by final devoicing

$$[-\text{sonorant}] \rightarrow [-\text{voice}] \; / \; \_\_ \; \#$$

UR	/#ʒwob#/	/#snop#/
o-raising	ʒwub	–
devoicing	**ʒwup**	–
SR	[ʒwup]	[snop]
UR	/#ʒwob+ɨ#/	/#snop+ɨ#/
o-raising	ʒwubɨ	–
devoicing	–	–
SR	[ʒwubɨ]	[snopɨ]

Ordered otherwise, vowel raising wouldn't occur:

The two rules are crucially ordered in Polish: the reverse order would yield the wrong singular forms.

UR	/#ʒwob#/	/#snop#/
devoicing	ʒwop	–
raising	–	–
SR	*[ʒwop]	[snop]
UR	/#voz#/	/#koʃ#/
devoicing	vos	–
raising	–	–
SR	*[vos]	[koʃ]

Outline

Syllables

- Up until now we have looked mostly at processes involving **segments**

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- Since segments are made up of features, the processes have made reference to feature matrices

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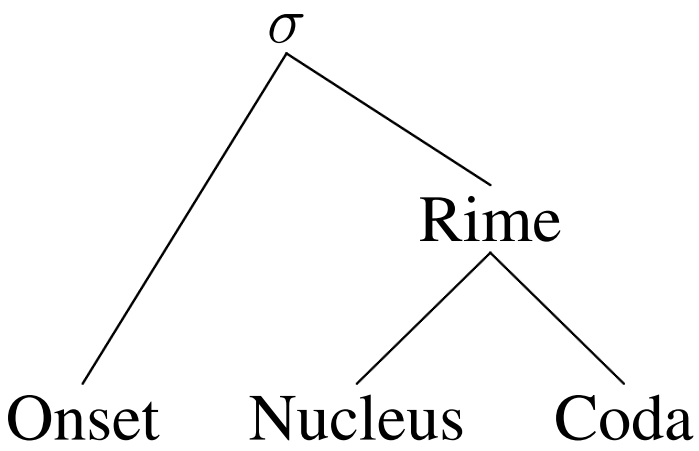
- Since segments are made up of features, the processes have made reference to feature matrices
- Phonological processes can also make reference to **syllable structure**

Syllable structure

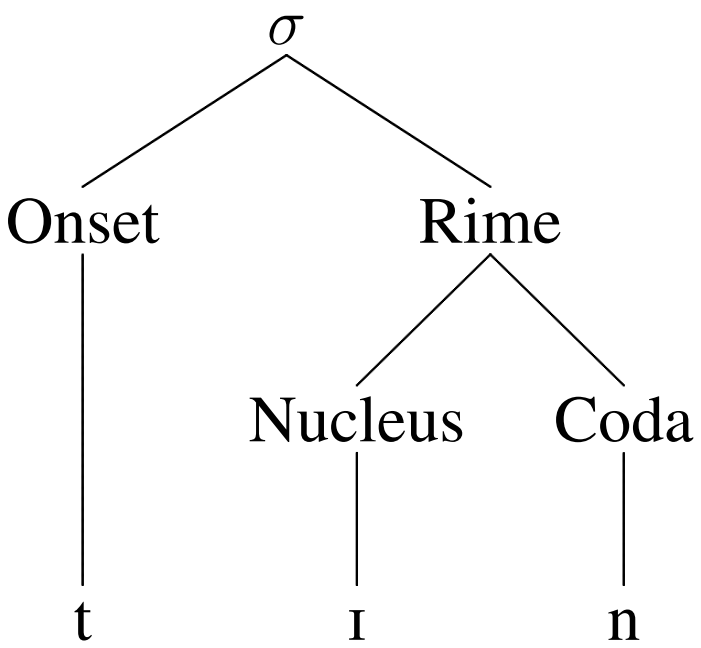
Syllables consist of an **onset**, a **nucleus** and a **coda**.



The nucleus and coda form the **rime** (or *rhyme*).

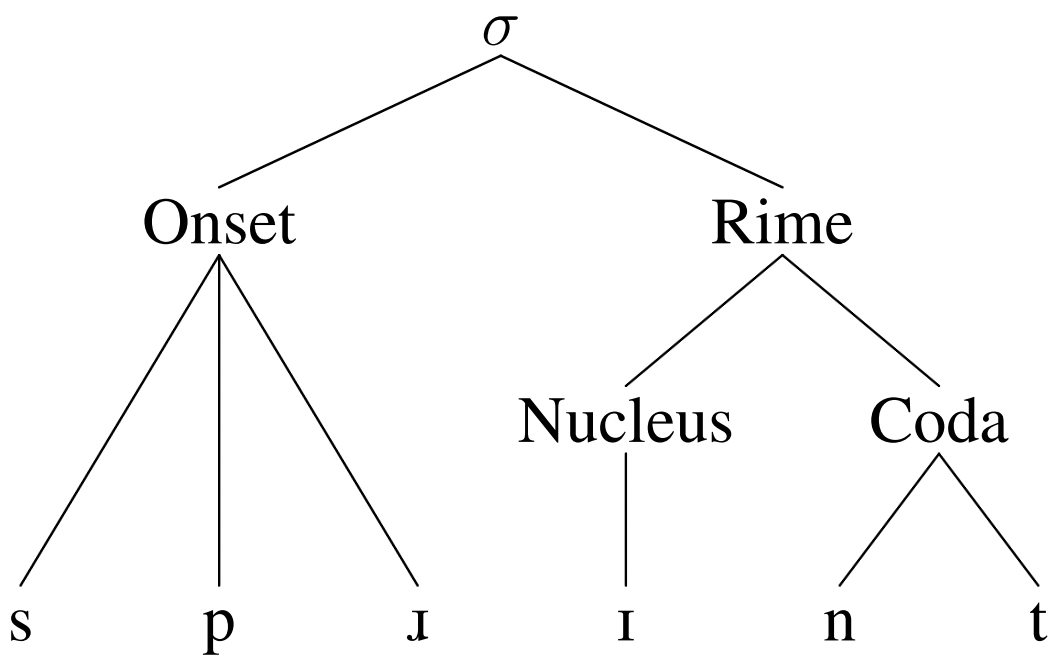
Syllable structure

Onsets and codas may contain a single segment...



Syllable structure

...or multiple segments:



Why syllables?

- Recall one of the fundamental things we know when we know a language: the set of not just actual but also **possible** words

flabble	prznk	spronk	mbil
squirthy	prlauiop	stroimpt	treh
keladulance	trozzit	ztreet	flampidator

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- This set of restrictions are called **phonotactics**
- The restrictions on segment sequences in onsets may not be the same as in codas.

Language games: Pig Latin

- More evidence for syllables: language games

pit	it-pay	*me*	e-may
see	ee-say	*I*	i-way
spit	it-spay	*stink*	ink-stay
stretch	etch-stray	*sixth*	ixth-say

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- What is happening here?
- The game doesn't target the initial *consonant*...
- ...but rather the entire *onset*.

Language games: Pig Latin

pit	it-pay	*me*	e-may
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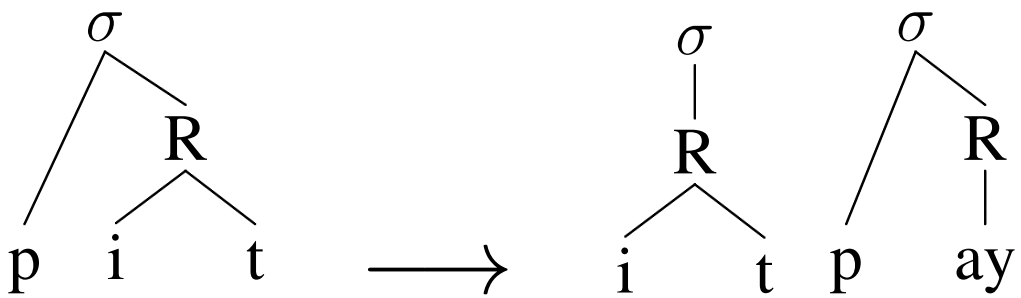

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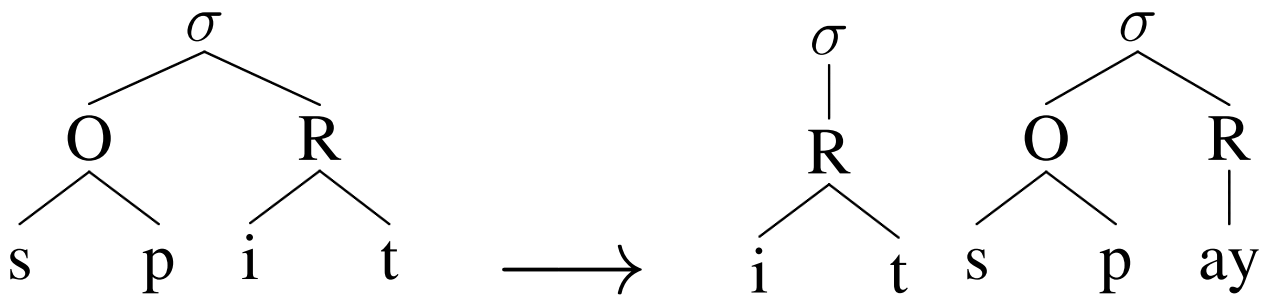

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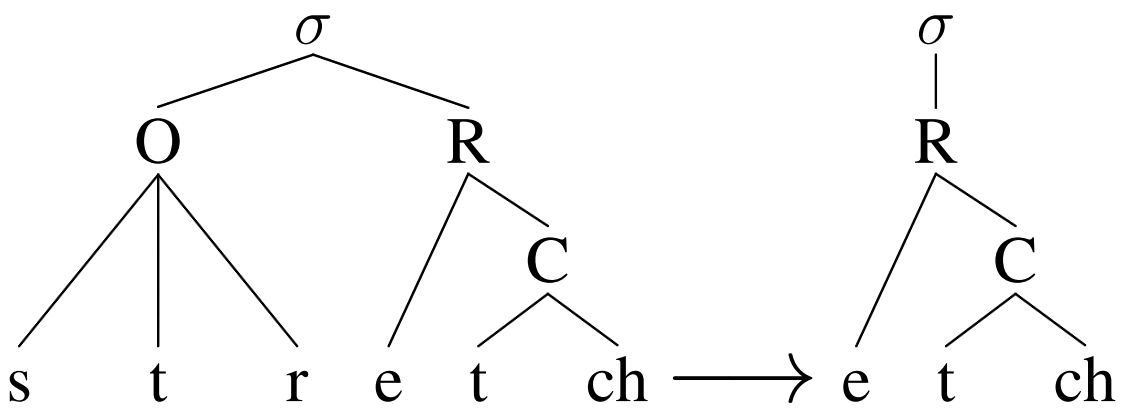

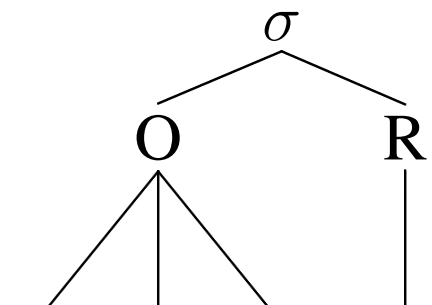

Language games: Pig Latin

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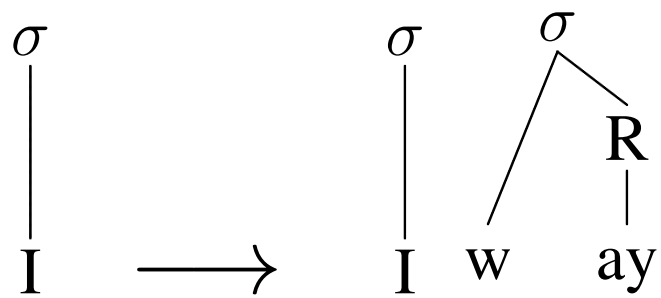

Syllabification

- Language-specific restrictions on how segments are organized (**parsed**) into syllables represent another aspect of subconscious linguistic knowledge.

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applaud
telegraph
print
improvise
explain

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- How many syllables do the following words have?

applaud	[ə.plɔd]
telegraph	[tɛ.lə.gɹæf]
print	[pɹɪnt]
improvise	[ɪm.pɹə.vaɪz]
explain	[ɛk.splen]

Syllabification

- Generally speaking, segments can't just combine willy-nilly in the various positions

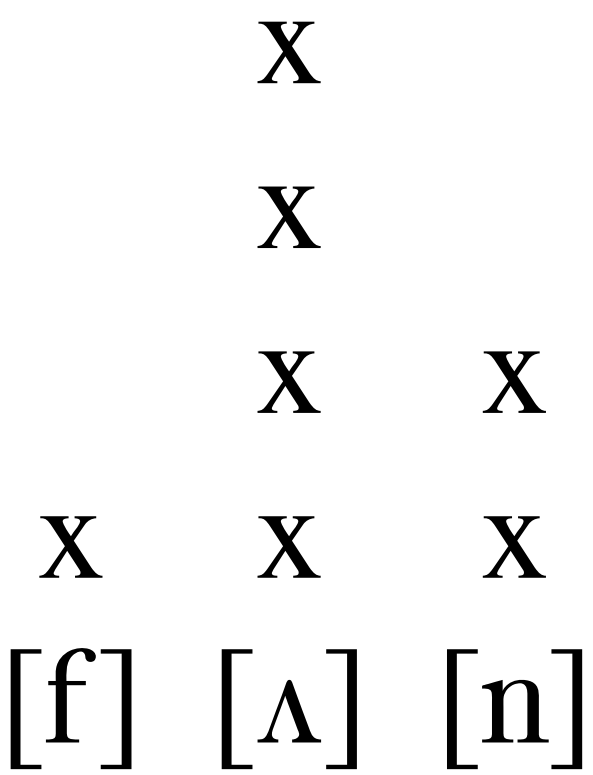
Syllabification

- Generally speaking, segments can't just combine willy-nilly in the various positions
- Languages tend to arrange segments within syllables in such a way so that the **least sonorous** sounds are at the margins, and the **most sonorous** (often, but not always, a vowel) are in the middle (nucleus).

The sonority hierarchy

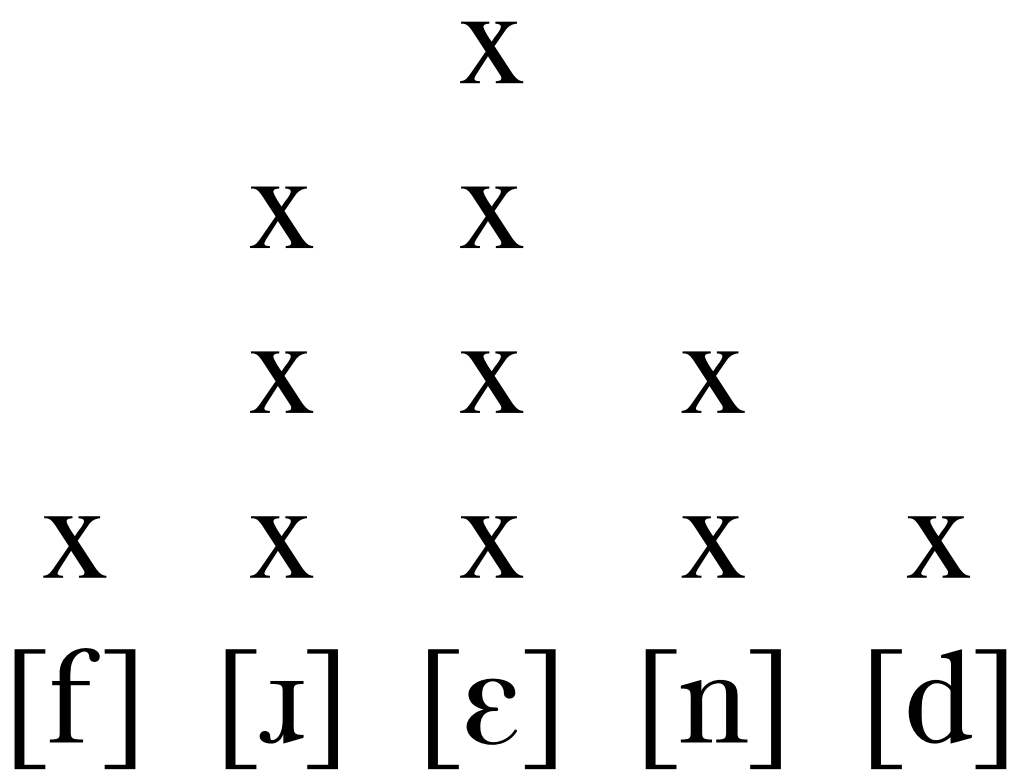
x						
x		x				
x		x		x		
x		x		x		x
vowels	>	liquids	>	nasals	>	obstruents

The sonority hierarchy



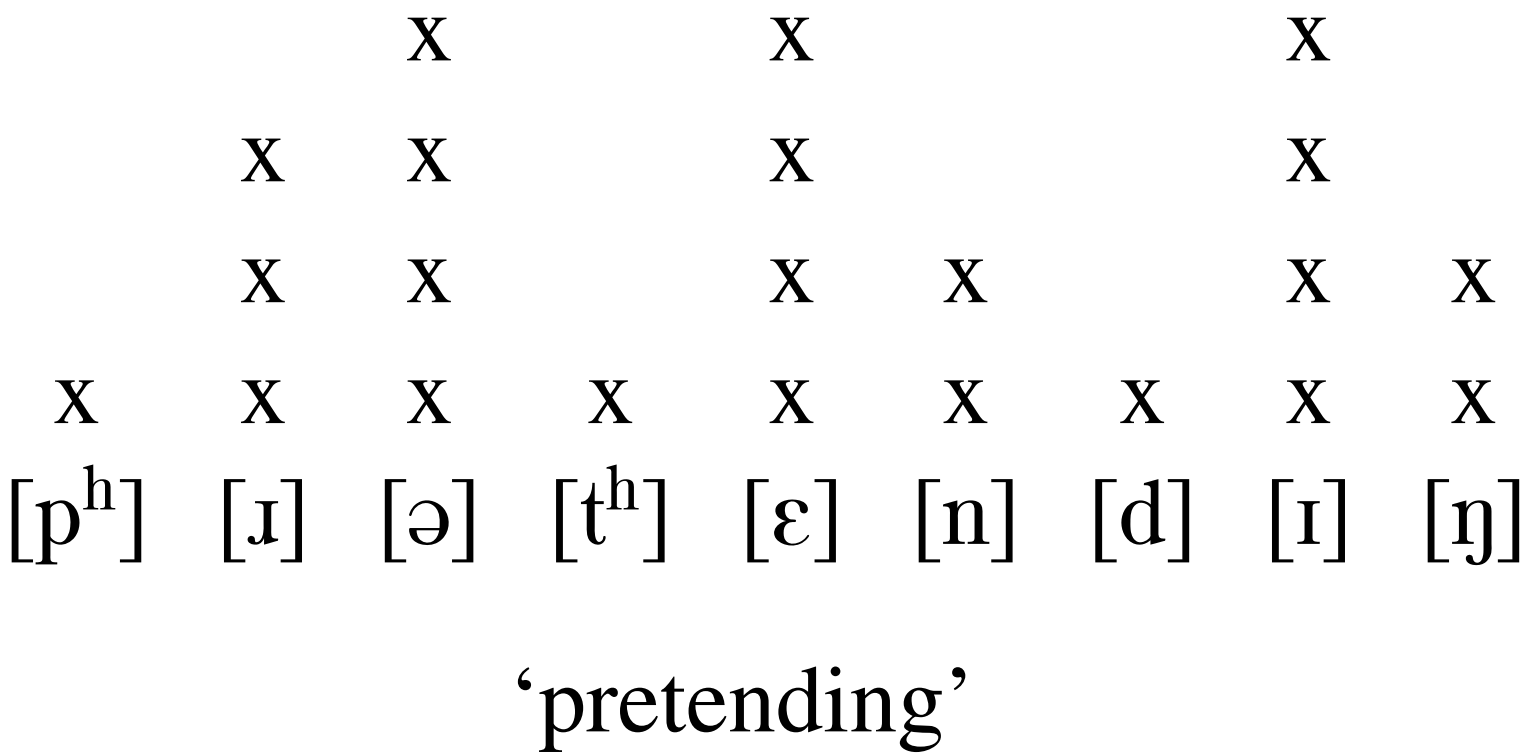
‘fun’

The sonority hierarchy



‘friend’

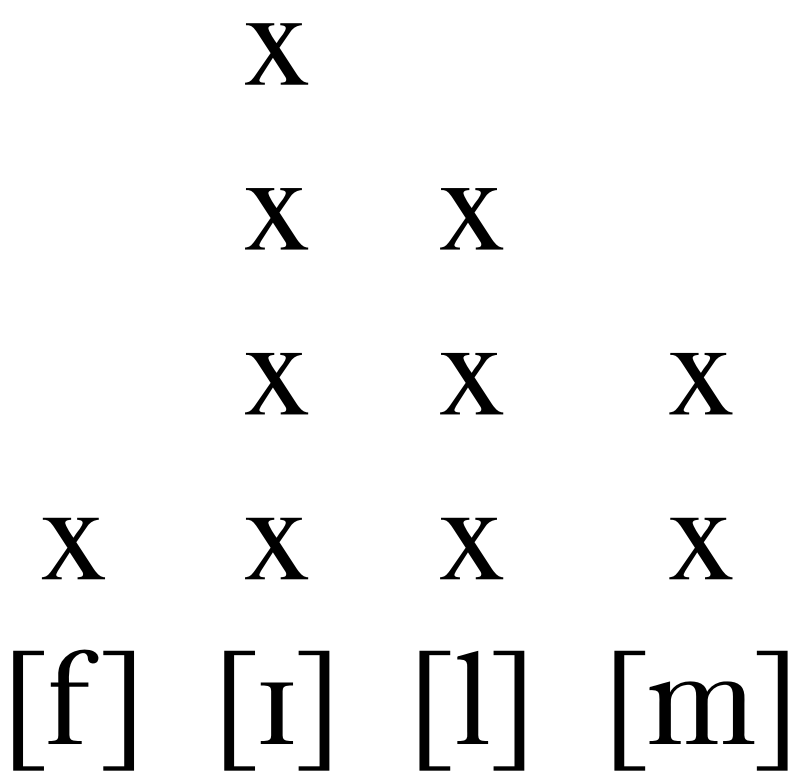
The sonority hierarchy



‘pretending’

The sonority hierarchy

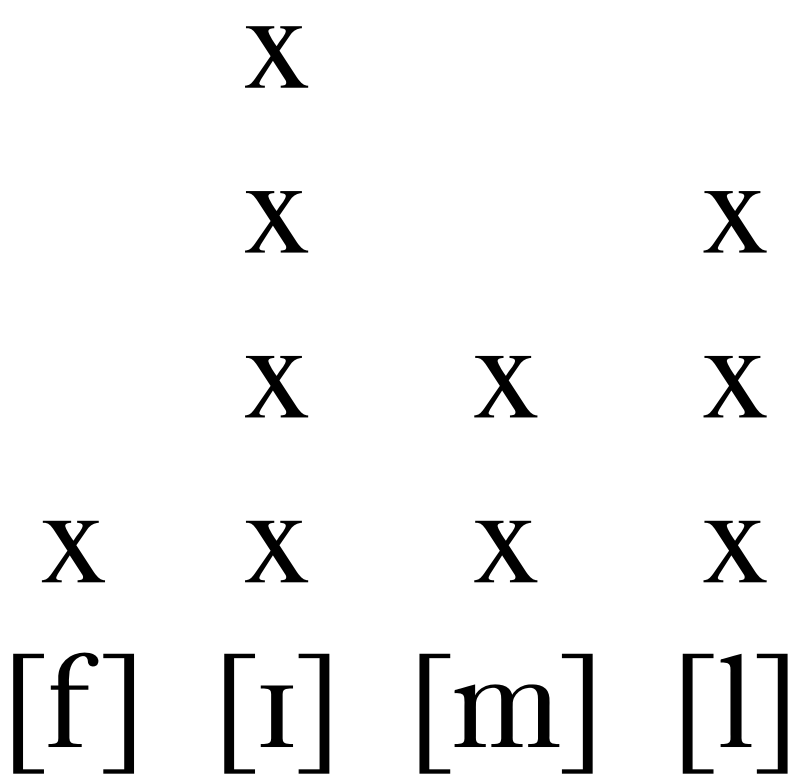
This explains why words like *film* are one syllable...



'film'

The sonority hierarchy

but hypothetical *fiml* would be two:



(cf. *pummel, drivel*)

Sonority: nuclei

- In a form like *pummel*, the consonant serves as the sonority peak in the second syllable

Sonority: nuclei

- In a form like *pummel*, the consonant serves as the sonority peak in the second syllable
- English allows nasals and liquids to serve as syllabic nuclei, at least in unstressed syllables:

[pɹɪzm]	*prism*	[hɪdn̩]	*hidden*
[bɑɹm̩]	*bottom*	[bʌdn̩]	*button*
[bɑɹl̩]	*bottle*	[haj͡ɹ̩]	*higher*
[lɪɹl̩]	*little*	[bʌɹɹ̩]	*butter*

Sonority: onsets

- Sonority considerations also govern what consonants can serve as an onset cluster

Sonority: onsets

- Sonority considerations also govern what consonants can serve as an onset cluster
- In general, sonority has to go up two steps (i.e. obstruent > liquid):

actual words			
[bɹɪk]	*brick*	[fli]	*flea*
[kɹæb]	*crab*	[glɪb]	*glib*
(im)possible words			
[bɹæp]	*[bnæp]	[klig]	*[knig]
[kɹæθ]	*[kdæθ]	[glɪk]	*[lgɪk]

What about [s]?

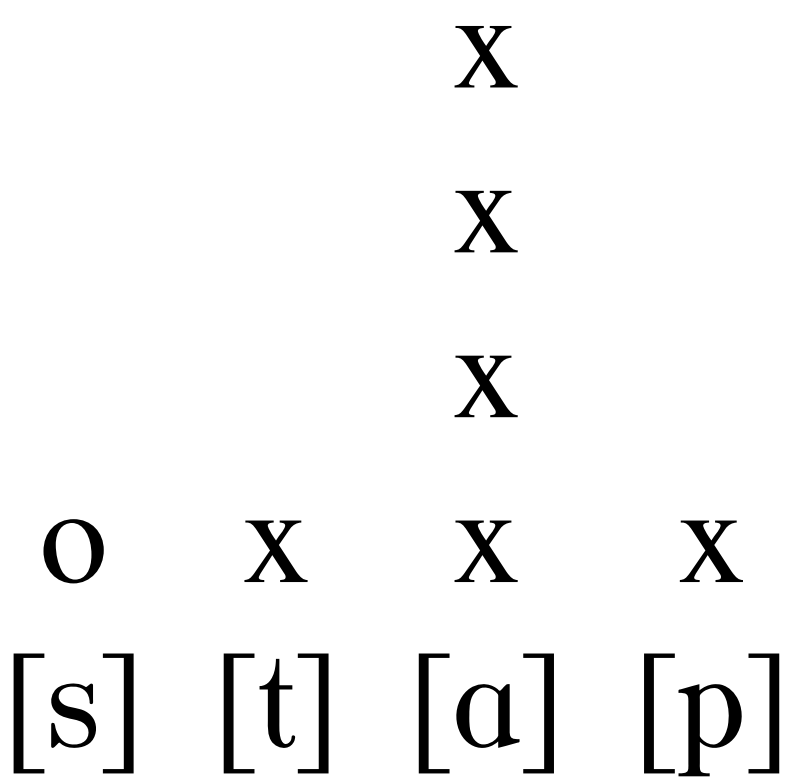
English onsets may actually contain up to *three* consonants:

[pl]	please	[tl]	–	[kl]	clean
[pɹ]	proud	[tɹ]	trade	[kɹ]	crowd
[pw]	–[1]	[tw]	twin	[kw]	quick
[pj]	pure	[tj]	tune (UK)	[kj]	cute
[spl]	splash	[stl]	–	[skl]	sclerotic
[spɹ]	spring	[stɹ]	-string	[skɹ]	scream
[spw]	–	[stw]	–	[skw]	squeak
[spj]	spew	[stj]	stew (UK)	[skj]	skewer

[1] *Puerto Rico*?

What about [s]?

[s] ‘doesn’t count’ in English for onset sonority purposes:



‘stop’

What about [s]?

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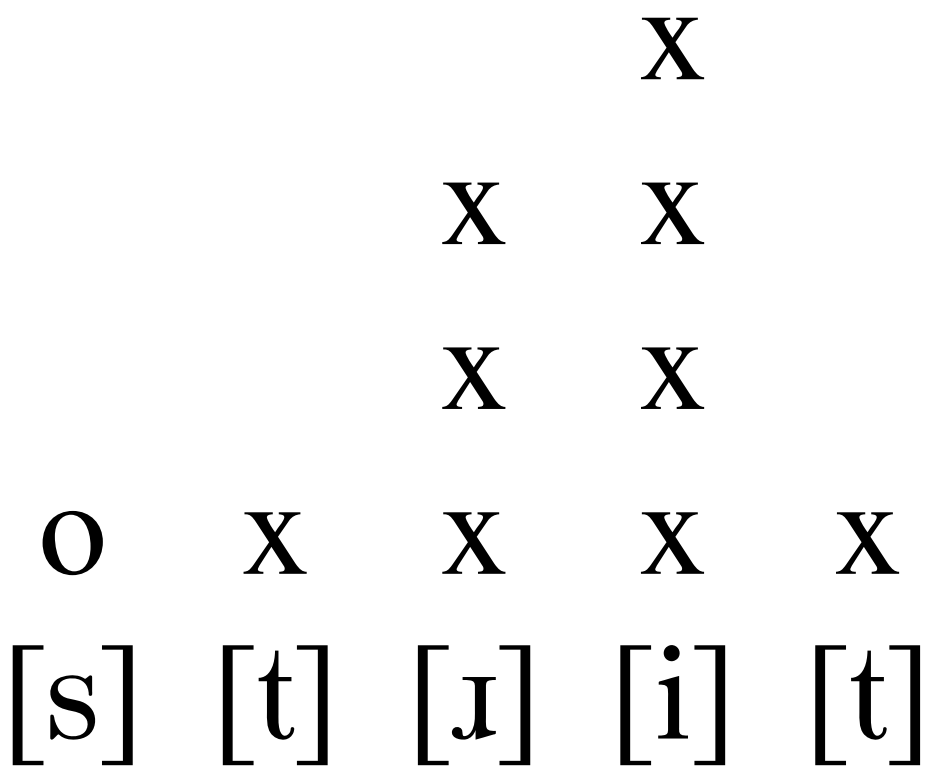

‘street’

Cross-linguistic tendencies in syllable structure

- Languages generally like consonants in the onset

Cross-linguistic tendencies in syllable structure

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- We say that they **prefer** consonants in this position
- Similarly, many languages **disprefer** coda consonants, such as Polynesian languages:

Tongan (Austronesian, Malayo-Polynesian)

- Tongan prohibits coda consonants altogether:

[ta.ŋa.ta]	‘man’
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- However, it requires onsets.
- Tongan permits just a single syllable type: CV

Japanese

- Japanese allows only CV, V, CVN, and CVC syllables, but restricts CVC to word-internal positions.

CV, V		*CVN, CVC*	
[ki]	‘tree’	[tom.bo]	‘dragonfly’
[ko.ko.ro.]	‘heart’	[neŋ.kin]	‘pension’
[ma.do]	‘window’	[kit.te]	‘stamp’
[i.to]	‘string’	[hak.ka]	‘peppermint’

Japanese

- We can see more evidence for this in loanwords:

word	*English*	*Japanese*
‘pin’	[pɪn]	[pin]
‘Chicago’	[ʃɪ.ka.go]	[ʃi.ka.go]
‘million’	[mɪ.li.jən]	[mi.ri.on]
‘free’	[fɹi]	[fɯ.riː]
‘peak’	[pik]	[piː.kɯ]
‘baseball’	[be͡js.bɔl]	[ba.sɯ.ba.rɯ]

Czech

- Czech allows up to **four** onset Cs, and three in codas:

VC	[on]	‘he’	CV	[to]	‘that’
CVC	[sin]	‘son’	CVC	[dej]	‘give (imp.)
CCVC	[jdu]	‘I go’	CCVCC	[trest]	‘punishmen
CCCVC	[strom]	‘tree’	CVVCCC	[zaːpst]	‘to freeze’
CCCCVC	[pʃtros]	‘ostrich’		–	–

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- Liquids can serve as syllabic nuclei:

strč	prst	skrz	krk
stick (imp.)	finger	through	neck

English

V	*I*	[a͡j]
CV	*me*	[mi͡j]
CCV	tree	[tɹi͡j]
CCCV	spray	[spɹe͡j]
VC	*eat*	[i͡jt]
VCC	*oats*	[o͡wts]
VCCC	*eighths*	[e͡jtθs]
CVC	*bit*	[bɪt]
CCVC	*spit*	[spɪt]
CCCVC	*split*	[splɪt]
CCCVCC	*splits*	[splɪts]
CCCVCCC	*splints*	[splɪnts]

Cross-linguistic tendencies in syllable structure

language	V	CV	CVC	VC	CCV	CCVC	CVCC	VCC	CCVCC	CVC
Hua		*								
Cayuvava	*	*								
Cairene Arabic		*	*							
Mazateco	*	*			*					
Mokilese	*	*	*	*						
Sedang		*	*		*	*				
Klamath		*	*				*			*
Spanish	*	*	*	*	*	*				
Finnish	*	*	*	*		*	*	*		
Totonac		*	*		*	*	*		*	*
English	*	*	*	*	*	*	*	*	*	*

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Cross-linguistic tendencies in syllable structure

- Tendencies are just that: tendencies
- Occasionally, you find a language that seems to flaunt sonority...
- ...and allows consonants basically **anywhere**.

Nuxálk (Bella Coola) (Salish)

łq	‘wet’
t’χt	‘stone’
sχs	‘seal fat’
χscc’	‘I’m now fat’
łχ^{w}tłcx^{w}	‘You spat on me’

Tashlhiyt Berber (Afro-Asiatic, Berber)

ks		‘feed on’
kks		‘take off’
kkstt		‘take it off (fem.)’
tkkststt		‘you took it off (fem.)’
tɕtft		‘it dried’
fqqs		‘irritate’
ftsχt		‘you cancelled’
sfqqst		‘irritate him’
tftχtstt		‘you dried it (fem.)’
tsskɕftstt		‘you dried it (fem.)’

(Carrier phrase *innajas* . . . *jat twalt* ‘he told him . . . once’)

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- Phonological processes often target syllables
- This lets our rules reference them, w00t!

Sensitivity to syllable structure: English aspiration

[pʰæn]	pan	[spæn]	span
[pʰejn]	pain	[spejn]	Spain
[pʰowk]	poke	[spowk]	spoke
[tʰown]	tone	[stown]	stone
[kʰɪn]	kin	[skɪn]	skin
[ˌpʰɹˈspajɹ]	perspire	[splæt]	splat
[ˌtʰəˈmeɾow]	tomato		
[ˌəˈkʰoɹd]	accord	[ˌækˈsɛpt]	accept
[ˌəˈpʰɔn]	upon	[ˌʌpˈsɛt]	upset
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Environment	*aspirated*	*unaspirated*
syllable-initially	yes	no
elsewhere	no	yes

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$$\begin{bmatrix} -\text{spr glottis} \\ -\text{continuant} \\ -\text{voice} \end{bmatrix} \longrightarrow [+\text{spr glottis}] \,/_{\sigma}[\_\_\_$$

"Voiceless stops are aspirated **in syllable-initial** position"

Sensitivity to syllable structure: Brazilian Portuguese

[max]	*mar*	'ocean'
[falax]	*falar*	'to speak'
[marɪz]	*mares*	'oceans'
[falara]	*falará*	's/he will speak'

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- /r/ has two allophones, [x] and [r]
- How can we describe their distribution?

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- If we know something about syllable structure...
- "/r/ is realized as [x] in coda position"

Sensitivity to syllable structure: Korean

root	*root + vowel initial suffix*	*root + consonant initial suffix*
/palp/ ‘tread on’	palp + a ‘treading on’	pap + t’a ‘to tread on’
/salm ‘boil’	salm + a ‘boiling’	sam + t’a ‘to boil’

- Why is the [l] deleted?

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- ...because Korean doesn’t allow multiple Cs in the coda.

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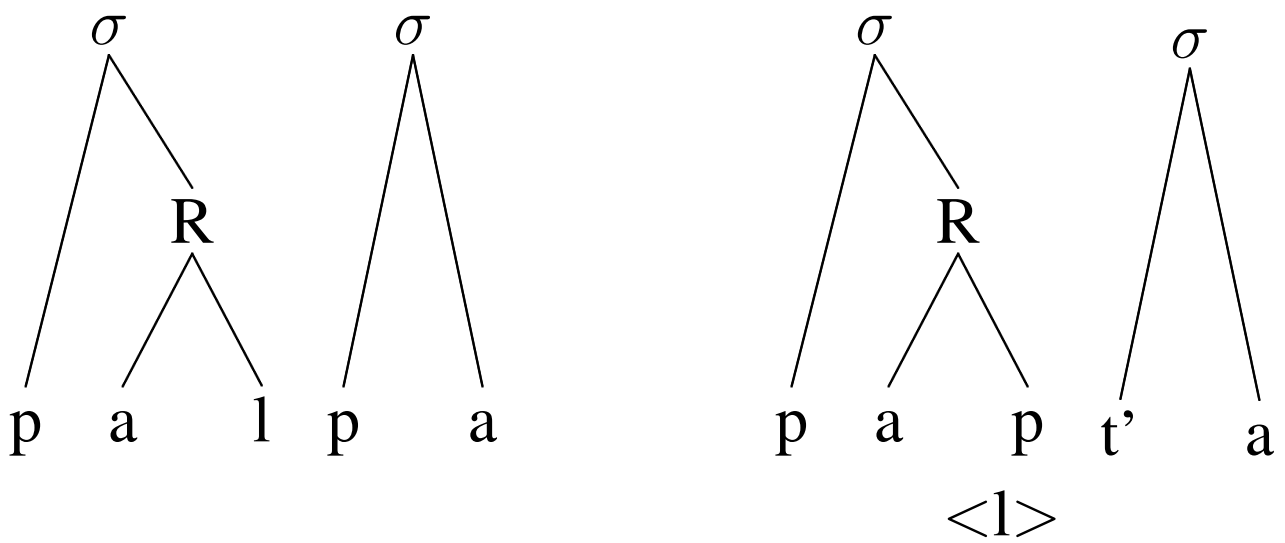

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- Segments are represented as a collections of features (**feature bundles**)
- Rules are schema of the form A $\rightarrow$ B / C ___ D which operate on representations
- Rules can also be crucially **ordered** with respect to one another

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- Surface representations (SRs) contain phonetic (allophonic) variation

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- Phonological representations contain more than segments...they can also include information about higher level structure such as **syllables**
- Phonological rules can make reference to this higher-order structure as well