

Class 3

Assimilation 1

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Lithuanian

Data

- In Lithuanian, there are various prefixes that appears on verbs that affect the meaning of the verb. One of them is shown below.
- ▷ It can have different surface forms. **What are they?**

at-eiti	‘to arrive’	at-prašyti	‘to ask’
at-imti	‘to take away’	at-kurti	‘to reestablish’
at-nešti	‘to bring’	ad-bekti	‘to run up’
at-leisti	‘to forgive’	ad-gauti	‘to get back’
at-likti	‘to complete’	ad-bukti	‘to become blunt’
at-ko:pti	‘to rise’	ad-gimti	‘to be born again’

Lithuanian

Allomorphs

- There are two **allomorphs** (surface forms) of the prefix: [at-] and [ad-].

at-eiti	‘to arrive’	at-praſi:ti	‘to ask’
at-imti	‘to take away’	at-kurti	‘to reestablish’
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Lithuanian

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- ▷ What is the difference between [at-] and [ad-] in terms of **features**?

Lithuanian

Voicing

- There are two **allomorphs** (surface forms) of the prefix: [at-] and [ad-].

at-eiti	‘to arrive’	at-prašiti	‘to ask’
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at-ko:pti	‘to rise’	ad-gimti	‘to be born again’

- ▷ What is the difference between [at-] and [ad-] in terms of **features**?
- The [t] in [at-] is **voiceless**. = [−voice]
 - The [d] in [ad-] is **voiced**. = [+voice]
 - * Both are *alveolar stops*.

Lithuanian

Voicing

- ▷ Can we use the feature $[\pm\text{voice}]$ to explain the distribution?

at- eiti	‘to arrive’	at- prašiti	‘to ask’
at- imti	‘to take away’	at- kurti	‘to reestablish’
at- nefti	‘to bring’	ad- bekti	‘to run up’
at- leisti	‘to forgive’	ad- gauti	‘to get back’
at- likti	‘to complete’	ad- bukti	‘to become blunt’
at- ko:pti	‘to rise’	ad- gimti	‘to be born again’

- ▷ What is the difference between $[\text{at-}]$ and $[\text{ad-}]$ in terms of **features**?
- The $[\text{t}]$ in $[\text{at-}]$ is **voiceless**. = $[-\text{voice}]$
 - The $[\text{d}]$ in $[\text{ad-}]$ is **voiced**. = $[\text{+voice}]$
 - * Both are *alveolar stops*.

Lithuanian

Voicing

▷ Can we use the feature $[\pm\text{voice}]$ to explain the distribution?

at-e iti	‘to arrive’	at-p rafi:ti	‘to ask’
at-i mti	‘to take away’	at-k urti	‘to reestablish’
at-n efti	‘to bring’	ad-b ekti	‘to run up’
at-l eisti	‘to forgive’	ad-g auti	‘to get back’
at-l ikti	‘to complete’	ad-b ukti	‘to become blunt’
at-k o:pti	‘to rise’	ad-g imti	‘to be born again’

- When there’s a **voiceless** sound at the beginning of the root, we always get the **voiceless** allomorph **[at-]**.
 - [p,t,k,s,f] are all **voiceless** sounds.

Lithuanian

Voicing

- ▷ Can we use the feature $[\pm\text{voice}]$ to explain the distribution?

at- eiti	‘to arrive’	at- praſiti	‘to ask’
at- imti	‘to take away’	at- kurti	‘to reestablish’
at- nefti	‘to bring’	ad- bekti	‘to run up’
at- leisti	‘to forgive’	ad- gauti	‘to get back’
at- likti	‘to complete’	ad- bukti	‘to become blunt’
at- ko:pti	‘to rise’	ad- gimti	‘to be born again’

- But when there’s a **voiced** sound at the beginning of the root, we sometimes get the **voiceless** allomorph **[at-]** and sometimes get the **voiced** allomorph **[ad-]**.
 - [b,d,g,z,ʒ,m,n,l,r] and all the vowels are **voiced** sounds.

Lithuanian

Voicing

▷ What else do we need?

at- eiti	‘to arrive’	at- praŋiti	‘to ask’
at- imti	‘to take away’	at- kurti	‘to reestablish’
at- nefti	‘to bring’	ad- bekti	‘to run up’
at- leisti	‘to forgive’	ad- gauti	‘to get back’
at- likti	‘to complete’	ad- bukti	‘to become blunt’
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- But when there’s a **voiced** sound at the beginning of the root, we sometimes get the **voiceless** allomorph [at-] and sometimes get the **voiced** allomorph [ad-].
 - [b,d,g,z,ʒ,m,n,l,r] and all the vowels are **voiced** sounds.

Lithuanian

Obstruent vs. Sonorant

▷ What else do we need: obstruent vs. sonorant

at-eiti	‘to arrive’	at-praſiti	‘to ask’
at-imti	‘to take away’	at-kurti	‘to reestablish’
at-neſti	‘to bring’	ad-bekti	‘to run up’
at-leisti	‘to forgive’	ad-gauti	‘to get back’
at-likti	‘to complete’	ad-bukti	‘to become blunt’
at-ko:pti	‘to rise’	ad-gimti	‘to be born again’

- The **voiced** sounds where we get the **voiceless** allomorph are all **sonorants** (sounds with little/no constriction of airflow): **[m,n,l,r]** and **vowels**
- The **voiced** sounds where we get the **voiced** allomorph are all **obstruents** (sounds with total or near total constriction of airflow): **[b,d,g,z,ʒ]**

Lithuanian

Morphological Rule

- ▷ What *morphological* rule can explain the distribution of the allomorphs?

at-e iti	‘to arrive’	at-p rafi:ti	‘to ask’
at-i mti	‘to take away’	at-k urti	‘to reestablish’
at-n efti	‘to bring’	ad-b ekti	‘to run up’
at-l eisti	‘to forgive’	ad-g auti	‘to get back’
at-l ikti	‘to complete’	ad-b ukti	‘to become blunt’
at-k o:pti	‘to rise’	ad-g imti	‘to be born again’

Lithuanian

Morphological Rule

- ▷ What *morphological* rule can explain the distribution of the allomorphs?

at-e iti	‘to arrive’	at-pra fi:ti	‘to ask’
at-i mti	‘to take away’	at-k urti	‘to reestablish’
at-ne fti	‘to bring’	ad-b ekti	‘to run up’
at-le isti	‘to forgive’	ad-g auti	‘to get back’
at-li kti	‘to complete’	ad-b ukti	‘to become blunt’
at-k o:pti	‘to rise’	ad-g imti	‘to be born again’

- (1) a. The voiced allomorph [**ad-**] appears before **voiced obstruents**.
 b. The voiceless allomorph [**at-**] appears everywhere else (before voiceless sounds, before sonorants)

Lithuanian

Phonological Rule

▷ Can we restate this as a *phonological rule*?

at-e iti	‘to arrive’	at-pra ĩiti	‘to ask’
at-i mti	‘to take away’	at-k urti	‘to reestablish’
at-n eĩti	‘to bring’	ad-b ekti	‘to run up’
at-l eĩsti	‘to forgive’	ad-g auti	‘to get back’
at-l ikti	‘to complete’	ad-b ukti	‘to become blunt’
at-k oĩpti	‘to rise’	ad-g imti	‘to be born again’

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at-l ikti	‘to complete’	ad-b ukti	‘to become blunt’
at-k o:pti	‘to rise’	ad-g imti	‘to be born again’

- (2) a. /t/ → [d] / _voiced obstruent
 b. /t/ → [t] elsewhere

Lithuanian

Phonological Rule

▷ How do we know that /t/ is the underlying form?

at-eiti	‘to arrive’	at-praſiti	‘to ask’
at-imti	‘to take away’	at-kurti	‘to reestablish’
at-neſti	‘to bring’	ad-bekti	‘to run up’
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- (2) a. /t/ → [d] / _voiced obstruent
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Lithuanian

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at-eiti	‘to arrive’	at-praŋiti	‘to ask’
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- (2) a. /t/ → [d] / _voiced obstruent
 b. /t/ → [t] elsewhere

- [t] is the **elsewhere** allophone; it doesn't appear in a single, unified context.

Features

The IPA chart: consonants

CONSONANTS (PULMONIC)

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	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Glottal
Plosive	p b			t d		ʈ ɖ	c ɟ	k ɡ	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.

Features

Place of articulation

CONSONANTS (PULMONIC)

PLACE OF ARTICULATION

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	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Glottal
Plosive	p b			t d		ʈ ɖ	c ɟ	k ɡ	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.

- The **location** in the vocal tract where a **constriction** is made is called the **place of articulation**.
 - Constrictions at the front of the mouth (labial) are further left.
 - Constrictions at the back of the vocal tract (glottal) are further right.

Features

Place of articulation

CONSONANTS (PULMONIC)

PLACE OF ARTICULATION

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	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Glottal
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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	ɻ	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.

- We can see how this looks using Real Time MRI imaging:

→ https://sail.usc.edu/span/rtmri_ipa/db_2015.html

Features

Manner of articulation

CONSONANTS (PULMONIC)

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	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Glottal
Plosive	p b			t d		ʈ ɖ	c ɟ	k ɡ	q ɢ		ʔ
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Tap or Flap		ⱱ		ɾ		ɽ					
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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.

MANNER OF ARTICULATION

- The **type** of constriction that is made when producing a sound is called the **manner of articulation**.
 - Complete constriction (stops) at the top of the chart.
 - Virtually no constriction (approximants and vowels) at the bottom.

Features

Manner of articulation

CONSONANTS (PULMONIC)

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	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Glottal
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Nasal	m	ɱ		n		ɳ	ɲ	ŋ	ɴ		
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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
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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.

MANNER OF ARTICULATION

- We can see how this looks too:

→ https://sail.usc.edu/span/rtmri_ipa/db_2015.html

Features

Voicing

CONSONANTS (PULMONIC)

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	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Glottal
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Tap or Flap				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				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.

- Within each place/manner combination, the sound on the left is **voiceless**.

Features

Voicing

CONSONANTS (PULMONIC)

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	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Glottal
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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			

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

- Within each place/manner combination, the sound on the left is **voiceless**.
- Within each place/manner combination, the sound on the right is **voiced**.

Features

Voicing

CONSONANTS (PULMONIC)

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	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.

- We can sort of see the difference with the MRI images:
 - https://sail.usc.edu/span/rtmri_ipa/db_2015.html

Features

Voicing

CONSONANTS (PULMONIC)

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	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Glottal
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Nasal		m ɱ		n ɳ			ɲ	ŋ	ɴ		
Trill		ʙ		r					ʀ		
Tap or Flap				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				ɹ			j	ɰ			
Lateral approximant				l			ʎ	ʟ			

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

- Here's a slightly more in depth explanation:
 - <https://www.youtube.com/watch?v=edYLoMRgaFw>
- And here's what that actually looks like with a laryngoscope:
 - https://www.youtube.com/watch?v=mJedwz_r2Pc

Features

Lithuanian consonants

- Here are the consonants of Lithuanian. (Most of the consonants also have a palatalized version, omitted here.)

	Labial	Alveolar	Palatal	Velar
Stops	p b	t d		k g
Affricates		ts ɖ	tʃ ɟʃ	
Fricatives	f v	s z	ʃ ʒ	x ɣ
Nasals	m	n		
Approximants		l,r	j	

- We're going to focus on the manner features.

Features

Stops

- **Stops** (aka plosives) are consonants that involve a complete closure in the oral cavity.

	Labial	Alveolar	Palatal	Velar
Stops	p b	t d		k g
Affricates		ts ɖ	tʃ ɟʃ	
Fricatives	f v	s z	ʃ ʒ	x ɣ
Nasals	m	n		
Approximants		l,r	j	

Features

Stops and Nasals

- **Nasals** technically also fall into this category, because they involve a complete closure in the oral cavity too.

	Labial	Alveolar	Palatal	Velar
Stops	p b	t d		k g
Affricates		ts dz	tʃ dʒ	
Fricatives	f v	s z	ʃ ʒ	x ɣ
Nasals	m	n		
Approximants		l,r	j	

- But nasals (technically, *nasal stops*) involve lowering the **velum** to allow air to pass through the nose.
- Stops (technically, *oral stops*) leave the velum raised so no air escapes through the nose.

Features

Fricatives

- **Fricatives** are consonants that involve an *incomplete closure*, i.e. a tight constriction that still allows air to pass through.

	Labial	Alveolar	Palatal	Velar
Stops	p b	t d		k g
Affricates		ts ɖ	tʃ ɟʃ	
Fricatives	f v	s z	ʃ ʒ	x ɣ
Nasals	m	n		
Approximants		l,r	j	

Features

Affricates

- **Affricates** are consonants that begin with a complete closure (stop portion) and end with an incomplete closure (fricative portion).

	Labial	Alveolar	Palatal	Velar
Stops	p b	t d		k g
Affricates		ts ɖ	tʃ ɟʃ	
Fricatives	f v	s z	ʃ ʒ	x ɣ
Nasals	m	n		
Approximants		l,r	j	

- Affricates are “complex” sounds, and thus transcribed with digraph symbols.
- ★ They are **not a sequence** of two sounds; they behave like other consonants.

Features

Approximants

- **Approximants**, often divided up into **liquids** ([l,r]) and **glides** ([w,j]), are consonants with very little constriction.

	Labial	Alveolar	Palatal	Velar
Stops	p b	t d		k g
Affricates		ts ɖ	tʃ ɟʃ	
Fricatives	f v	s z	ʃ ʒ	x ɣ
Nasals	m	n		
Approximants		l,r	j	

- Approximants share a lot of properties with vowels, especially that they allow for a high degree of airflow.

Features

Manner Features

- It is frequently useful in phonological analysis to group these individual consonant manner of articulation categories into large feature classes.

	Labial	Alveolar	Palatal	Velar
Stops	p b	t d		k g
Affricates		ts ɖ	tʃ ɟʃ	
Fricatives	f v	s z	ʃ ʒ	x ɣ
Nasals	m	n		
Approximants		l,r	j	

- ▷ Does anybody remember any of these manner features?

Features

Obstruent vs. Sonorant

	Labial	Alveolar	Palatal	Velar
Stops	p b	t d		k g
Affricates		ts ɖ	tʃ ɟʃ	
Fricatives	f v	s z	ʃ ʒ	x ɣ
Nasals	m	n		
Approximants		l,r	j	

- **Sonorants** ([+sonorant]): sounds with a large amount of airflow
 ↪ nasals, approximants, vowels (prototypically voiced)
- **Obstruents** ([-sonorant]): sounds with a little to no airflow
 ↪ stops, fricatives, affricates

Features

Continuants

	Labial	Alveolar	Palatal	Velar
Stops	p b	t d		k g
Affricates		ts dz	tʃ dʒ	
Fricatives	f v	s z	ʃ ʒ	x ɣ
Nasals	m	n		
Approximants		l,r	j	

- **Continuants** ([+continuant]): sounds with continuous *oral* airflow
 ↪ fricatives, approximants, vowels (prototypically voiced)
- **Non-continuants** ([−continuant]): sounds without continuous oral airflow
 ↪ stops, affricates, nasals

Features

Approximants

	Labial	Alveolar	Palatal	Velar
Stops	p b	t d		k g
Affricates		ts ɖ	tʃ ɟʃ	
Fricatives	f v	s z	ʃ ʒ	x ɣ
Nasals	m	n		
Approximants		l,r	j	

- **Approximants** ([+approximant]): sounds with minimal constriction
↔ approximants (liquids and glides), vowels
- **Non-approximants** ([−approximant]): sounds with non-minimal constriction
↔ stops, affricates, fricatives, nasals

Lithuanian Analysis

Rules revisited

- Let's go back to our analysis of Lithuanian:

at- eiti	'to arrive'	at- prašiti	'to ask'
at- imti	'to take away'	at- kurti	'to reestablish'
at- nefti	'to bring'	ad- bekti	'to run up'
at- leisti	'to forgive'	ad- gauti	'to get back'
at- likti	'to complete'	ad- bukti	'to become blunt'
at- ko:pti	'to rise'	ad- gimti	'to be born again'

- The voiced allomorph [**ad-**] appears before voiced obstruents.
 - The voiceless allomorph [**at-**] appears everywhere else (before voiceless sounds, before sonorants)
- $/t/ \rightarrow [d] / _ \text{voiced obstruent}$
 - $/t/ \rightarrow [t] \text{ elsewhere}$

Lithuanian Analysis

Rules revisited

▷ How should we represent the rule in terms of features?

at- eiti	‘to arrive’	at- prašiti	‘to ask’
at- imti	‘to take away’	at- kurti	‘to reestablish’
at- nefti	‘to bring’	ad- bekti	‘to run up’
at- leisti	‘to forgive’	ad- gauti	‘to get back’
at- likti	‘to complete’	ad- bukti	‘to become blunt’
at- ko:pti	‘to rise’	ad- gimti	‘to be born again’

- (1) a. The voiced allomorph [**ad-**] appears before voiced obstruents.
 b. The voiceless allomorph [**at-**] appears everywhere else (before voiceless sounds, before sonorants)
- (2) a. /t/ → [**d**] / _voiced obstruent
 b. /t/ → [**t**] elsewhere

Lithuanian Analysis

Feature-based rules

▷ How should we represent the rule in terms of features?

at-eiti	‘to arrive’	at-prašiti	‘to ask’
at-imti	‘to take away’	at-kurti	‘to reestablish’
at-nefti	‘to bring’	ad-bekti	‘to run up’
at-leisti	‘to forgive’	ad-gauti	‘to get back’
at-likti	‘to complete’	ad-bukti	‘to become blunt’
at-ko:pti	‘to rise’	ad-gimti	‘to be born again’

- (3) a. /t/ → [d] / _[+voice, −sonorant]
 b. /t/ → [t] elsewhere

- [+voice] eliminates the voiceless consonants from conditioning the change.
- [−sonorant] eliminates the voiced sonorants from conditioning the change.

Lithuanian Analysis

Feature-based rules

▷ Can we go any further?

at-eiti	‘to arrive’	at-prašiti	‘to ask’
at-imti	‘to take away’	at-kurti	‘to reestablish’
at-nefti	‘to bring’	ad-bekti	‘to run up’
at-leisti	‘to forgive’	ad-gauti	‘to get back’
at-likti	‘to complete’	ad-bukti	‘to become blunt’
at-ko:pti	‘to rise’	ad-gimti	‘to be born again’

- (3) a. /t/ → [d] / _[+voice, −sonorant]
 b. /t/ → [t] elsewhere

- [+voice] eliminates the voiceless consonants from conditioning the change.
- [−sonorant] eliminates the voiced sonorants from conditioning the change.

Lithuanian Analysis

Feature-based rules

- Identify the featural composition of the segments in the rule.

at-e iti	‘to arrive’	at-pra ĩiti	‘to ask’
at-i mti	‘to take away’	at-k urti	‘to reestablish’
at-ne fti	‘to bring’	ad-b ekti	‘to run up’
at-le isti	‘to forgive’	ad-g auti	‘to get back’
at-l ikti	‘to complete’	ad-b ukti	‘to become blunt’
at-k o:pti	‘to rise’	ad-g imti	‘to be born again’

- (3) a. /t/ → [d] / _[+voice, −sonorant]
 b. /t/ → [t] elsewhere

Lithuanian Analysis

Feature-based rules

- We describe sounds with their (1) voice (2) place (3) manner.

at-e iti	‘to arrive’	at-p rafi:ti	‘to ask’
at-i mti	‘to take away’	at-k urti	‘to reestablish’
at-n efti	‘to bring’	ad-b ekti	‘to run up’
at-l eisti	‘to forgive’	ad-g auti	‘to get back’
at-l ikti	‘to complete’	ad-b ukti	‘to become blunt’
at-k o:pti	‘to rise’	ad-g imti	‘to be born again’

- (3) a. /t/ → [d] / _[+voice, −sonorant]
 b. /t/ → [t] elsewhere

- [t] = *voiceless alveolar stop* = [−voice, +alveolar, −sonorant, −continuant]

Lithuanian Analysis

Feature-based rules

- We describe sounds with their (1) voice (2) place (3) manner.

at-eiti 'to arrive'	at-praʃi:ti 'to ask'
at-imti 'to take away'	at-kurti 'to reestablish'
at-neʃti 'to bring'	ad-bekti 'to run up'
at-leisti 'to forgive'	ad-gauti 'to get back'
at-likti 'to complete'	ad-bukti 'to become blunt'
at-ko:pti 'to rise'	ad-gimti 'to be born again'

- (3) a. /t/ → [d] / _[+voice, -sonorant]
 b. /t/ → [t] elsewhere

- [t] = *voiceless alveolar stop* = [−voice, +alveolar, −sonorant, −continuant]
- [d] = *voiced alveolar stop* = [+voice, +alveolar, −sonorant, −continuant]

Lithuanian Analysis

Feature-based rules

- Now let's put the features into the rule:

at-eiti	'to arrive'	at-prašiti	'to ask'
at-imti	'to take away'	at-kurti	'to reestablish'
at-nefti	'to bring'	ad-bekti	'to run up'
at-leisti	'to forgive'	ad-gauti	'to get back'
at-likti	'to complete'	ad-bukti	'to become blunt'
at-ko:pti	'to rise'	ad-gimti	'to be born again'

$$(4) \quad /-\mathbf{voi}, +\mathbf{alv}, -\mathbf{son}, -\mathbf{cont}/ \rightarrow [+ \mathbf{voi}, +\mathbf{alv}, -\mathbf{son}, -\mathbf{cont}] / _ [+ \mathbf{voi}, -\mathbf{son}]$$

Lithuanian Analysis

Feature-based rules

▷ What have we learned by using the features?

at-eiti	‘to arrive’	at-prašiti	‘to ask’
at-imti	‘to take away’	at-kurti	‘to reestablish’
at-nefti	‘to bring’	ad-bekti	‘to run up’
at-leisti	‘to forgive’	ad-gauti	‘to get back’
at-likti	‘to complete’	ad-bukti	‘to become blunt’
at-ko:pti	‘to rise’	ad-gimti	‘to be born again’

(4) $/-\mathbf{voi}, +\mathbf{alv}, -\mathbf{son}, -\mathbf{cont}/ \rightarrow [+ \mathbf{voi}, +\mathbf{alv}, -\mathbf{son}, -\mathbf{cont}] / _ [+ \mathbf{voi}, -\mathbf{son}]$

Lithuanian Analysis

Feature-based rules

▷ What have we learned by using the features?

at-e iti	‘to arrive’	at-pra firi:ti	‘to ask’
at-i mti	‘to take away’	at-k urti	‘to reestablish’
at-ne fti	‘to bring’	ad-b ekti	‘to run up’
at-le isti	‘to forgive’	ad-g auti	‘to get back’
at-li kti	‘to complete’	ad-b ukti	‘to become blunt’
at-k o:pti	‘to rise’	ad-g imti	‘to be born again’

(4) $/-vo_i,+alv,-son,-cont/ \rightarrow [+vo_i,+alv,-son,-cont] / _ [+vo_i,-son]$

- When we identify the features of the segments involved in the rule, we can identify which features are changing: this is a rule that changes $[\pm voice]$.

Lithuanian Analysis

Voicing Assimilation

▷ What have we learned by using the features?

at-e iti	‘to arrive’	at-pra firi	‘to ask’
at-i mti	‘to take away’	at-k urti	‘to reestablish’
at-n efti	‘to bring’	ad-b ekti	‘to run up’
at-l eisti	‘to forgive’	ad-g auti	‘to get back’
at-l ikti	‘to complete’	ad-b ukti	‘to become blunt’
at-k o:pti	‘to rise’	ad-g imti	‘to be born again’

(4) /-**voi**,+alv,-son,-cont/ → [+**voi**,+alv,-**son**,**-cont**] / _[+**voi**,-son]

- The change in [±voice] **matches** the environment, making the sounds **more similar**: this is an assimilation rule.