Rational Phonology
A naysayer's guide to some phonological notions

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GLOWing Lecture

Video here

- Present conventional wisdom on some point of phonology

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- Offer an outlandish and idiosyncratic alternative

Strategy and goals

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- Show unity of linguistics—mostly by citing Chomsky

Outline

- Phonology depends on phonetics.

Conventional wisdom

- Phonology depends on phonetics.
- Segments and features can be observed in the signal.

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- Phonology depends on phonetics.
- Segments and features can be observed in the signal.
  - ☹ I say 'nay' to this.

Two perspectives

Commonsense: phonetics comes before phonology

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My own subject, Phonetics, is one which is useless by itself, while at the same time it is the foundation of all study of language, whether theoretical or practical.

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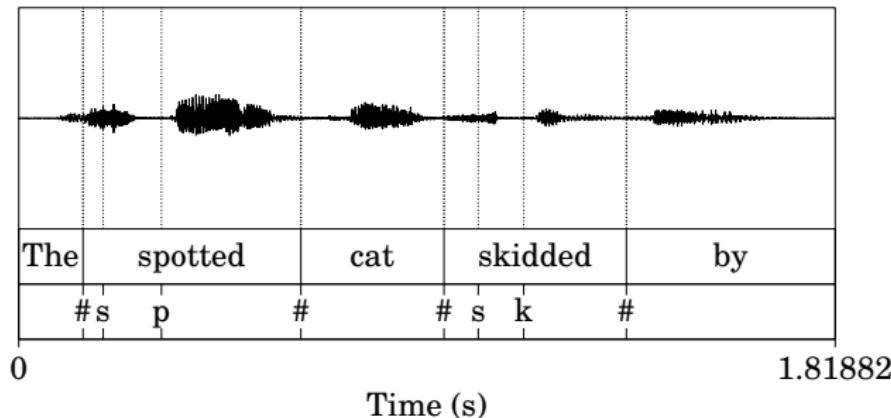
'The Metaphysics of Coarticulation,' Hammarberg 1976

> *phonology is logically and epistemologically prior to phonetics*

Words and the Poverty of the Stimulus (PoS)
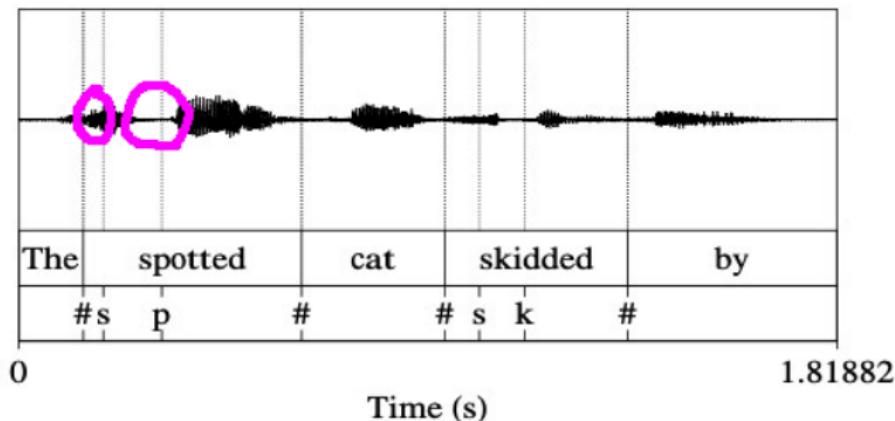
> **Howard Lasnik (2000:3)**
>
> *The big step is going from "noise" to "word".*

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The big step is going from "noise" to "word".

Howard is not being radical enough

Poverty of the stimulus is everywhere

- Phonological patterns
  - alternations, intonation, stress
- Syllables
- Segments
- Features
- Rules

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- PoS: The input underdetermines the acquired knowledge state w/o significant priors: UG exists.
- Rationalism beats empiricism

Abstractness is not just in language
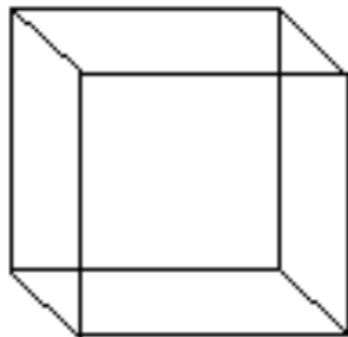
Pylyshyn 1984

- Equivalence classes are not stimulus bound

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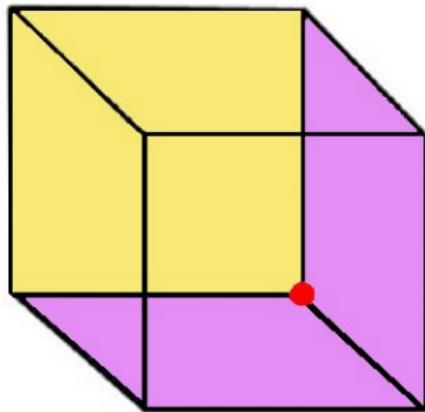
- Equivalence classes are not stimulus bound
- An infinite range of physical arrays lead to Necker Cube percept

There are no necessary or sufficient **physical** conditions for the definition of a Necker cube ...

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Stimulus independence in vision—(and for language)

There are no necessary or sufficient **physical** conditions for the definition of a Necker cube ...or a syllable or a /t/ or an /æ/ or an NP or a subject

Rationalism and the segment

For linguists and humans (Hammarberg, 1976, p. 354)

- **Linguist**: the concept of the segment, which is indispensable to phonetics and phonology, is a creature of the paradigm, not of the raw data
- **Human**:[I]t should be perfectly obvious by now that segments do not exist outside the human mind.

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- Nahhh.
- Can't talk about 'rounded [k]' or 'unrounded [k]' w/o category [k]

Chomsky meets Scrooge[1]: [ba], humbug!

---

[1] *A Christmas Carol* by Charles Dickens

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Cognoscitive powers give us symbols inside language

- "No one is so deluded as to believe that there is a mind-independent object corresponding to the internal syllable [ba], some construction from motion of molecules perhaps, which is selected when I say [ba] and when you hear it" (Chomsky 2015, p.126)

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and outside

- "No entity in human experience can be adequately defined as the mechanical sum or product of its physical properties." Sapir (1933)

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Martian scientists and features

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    - Howard's "big leap" also applies from noise to feature

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and it's UG that decides what kids can learn

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  - ☺ To this I say 'aye'.

Outline

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Justifying features

(The?) 8 Turkish vowels

singular	meaning
ip	rope
öç	vengeance
gül	rose
ek	junction
kıl	body hair
sap	stalk
uç	edge
son	end

Features are symbols that get transduced

|	−Back		+Back	
+High	i	ü	ı	u
−High	e	ö	a	o
	−Round	+Round	−Round	+Round
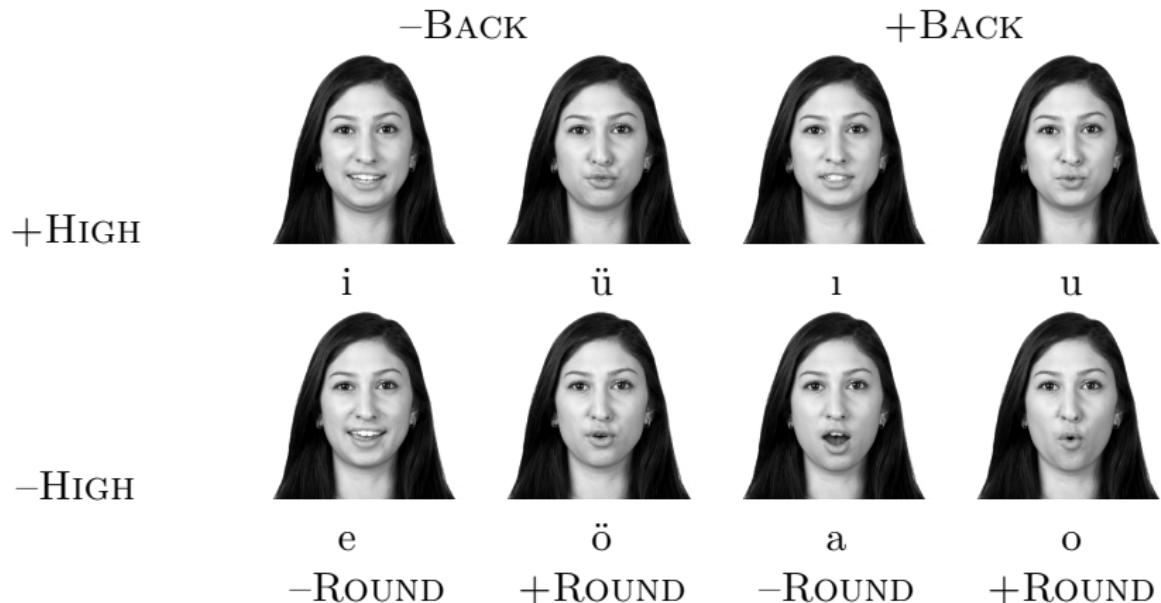
Figure: Ezgi pronouncing the eight Turkish surface vowels.

Turkish vowels page. Photos by Sabina Matyiku.

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$$/i/ = \left\{ \begin{array}{c} -\text{Back} \\ -\text{Round} \\ +\text{High} \\ \vdots \end{array} \right\} \quad /u/ = \left\{ \begin{array}{c} +\text{Back} \\ +\text{Round} \\ +\text{High} \\ \vdots \end{array} \right\}$$

Turkish singular / plural pairs

singular	plural	meaning
dev	devler	giant
kek	kekler	cake
cep	cepler	pocket
çek	çekler	check
ters	tersler	contrary
can	canlar	soul
tarz	tarzlar	type
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  - ~ "The vowel of the plural suffix is set to the value of the vowel of the preceding syllable"

More Turkish singular / plural pairs

singular	plural	meaning
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Vowel Harmony II: The vowel of the suffix is identical to the preceding vowel w.r.t. the feature BACK.

- i, e, ü, ö are −BACK (IPA: i, e, y, œ)
- u, o, ı, a are +BACK (IPA: u, o, ɯ, a)

What have we learned?

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- Discovery 1! Phonology can compute identity!
- Discovery 2! Segments are not the atoms of computation, valued features are.
- The innate feature set determines what the patterns/equivalence classes are—not the acoustics and physiology.
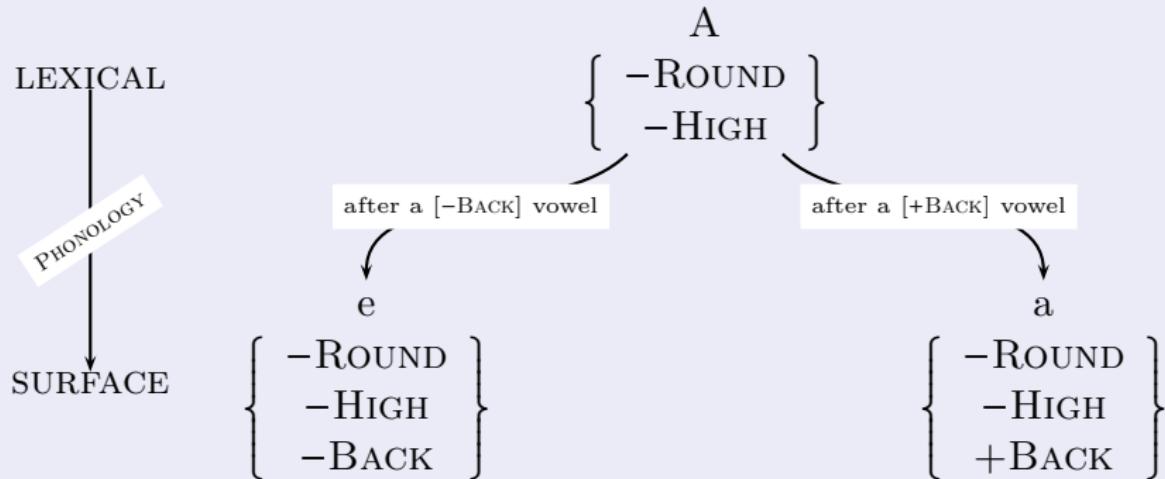
Underspecification: A 9th vowel for Turkish?
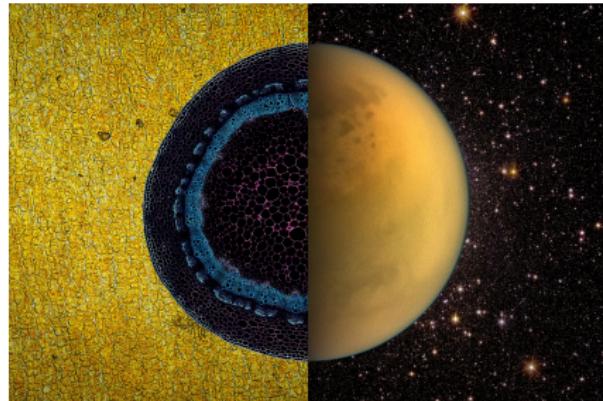
- *He went to the <u>park</u>.* FALLING INTONATION
- *He went to the <u>park</u>?* RISING INTONATION
  - ▸ What is stored? Something that is never heard!

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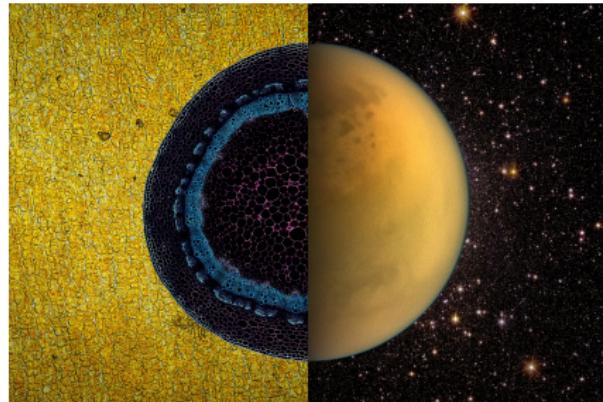
Kids NEVER hear [A], but they store that vowel!

A
$\left\{ \begin{array}{c} -\text{ROUND} \\ -\text{HIGH} \end{array} \right\}$

LEXICAL

PHONOLOGY

after a [−BACK] vowel

after a [+BACK] vowel

e
$\left\{ \begin{array}{c} -\text{ROUND} \\ -\text{HIGH} \\ -\text{BACK} \end{array} \right\}$

a
$\left\{ \begin{array}{c} -\text{ROUND} \\ -\text{HIGH} \\ +\text{BACK} \end{array} \right\}$

SURFACE

Exactly How Much Life Is on Earth?

According to a recent calculation by a team of biologists and geologists, there are a more living cells on Earth — a million trillion trillion, or 10^{30} in math notation, a 1 followed by 30 zeros — than there are stars in the universe or grains of sand on our planet.

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These numbers are kids' stuff!

Working with features

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- **Segments are Sets of valued features** (at least: X-slots, etc.)
- **Segments are Consistent**—can't have $+F$ and $-F$ (for now)

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  That's already a thousand times more than the number of grains of sand on earth

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- Underspecification is elegant, like collapsing of MERGE and MOVE

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'Approaching UG from below' (Chomsky, 2007)

the less attributed to genetic information (in our case, the topic of UG) for determining the development of an organism, the more feasible the study of its evolution

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- Underspecification comes for free—
  - just don't stipulate that segments need to be fully specified

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- Phonology is concerned with minimal pairs and contrast.

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Not this.

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Instead:

'Language as a natural object' (Chomsky, 2000a, 122)

...to abstract from the welter of descriptive complexity certain general principles governing computation that would allow the rules of a particular language to be given in very simple forms

Simple rule I

Copy/Assimilate/Harmony *apparently* is a thing

- e → ẽ / __ n
- Search and Copy:
  - "vowel looks at segment to immediate right, if it finds +Nasal it *copies* that feature"

Simple rule II

Search no copy

- e → i / ___ n
- Search but NOT Copy:
  - "vowel searches to immediate right, if it finds +NASAL the vowel becomes +HIGH"

Simple rule III

Search and change

- e →X / ___n
- Search and Change:
  - "vowel searches to immediate right, if it finds +Nasal something happens to the vowel"

Assimilation is not a(n important) thing

environment ≠ change

What you look for (check for a following nasal)

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What happens (nasalize, raise, whatever)

Terrestrial mammals and household pets

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Chomsky (2000b, 8): carve nature at its joints

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- 'assimilation', 'vowel harmony', 'opaqueness' and 'adjacency' in phonology parallel
- 'grammatical constructions' like 'passive' or 'relative clause' in syntax
- and our job is to see beyond these "taxonomic artifacts"

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- Assimilation requires different tools from other processes
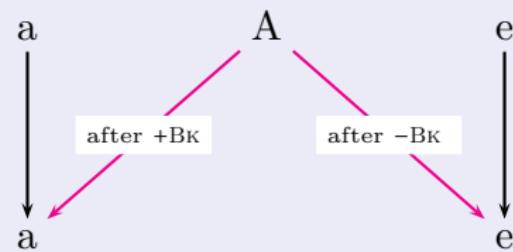
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Segment mapping diagrams (SMDs)
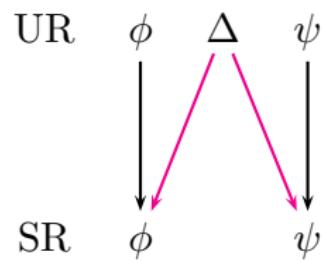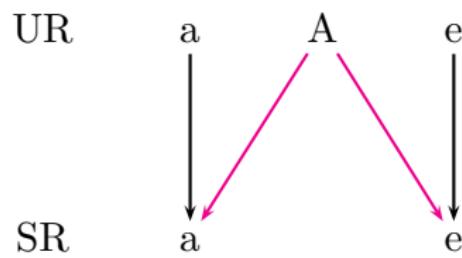
- These SMDs are part of our **epistemic toolkit**—they are not objects in the theory.
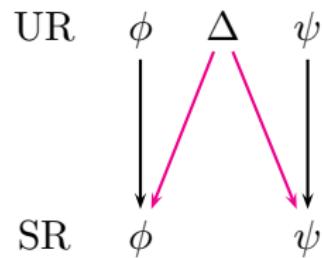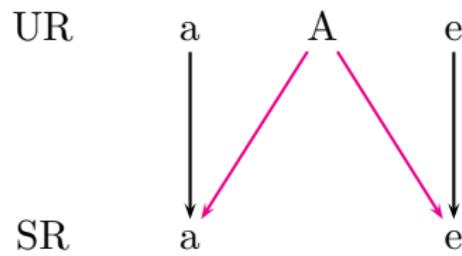
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	a	A	e		ϕ	Δ	ψ

UR   a   A   e   UR ϕ Δ ψ

SR   a   e   SR ϕ ψ
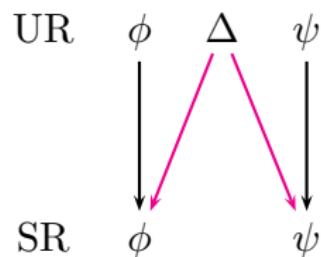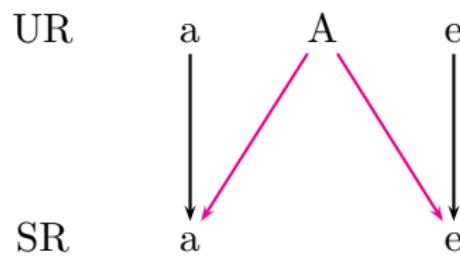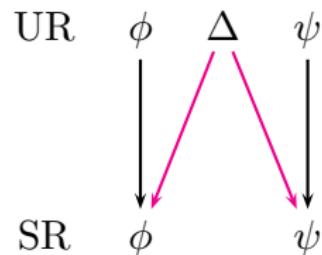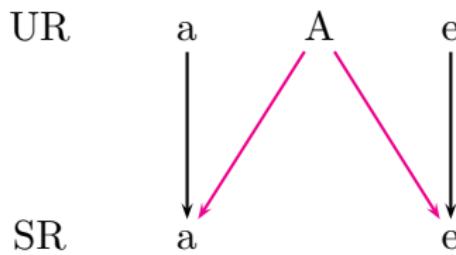
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- $\phi \cap \psi = \Delta$

Fairly complete model of segmental changes (FCMSC)

Deconstructing →: Two basic operations

a. **unify**

add s.t.

Δ

ϕ

b. **subtract**

delete s.t.

ϕ

Δ

- **Unification**-based rules *add* a feature to a segment/set
- Set **subtraction**-based rules *delete* a feature from a segment/set
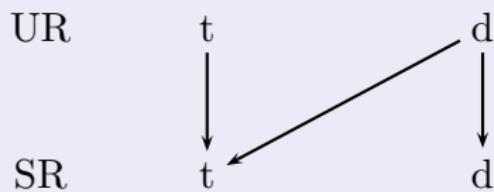
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'Normal' neutralization
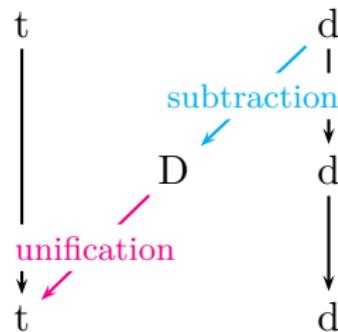
Final devoicing of d →t in Russian

UR	t	d

SR   t   d

- /d/ is +VOICED coronal stop
- /t/ is −VOICED coronal stop

Two-step SMD for final devoicing of d in Russian

An old trick (J. Harris, B. Poser, P. Siptár) of 2-step feature changing:
/d/ →D →[t]

- /d/ is +VOICED coronal stop
- /t/ is −VOICED coronal stop
- /D/ is a coronal stop unspecified for VOICE
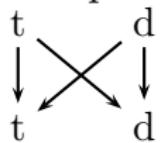
Reciprocal neutralization in Hungarian

Both nouns show up with *t* and *d*
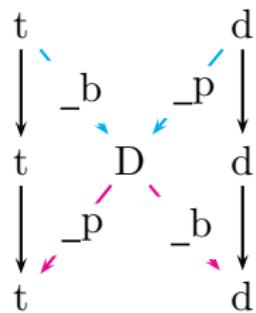
Noun	In N	From N	To N		
kuːt	kuːdban	kuːttoːl	kuːtnak	'well'	/kuːt/
kaːd	kaːdban	kaːttoːl	kaːdnak	'tub'	/kaːd/

Reciprocal neutralization SMD:

Subtraction: $\begin{bmatrix} -\textsc{Son} \end{bmatrix} - \{\alpha\textsc{Voic}\} \; / \; \underline{\hspace{1em}} \begin{bmatrix} -\textsc{Son} \\ -\alpha\textsc{Voic} \end{bmatrix}$

Unification: $\begin{bmatrix} -\textsc{Son} \end{bmatrix} \sqcup \{\alpha\textsc{Voic}\} \; / \; \underline{\hspace{1em}} \begin{bmatrix} -\textsc{Son} \\ \alpha\textsc{Voic} \end{bmatrix}$

Combinatorics strike again

$$\begin{array}{ccc}
\text{UR} & \phi & \psi \\
& \downarrow \searrow\,\Delta\,\swarrow \downarrow & \\
\text{SR} & \phi & \psi
\end{array}$$

Phenomena get more complex, yet model remains simple.
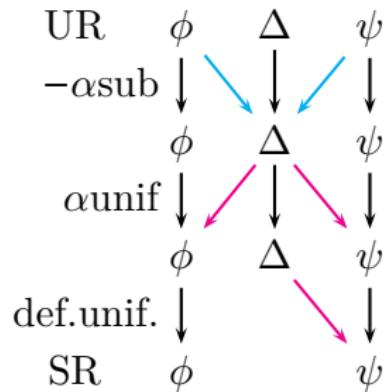
- *As concepts and principles become simpler, argument and inference tend to become more complex—a consequence that is naturally very much to be welcomed.*[Chomsky 1982, p.3]

Hungarian with 'exceptional' *v*
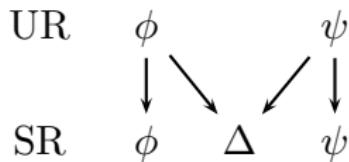
- *v* is a target of devoicing: *óvtam* /vt/ ↝ [ft]
- *v* does **not** trigger voicing: *pitvar* /tv/ ↝̸ [dv]

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Derived surface underspecification

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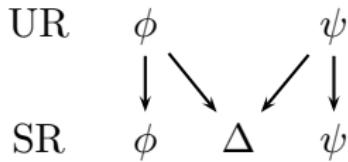
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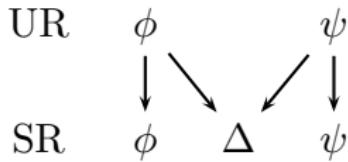
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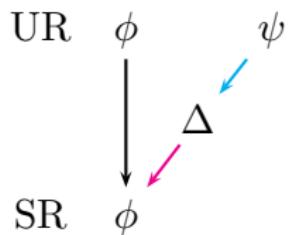
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- No stipulation that segments be complete at SR

What could this mean?

$$\begin{array}{ccc} \text{UR} & \phi & \psi \\ & \downarrow & \searrow \\ & & \Delta \\ \text{SR} & \phi & \end{array}$$

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UR $\quad \phi \qquad \psi$

$\qquad\qquad\downarrow\quad \Delta$

SR $\quad \phi$
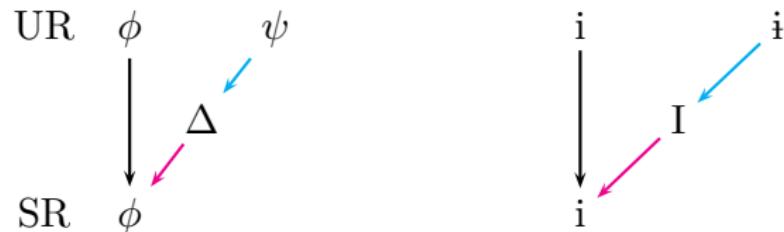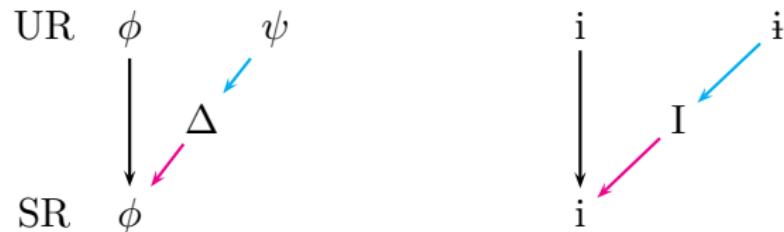
What justifies positing $/\psi/$?

Feature-changing absolute neutralization of ϕ and ψ with Hungarian parallel
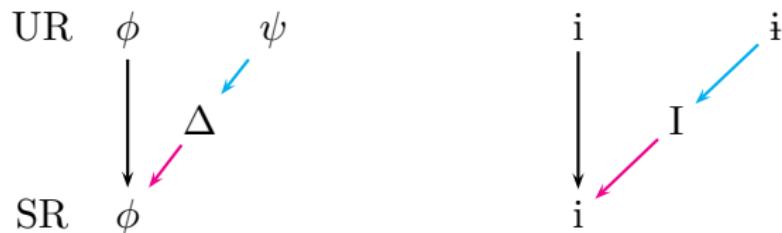
UR ϕ ψ i   ɨ

Δ I

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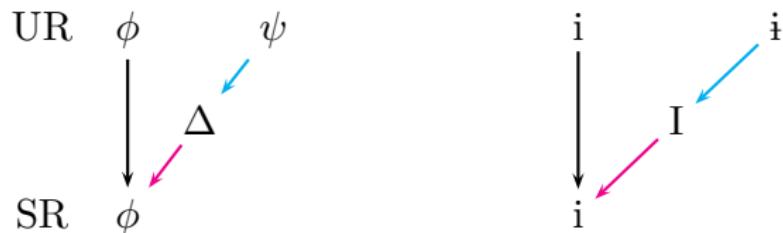
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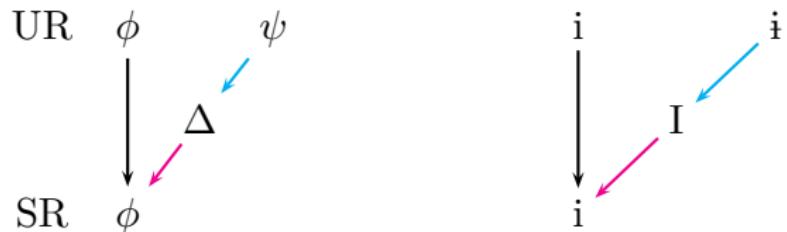
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Duh! The essence of an element is not to be inferred only from its appearance, but also from its effect on other elements.

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- etc. all from the same simple model of unification and subtraction

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- Imagine a world without plastics!

Rational Phonology View

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  no transparent consonants *or vowels*, they're all opaque

68

Informal analogy

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4. (Scan ahead of you in line until you find a person with a hat. Take the hat.)

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The phonology repairs ill-formed/marked/pathological/complex representations

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- phonological computation has to "cure" a "condition" (Yip, 1988)
- Phonology contains "principles of well-formedness (the 'laws) that drive it" (Prince and Smolensky, 1993, p. 216), taking input representations and making them somehow better, more harmonic or optimal.
- "repair strategies" (Paradis, 1988)
- "output drivenness" (Tesar, 2014)
  - I say 'nay' to this.

In a nutshell

It's all teleological, driven by purpose
- epenthesis exists to eliminate bad syllables

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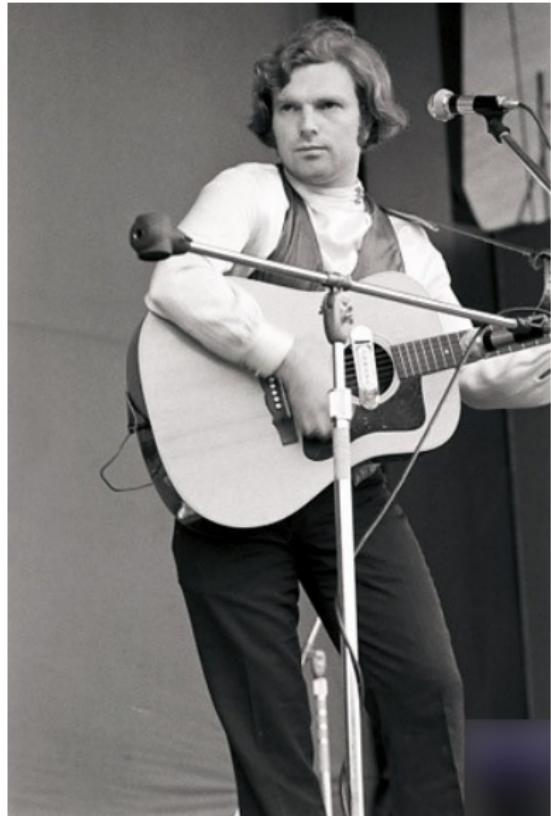
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- The claims are no better than Aristotle's view that a lantern shines **so that** we don't stumble.
- Lanterns/grammars don't care about stumbling/ambiguity
  - ...or anything else

It ain't why, why, why. It just is.
— Van Morrison
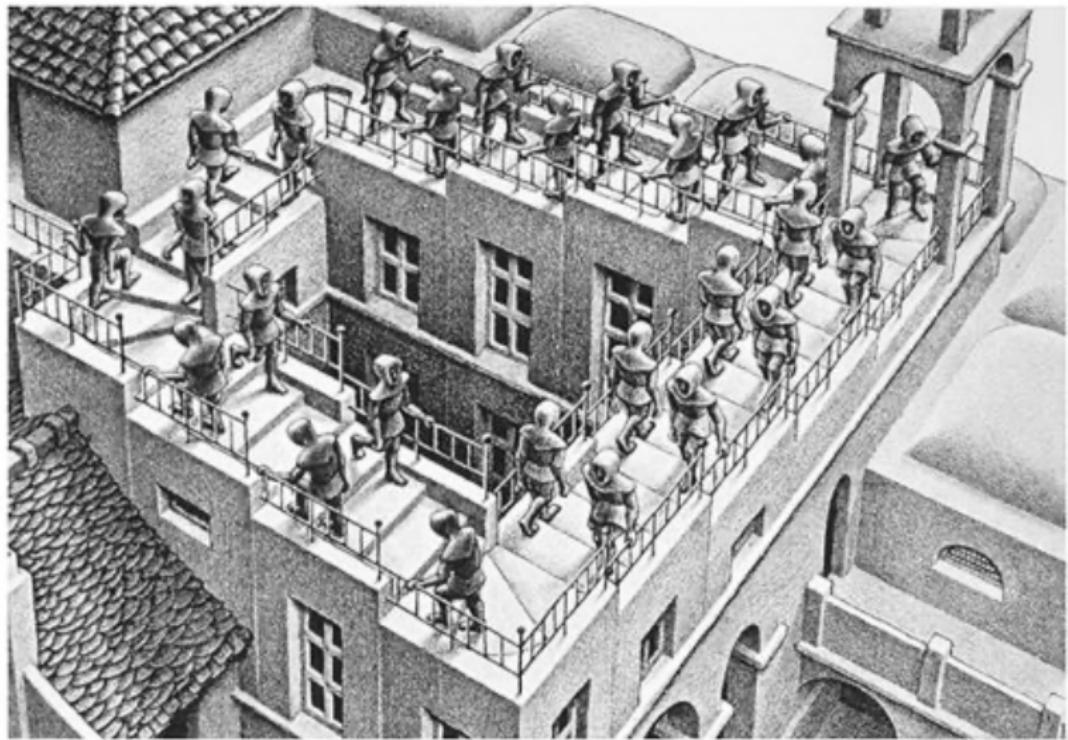
Confessio Grammatici (Halle, 1975)

Since language is not, in its essence, a means for transmitting [cognitive] information—though no one denies that we constantly use language for this very purpose—then it is hardly surprising to find in languages much ambiguity and redundancy, as well as other properties that are obviously undesirable in a good communication code.

Escher Staircase...but possible visual representation

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- Soft constraints reflect markedness prejudices. Why generate and filter (like "Move-α, then filter")? Just build the (licit) structures, as in Minimalism.

Rational phonology view

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  - ☺ To this I say 'aye'.

Outline

- There is no Argument from the Poverty of the Stimulus in Phonology

Conventional wisdom

- There is no Argument from the Poverty of the Stimulus in Phonology
  - ☹ I say 'nay' to this.

Peter MacNeilage

The origin of speech (2008: 41)

> however much poverty of the stimulus exists for language in general, there is none of it in the domain of the structure of words, the unit of communication I am most concerned with. Infants *hear all the words* they expect to produce. Thus, the main proving ground for *UG does not include phonology*

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- Do Shona kids hear all 10^{33} forms of a verb they can parse and generate if need be? (David Odden, p.c.)

Jeff Mielke

The Emergence of Distinctive Features, 2008

- *Many of the arguments for UG in other domains do not hold for phonology. For example, there is little evidence of a learnability problem in phonology* (p. 33)

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- *Many of the arguments for UG in other domains do not hold for phonology. For example, there is little evidence of a learnability problem in phonology* (p. 33)

- *[Most of the evidence for] UG is not related to phonology, and phonology has more of a guilt-by-association status with respect to innateness.* (p. 34)

⇒'Phonology without universal grammar'⇐ (2015)

- *features cannot be innately defined, but must be learned*

Archangeli & Pulleyblank

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- *features cannot be innately defined, but must be learned*
- *[Children face] the challenge of isolating specific sounds from the sound stream*
- *the predictions of [Emergent Grammar] fit the data better than do the predictions of UG.*

Philip Carr

‘Universal grammar and syntax/phonology parallelisms’ (2006)

Phonological objects and relations are internalisable: there is no poverty of the stimulus argument in phonology. No phonological knowledge is given by UG.

Evolutionary Phonology

Within the domain of sounds, there is no poverty of the stimulus. [I offer] general arguments against the "poverty of stimulus" in phonology, …[there is no evidence that] regular phonological alternations cannot be acquired on the basis of generalizations gleaned directly from auditory input.

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- Obviously you need more than auditory input to get alternations—you need meaning.
- Auditory input is not linguistic input.

Empirical base

SR	[mæts]	[klɪfs]	[hɛdz]	[bʊʃɨz]	[mæsɨz]	[wɪzɨz]
Gloss	'mats'	'cliffs'	'heads'	'bushes'	'masses'	'whizzes'

Empirical base

English regular plural

SR	[mæts]	[klɪfs]	[hɛdz]	[bʊʃɨz]	[mæsɨz]	[wɪzɨz]
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Speech sounds are sets of features

- [s] in *mats* is −Voiced (w/ vocal fold vibration) and +Coronal, ...

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Speech sounds are sets of features

- [s] in *mats* is −Voiced (w/ vocal fold vibration) and +Coronal, ...
- [z] in *heads* is +Voiced (w/o vocal fold vibration) and +Coronal, ...
- [ɨz] in *bushes* has an extra vowel

Amodal completion

(a)

(b)
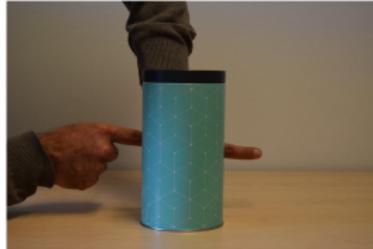
Amodal completion

(a)

(b)
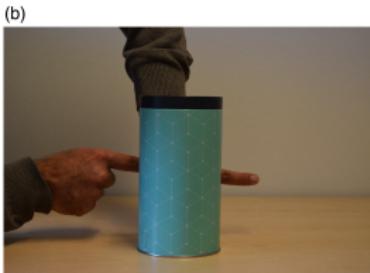
(c)

(d)

Amodal completion

(a) (b) (c) (d)

- Your visual system infers extra finger meat, even though you know it's crazy to do so
- Imagine explaining this as "repair" by the visual system
- "View is obstructed, so let's make a representation of an impossibly long finger"

Which segments take [-s]?

- *caps, cats, rocks, cliff, myths*

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  - (set of sets of valued features)

$$
\bigcap \left\{
\begin{array}{l}
\text{p} \\
\left[
\begin{array}{l}
- \text{Cor} \\
- \text{Strid} \\
- \text{Nas} \\
+ \text{Lab} \\
- \text{Son} \\
- \text{Lat} \\
- \text{Del} \\
- \text{Con} \\
+ \text{Ant} \\
- \text{Voi}
\end{array}
\right]
\end{array}
,
\begin{array}{l}
\text{t} \\
\left[
\begin{array}{l}
+ \text{Cor} \\
- \text{Strid} \\
- \text{Nas} \\
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\end{array}
\right]
\end{array}
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\end{array}
\right]
\end{array}
,
\begin{array}{l}
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\end{array}
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\end{array}
\right]
\end{array}
\right\}
$$

- *caps, cats, rocks, cliff, myths*
- Segment are sets of (valued) features
- Rules are built on natural classes
- Natural classes are sets of segments
  - (set of sets of valued features)
- Natural classes are defined by generalized intersections

$$\bigcap \{p,\ t,\ k,\ f,\ \theta\} = \left\{ \begin{array}{l} - \text{Nas} \\ - \text{Son} \\ - \text{Lat} \\ - \text{Del} \\ - \text{Voi} \end{array} \right\}$$

Natural class expressed intensionally (superset version)

$$\left\{ y : y \supseteq \left\{ \begin{array}{l} - \text{ Nas} \\ - \text{ Son} \\ - \text{ Lat} \\ - \text{ Del} \\ - \text{ Voi} \end{array} \right\} \right\}$$

Natural class expressed intensionally (subset version)

$$\left\{ y : \begin{bmatrix} - \ \text{Nas} \\ - \ \text{Son} \\ - \ \text{Lat} \\ - \ \text{Del} \\ - \ \text{Voi} \end{bmatrix} \subseteq y \right\}$$

Natural class and subsets

$$
\begin{Bmatrix}
- \text{NAS} \\
- \text{SON} \\
- \text{LAT} \\
- \text{DEL} \\
- \text{VOI}
\end{Bmatrix}
\subseteq
\overset{\text{p}}{
\begin{Bmatrix}
- \text{COR} \\
- \text{STRID} \\
- \text{NAS} \\
+ \text{LAB} \\
- \text{SON} \\
- \text{LAT} \\
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- \text{VOI}
\end{Bmatrix}
}
$$

Natural class and subsets

t

$$
\begin{Bmatrix}
- \text{NAS} \\
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- \text{DEL} \\
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\end{Bmatrix}
$$

Natural class and subsets

$$
k
$$

$$
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Natural class and subsets

f

$$
\left\{
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\right\}
$$

Natural class and subsets

$$\theta$$

$$
\left\{
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\end{array}
\right\}
$$

A 'new' segment

$$\left\{ \begin{array}{l} - \text{Nas} \\ - \text{Son} \\ - \text{Lat} \\ - \text{Del} \\ - \text{Voi} \end{array} \right\} \subseteq$$

A 'new' segment

x

$$\left\{\begin{array}{l} - \text{NAS} \\ - \text{SON} \\ - \text{LAT} \\ - \text{DEL} \\ - \text{VOI} \end{array}\right\} \subseteq \left\{\begin{array}{l} - \text{COR} \\ - \text{STRID} \\ - \text{NAS} \\ - \text{LAB} \\ - \text{SON} \\ - \text{LAT} \\ - \text{DEL} \\ + \text{CON} \\ - \text{ANT} \\ - \text{VOI} \end{array}\right\}$$

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  ▷ Is this PoS?

- We now have a mechanism for predicting whether 'generalization' will occur

Poverty of the stimulus

Positive view

- Kids learn despite the messy, incomplete input

Negative view

Poverty of the stimulus

Positive view

- Kids learn despite the messy, incomplete input
- able to front the 'right' AUX

Negative view

Poverty of the stimulus

Positive view

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Negative view

- Kid can't help but learn the right rule

Poverty of the stimulus

Positive view
- Kids learn despite the messy, incomplete input
- able to front the 'right' Aux

Negative view
- Kid can't help but learn the right rule
- Not able to learn rules that don't make use of c-command, etc

Poverty of the stimulus

Positive view
- Kids learn despite the messy, incomplete input
- able to front the 'right' Aux

Negative view
- Kid can't help but learn the right rule
- Not able to learn rules that don't make use of c-command, etc
- Not able to count or use linear order

Think negative

What the learner *can't* do

- Given the stimulus, there are several extensionally equivalent grammars, e.g.

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- Our scope/limits prevent us from *not* devoicing after [x]

- Doing so is beyond the limits of UG—humans are incapable of *not* using natural classes

English nouns with each alternant of the regular plural suffix

a. [-s]	b. [-z]	c. [-ɨz]
cup	cub, head, rug	bus
mat	farm, son, song	bush
rack	car, hill	match
cliff	hive	whiz
myth	bow, bee, clue	garage
	pickle, burger	judge
		natural class
		coronal stridents

$$\bigcap\{s, \int, t^\int, z, \textipa{Z}, d^3\} =$$

$$\bigcap\left\{
\begin{array}{cccccc}
\text{s} & \int & t^\int & \text{z} & \textipa{Z} & d^3 \\[4pt]
\begin{bmatrix}
+\ \textsc{Cor} \\
+\ \textsc{Strid} \\
-\ \textsc{Nas} \\
-\ \textsc{Lab} \\
-\ \textsc{Son} \\
-\ \textsc{Lat} \\
-\ \textsc{Del} \\
+\ \textsc{Con} \\
+\ \textsc{Ant} \\
-\ \textsc{Voi}
\end{bmatrix} &
\begin{bmatrix}
+\ \textsc{Cor} \\
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-\ \textsc{Ant} \\
+\ \textsc{Voi}
\end{bmatrix}
\end{array}
\right\}$$

$$= \text{Let's say} \left\{
\begin{array}{c}
+\ \textsc{Cor} \\
+\ \textsc{Strid} \\
(\dots)
\end{array}
\right\}$$

Alternants of the regular plural suffix /-z/

a. [-s]	b. [-z]	c.[-ɨz]
cup	cub, head, rug	bus
mat	farm, son, song	bush
rack	car, hill	match
cliff	hive	whiz
myth	bow, bee, clue	garage
	pickle, burger	judge
	not natural class	natural class:
	ᴇʟsᴇᴡʜᴇʀᴇ case	coronal stridents
	UR -z appears	vowel insertion

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a. [-s]	b. [-z]	c. [-ɨz]
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rack	car, hill	mass
cliff	hive	whiz
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	pickle, burger	judge
not a natural class	not natural class	natural class
PROBLEM!	ELSEWHERE case	coronal stridents
	UR *-z* appears	vowel insertion

Consider /s/ (and /ʃ/)

$$
s = \left\{
\begin{array}{l}
+ \ \text{Cor} \\
+ \ \text{Strid} \\
- \ \text{Nas} \\
- \ \text{Lab} \\
- \ \text{Son} \\
- \ \text{Lat} \\
- \ \text{Del} \\
+ \ \text{Con} \\
+ \ \text{Ant} \\
- \ \text{Voi}
\end{array}
\right\}
$$

Obviously /s/ is relevant to any rule that refers to {s, ʃ, tʃ, z, ʒ, dʒ}

Consider /s/ (and /ʃ/)

$$
s = \begin{Bmatrix} + \text{Cor} \\ + \text{Strid} \\ - \text{Nas} \\ - \text{Lab} \\ - \text{Son} \\ - \text{Lat} \\ - \text{Del} \\ + \text{Con} \\ + \text{Ant} \\ - \text{Voi} \end{Bmatrix} \supseteq \begin{Bmatrix} + \text{Cor} \\ + \text{Strid} \end{Bmatrix}
$$

Obviously /s/ is relevant to any rule that refers to {s, ʃ, tʃ, z, ʒ, d³}

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$$
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+ \text{ Con} \\
+ \text{ Ant} \\
- \text{ Voi}
\end{array} \right\}
$$

But /s/ is (also) necessarily relevant to any rule that refers to {p,t,k,f,θ} (and x)

$$
s = \left\{ \begin{array}{l} + \ \text{Cor} \\ + \ \text{Strid} \\ - \ \text{Nas} \\ - \ \text{Lab} \\ - \ \text{Son} \\ - \ \text{Lat} \\ - \ \text{Del} \\ + \ \text{Con} \\ + \ \text{Ant} \\ - \ \text{Voi} \end{array} \right\} \supseteq \left\{ \begin{array}{l} - \ \text{Nas} \\ - \ \text{Son} \\ - \ \text{Lat} \\ - \ \text{Del} \\ - \ \text{Voi} \end{array} \right\}
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But /s/ is (also) necessarily relevant to any rule that refers to {p,t,k,f,θ} (and x)

Why doesn't /s/ devoice the plural /-z/?

Bleeding rule ordering

- First insert a vowel between a coronal strident and /z/

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  Insertion rule: $\epsilon \rightarrow \dot{\imath} / \begin{bmatrix} +\text{COR} \\ +\text{STRID} \end{bmatrix}$ ___ z

  ▸ /mæs-z/ →/mæsɨz/

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  - ▸ Rule does not affect [z] in /mæsɨz/ since /s/ and /z/ are not adjacent
  - ▸ Circumstances have changed! But the (intensional) rule applies to a natural class.

The key

Intensional rule

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- POVERTY OF THE STIMULUS

English Plural Derivations

UR	/mæt-z/	/klɪf-z/	/hɛd-z/	/bʊʃ-z/	/mæs-z/	/wɪz-z/
SR	[mæts]	[klɪfs]	[hɛdz]	[bʊʃɨz]	[mæsɨz]	[wɪzɨz]
Gloss	'mats'	'cliffs'	'heads'	'bushes'	'masses'	'whizzes'

UR	/mæt-z/	/klɪf-z/	/hɛd-z/	/bʊʃ-z/	/mæs-z/	/wɪz-z/
Insert Rule	—	—	—	bʊʃɨz	mæsɨz	wɪzɨz
SR	[mæts]	[klɪfs]	[hɛdz]	[bʊʃɨz]	[mæsɨz]	[wɪzɨz]
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- Vowel insertion between coronal stridents and -z

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Insert Rule	—	—	—	bʊʃɨz	mæsɨz	wɪzɨz
Devoic Rule	mæts	klɪfs	—	BLED	BLED	—
SR	[mæts]	[klɪfs]	[hɛdz]	[bʊʃɨz]	[mæsɨz]	[wɪzɨz]
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- Intensional formulation of devoicing rule targets /z/ before p,t,k,f,θ,s,ʃ
  - but the rule is bled in some forms

English Plural Derivations

UR	/mæt-z/	/klɪf-z/	/hɛd-z/	/buʃ-z/	/mæs-z/	/wɪz-z/
Insert Rule	—	—	—	buʃɨz	mæsɨz	wɪzɨz
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SR	[mæts]	[klɪfs]	[hɛdz]	[buʃɨz]	[mæsɨz]	[wɪzɨz]
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- The 'data' says that devoicing is not triggered by s,ʃ

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- Kids don't encode the 'patterns in the surface data' or the 'auditory input'

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Gloss	'mats'	'cliffs'	'heads'	'bushes'	'masses'	'whizzes'
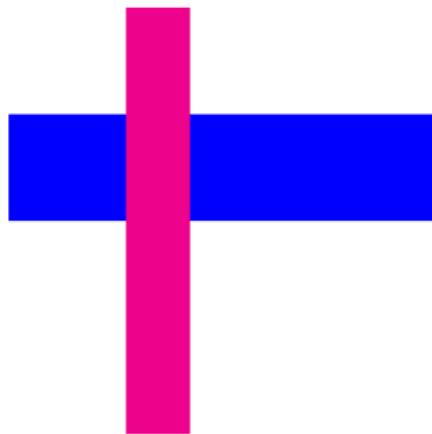
- Kids don't encode the 'patterns in the surface data' or the 'auditory input'
- Kids *can't* encode the 'patterns in the surface data' or the 'auditory input'
    - They can't be little empiricists
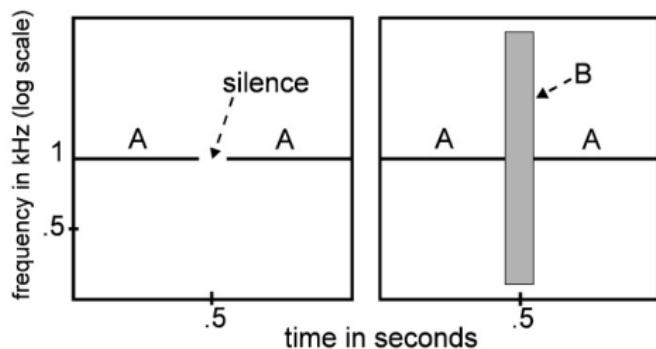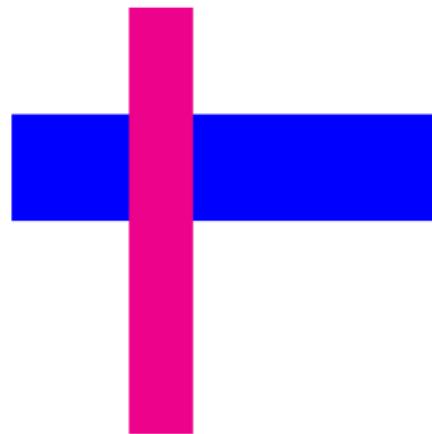
113
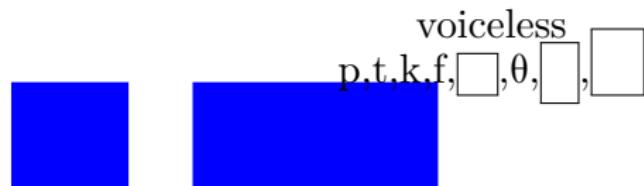
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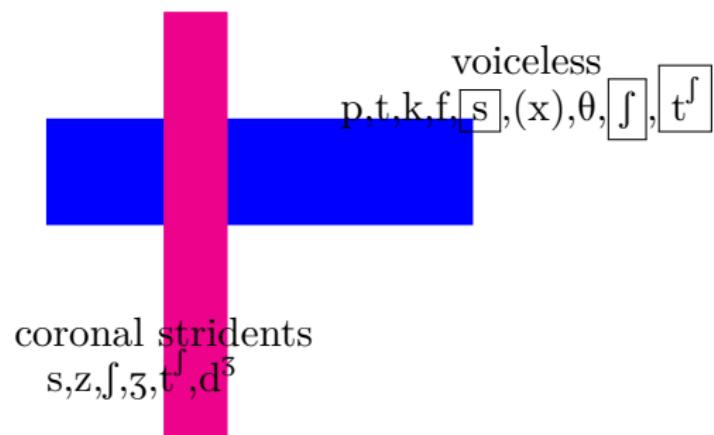
- The stimulus for devoicing
- NOT a natural class
- "voiceless segments that are non-strident OR non-coronal"
- Phonological UG does not provide OR
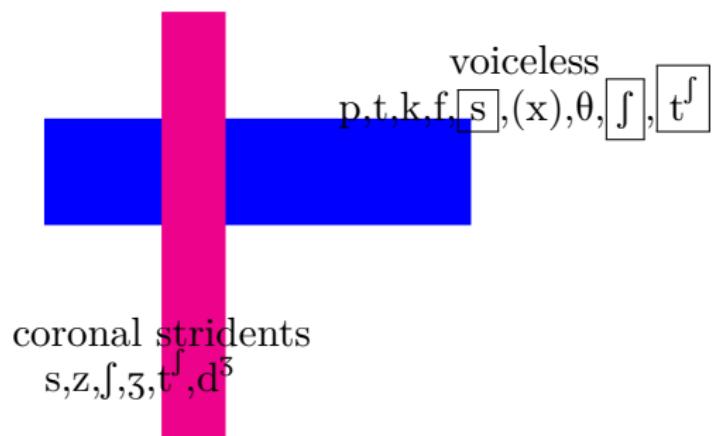
voiceless
p.t.k.f,☐,θ,☐,☐

Masking in phonology 2: amodal completion

- Can't help but formulate rule (based on natural class)
- Problem of /s,ʃ,tʃ/ solved by masking, amodal completion
- *Bach*[s] with /x/ follows automatically

voiceless
p,t,k,f, s ,(x),θ, ʃ , tʃ

coronal stridents
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/s,ʃ,tʃ/ are "masked" by bleeding rule ordering

Masking in phonology 3:

- What's acquired for devoicing rule?

voiceless
p,t,k,f,s,(x),θ,ʃ,tʃ

Despite PoS

- The big step is going from noise to word/segment/feature! (Lasnik)

Rational phonology view

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  - 'Rules are ordered'
  - Rule ordering obscures natural classes
  - ☺ To this I say 'aye'!

Outline

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Of course there is more

- formalizing insertion, deletion and metathesis
- syllable structure
- stress

No surprises here

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- Controversies remain, but we have achieved "high quality ignorance" (Stuart Firestein's olfactory neuroscience talk)
- Linguistic reasoning applies across modules

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