Why epenthesis can help us answer the question of where phonology comes from

Rebecca L. Morley
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Stony Brook Workshop on Epenthesis
September 19, 2021

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Why epenthesis[1] can help us answer the question of where phonology[2] comes from

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[1] There are a number of different kinds of epenthesis, and "epenthesis" means different things to different people
[2] Can phonology be reliably differentiated from phonetics?

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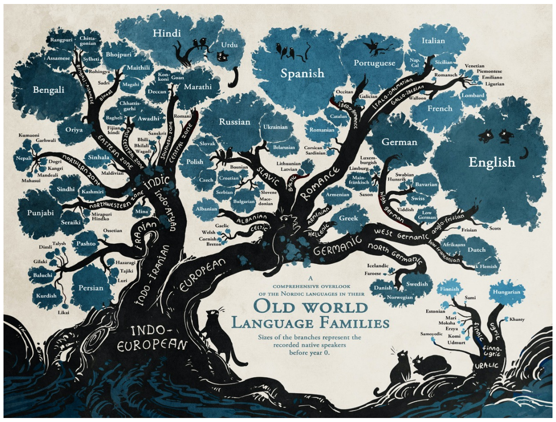
Where does phonology come from?



VS.

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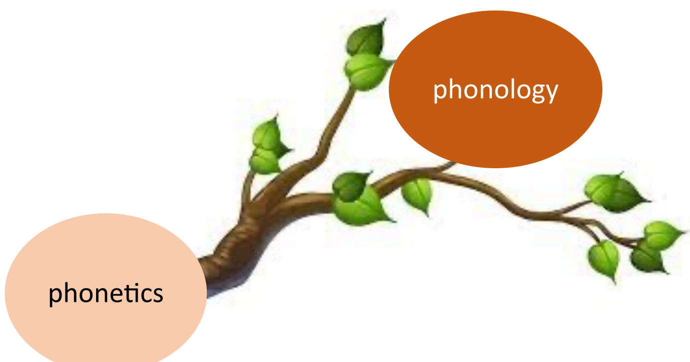

- What differentiates phonetics from phonology?
  - Is phonology more abstract?
    - Do all phonological patterns have a phonetic source?
      - Are phonological patterns merely the residue of sound change?

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What is the most abstract phonological phenomenon?

EPENTHESIS!

CONSONANT EPENTHESIS

HARMONY-INCREASING

CONSONANT EPENTHESIS
not involving: w, j, h, ʔ, ʋ, ɣ

Ajyíninka Apurucayali : *(better known as Axininca Campa)* Payne (1981)

/i/ + /N/ + /kim/ + /i/	→	[iŋkimi]	s/he will hear
/i/ + /N/ + /pija/ + /i/	→	[impijati]	s/he will avenge
/i/ + /pija/ + /piro/	→	[ipijapiro]	s/he truly avenges

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Stage 1 : Where does Phonology come from?

Phonologization!

$\emptyset \rightarrow t/V\_(+)V$

Assumptions:
- Phonological forms are generated via algorithm (rules/constraints)
- Synchronic phonological algorithms derive from diachronic processes
- Diachronic processes transform phonetic algorithms to phonological algorithms

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Itinerary

- Case Study: Epenthesis
  - The facts of the matter: typology
    - Analysis
  - Getting from phonetics to phonology
    - Sound change
  - The synchronic grammar
    - Learning/acquisition
- Case Study: Vowel Nasalization
  - The synchronic grammar
    - Representations
  - Getting from phonetics to phonology
    - Sound change

Data vs Evidence: The Linguist

Data vs Evidence: The Learner (diachronic)

Data vs Evidence: The Learner (synchronic)

Where does phonology come from?

Stage 1

Stage 2

Stage 3

Stage 4

Stage 5

Stage 6

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A Quick Note about Notation

- I will use SPE-style notation in a number of slides
- It is only that these representations are more transparent and intuitive for people
- It does not mean that I am assuming that this is what the generative grammar looks like
- **In fact, all of the analysis I describe here is what must occur prior to the analysis of rule ordering or constraint interaction (what are the URs/inputs?)**
- What this means is that there is typically much less attention paid to this step of analysis by theoretical phonologists
- And a glaring absence of formal machinery, or even consensus heuristics

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Case Study

Epenthesis

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Data vs. Evidence

The Linguist

Morley, R. L. (2015). Deletion or epenthesis? On the falsifiability of phonological universals. *Lingua*, *154*, 1-26.

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Data vs. Evidence

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Data vs. Evidence

The Linguist

Data	"3 year old sheepskin"	"parasitic worm"	
Acc.	[pamito]	[fisemo]	/o/
Nom.	[pami]	[fisem]	∅
	/pami/	/fisem/	

Evidence

The result of phonological analysis

$\emptyset \rightarrow t / V\_(+)V$

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Data vs. Evidence

The Linguist

Evidence

The result of phonological analysis

Data	"3 year old sheepskin"	"parasitic worm"	
Acc.	[pamito]	[fisemo]	/o/
Nom.	[pami]	[fisem]	Ø
	/pamit/	/fisem/	

$t \rightarrow \emptyset / \_\_\#$

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Data vs. Evidence

The Linguist

Evidence

The result of phonological analysis

Data	"3 year old sheepskin"	"parasitic worm"	
Acc.	[pamito]	[fisemo]	/to/
Nom.	[pami]	[fisem]	Ø
	/pami/	/fisem/	

$t \rightarrow \emptyset / C(+)\_\_$

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Data vs. Evidence

The Linguist

	"3 year old sheepskin"	"parasitic worm"	"my favorite competitive foosball team"	
Acc.	[pamito]	[fisemo]	[oruo]	/o/
Nom.	[pami]	[fisem]	[oru]	∅
	/pami/	/fisem/	/oru/	

What happens when there are exceptions?

In reality, all patterns have exceptions

$t \rightarrow \emptyset / \_\_\#$

$\emptyset \rightarrow t / V\_\_(+)V$

With *n* exceptions

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Data vs. Evidence

The Linguist

What happens when epenthesis isn't always "selected"?

Data	"3 year old sheepskin"	"parasitic worm"	
Acc.	[pamito]	[fisemo]	/to/
Nom.	[pami]	[fisem]	∅
	/pami/	/fisem/	

	"3 year old sheepskin"	"parasitic worm"	
Acc Pl.	[pamju]	[fisemu]	/u/
Nom. Pl.	[pamiz]	[fisemz]	/z/
	/pami/	/fisem/	

$\emptyset \rightarrow t / V\_\_(+)V$

$\mathrm{i} \rightarrow j / \_\_ + u$

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Ajyíninka Apurucayali : *(better known asAxininca Campa)*

Axininca Campa: Arawakan [Payne 1981]

t Insertion			Other			
Verbal Suffixes						
Reflexive			**Interruptive**			t͡s
/ir + oti + a/→[hotita]	"he got in (put himself in)"	p.126	/pi + N + koma + ima + i/→ [piŋkomat͡simati]	"(you) ready to paddle"	p.123	
cf. /ir + t͡ʃʰik + a/→ [it͡ʃʰika]	"he cut himself"	p.126	cf. /pi + N + t͡ʃʰik + ima + i/ →[pint͡ʃʰikimati]	"(you) ready to cut"	p.123	
Perfect			**Non-Future**			
/no + na + ak + i + ro/→ [nonatakiro]	"I have carried her"	p.109	/no + pisi + i/ → [nopisit͡si]	"I swept"	p.122	
cf. /ir + t͡ʃʰik + ak + i + ro/ →[it͡ʃʰikakiro]	"he has cut her"	p.234	cf. /ir + t͡ʃʰik + i + ro/ →[it͡ʃʰikiro]	"he cut it"	p.116	
Progressive			**Adverbializer**			
/ir + oti + at͡ʃ + a/→ [hotitat͡ʃa]	"he is getting in"	p.31	/t͡sʰirinii + iti + ini/→ [t͡shiriniitiini]	"at night"	(13) p.177 p.185 p.198 p.220	Hiatus
cf. /ir + t͡ʃʰik + at͡s + i/→ [it͡ʃʰikiat͡si]	"he is cutting"	p.233				
Departure			**Velar glide deletion**			
/ir + impoi + it͡sʰi + an + ak + a/→[himpoit͡sʰitanaka]	"he followed along behind, in addition, departing"	p.44 p.191 p.209	/ir + aɰ + ak + i + ro/→ [haakiro]	"he has taken it"	p.116	Hiatus
cf. /ir + kant + aβ + ak + aɰ + aij + an + ak + a + ni/→ [ikantaβakaijanakani]	"they said to one another, departing"	p.41 p.188 p.204	cf. /ir + aɰ + aij + ro + ni/ →[haɰaijironi]	"they took it"	p.116	
Modal Plural						
/ir + N + pisi + aij + i + ni/ →[impisitaijini]	"they will sweep"	p.150	/ir + N + pisi + aij + i + ni/ →[impisiijini]	"they will sweep"	p.150	Deletion
cf. /ir + N + t͡ʃʰik + aij + i + ni/ →[int͡ʃʰikaijini]	"they will cut"	p.150				
Reduplicative (CVCV template)						
ta /na + RED + βai + ak + i/ →[natanataβaitaki]	"he has continued to carry more and more"	p.143	/aasi + RED + βai + ak + i/→ [aasi aasiβaitaki]	"he has continued to meet more and more"	p.144	Hiatus
Dative			**Distributive**			
/ir + N + koma + ako + i/→ [iŋkomatakoti]	"he will paddle for"	p.108	/ir + impoi + it͡sʰi + an + ak + a/→ [himpoit͡sʰitanaka]	"he followed along behind, in addition, departing"	p.44 p.191 p.209	Deletion
cf. /ir + N + t͡ʃʰik + ako + i/ →[int͡ʃʰikakoto]	"he will cut for"	p.108				
Repetitive			cf. /no + tʰoŋk + it͡sʰi + a + ro/→[notʰoŋkit͡sʰitaβo]	"I finished it also (in addition)"	p.44 p.187 p.200 -201	
/ir + N + koma + aa + i/→ [iŋkomataati]	"he will paddle again"	p.108				
cf. /pok + aa + i/→[pokaat͡ʃi]	"came again"	p.43	**'Recently'**			
			/iʃaaβi + iti + ini/→ [it͡ʃaaβiitiini]	"(the sun) getting low"	(142) p.180 p.191 p.208	
Future			**Reflexive Future**			
/ir + N + koma + i/ →[iŋkomati]	"he will paddle"	p.108	/ir + N + kisi + ia/→ [iŋkisitʃa]	"he will comb himself"	p.129	t͡ʃ iija ija ja
cf. /ir + N + t͡ʃʰiki + i/ →[int͡ʃʰiki]	"he will cut"	p.108	cf. /ir + N + t͡ʃʰik + ia/→ [int͡ʃʰit͡ʃa]	"he will cut himself"	p.129	
Infinitive						
/koma + aantsʰi/→ [komataantsʰi]	"to paddle"	p.55	/ir + N + kimi + ia/→ [iŋkimija]	"he will hear himself"	p.129	
cf. /t͡ʃʰik + aant͡sʰi/→ [t͡ʃʰikaant͡sʰi]	"to cut"	p.55				
Receiving			**Nominal Suffixes**			
			Diminutive			
/ir + kant + βi + aβ + aɰ + a + ri/→[ikantaβitaβaari]	"he said to the one arriving"	p.47 p.188 p.203	/hito + iriki/ → [hitoiriki]	"little spiders"	p.110	
cf. /no + ɲ + aβ + ak + i + ri + ta/→[noɲaaβakiriita]	"I will see"	(85) p.179 p.189 p.205 p.223	/sampaa + iriki/→ [sampairiki]	"little balsas"	p.141	Fusion
Resolved			**'Drink'**			
/ir + aa + aɰ + i/→[aatai]	"he will go back"	p.46	/siŋki + a/ → [sint͡ʃa]	"corn drink"	p.128	t͡ʃ
cf. /ir + kant + βi + aβ + aɰ + a + ri/→[ikantaβitaβaari]	"he said to the one arriving"	p.47	/kimi + a/ → [kimija]	"squash drink"	p.128	j
Passive			**Verbal/Nominal Prefixes**			
			1st person singular			
/ir + ii + ai + i + ri/→ [hiitait͡siri]	"that which is named"	p.40 p.196 p.216	/no + ir + i/→[niri]	"I will drink"	p.78	Deletion
cf. /ir + t͡ʃʰik + ai + ak + i + ro/→[it͡ʃʰikaitakiro]	"it was cut"	p.40	cf. /no + saik + i/→[nosaiki]	"I will sit"	p.78	
Purpose			**2nd person singular**			
/no + ojaa + asi + a + ri/→ [nojaatasitari]	"I followed (for the purpose of visiting)"	p.43 p.193 p.212	/pi + iitʰoŋki + i/→ [piitʰoŋkiti]	"you will climb"	p.78	

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"Non-minimal" consonant epenthesis

Seg	Language	Seg	Language
t	Ajyíninka Apurucayali, Maori, Odawa Ojibwa, French, Amharic, Plains Cree, Maru, Finnish, Korean, Kodava	j	Turkish, Uyghur, Greenlandic, various Indic languages, Arabic, Slavic, Tamil, Kodava
k	Maru,Kodava	h	Ayutla Mixtec, Chipewyan, Huariapano, Slave (Bear Lake, Hare), Tigre, Tucanoan, Yagua,Yucatec Maya, Huaripano, Onondaga
g	Mongolian; Buryat	w	Abajero Guajiro, Greenlandic, Arabic, Chamicuro, Tamil
r	English, German, Uyghur, Zaraitzu Basque, Seville Spanish, Anejom, Japanese, Southern Tati	ʔ	Chadic, Cupeno, Larike, Misantla Totonac, Mohawk, Tsishaath Nootka, Hawaiian, Arabic, Selayarese, German, Ilokano, Czech, Kisar, Malay, Koryak, Indonesian, Gokana, English, Konni,Tunica, Tubatulabal, Nancowry, Tamil
n	Korean, Greek, Dutch, German dialects, Sanskrit, Murut, Tunica	x	Land Dayak
l	Bristol English, Midlands American English, Motu	ʃ	Basque dialects
v	Marathi	ʒ	Cretan and Mani Greek, Basque dialects
b	Basque dialects	ŋ	Buginese
s/z	French, Land Dayak, Dominican Spanish	ɴ	Inuktitut, East Greenlandic, Uradhi, Kaingang

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Epenthesis Typology

Working Diagnostic

Epenthesis is considered the best analysis for patterns that have
- at least 65% of possible contexts participating
- AND an absolute number of at least 5 participating morphemes.
- OR more than 10 participating morphemes

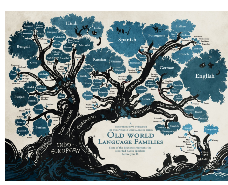
Non-Minimal Segments		Minimal Segments	
Seg.	Language	Seg.	Language
t	Cree	ʔ	Selayarese
t	A. Apurcali	ʔ	Misantla Totonac
k	Waropen	j	Turkish
g	Buryat	j	Berber
n	Dutch		

Maximum number of default epenthesis languages: 9/56

Minimum number of default epenthesis languages : 0/56

Stage 2 : Where does Phonology come from?

Phonologization!



$\emptyset \rightarrow t/V\_(+)V$

Evidence for this is not great

And there are no formal metrics for assessing either the data or the evidence

Assumptions:
- Phonological forms are generated via algorithm (rules/constraints)
- Synchronic phonological algorithms derive from diachronic processes
- Diachronic processes transform phonetic algorithms to phonological algorithms

[t] does not appear out of thin air

Data vs. Evidence

The Learner

Diachronic

Morley, R. L. (2012). The emergence of epenthesis: An incremental model of grammar change. *Language Dynamics and Change*, *2*(1), 59-97.

Data vs. Evidence

The Learner: Diachronic

/pamit/ + /nu/	→	[pamitnu]	>	[paminu]	↩	/pami/ + /nu/	epenthesis?
/pamit/ + /o/		[pamito]		[pamito]		/pami/ + t + /o/	
			C1 loss				

"rule inversion" Venneman (1972)

Data vs. Evidence

The Learner: Diachronic

/pamit/ + /nu/	→	[pamitnu]	>	[paminu]	↩	/pamit/ + /nu/	deletion
/pamit/ + /o/		[pamito]		[pamito]		/pamit/ +/o/	

C1 loss

"rule inversion" Venneman (1972)

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Data vs. Evidence

The Learner: Diachronic

epenthesis

/pamit/ + Ø		[pamit]		[pamit]		/pami/ → [pamit]	
/pamit/ + /nu/	→	[pamitnu]	>	[paminu]	↩	/pami/ + /nu/	no alternation
/pamit/ + /o/		[pamito]		[pamito]		/pami/ + /to/	

C1 loss

"rule inversion" Venneman (1972)

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Data vs. Evidence

The Learner: Diachronic

/pamit/		[pamit]		[pami]		/pami/ + Ø
/pamit/ + /nu/	→	[pamitnu]	>	[paminu]	↩	/pami/ + /nu/
/pamit/ + /o/		[pamito]		[pamito]		/pami/ + /to/

/pami/ + t + /o/

C1 loss

C# loss

No consonant final stems!

"rule inversion" Venneman (1972)

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Data vs. Evidence

The Learner: Diachronic

/pamit/		[pamit]		[pami]		/pami/ + Ø
/pamit/ + /nu/	→	[pamitnu]	>	[paminu]	↩	/pami/ + /nu/
/pamit/ + /o/		[pamito]		[pamito]		/pami/ + /to/
/fisem/ + /o/		[fisemo]		[fisemo]		/fisem/ + /o/

/pami/ + t + /o/

C1 loss, coronals only

C# loss, coronals only

epenthesis of t?

"rule inversion" Venneman (1972)

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Data vs. Evidence

The Learner: Diachronic

	/pamit/		[pamit]		[pami]		/pami/ + ∅	
	/pamit/ + /nu/	→	[pamitnu]	>	[paminu]	↩	/pami/ + /nu/	
	/pamit/ + /o/		[pamito]		[pamito]		/pami/ + /to/	
	/fisem/ + /o/		[fisemo]		[fisemo]		/fisem/ + /o/	
								/pami/ + t + /o/
Historically vowel-final stems	/oru/ + /nu/	→	[orunu]	>	[orunu]	↩	/oru/ + /nu/	
	/oru/ + /o/	→	[oruo]	>	[oruo]	↩	/oru/ + /o/	✗

C1 loss, coronals only

C# loss, coronals only

“rule inversion” Venneman (1972)

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Data vs. Evidence

The Learner: Diachronic

	Historically vowel-final and consonant final stems	Historically vowel-initial and consonant initial suffixes
C1 loss, coronals only C# loss, coronals only	/pami/ /oru/ /fisem/	/nu/ /o/
Generalization across historically vowel-final stems	[oruo] ⇣ [oruto] [pefio] [meo] [gadao]	/pami/ + /to/ /oru/ + /to/

$$\emptyset \rightarrow t / V\_(+)V$$

“rule inversion” Venneman (1972)

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Data vs. Evidence

The Learner: Diachronic

Otherwise: deletion, suppletive allmorphy

1. Under deletion in consonant clusters C_1 deletes (alternatively, the prefix-final consonant deletes)
2. But only a subset of C_1's delete
3. Both consonant-final and vowel-final stems are present at time t_i (before deletion)
4. At time t_j (after deletion), the underlying representation of the suffix is vowel-initial, and the underlying representation of the stem is vowel-final
5. All stems end in the same consonant at time t_i (or generalization is required)
6. Regularization over all allomorphs that occur after vowel-final stems (reduction to –CVX)
7. *Failure* to generalize to consonant-final stems (retaining the –VX allomorph)
8. Regularization across all affixes, such that all affixes choose the same C in -CVX/-VX alternations

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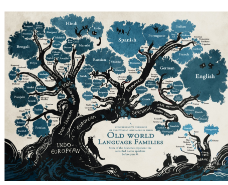
Stage 3 : Where does Phonology come from?

Phonologization!



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- Diachronic processes transform phonetic algorithms to phonological algorithms

[t] does not appear out of thin air

Learner's input is messy/inconsistent

Rule inversion is harder than it seems

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Data vs. Evidence

The Learner

Synchronic

Morley, R. L. (2018). Is phonological consonant epenthesis possible? A series of artificial grammar learning experiments. *Phonology*, *35*(4), 649-688.

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Data vs. Evidence

The Learner: Synchronic

Generalization across all vowel-initial suffixes

Generalization across all vowel-final stems

Generalization across all consonant-final stems

No generalization **between** C and V final stems

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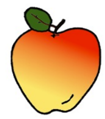
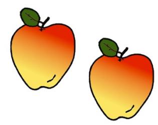
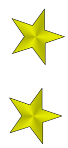
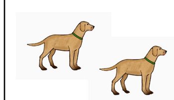
Experiments

Training		Test	
[ˈɹatu]	[ˈɹatuwək]	[ˈdaɹum]	???
			
[ˈhædi]	[ˈhædijək]	[ˈribæz]	???
			

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Data vs. Evidence

The Learner: Synchronic

1. Impoverished stimuli:

C-final held out

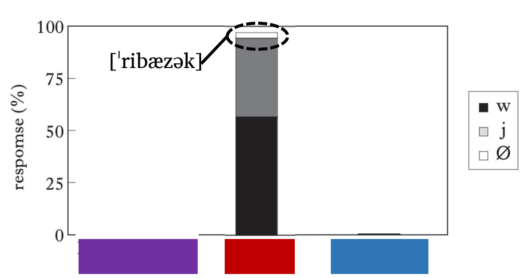
[ˈɹatu] [ˈɹatujək]
[ˈskibe] [ˈskibewək]

Epenthesis

/ˈɹatu/ + j + /ək/ → [ˈribæz] [ˈribæzək]
/ˈskibe/ + w + /ək/

/ˈɹatu/ + /jək/ → [ˈribæz] [ˈribæzwək]; [ˈribæzjək]
/ˈskibe/ + /wək/

Consonant-Final Test Items



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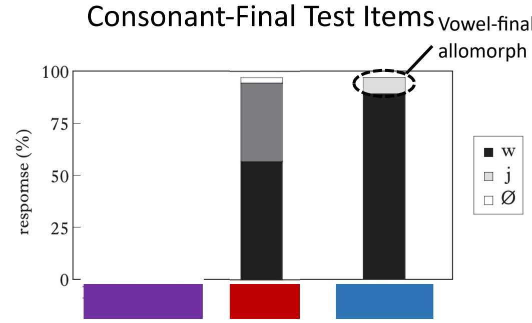
Data vs. Evidence

The Learner: Synchronic

1. Impoverished stimuli:

C-final held out	['ɹatu] ['ɹatujək] ['skibe] ['skibewək]
Front vowel final held out	['ɹatu] ['ɹatujək] ['daɹum] ['daɹumwək]

Consonant-Final Test Items



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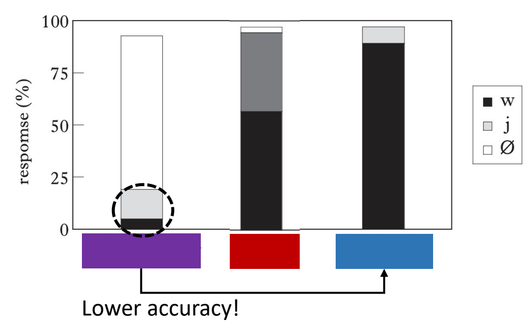
Data vs. Evidence

The Learner: Synchronic

1. Impoverished stimuli:

C-final held out	['ɹatu] ['ɹatujək] ['skibe] ['skibewək]
Front vowel final held out	['ɹatu] ['ɹatujək] ['daɹum] ['daɹumwək]
Full pattern:	['ɹatu] ['ɹatujək] ['skibe] ['skibewək] ['daɹum] ['daɹumək]

Consonant-Final Test Items



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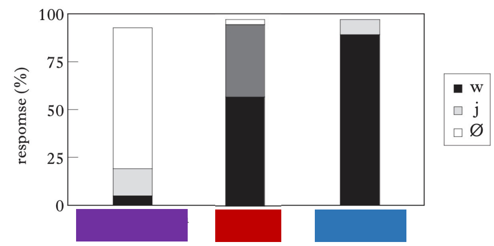
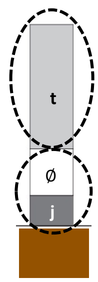
Data vs. Evidence

The Learner: Synchronic

- Novel stem type inflected according to input allomorph distribution (regardless of predictability)
- **Familiar** stem types show errors across C/V boundary
- The more allomorphs, the higher the error rate
- Frequency matching





High-frequency allomorph

[ˈɹatu] [ˈɹatutək] x 2
[ˈskibe] [ˈskibejək]

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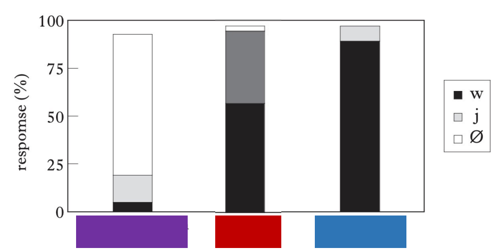
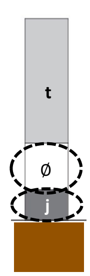
Data vs. Evidence

The Learner: Synchronic

- Novel stem type inflected according to input allomorph distribution (regardless of predictability)
- **Familiar** stem types show errors across C/V boundary
- The more allomorphs, the higher the error rate
- Frequency matching
- Phonetic and phonological interpretations (~ equally) available





High-frequency allomorph

[ˈɹatu] [ˈɹatutək] x 2
[ˈskibe] [ˈskibejək]

[ˈskibejək] → /ˈskibeək/
[ˈskibejək] → /ˈskibejək/

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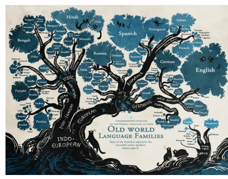
Stage 4 : Where does Phonology come from?

Phonologization!



$\emptyset \rightarrow t/V\_(+)V$

Learners don't generalize as much as expected

Epenthesis doesn't seem to be in the hypothesis space (or deletion, for that matter)

Evidence for this is not great

And there are no formal metrics for assessing either the data or the evidence

Assumptions:
- Phonological forms are generated via algorithm (rules/constraints)
- Synchronic phonological algorithms derive from diachronic processes
- Diachronic processes transform phonetic algorithms to phonological algorithms

[t] does not appear out of thin air

Learner's input is messy/inconsistent

Rule inversion is harder than it seems

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A completely unexpected result…

C-final held out

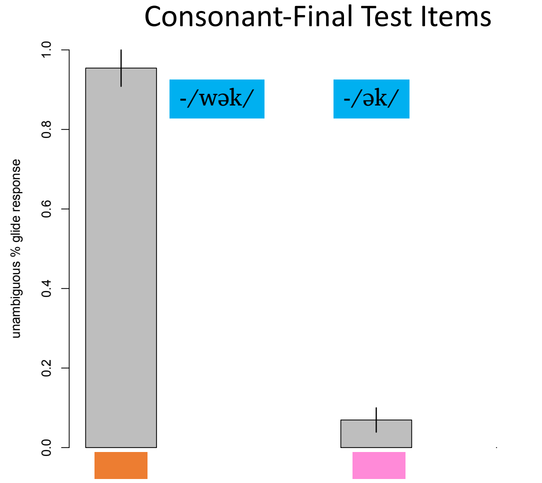
[ˈɹatu] [ˈɹatuwək]
[ˈskibe] [ˈskibejək]

/w/ vs [w]

[ˈɹatu] [ˈɹatuwək]
[ˈdaɹum] [ˈdaɹumwək]

Single allomorph analysis so highly preferred that it completely flips perception of ambiguous acoustic signal

Consonant-Final Test Items



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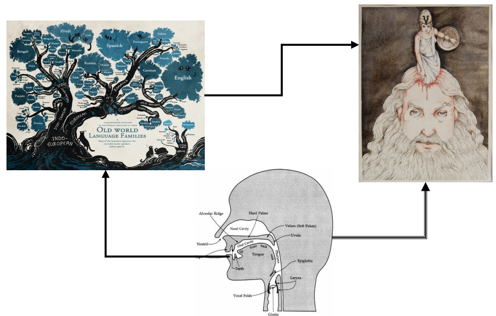
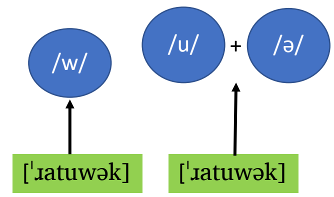
Stage 5 : Where does Phonology come from?





Assumptions:
- phonological categories are composed of phonetic representations
- Changes in phonetic representations produce changes in phonological representations
- Speech perception is inherently abstract: segmentation and categorization
- Speech perception is inherently ambiguous
- Changes in individual parses produce changes in the make-up of phonological categories

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Case Study

Vowel
Nasalization

Morley, R.L. Sound Structure and Sound Change: A Modeling Approach. *Conceptual Foundations of Language Science Monograph Series. Language Science Press (2019)*

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The Actuation Paradox

Synchronic: allophonic rule	$V \rightarrow \tilde{V} / \_\_N$	$/V/ \rightarrow [\tilde{V}]$, $[V]$	Normalization
Diachronic: context lost	$[\tilde{V}N] > \tilde{V}$	$/\tilde{V}/$	Failure to Normalize

Solving the paradox in the diachronic domain requires changes to our usual assumptions about synchronic representations

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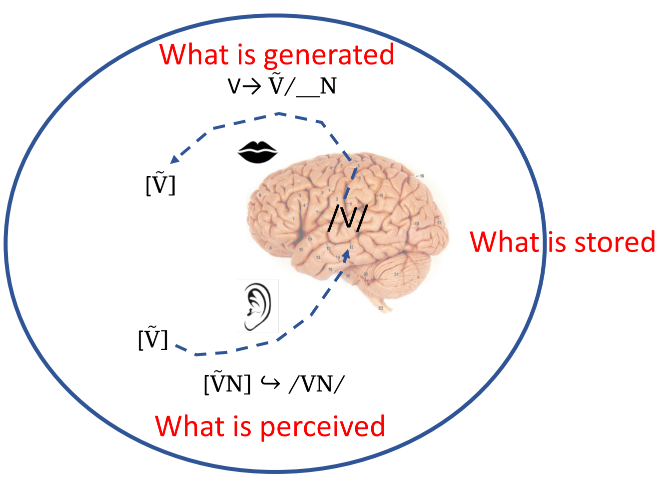
The usual assumptions



- Categories have a single realization (or all realizations are identical)

- There exists a **process** that generates predictable elements at the phone level
- Only unpredictable material is **stored**

- Words are generated by concatenating phonemes
- Rules are applied to phoneme-level representations of words prior to production

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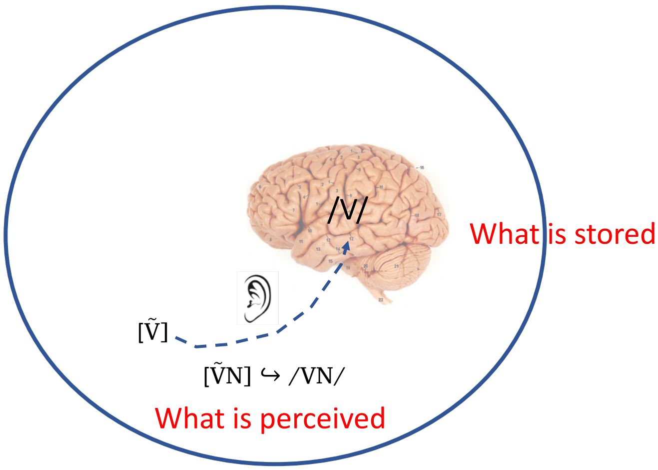
The usual assumptions



- Perception tokens are identical to production tokens
- Inputs are normalized to recover underlying representations

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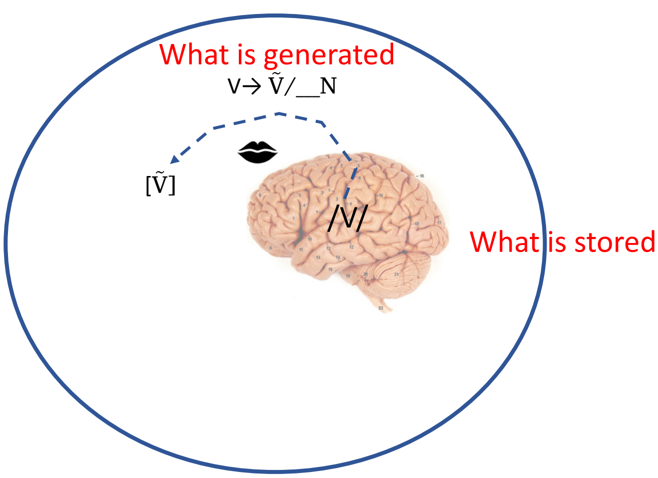
The usual assumptions



- Perception tokens are identical to production tokens
- Allophonic rules affect only one of the two segments involved

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Representational Assumptions

- Categories have a single realization (or all realizations are identical)

- There exists a **process** that generates predictable elements at the phone level
- Only unpredictable material is **stored**

- Words are generated by concatenating phonemes
- Rules are applied to phoneme-level representations of words prior to production

- Perception tokens are identical to production tokens

- Inputs are normalized to recover underlying representations

- Allophonic rules affect only one of the two segments involved

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Representational Assumptions

- ~~Categories have a single realization (or all realizations are identical)~~

- There exists a **process** that generates predictable elements at the phone level
- ~~Only unpredictable material is **stored**~~

- ~~Words are generated by concatenating phonemes~~
- Rules are applied to phoneme-level representations of words prior to production

- ~~Perception tokens are identical to production tokens~~

- Inputs are normalized to recover underlying representations

- ~~Allophonic rules affect only one of the two segments involved~~

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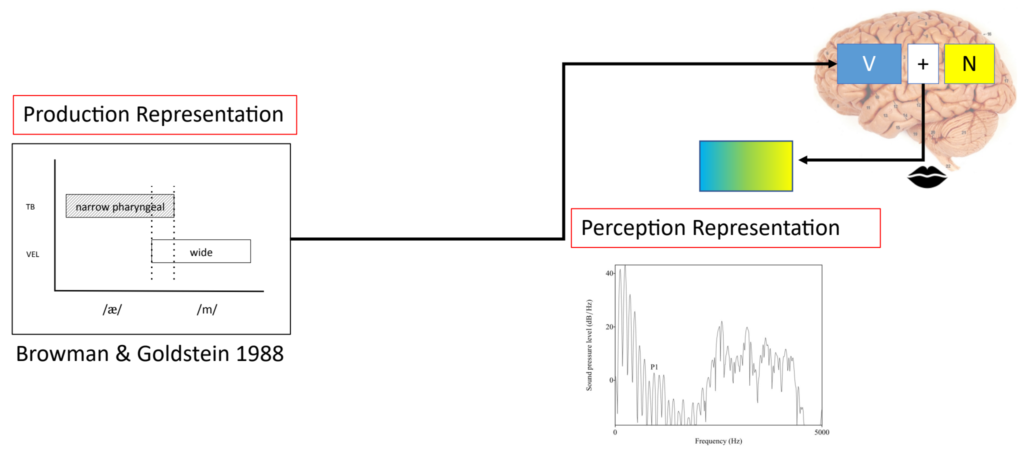
Where do allophones come from?



Neither input nor output actually consists of abstract, discrete units V,N

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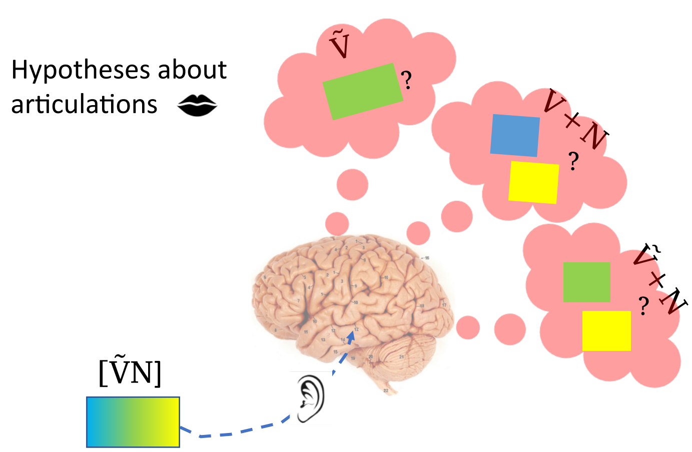
Perception ⇔ Production



- Single-segment parse is always available
- Multiple acoustic and articulatory representations stored
- Change occurs over distribution of variants

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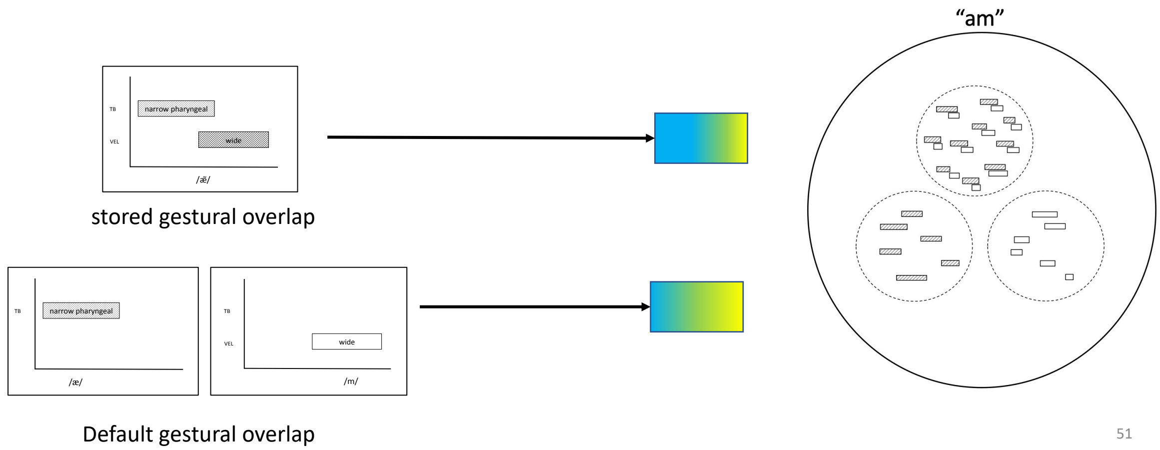
Synchrony ⇔ Diachrony

Synchronic/Diachronic

V → Ṽ/__N



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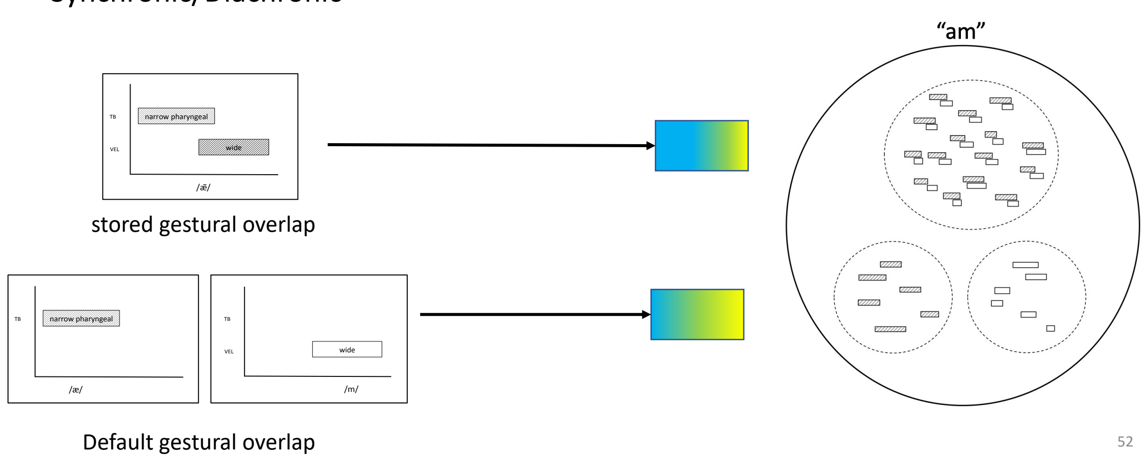
Synchrony ⇔ Diachrony

Synchronic/Diachronic

/Ṽ/



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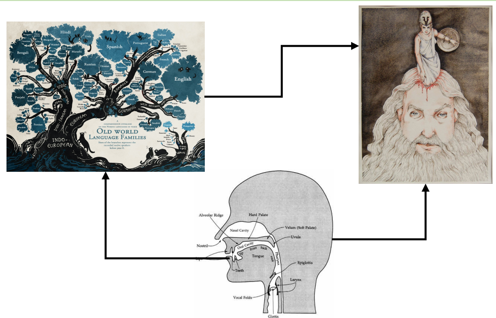
Stage 6 : Where does Phonology come from?



Assumptions:

- Words are generated by executing articulatory plans
- Word recognition can occur prior to phoneme identification
- Acoustic word tokens are stored without normalization
- *Inferred* articulatory tokens are also stored
- Listener picks best hypothesis available regarding articulatory targets

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Thank you!

Paul Smolensky, Ariel Goldberg, Matt Goldrick, Peter Culicover, Colin Wilson, Jennifer Culbertson

Bridget Smith, Bjoern Koehnlein, Nohyong Kim

Emily Clem, MarDez Desmond, Christina Heaton, Lark Hovey, Dahee Kim, Karen Kuhn, Sara Pennington, Joseph Conley, Evan Nelson, Hannah Young, Jessica Jelinger, and Allie Baker

If any of this looks interesting, I'm always looking for good graduate students!

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