

Modeling gradual learning in serial and parallel phonological grammars

Anne-Michelle Tessier * University of Alberta * amtessier@ualberta.ca

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SUMMARY

What kinds of variation occur during the variable stages in which children are gradually mastering a sound pattern? Current phonotactic learning theories make different predictions about longitudinal variation, based in part on how 'global' or 'local' information a children can learn from a single error. Using a newly-published corpus this poster argues that the data support serial, local learning and interprets this result as evidence for a serial phonological grammar.

A Way to Study Phonotactic Learning

Step 1: Build theoretical learners that acquire all and only a language's observed marked structure

Step 2: Compare learners' developmental paths with child corpora, and analyze their differences

The two grey panels spell out one method for Step 1
The rightmost blue panel provides fodder for Step 2

Learning from a Multiply-Marked Error

Learning from a Multiply-Marked Error

'keep' /kip/	*VELAR	*CODA	MAX	IDENT-VELAR
kip	*!	*!		
tip		*!		*
ki	*!		*	
ti			*	*

Interpreting this error (Prince 2002)

winner ~ loser	*VELAR	*CODA	MAX	IDENT-VELAR
kip ~ ti	L	L	W	W

How to Learn with BCD, Step by Step:

Save this error, build new grammar H-1
Use H-1 make and save a new error
Build H-2 from the two stored errors
Keep making/storing errors/learning...
... until H-n makes no more errors.

A More Local Approach: Harmonic Serialism (HS)

(for HS rationale and formalism: McCarthy 2000, 2008, Pruitt 2010 and refs therein)

In HS: each output differ from its input in only one way. Changing multiple input properties means multiple derivations:

/kip/	*VELAR	*CODA	MAX	IDENT
kip	*!	*		
tip		*		*
ki	*!		*	

/tip/	*VELAR	*CODA	MAX	IDENT
kip	*!	*		*
tip		*!		
ti			*	*

In HS learning, this error takes multiple derivations. The learner can profit from only storing the first derivation as an error.

A Global Approach: Parallel OT

One possible learning path:

H-1: *Velar >> Max >> *Coda >> Ident-Velar
New error: /kip/ → [tip]
New set of stored errors:

winner ~ loser	*VELAR	*CODA	MAX	IDENT-VELAR
kip ~ ti	L	L	W	W
kip ~ tip	L	e	e	W

H-2: Ident-Velar >> *Velar, *Coda >> Max
New error: /kip/ → [ki] codas have regressed!
New set of stored errors:

winner ~ loser	*VELAR	*CODA	MAX	IDENT-VELAR
kip ~ ti	L	L	W	W
kip ~ tip	L	e	e	W
kip ~ ki	e	L	W	e

H-3 (target): Ident-Velar >> *Velar >> Max >>> *Coda

One possible learning path:

winner ~ loser	*VELAR	*CODA	MAX	IDENT-VELAR
kip ~ tip	L	e	e	W

H-1: Ident-Velar >> *Velar, *Coda >> Max
New error: /kip/ → [ki]
New set of stored errors:

winner ~ loser	*VELAR	*CODA	MAX	IDENT-VELAR
kip ~ tip	L	e	e	W
kip ~ ki	e	L	W	e

H-2 (target): Ident-Velar >> *Velar >> Max >>> *Coda

Upspot: An HS learner doesn't regress like the OT learner... because it can only learn one thing at a time

DIFFERENT PREDICTIONS

Using a Parallel OT Grammar: this learner will regress over time in multiply-marked words:

'keep': [ti] → [tip] → [ki] → [kip]
'gas': [dae] → [daet] → [gae] → [gaet] → [daes] → [gaes]

Using a Serial HS Grammar: this learner will not regress in any way (at least as described here)

RESEARCH QUESTION

Do L1 longitudinal corpora provide evidence of consistent phonological regressions, whose time course matches the order of acquisition of multiple marked structures within single words?

References

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Error-Driven Learning in a Nutshell

- Learner observes (hears): 'boot' [but]
- Learner produces: 'bu' [bu]
- The result is an Error:

/but/	*VELAR	*CODA	MAX	IDENT-VELAR
but		*!		
bu			*	

Hypothesis: Errors are enough to learn phonotactics

Learning: Re-arranging the current grammar so that the next one doesn't make any of the learner's known errors

Restrictive Learning: Biased Constraint Ranking

The initial state grammar: most restrictive
- only the most unmarked structures possible
- e.g. H₀: *Velar, *Coda >> Max, Ident

But how to move away from that state?
- H₁: Max >> *Coda >> *Velar >> Ident?
- H₂: *Velar >> Ident >> Max >> *Coda?
- H₃: Max >> Ident >> *Velar >> *Coda?

What 'boot' shows the learner:
- in the target language, *Coda is not obeyed

What 'boot' doesn't show the learner:
- whether or not *Velar is obeyed

Biased Constraint Demotion (BCD: Prince and Tesar 2004)
uses 'boot' to learn a ranking nearly as restrictive as H₀
- H₁: *Velar >> Max >> *Coda >> Ident

Via BCD learning:
- errors are resolved, i.e. no more coda deletion
- but otherwise markedness is enforced (*Velar!)

Acknowledgments

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CORPUS STUDY

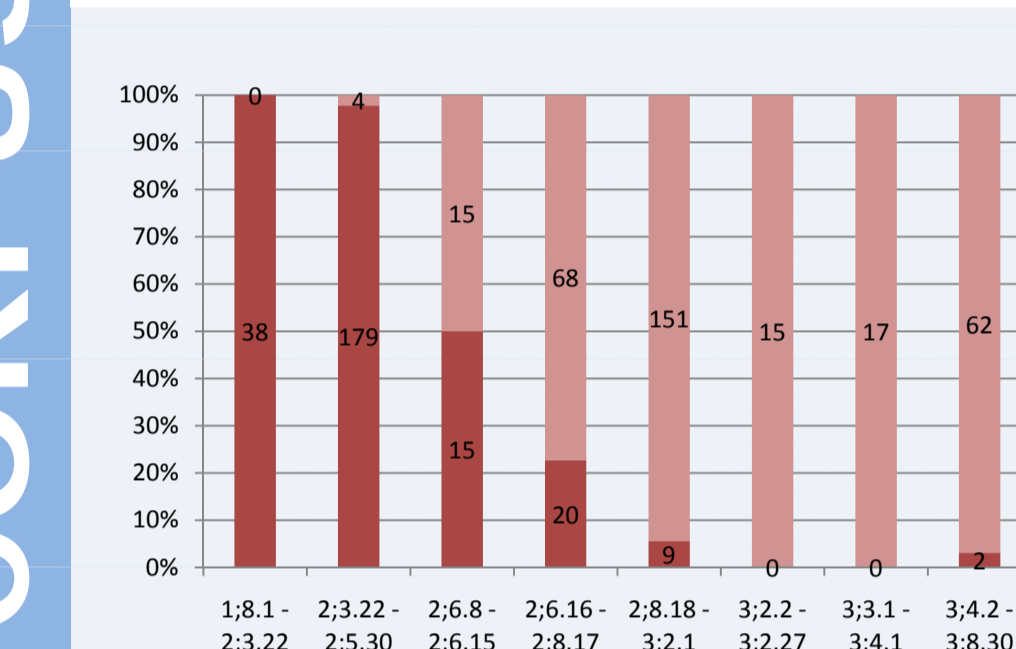
The Child: Zack (Smith, 2010)

Smith (2010) provides a corpus of Zack's speech from 1;8 - 3;8, with sessions about once a week

Approach taken here:

- every output with a 2-member complex onset extracted
- each extracted output coded for additional marked structure
- stages determined by first session with at least two faithful outputs
- only patterns with sufficient data discussed on this poster

Zack's Acquisition of Complex Onsets

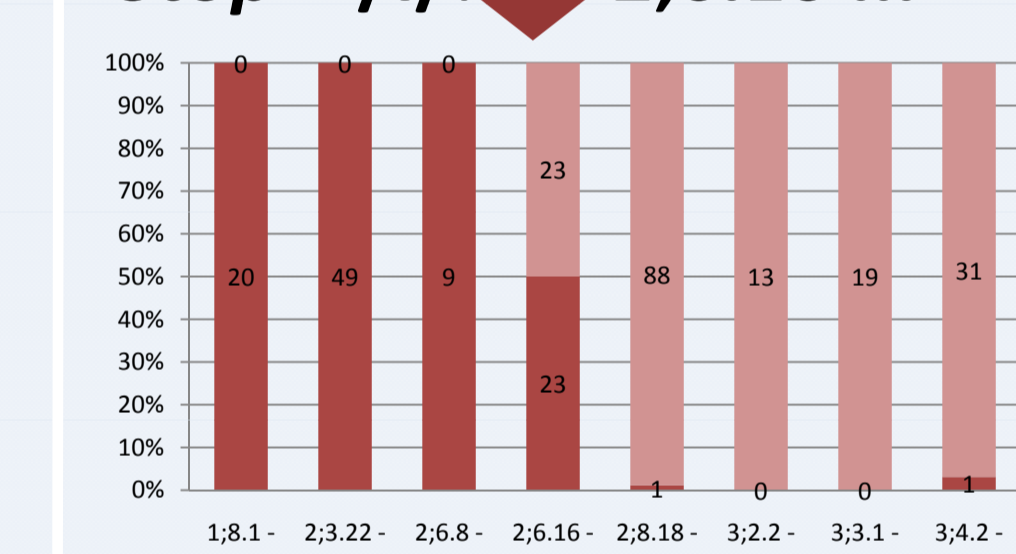


Stop + /r/: 2;6...

bread	black	spirit
[bed], [bred]	[bae]	[pirit]
dragon	glue	step
[drae.dən]	[du:]	[tɛp]
crane	clean	scoop
[trein]	[ti:n]	[tu:p]
track	place	stop
[trae], [trae]	[peit]	[da:p]

bricks	black	special
[brits]	[blae?]	[pedu]
dressed	Glenferrie	step
[dres], [dret]	[dwenfer:]	[tɛp]
crying	close, closing	scoop
[traɪn]	[təud]	[tu:p]
tractor	plug	stand
[trae?.tə]	[plʌd], [plʌd]	[taen]

Stop + /l/: 2;6.16...

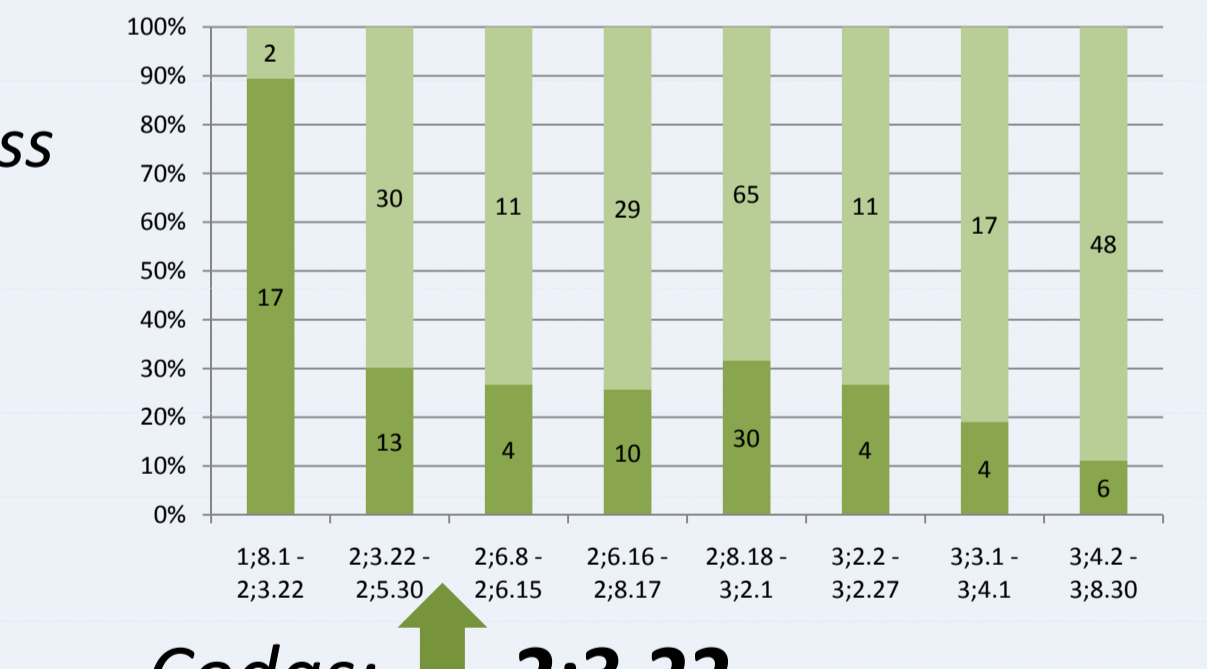


Comparing Zack's Acquisition of Codas, Fricatives and Velars

Zack begins to master obstruent codas before 2;4

- as other marked structures emerge, codas do not regress

codas before stop-: 2;4.15-19	codas after stop-: 2;6.15-29
glasses [da:t]	glass [dra:s]
glasses [da:tid]	glasses [dra:siz]
plug [plʌd]	plug [plʌd]
pliers [gae.əd]	plate [pleit]

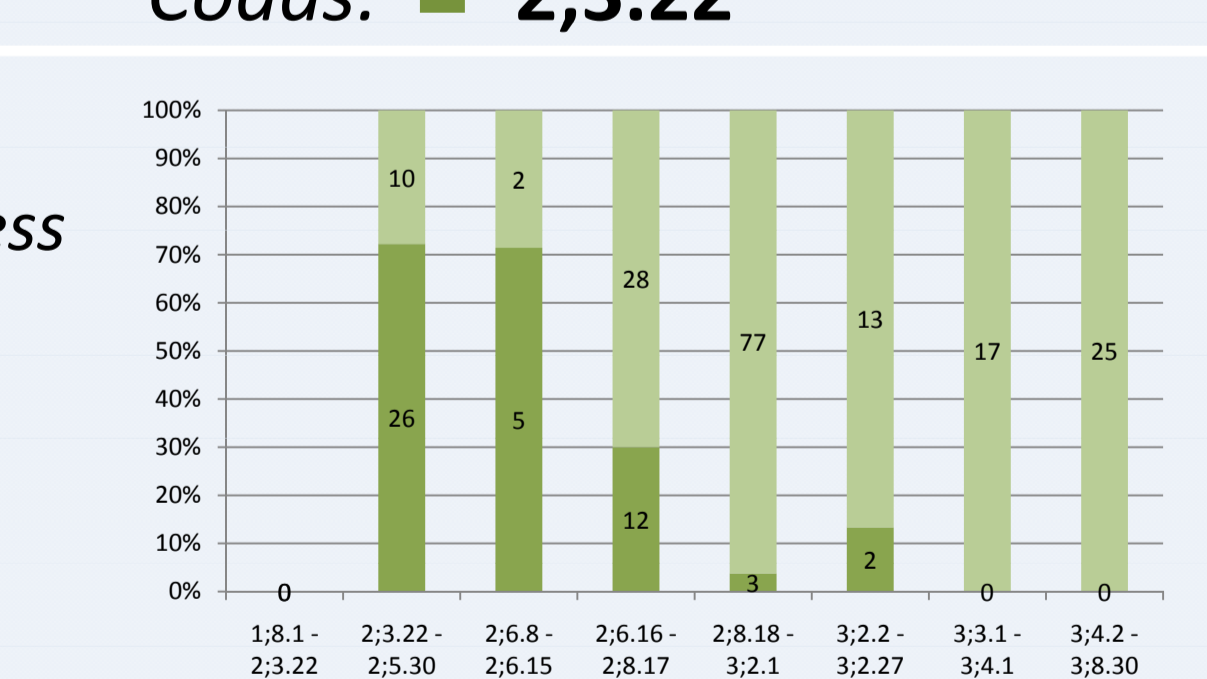


Codas: 2;3.22

Coda fricatives emerge alongside stop + liquid (2;6-2;8)

- as both emerge in a word, other structures do not regress

complex Os & coda frics @ 2;7	complexOs & coda frics @ 2;9
Gruff [dʌf]	Gruff [drʌf]
close [trəud]	close [trəuz]
please [pi:d], [pi:z]	please [pri:z]
ice cream [aɪtɪm], [aɪsɪm]	ice cream [aɪsɪm]

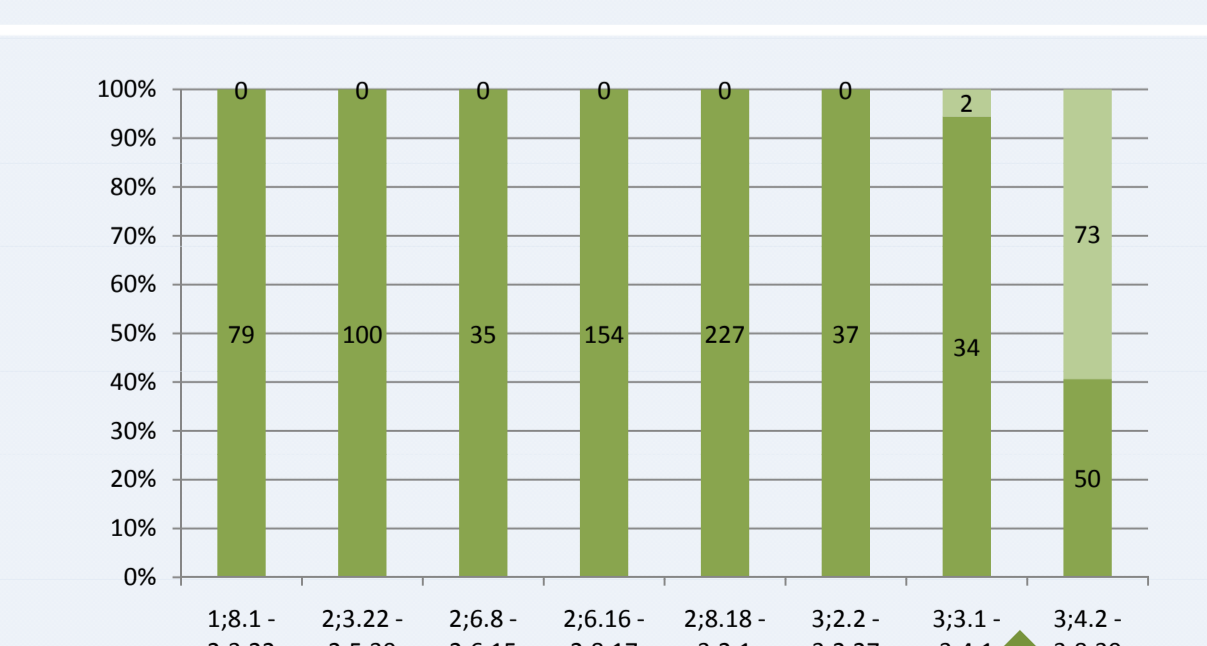


Coda Fricatives: 2;6-2;8

Zack's velar fronting persists until 3;4-3;8

- as velars emerge, other structures do not regress

s-stop before velars: 3;3	s-stop after velars: 3;5
scoop [stɪu:p]	scoop [skɪu:p]
sky [stɪaɪ]	sky [stɪaɪ], [skɪaɪ]
stick [stɪt]	stick [stɪt], [stɪk]



Velar Place of Articulation: 3;4

NEXT QUESTIONS: 1) So how do child phonologies regress and why?

(cf. Bernhardt and Stemberger 1998; Menn 1983, 1992; Becker and Tessier 2011)

2) How do multiply-marked structures interact in child phonology? (Jesney 2011)