Idiosyncrasy and Derived Environment Effects in Gradient Harmonic Grammar

Brandon Osgan
https://bosgan.github.io/
brandon.osgan@stonybrook.edu

Brown Bag Talks
September 9th, 2026

Stony Brook University
STATE UNIVERSITY OF NEW YORK

Introduction

Vowel reduction (VR) and deletion (VD) in Bolognese present unique challenges for constraint-based frameworks of phonology:

- Vowels reduce/delete in only newly derived stressless environments
  - Stress shift due to suffixation triggers vowel reduction/deletion in only the newly unstressed environment; all qualities surface faithfully when consistently unstressed
- Reduction and deletion occur in identical derived environments
  - Reduction occurs systematically; deletion occurs idiosyncratically

Proposal

I propose that derived environment effects and idiosyncrasy can be simultaneously modeled with Gradient Harmonic Grammar.

- A segment's degree of *input activity* can condition its output:
  - high activity → faithful surfacing
  - medium activity → vowel reduction
  - low activity → vowel deletion

Bolognese Vowel Reduction

- Bolognese (Gallo-Italic; Bologna, Italy): Vowels surface faithfully when stressed; reduce to [i, a, u] when stress shifts (Osgan, 2026)

(1)

Plain	Suffixed	Gloss
'tɔurt-a	turt'-eŋn-a	‘cake’
'ʤaŋːd-a	ʤaŋ'd-eŋn-a	‘acorn’
'gɛːbj-a	gab'j-eŋn-a	‘cage’
ma'nesː-a	mani's-eŋn-a	‘wrench’
koper'tɔŋː	kopertuŋ'θ-eŋː	‘tire’
mu'naid-a	muni'd-eŋn-a	‘coin’

Data from the fieldwork of Edward Rubin*, Lepri & Vitali (2009), and Vitali (2009, 2022)
*University of Utah

Bolognese Vowel Deletion

Though stress shift due to suffixation most often results in vowel reduction, we sometimes also observe vowel deletion

- VR and VD both occur in the same prosodic environment
- /ɛː/, /a/, and /ai/ appear to be the only candidates for deletion

(2)

Plain	Suffixed	Gloss
ˈtɛːst-a	tØˈst-eŋn-a	‘head’
ˈpasː	pØˈs-eŋː	‘fish’
ˈmail-a	mØˈl-eŋn-a	‘apple’

Bolognese Vowel Deletion

Though /ɛː/ and /a/ frequently delete in unstressed affixal positions, there are many instances of root-internal alternations.

(3)

Deletion targeting non-root vowels		
No DIM. suffix	With DIM. suffix	Gloss
luˈk-atː	luk-∅ˈt-eŋː	‘lock’
braθaˈl-atː	braθal-∅ˈt-eŋː	‘bracelet’
paˈd-ɛːl-a	pad-∅ˈl-eŋn-a	‘pan’
karˈt-ɛːl	kart-∅ˈl-eŋː	‘sign’
Deletion targeting root vowels		
ˈsaig-a	ˈz∅g-eŋn-a	‘jigsaw’
mazˈaɲː-a	mazˈ∅ɲ-eŋː	‘boulder’
ˈbɛːl	ˈb∅l-eŋː	‘beauty’

Bolognese Vowel Deletion

Deletion cannot be the result of a strong pressure to preserve syllable count; decreases in syllable count are tolerated:

σσσ	[ma.ˈza.ɲː-a]	‘boulder’
σσ	[maz.Øˈɲ-eŋː]	‘small boulder’

Likewise, increases in syllable count are tolerated:

σσσ	[ˈa.gu.ˈʧɛː]	‘a length of thread’
σσσσσ	[a.gu.ʧa.ˈd-eŋ.n-a]	‘a small/short length of thread’

Bolognese Vowel Deletion

Additionally, near-minimal pairs are observed in the data. For these reason, I analyze vowel deletion as **lexically exceptional**.

(4)

Plain	Suffixed	Gloss
ka'nɛːl	kana'l-eŋː	‘canal’
a'nɛːl	anØ'l-eŋː	‘ring’
'θasːt	θas't-eŋː	‘basket’
'pasː	pØ's-eŋː	‘fish’

Derived Environments Effects

The environment which vowel reduction and deletion occur in are described as **morphologically derived environments** (Kiparsky 1973, 1993; Kean 1974)

No suffix, no change: /kopertɔn/ → [koper'tɔŋː]

Added suffix, MDDE: /kopertɔn/ + /-en/ → [kopertuŋ'θ-eŋː]

Processes which are restricted to these derived contexts are called *Morphologically Derived Environment Effects* (MDEEs).

Derived Environments Effects

In Bolognese, it is not the suffix morpheme itself that undergoes a phonological process, but the *vowel within the derived environment.*

- We cannot simply say all unstressed vowels undergo VR or VD
  - No derived environment (DE), no phonological process

Furthermore, while all vowel inputs can undergo VR, not all inputs can undergo VD, only /ɛː, a, ai/.

- This results in a continuum of effects

Any vowel input; no DE		Any vowel input; DE		/a, ai, ɛː/; DE
no change	$\gg$	*vowel reduction*	$\gg$	*vowel deletion*

Derived Environments Effects

- How do we model MDEEs which do not target specific morphemes?
- How do we further model the exceptionality between MDEEs?

I argue that the solution lies in the use of **Gradient Harmonic Grammar.** (Smolensky & Goldrick 2016; Hsu 2022)

With Gradient Harmonic Grammar, it is possible to not only model MDEEs, but also idiosyncratic patterns. (Hsu 2022)

Gradient Harmonic Grammar

Like Harmonic Grammar (Legendre et al. 1990), Gradient Harmonic Grammar (GHG) assigns numerical values (weights) to constraints and determines a candidate's optimality by its harmony score.

- GHG assumes that inputs can have gradient degrees of **activity** between 0.0–1.0

This use of gradience in the input directly mirrors the notion of *confidence scales.* (Inkelas 2015)

- Factors of frequency and regularity of perception and production influence the level of confidence of a segment

Gradient Harmonic Grammar

Following the assumptions of similar works (Rosen 2016; Markopoulos & Apostolopoulou 2022; Hsu & Smith 2023), the activity level of a segment is the same as each of its associated features.

$/\varepsilon_{0.75}/$ = $[\text{-}\textsc{High}]_{0.75}$, $[\text{-}\textsc{Low}]_{0.75}$, $[\text{-}\textsc{Round}]_{0.75}$, etc.

While <u>inputs</u> can have gradient levels of activity, <u>outputs</u> cannot.

As such, changes in vowel quality must be evaluated as the **deletion** of a (gradient) feature, *plus* the **epenthesis** of a fully active feature.

Gradient Harmonic Grammar

Candidates receive violations of faithfulness constraints proportional to the amount of activity of the element which incurs the violation.

(5)

/g$e_{0.75}$ɲ-en-a/		MAX[-LOW] *w = 1.0*	DEP[+LOW] *w = 1.0*	MAX *w = 1.0*	DEP *w = 1.0*	H
☞ a.	g$i_{1.0}$ɲ'-eŋn-a				-0.25	-0.25
b.	g$a_{1.0}$ɲ'-eŋn-a	-0.75	-1.0		-0.25	-2.0
c.	g$Ø_{0.0}$ɲ'-eŋn-a	-0.75		-0.75		-1.5

Because outputs must be fully active, activity must be added to bring the underlying level up to 1.0.

MDEEs in Gradient Harmonic Grammar

With confidence scales (Inkelas 2015), segments which occur in invariant contexts are stronger than those in variant contexts.

Connecting this idea to Bolognese VR and VD, vowels whose stress assignment varries contingent on suffixation are ***weaker*** (have lower activity) than those whose stress assignment is consistent.

/le $_{1.0}$ɲɛː$_{0.75}$/ → [le $_{1.0}$ˈɲɛː$_{1.0}$]

/le $_{1.0}$ɲɛː$_{0.75}$/ + /-en-a/ → [le $_{1.0}$ɲa$_{1.0}$ˈd-eŋn-a]

MDEEs in Gradient Harmonic Grammar

Low activity & stressed = too costly to change; no MDEE

(6)

/leɲɛː$_{0.75}$/		DEP *w = 4.0*	MAX[-LOW] *w = 2.5*	LIC.NON-PERIPH. *w = 2.0*	H
☞ a.	[leˈɲɛː$_{1.0}$]	-0.25			-1.0
b.	[leˈɲa$_{1.0}$]	-0.25	-0.75		-2.875

Low activity & unstressed = too costly to surface faithfully; MDEE

(7)

/leɲɛː$_{0.75}$d-en-a/		DEP *w = 4.0*	MAX[-LOW] *w = 2.5*	LIC.NON-PERIPH. *w = 2.0*	H
a.	[leɲɛː$_{1.0}$ˈd-eɲn-a]	-0.25		-1.0	-3.0
☞ b.	[leɲa$_{1.0}$ˈd-eɲn-a]	-0.25	-0.75		-2.875

MDEEs in Gradient Harmonic Grammar

High activity & unstressed = too costly to change; no MDEE

(8)

	/le$_{1.0}$ɲɛː/	DEP *w = 4.0*	MAX[-LOW] *w = 2.5*	LIC.NON-PERIPH. *w = 2.0*	H
☞ a.	[le$_{1.0}$'ɲɛː]			-1.0	-2.0
b.	[li$_{1.0}$'ɲa]		-1.0		-5.0

(9)

	/le$_{1.0}$ɲɛːd-en-a/	DEP *w = 4.0*	MAX[-LOW] *w = 2.5*	LIC.NON-PERIPH. *w = 2.0*	H
☞ a.	[le$_{1.0}$ɲɛː'd-eŋn-a]			-1.0	-2.0
b.	[li$_{1.0}$ɲa'd-eŋn-a]		-1.0		-5.0

MDEEs in Gradient Harmonic Grammar

To generate the exceptional instances of VD, we model the participating vowels /ɛː, ai, a/ with an *even lower* level of activity.

(10)

/kurbɛː$_{0.25}$l-en/		DEP $w = 4.0$	MAX[-LOW] $w = 2.5$	MAX[-HIGH] $w = 2.5$	LNP $w = 2.0$	MAX $w = 1.0$	H
a.	[kurbɛ$_{1.0}$l-eŋː]	-0.75			-1.0		-5.0
b.	[kurba$_{1.0}$l-eŋː]	-0.75	-0.25				-3.625
☞ c.	[kurbØ$_{0.0}$l-eŋː]		-0.25	-0.25		-0.25	-1.5

Because the input activity is so low, the grammar can longer tolerate the epenthesis of activity; deletion is less costly.

MDEEs in Gradient Harmonic Grammar

With identical weights and violations, the difference between VR and VD is modeled via a difference in input activity level.

(11)

/kurbɛː$_{0.25}$l-en/		DEP *w = 4.0*	MAX[-LOW] *w = 2.5*	MAX[-HIGH] *w = 2.5*	LNP *w = 2.0*	MAX *w = 1.0*	H
a.	[kurbɛ$_{1.0}$l'-eŋː]	-0.75			-1.0		-5.0
b.	[kurba$_{1.0}$l'-eŋː]	-0.75	-0.25				-3.625
☞ c.	[kurbØ$_{0.0}$l'-eŋː]		-0.25	-0.25		-0.25	-1.5

(12)

/frɛː$_{0.75}$vl-en-a/		DEP *w = 4.0*	MAX[-LOW] *w = 2.5*	MAX[-HIGH] *w = 2.5*	LNP *w = 2.0*	MAX *w = 1.0*	H
a.	[frɛ$_{1.0}$vl'-eŋn-a]	-0.25			-1.0		-3.0
☞ b.	[fra$_{1.0}$vl'-eŋn-a]	-0.25	-0.75				-2.875
c.	[frØ$_{0.0}$vl'-eŋn-a]		-0.75	-0.75		-0.75	-4.5

Analysis

With **Gradient Harmonic Grammar**, we can simultaneously generate the morphologically derived environment which VR and VD occur in and the exceptionality of VD.

- Using OT-Help (Staubs et al. 2010), precise weights are calculated for each relevant constraint for VR and VD (Osgan, 2026)
- MDEEs are generated purely as an effect of input activity

While precise threshold values can be calculated to find the minimum activity levels needed (Smolensky & Goldrick 2016:19–21), the values presented here (1.0, 0.75, 0.25) will suffice to generate the Bolognese patterns.

Analysis

Low activity & unstressed: less MAX penalty, greatest DEP penalty

(13)

	/pɛː$_{0.25}$l-en-a/	MAX[-HIGH] $12.\overline{6}$	MAX[-LOW] 12.0	LNP 11.75	DEP $8.\overline{3}$	MAX[+HIGH] $2.\overline{6}$	MAX[+ROUND] $2.\overline{6}$	*UNSTRESSED/[+LOW] 2.0	MAX[-ROUND] $1.\overline{3}$	MAINT.(SON.) 1.25	H
a.	[pɛ$_{1.0}$l'-eŋn-a]			-1.0	-0.75					-2.0	-20.5
b.	[pi$_{1.0}$l'-eŋn-a]	-0.25			-0.75					-3.0	$-13.1\overline{6}$
c.	[pa$_{1.0}$l'-eŋn-a]		-0.25		-0.75			-1.0		-1.0	-12.5
d.	[pu$_{1.0}$l'-eŋn-a]	-0.25			-0.75				-0.25	-3.0	-13.5
☞ e.	[pØ$_{0.0}$l'-eŋn-a]	-0.25	-0.25						-0.25	-4.0	-11.5

Analysis

Low activity & *stressed*: no LNP violation; no motivation to reduce

(14)

	$/\text{p}\varepsilon\text{ː}_{0.25}\text{l}/$	MAX[-HIGH] $12.\overline{6}$	MAX[-LOW] 12.0	LNP 11.75	DEP $8.\overline{3}$	MAX[+HIGH] $2.\overline{6}$	MAX[+ROUND] $2.\overline{6}$	*UNSTRESSED/[+LOW] 2.0	MAX[-ROUND] $1.\overline{3}$	MAINT.(SON.) 1.25	H
☞ a.	$[\text{ˈp}\varepsilon\text{ː}_{1.0}\text{l}]$				-0.75					-2.0	-8.75
b.	$[\text{ˈpi}_{1.0}\text{l}]$	-0.25			-0.75					-3.0	$-13.1\overline{6}$
c.	$[\text{ˈpa}_{1.0}\text{l}]$		-0.25		-0.75			-1.0		-1.0	-12.5
d.	$[\text{ˈpu}_{1.0}\text{l}]$	-0.25			-0.75				-0.25	-3.0	-13.5
e.	$[\text{ˈp}\emptyset_{0.0}\text{l}]$	-0.25	-0.25						-0.25	-4.0	-11.5

Analysis

Medium activity & unstressed: greater MAX penalty, less DEP penalty

(15)

		MAX[-HIGH]	MAX[-LOW]	LNP	DEP	MAX[+HIGH]	MAX[+ROUND]	*UNSTRESSED/[+LOW]	MAX[-ROUND]	MAINT.(SON.)	
/bɛː$_{0.75}$z-en/		$12.\bar{6}$	12.0	11.75	$8.\bar{3}$	$2.\bar{6}$	$2.\bar{6}$	2.0	$1.\bar{3}$	1.25	H
a.	[bɛ$_{1.0}$z'-eŋː]			-1.0	-0.25					-2.0	$-16.\bar{3}$
b.	[bi$_{1.0}$z'-eŋː]	-0.75			-0.25					-3.0	$-15.\bar{3}$
☞ c.	[ba$_{1.0}$z'-eŋː]		-0.75		-0.25			-1.0		-1.0	$-14.\bar{3}$
d.	[bu$_{1.0}$z'-eŋː]	-0.75			-0.25				-0.75	-3.0	$-16.\bar{3}$
e.	[bø$_{0.0}$z'-eŋː]	-0.75	-0.75						-0.75	-4.0	-24.5

Analysis

Medium activity & *stressed*: no LNP violation; no motivation to reduce

(16)

/bɛː$_{0.75}$z/		MAX[-HIGH] $12.\overline{6}$	MAX[-LOW] 12.0	LNP 11.75	DEP $8.\overline{3}$	MAX[+HIGH] $2.\overline{6}$	MAX[+ROUND] $2.\overline{6}$	*UNSTRESSED/[+LOW] 2.0	MAX[-ROUND] $1.\overline{3}$	MAINT.(SON.) 1.25	H
☞ a.	[ˈbɛː$_{1.0}$z]				-0.25					-2.0	$-4.58\overline{3}$
b.	[ˈbi$_{1.0}$z]	-0.75			-0.25					-3.0	$-15.\overline{3}$
c.	[ˈba$_{1.0}$z]		-0.75		-0.25			-1.0		-1.0	$-14.\overline{3}$
d.	[ˈbu$_{1.0}$z]	-0.75			-0.25				-0.75	-3.0	$-16.\overline{3}$
e.	[ˈbØ$_{0.0}$z]	-0.75	-0.75						-0.75	-4.0	-24.5

Analysis

High activity & unstressed: greatest MAX penalty, no DEP penalty

(17)

	/le$_{1.0}$ɲɛːd-en-a/	MAX[-HIGH] $12.\overline{6}$	MAX[-LOW] 12.0	LNP 11.75	DEP $8.\overline{3}$	MAX[+HIGH] $2.\overline{6}$	MAX[+ROUND] $2.\overline{6}$	*UNSTRESSED/[+LOW] 2.0	MAX[-ROUND] $1.\overline{3}$	MAINT.(SON.) 1.25	H
☞ a.	[le$_{1.0}$ɲa'd-eŋn-a]			-1.0							-11.75
b.	[li$_{1.0}$ɲa'd-eŋn-a]	-1.0								-1.0	$-13.91\overline{6}$
c.	[la$_{1.0}$ɲa'd-eŋn-a]		-1.0					-1.0		-1.0	-15.25
d.	[lu$_{1.0}$ɲa'd-eŋn-a]	-1.0							-1.0	-1.0	-15.25
e.	[lØ$_{1.0}$ɲa'd-eŋn-a]	-1.0	-1.0						-1.0	-2.0	-28.5

Alternatives to Gradient Harmonic Grammar?

There is currently no prior approach which can generate both MDEEs *and* idiosyncratic alternations within a single framework.

Hypothetically, one could posit a framework in which individual segments may be indexed, a modification of morpheme-specific constraint indexation. (Pater 2007, 2009a)

- All segments in derived environments are indexed for VR
- Some segments in derived environments are also indexed for VD

Unlike this approach, GHG does not require modification to its basic assumptions, nor does it predict constraint overgeneration.

Conclusion

This work presents the first use of **Gradient Harmonic Grammar** to *simultaneously* model both MDEEs and idiosyncratic patterns

- Vowel reduction, deletion, and faithful realization emerge as different outcomes along a single continuum of representation
  - Vowels in positions of variable stress assignment have less representational robustness
- Changes in vowel quality are tolerated only for vowels with low **input activity** in unstressed environments
  - Deletion is tolerated when epenthesis of missing activity is too costly

References

Hsu, B. (2022). Gradient symbolic representations in Harmonic Grammar. Language and Linguistics Compass 16(9). e12473. https://doi.org/10.1111/lnc3.12473.

Hsu, B. & Smith, C. (2023). Idiosyncratic Hiatus Resolution: An Argument for Gradient Harmonic Grammar. Proceedings of the Annual Meetings on Phonology 10. https://doi.org/10.3765/amp.v10i0.5459.

Inkelas, S. (2015). Confidence scales: a new approach to derived environment effects. Capturing phonological shades within and across languages. Cambridge Scholars Publishing Newcastle upon Tyne 45–75.

Kean, M. L. (1974). The Strict Cycle in Phonology. Linguistic Inquiry. The MIT Press 5(2). 179–203.

Kiparsky, P. (1973). Three Dimensions in Linguistic Theory. In Osamu Fujimura (ed.), Phonological representations. Tokyo: TEC Company.

Kiparsky, P. (1993). Blocking in nonderived environments. In Sharon Hargus & Ellen M. Kaisse (eds.), Studies in lexical phonology, vol. 4, 277–313. Boston: Academic Press. https://doi.org/10.1016/B978-0-12-325071-1.50016-9.

Legendre, G., Miyata, Y., & Smolensky, P. (1990). Harmonic Grammar–a formal multi-level connectionist theory of linguistic well-formedness: an application. In Proceedings of the Annual Meeting of the Cognitive Science Society, vol. 12, 388–395. Cambridge, MA: Lawrence Erlbaum Associates.

References

Lepri, L., & Vitali, D. (2009). *Dizionario Bolognese-Italiano, Italiano Bolognese* (2nd ed.). Edizioni Pendragon.

Lindblom, B. (1986). Phonetic Universals in Vowel Systems. *Experimental Phonology*, 13–44.

Markopoulos, G. & Apostolopoulou, E. (2022). Vowel height as sonority level. Selected papers on theoretical and applied linguistics. Selected papers on theoretical and applied linguistics 24. 513–529. https://doi.org/10.26262/ISTAL.V24I0.9202.

Osgan, Brandon. 2026. Vowel reduction is conditioned by quality and quantity interactions: evidence from Bolognese. In Proceedings of the Linguistic Society of America, vol. 11, 6117. Linguistic Society of America. https://doi.org/10.3765/plsa.v11i1.6117.

Pater, J. (2009a). Morpheme-Specific Phonology: Constraint Indexation and Inconsistency Resolution. Equinox Publishing Ltd. https://doi.org/10.7282/T3FX77CX

Pater, J. (2009b). Weighted Constraints in Generative Linguistics. *Cognitive Science*, *33*(6), 999–1035.

Rosen, E. (2016). Predicting the unpredictable: Capturing the apparent semi-regularity of rendaku voicing in Japanese through harmonic grammar. In Proceedings of BLS, vol. 42, 235–249. Berkeley Linguistic Society Berkeley, CA.

References

Pater, J. (2009a). Morpheme-Specific Phonology: Constraint Indexation and Inconsistency Resolution. Equinox Publishing Ltd. https://doi.org/10.7282/T3FX77CX

Pater, J. (2009b). Weighted Constraints in Generative Linguistics. *Cognitive Science*, *33*(6), 999–1035.

Rosen, E. (2016). Predicting the unpredictable: Capturing the apparent semi-regularity of rendaku voicing in Japanese through harmonic grammar. In Proceedings of BLS, vol. 42, 235–249. Berkeley Linguistic Society Berkeley, CA.

Smolensky, P. & Goldrick, M. (2016). Gradient symbolic representations in grammar: the case of French liaison. Rutgers Optimality Archive. New Brunswick, NJ: Rutgers University 1552. 1–37.

Staubs, R., Becker, M., Potts, C., Pratt, P., McCarthy, J. J., & Pater, J. (2010). OT-Help 2.0. Amherst, MA: University of Massachusetts Amherst. https://people.umass.edu/othelp/.

Vitali, D. (2009). *Dscårret in Bulgnaiś? Manuale e Grammatica del Dialetto Bolognese*. Perdisa.

Vitali, D. (with Lepri, L., & Serra, R.). (2022). *Mé a Dscårr in Bulgnaiś. Manuale per Imparare il Dialetto Bolognese* (Ediziån nôva nuvänta. Edizione nuovissima). Pendragon.

Idiosyncrasy and Derived Environment Effects in Gradient Harmonic Grammar

Brandon Osgan
https://bosgan.github.io/
brandon.osgan@stonybrook.edu

Brown Bag Talks
September 9th, 2026

Stony Brook University
STATE UNIVERSITY OF NEW YORK