GSR and Suppletion in Bolognese Clitics

Edward Rubin and Aaron Kaplan

1. Introduction

Gradient Symbolic Representations (GSRs; Smolensky & Goldrick 2016) permit distinctions to be made between elements in terms of their level of activity. The resulting asymmetries have been shown to account for certain kinds of phonologically conditioned morphological phenomena (Faust & Smolensky 2017, Zimmermann 2019). In this paper we extend this line of research by probing its ability to account for suppletion (following a suggestion made by Hsu (2022)). Our test case is clitic allomorphy in Bolognese (Romance; Italy), which presents an analytical challenge for GSRs: the language uses both suppletion and vowel epenthesis to comply with phonotactic restrictions, and both of these processes are regulated by DEP. Thus the choice between suppletion and epenthesis cannot be modeled by merely ranking the constraint favoring one over the constraint favoring the other.

We will argue that a GSR-based account of Bolognese's suppletion is indeed possible, and it compares favorably to one couched in Lexical Selection (LS; Mascaró 2007), a theory designed specifically for suppletion.

2. Clitic Inventory and Phonotactics

Bolognese's pronominal clitics are shown in (1). Our focus here is largely on the 3MS.NOM and 3MS.ACC clitics, both of which display suppletion. (All data comes from Canepari & Vitali (1995) and Vitali (2009), and one of the current author's—Rubin's—extensive work with native speakers.)

(1) Clitic Pronouns in Bolognese

	NOM		DAT		ACC		PRT
	SING	PLUR	SING	PLUR	SING	PLUR	
1	a=/=ja	a=/=ja	m	s	m	s	
2	t	a=/=v	t	v	t	v	
3M	(a)l	i	i	i	(a)l	i	n
3f	l(a)	æl/æʎ	i	i	l(a)	i	
3RFLX			s	s	s	s	

Before examining clitic allomorphy itself, it is necessary to discuss phonotactic restrictions that bear on that allomorphy. To begin, Bolognese admits a variety of consonant clusters that do not conform to sonority sequencing expectations (e.g. Clements 1991, Selkirk 1984), both in onset and coda position (2).

* Edward Rubin, University of Utah, e.rubin@utah.edu. Aaron Kaplan, University of Utah, a.kaplan@utah.edu. We are grateful to audiences at AMP 2022 and WCCFL 41 for feedback on various stages of this work. We also wish to express our gratitude to the native speakers of Bolognese who generously shared their knowledge of the language with us, and we wish to thank Brian Hsu for suggesting that GSRs might be fruitfully applied to clitic allomorphy in Bolognese.

 Proceedings of the 41st West Coast Conference on Formal Linguistics, ed. Nikolas Webster et al., 501-510. Somerville, MA: Cascadilla Proceedings Project.

(2)

zbdɛl	'hospital'
ftleɲna	'slice'
tskɲɔser	'to disavow'
vdand	'seeing'
forbz	'scissors'
poːrdg	'portico'

However, sonorants are limited in their ability to appear in clusters. For example, sonorant-final coda clusters are prohibited. In (3), the singular forms on the left have a final [a] that allows the two preceding consonants to be split between syllables. The plural forms on the right lack the final [a], and the underlined epenthetic [e] avoids a sonorant-final coda cluster.

(3)

tɛːvla	'table'	tɛːvel	'tables'
laɲteːrna	'lantern'	laɲteːreŋ	'lanterns'
liːvra	'hare'	liːver	'hares'

Sonorant-initial onset clusters are also banned, except for a handful of root-internal [mC] clusters (e.g. [mdajɑŋ] 'medallion'). No (would-be) sonorant-initial onset clusters exist underlyingly, but when they arise through concatenation of morphemes, epenthesis is triggered. The examples in (4), which are central to the analysis of allomorphy developed below, illustrate this. In each form, [e] is epenthesized after the accusative clitic to avoid a sonorant-initial onset cluster. (The accusative [l] presumably cannot be syllabified in a coda with the preceding [l] because of the restriction on sonorant-final coda clusters, or else because of OCP restrictions, constraints on the syllabification of geminates, etc.)

(4) a. al= le= vad
3MS.NOM= 3MS.ACC= sees
'he sees him.'

b. al= le= tra
3MS.NOM= 3MS.ACC= throws
'he throws it.'

Because clusters violating sonority expectations are widely attested in Bolognese, we account for restrictions on sonorants with the constraint in (5), which targets sonorants specifically.

(5) *[+son]PERIPHERY: no sonorant-initial onset clusters or sonorant-final coda clusters.

3. Allomorphy

3.1. 3MS.NOM

We begin the examination of allomorphy in Bolognese with the 3MS.NOM clitic. It surfaces as [l] prevocalically (6) and [al] preconsonantally (7). This alternation must be suppletive: [a] epenthesis/deletion is not a regular phonological process in the language (Rubin & Kaplan 2022b), apart from coalescence of adjacent unstressed [a]s (/a=aŋdæŋ/ → [aŋdæŋ] 'we go').

(6) l= arspɑnd
3MS.NOM= responds
'he responds'

(7) al= vad
3MS.NOM= sees
'he sees'

The [l] allomorph also appears post-verbally (e.g. in interrogative constructions), as in (8). With consonant-final verbs, epenthesis is triggered by *[+son]PERIPHERY; curiously, if the [al] allomorph had appeared here instead, epenthesis would not have been necessary.

(8) vad=el, *vad=al 'Does he see?'

We suggest that [l] appears in (6) and (8) to avoid misalignment of [al] with respect to syllable boundaries. Were [al] to appear in (6) (*[a.l=arspɑnd]), there would be a syllable boundary in the middle of the clitic. Likewise, in (8) (*[va.d=al]), [al] would not be left-aligned with a syllable boundary. We adopt the cover constraint ALIGN-[al]$_{NOM}$ to penalize both of these illicit configurations.

This analysis amounts to the claim that [al] is the default allomorph and that [l] appears just where [al] cannot. Alternatively, one might argue that [l] is the default and [al] appears where [l] would violate *[+son]PERIPHERY (e.g. *[l=vad]). This does not extend to (8), however, where an additional explanation for [al]'s absence is required. Our account has the advantage of offering a unified explanation for the choice of allomorphs in both domains.

Ostensibly, a third 3MS.NOM allomorph, [a], surfaces before certain ACC and DAT clitics:

(9) a. [a]= m= la= da
3MS.NOM 1S.DAT 3FS.ACC gives
'he gives it to me.'

b. [a]= t= la= da
3MS.NOM 2S.DAT 3FS.ACC gives
'he gives it to you.'

c. [a]= s= al= da
3MS.NOM 1P.DAT 3MS.ACC gives
'he gives it to us.'

d. [a]= v= al= da
3MS.NOM 2P.DAT 3MS.ACC gives
'he gives it to you.'

We have argued elsewhere (Rubin & Kaplan 2022b) that the [am], [as], [at], and [av] sequences in (9) are actually single lexical items that are the exponent of two sets of pronominal features. We call such items "duplexes." Transcriptions of the data in (9) reflecting this position are given below.

(10) a. [am]= la= da
{3MS.NOM, 1S.DAT} 3FS.ACC gives
'he gives it to me.'

b. [at]= la= da
{3MS.NOM, 2S.DAT} 3FS.ACC gives
'he gives it to you.'

c. [as]= al= da
{3MS.NOM, 1P.DAT} 3MS.ACC gives
'he gives it to us.'

d. [av]= al= da
{3MS.NOM, 2P.DAT} 3MS.ACC gives
'he gives it to you.'

The duplex analysis explains why [al] occurs preconsonantly instead of the codaless [a] (namely, [a] is not in fact an available allomorph) and why [a] appears only before certain clitics. The analysis also reinforces the conclusion that the 3MS.NOM clitic exhibits suppletion: the duplexes are not morphosyntactically identical to simplex clitics, so they must be separate lexical entries. As we will see, duplexes are required in examples like (10), but they are optional or even prohibited under other circumstances.

3.2. 3MS.ACC

Like 3MS.NOM, the 3MS.ACC clitic is [l] prevocalically (11) and [al] preconsonantally (12). Again, this must be suppletion because no regular process in Bolognese accounts for [a] deletion/epenthesis.

(11) at= l= a dɛ
{3MS.NOM, 2S.DAT}= 3MS.ACC= has given
'he gave it to you.'

(12) at= al= da
{3MS.NOM, 2S.DAT}= 3MS.ACC= gives
'he gives it to you.'

3.3. Interaction of Clitics

We now turn to the behavior of the 3MS.NOM and 3MS.ACC clitics when they appear together. Preceding a vowel-initial verb, they surface exactly as expected (13): the ACC clitic is prevocalic and surfaces as [l]; the NOM clitic is therefore preconsonantal, and it surfaces as [al].

(13) a. al= l= iŋdveŋna
3MS.NOM= 3MS.ACC= guesses
'he guesses it.'
b. al= l= a vest
3MS.NOM= 3MS.ACC= has seen
'he saw him.'

However, when the verb is consonant-initial, we find something unexpected. As we saw in (4), repeated in (14), the ACC clitic surfaces as [l], not the expected [al]. *[+son]PERIPHERY triggers epenthesis, an outcome that could have been avoided by [al]. The NOM clitic is [al] because it is preconsonantal.

(14) a. al= le= vad
3MS.NOM= 3MS.ACC= sees
'he sees him.'
b. al= le= tra
3MS.NOM= 3MS.ACC= throws
'he throws it.'

An analysis of the allomorphy presented here must explain why the facts in (14) obtain and not the a priori expected forms such as *[l=al=vad]. In the next section we show that GSRs can do this.

4. Analysis

4.1. 3MS.NOM & Duplexes

At its core, our analysis posits that the choice of one suppletive form over another is driven by asymmetries in activities across allomorphs plus the usual dynamics of constraint interaction that may favor one allomorph over another (say, for phonotactic reasons). We make the following additional assumptions about how the grammar copes with suppletion. All allomorphs appear in the input, and each candidate contains at most one of those allomorphs. In this respect, our analysis is much like LS, but whereas LS allows allomorphs to be ranked hierarchically to encode preferences for one over the other (absent external reasons to favor an allomorph), we use GSRs to encode such preferences. Activity is assigned to whole allomorphs (rather than each segment within an allomorph), and, as we will see, allomorphs with greater underlying activities are favored by faithfulness constraints. Thus we employ inputs like (15), where allomorphs are listed in parentheses and each is tagged with its activity. This input, and the following discussion, ignores duplexes for the moment. We return to them below.

(15) /(0.1·l, 0.8·al)= vad/
3MS.NOM= sees
'he sees'

We further make the simplifying assumption that each surface element—and therefore everything in all candidates—has activity of exactly 1. This follows Smolensky & Goldrick (2016), and though much subsequent work abandons that assumption, it is convenient for present purposes. Again following Smolensky & Goldrick, we adopt a positive MAX that rewards input activity that a candidate preserves. For example, the /l/ allomorph in (15) has an activity of 0.1, so any candidate containing that allomorph receives a reward of 0.1 from MAX. DEP penalizes the activity that must be added to an element to bring its activity up to 1, so candidates that retain the /l/ allomorph from the input receive a penalty of −0.9 from DEP. As is apparent, allomorphs with greater underlying activity are favored by faithfulness: they earn greater rewards from MAX and smaller penalties from DEP. Of course, DEP assigns its usual −1 for each epenthetic segment. To keep tableaux simple, we omit roots' activities and their faithfulness rewards/violations.

The evaluation of (15) is shown in (16). Candidates (a) and (b) differ in the choice of clitic allomorph, and because /al/ has greater underlying activity, candidate (b) is more harmonic. Candidate (c) is identical to candiate (a) except that it includes an epenthetic vowel, for which it receives an additional −1 from DEP. (Constraint weights are discussed below.)

(16)

/(0.1·l, 0.8·al)=vad/	DEP 15	MAX 5	*H*
a. l=vad	−0.9	0.1	−13
☞ b. al=vad	−0.2	0.8	1
c. le=vad	−1.9	0.1	−28

Of course, in this example *[+son]PERIPH also favors [al=vad]. As shown in (17), this constraint adds to candidate (a)'s penalties.

(17)

/(0.1·l, 0.8·al)=vad/	*[+son]PERIPH 37	DEP 15	MAX 5	*H*
a. l=vad	−1	−0.9	0.1	−50
☞ b. al=vad		−0.2	0.8	1
c. le=vad		−1.9	0.1	−28

Low activity need not be fatal. If the allomorph with greater activity violates a constraint with sufficient weight, another allomorph can emerge. This is how the analysis generates [l=arspɑnd] (6): candidate (b) in (18) violates ALIGN-[al]$_{NOM}$ and therefore loses despite containing the allomorph with higher underlying activity.

(18)

/(0.1·l, 0.8·al)=arspɑnd/	ALIGN-[al]$_{NOM}$ 40	DEP 15	MAX 5	*H*
☞ a. l=arspɑnd		−0.9	0.1	−13
b. a.l=arspɑnd	−1	−0.2	0.8	−39

Furthermore, the analysis can favor a candidate with both a low-activity allomorph and epenthesis. In (19), both candidates that lack epenthesis violate a high-weighted constraint. The winner avoids those violation by using the [l] allomorph (which is not subject to alignment) and epenthesizing a vowel so that *[+son]PERIPH is satisfied. Thus a puzzle highlighted above is solved: these high-weighted constraints force the appearance of [l] postverbally, even though that necessitates epenthesis.

(19)

/vad=(0.1·l, 0.8·al)/	ALIGN-[al]$_{NOM}$ 40	*[+son]PERIPH 37	DEP 15	MAX 5	H
a. vad=l		−1	−0.9	0.1	−50
b. va.d=al	−1		−0.2	0.8	−39
☞ c. va.d=el			−1.9	0.1	−28

We now come to the duplexes. With one exception to be discussed below, duplexes are always at least optional whenever the morphosyntactic conditions for them are met—i.e. when the two sets of pronominal features they represent are present. Otherwise, they are illicit. We account for this in the following way, using [at] '{3MS.NOM, 2S.DAT}' as our example and drawing inspiration from Smolensky & Goldrick's (2016) treatment of liaison consonants in French. This morpheme is in the allomorph list for both 3MS.NOM and 2S.DAT. We assign /at/ an activity of 0.45; because that value is lower than /al/'s 0.8, it is generally disfavored as an allomorph of 3MS.NOM. But when 2S.DAT is also present, it too contributes /at/ with an activity of 0.45, and candidates containing that allomorph combine the two activities: $0.45 + 0.45 = 0.9$. Faithfulness now favors this allomorph.

The tableaux below illustrate the system. Normally, duplexes are suboptimal. In (20a), faithfulness favors candidate (b) over candidate (c). (Candidate (a) is doomed by *[+son]PERIPH.) But in (20b), the combined activities of 3MS.NOM /at/ and 2S.DAT /at/ render candidate (c) optimal. DEP is decisive. Candidate (b) does better on MAX than candidate (c) because the former earns rewards for two different clitic morphemes, but that also means it has two morphemes that DEP can penalize. Because DEP outweighs MAX, the duplex is favored. In this way the analysis (and GSRs in general) can favor economy: a single morpheme presents fewer opportunities for faithfulness penalties than two morphemes do.

(20) a.

/(0.1·l, 0.8·al, 0.45·at)=vad/	*[+son]PERIPH 37	DEP 15	MAX 5	H
a. l=vad	−1	−0.9	0.1	−50
☞ b. al=vad		−0.2	0.8	1
c. at=vad		−0.55	0.45	−6

b.

/(0.1·l, 0.8·al, 0.45·at)=(0.3·t, 0.45·at)=la=da/	*[+son]PERIPH 37	DEP 15	MAX 5	H
a. l=t=la=da	−1	−0.9 − 0.7	0.1 + 0.3	−59
b. al=t=la=da		−0.2 − 0.7	0.8 + 0.3	−8
☞ c. at=la=da		−0.1	0.45 + 0.45	3

4.2. 3MS.ACC

For the 3MS.ACC clitic, the analysis produces [l] prevocalically (21a) and [al] preconsonantally (21b): faithfulness favors [l] this time, and [al] appears when [l] violates *[+son]PERIPH. As indicated in these tableaux, the 3MS.ACC clitic is always preceded by some other clitic; that first clitic has been omitted to simplify candidate comparison.

(21) a.

/…= (0.95·l, 0.7·al)=a da/	*[+son]PERIPH 37	DEP 15	MAX 5	H
☞ a. …=l=a dɛ		−0.05	0.95	4
b. …=al=a dɛ		−0.3	0.7	−1
c. …=le=a dɛ		−1.05	0.95	−11

b.

/…= (0.95·l, 0.7·al)=da/	*[+son]PERIPH 37	DEP 15	MAX 5	*H*
a. …=l=da	−1	−0.05	0.95	−33
☞ b. …=al=da		−0.3	0.7	−1
c. …=le=da		−1.05	0.95	−11

The fact that /al/ has higher activity than /l/ for 3MS.NOM while the opposite holds for 3MS.ACC produces the correct (but surprising) result when the two clitics appear together (22). The combined preference for 3MS.NOM /al/ and 3MS.ACC /l/ is great enough to override other considerations, even though that combination requires epenthesis to avoid violating *[+son]PERIPH.

(22)

/(0.1·l, 0.8·al)=(0.95·l, 0.7·al)=vad/	*[+son]PERIPH 37	DEP 15	MAX 5	*H*
☞ a. al=le=vad		$-0.2 - 0.05 - 1$	$0.8 + 0.95$	−10
b. l=al=vad		$-0.9 - 0.3$	$0.1 + 0.7$	−14
c. al=l=vad	−1	$-0.2 - 0.05$	$0.8 + 0.95$	−32

To summarize, GSRs permit an account of suppletion patterns in Bolognese involving the 3MS.NOM and 3MS.ACC clitics, including the unexpected realizations highlighted above. The analysis also properly adjudicates the competition between suppletion and epenthesis.

5. Simulations in Noisy Harmonic Grammar

We further tested the analysis presented in the previous section with simulations in Noisy Harmonic Grammar (NHG; Boersma & Pater 2016, Jesney 2007, Hayes 2017), which we implemented in R (R Core Team 2022). In these simulations we broadened the range of data as described below. NHG is a useful framework in the present case because some of the additional data involves optionality, which NHG is designed to model. In this section we first summarize the data and constraints included in the simulations, and we then discuss the results of the simulations.

5.1. Data and Constraints

This larger analysis included representative data presented above. For the basic behavior of the 3MS.NOM clitic, we used (6)–(8). For duplexes, we included (10b). For the 3MS.ACC clitic, we included (11) and (12). Finally, we included (13a) and (14a) to capture the interaction of 3MS.NOM and 3MS.ACC.

We also included other data illustrating clitics' behavior in a broader range of configurations. To begin, while duplexes are obligatory in (10), where NOM, DAT, and ACC are all present, they are optional when just one of DAT and ACC is present and the verb begins with a consonant. In (23), only NOM and DAT features are present. They may be realized with separate clitics (the (i) examples) or with duplexes (the (ii) examples). Likewise for NOM and ACC in (24). We included (23a) in our account.

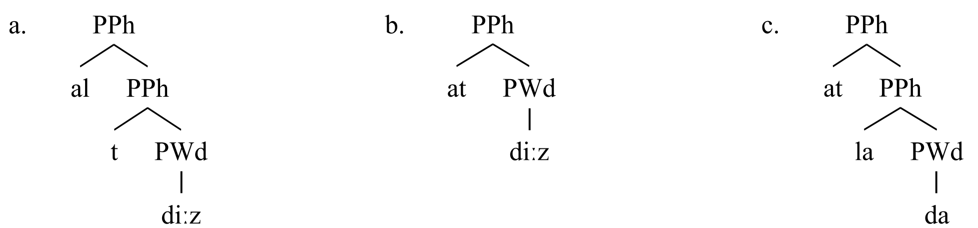
(23) a. (i) [al]= [t]= di:z
3MS.NOM 2S.DAT says
'he says to you.'
(ii) [at]= di:z
{3MS.NOM, 2S.DAT} says
'he says to you.'
b. (i) [al]= [s]= di:z
3MS.NOM 1P.DAT says
'he says to us'

(ii) as= di:z
{3MS.NOM, 1P.DAT} says
'he says to us.'

(24) a. (i) al= t= tsa:ma
3MS.NOM 2S.ACC calls
'he calls you.'
(ii) at= tsa:ma
{3MS.NOM, 2S.ACC} calls
'he calls you.'
b. (i) al= s= tsa:ma
3MS.NOM 1P.ACC calls
'he calls us'
(ii) as= tsa:ma
{3MS.NOM, 1P.ACC} calls
'he calls us.'

We account for the optionality in (23)–(24) as follows. Cardinaletti & Repetti (2008), in their analysis of Donceto (which is closely related to Bolognese), argue that proclitics are outside the verb's Prosodic Word (PWd). We adopt this view and implement it by assigning proclitics to the Phonological Phrase (PPh). We further adopt recursive prosodic structure (Ito & Mester 2007, 2009a,b, 2013): each clitic induces a new Phh. Thus (23ai) has the structure in (25a), and (23aii) has the structure in (25b). *DUPLEX-PPh_{min} discourages duplexes in the minimal (= lowest) PPh and therefore penalizes (25b). But as we have seen, MAX and DEP favor duplexes and therefore militate against (25a). Which construction emerges depends on whether or not *DUPLEX-PPh_{min} can overcome faithfulness.

When NOM, DAT, and ACC are present, we find (25c), with the duplex outside the minimal PPh. *DUPLEX-PPh_{min} therefore satisfied, and the alternative with simplexes is not possible here.

(25)


With just one of DAT/ACC and a vowel-initial verb, duplexes are illict, and only a sequence of simplexes is permitted:

(26) a. (i) al= t= arspɑnd
3MS.NOM 2S.DAT responds
'he responds to you.'
(ii) *at=arspɑnd
b. (i) al= s= abraθa
3MS.NOM 1P.ACC hugs
'he hugs us.'
(ii) *as=abraθa

In our account, this prohibition on duplexes stems from two constraints. First, ONSET-PWd forces clitics to provide an onset for the verb. Second, CRISPEDGE-PWd (e.g. Ito & Mester 1999) prevents morphemes from straddling the PWd boundary. To be precise, CRISPEDGE-PWd is violated when part of a morpheme is in the PWd and another part is outside it. As shown in (27), duplexes adjacent to a vowel-initial verb must violate one of these constraints, but simplexes do not.

(27)

/3MS.NOM, 2S.DAT, arspand/	ONSET-PWd	CRISPEDGE-PWd
☞ a. al=[t=arspand]$_{PWd}$		
b. a[t=arspand]$_{PWd}$		-1
c. [at=arspand]$_{PWd}$	-1	
d. at=[arspand]$_{PWd}$	-1	

One more constraint was included in our analysis. We found DEP-σ_1 to be useful in ruling out extraneous alternations for 3MS.NOM (which is always word-initial, except in inversions like (8)). To be clear, this constraint operates exactly like DEP, except that it penalizes only initial-syllable epenthesis.

5.2. NHG Simulations

In NHG, constraint weights are perturbed on each evaluation, potentially yielding different outputs on different occasions. We implemented NHG in R (R Core Team 2022; the code is available at https://github.com/afkaplan/Bolognese). Noise was drawn from a Gaussian distribution with a mean of 0 and a standard deviation of 1. Constraint weights (28) and activities (29) are given below. Though we arrived at these numbers through trial and error, they reflect basic facts about Bolognese. For example, the high weights for the last four constraints in (28) renders these constraints effectively inviolable, and as described above, when MAX and DEP conflict, the latter should win.

(28)

Constraint	**Weight**
MAX	5
DEP	15
DEP-σ_1	28
*DUPLEX-PPh$_{min}$	34
*[+son]PERIPHERY	37
ONSET-PWd	55
CRISPEDGE-PWd	55

(29)

Clitic	**Allomorph**	**Activity**
3MS.NOM	[l]	0.1
	[al]	0.8
	duplexes	0.45
3MS.ACC	[l]	0.95
	[al]	0.7
2S.DAT	[t]	0.3
	[at]	0.45
2S.NOM	[t]	0.3

Each of the forms identified in section 5.1 was passed through the grammar 10,000 times. For the categorical data, the simulations produced the lone attested forms exclusively. For the optional duplexes (23a), [al=t=diːz] was produced with a frequency of 0.648 and [at=diːz] was produced with a frequency of 0.352. Without frequency data, we cannot assess the accuracy of these numbers; all we can say is that the simulations produced all and only the attested outputs.

6. Conclusion

GSRs offer an account of suppletive allomorphy without requiring a suppletion-specific apparatus. In an earlier analysis (Rubin & Kaplan 2022a), we used LS, a framework in which allomorphs are ranked on a hierarchy and the constraint PRIORITY penalizes candidates that use allomorphs lower on the hierarchy. The GSR-based analysis mimics this hierarchy by assigning preferred allomorphs greater activity than other allomorphs, and the work done by PRIORITY is instead done by MAX and DEP. Though DEP now does double duty, regulating both suppletion and epenthesis, the analysis nonetheless disentangles those two processes, with each occurring exactly where it should.

Finally, our analysis raises intriguing possibilities for future exploration. We assumed that whole allomorphs are assigned activity rather than individual segments. The central allomorphs at issue, [al] and [l], are sufficiently similar that one could reasonably ask if they both derive from /al/, despite Bolognese having no general [a]-deletion process. Perhaps [a] deletes only in these morphemes because it has lower activity than [a] in other morphemes. This approach would reduce the amount of suppletion attributed to Bolognese's clitic system by conflating [al] and [l], but the duplexes would still require a suppletion analysis. And on the NHG front, it is worth probing the characteristics of a system that perturbs activity rather than constraint weights.

References

Boersma, Paul & Joe Pater. 2016. Convergence properties of a Gradual Learning Algorithm for Harmonic Grammar. In John J. McCarthy & Joe Pater (eds.), *Harmonic grammar and harmonic serialism*, 389–434. Bristol, CT: Equinox.

Canepari, Luciano & Daniele Vitali. 1995. Pronuncia e grafia del Bolognese. *Rivista Italiana di Dialettologia* 19. 119–164.

Cardinaletti, Anna & Lori Repetti. 2008. The phonology and syntax of preverbal and postverbal subject clitics in Northern Italian dialects. *LI* 39(4). 523–563.

Clements, G.N. 1991. Place of articulation in consonants and vowels: a unified theory. *Working Papers of the Cornell Phonetics Laboratory* 5. 77–123.

Faust, Noam & Paul Smolensky. 2017. *Activity as an Alternative to Autosegmental Association*. Paper presented at the 25th Manchestser Phononology Meeting.

Hayes, Bruce. 2017. Varieties of noisy HG. In Karen Jesney, Charlie O'Hara, Caitlin Smith & Rachel Walker (eds.), *Proceedings of AMP 2016*. Washington, DC: Linguistic Society of America.

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

Ito, Junko & Armin Mester. 1999. Realignment. In René Kager, Harry van der Hulst & Wim Zonneveld (eds.), *The prosody-morphology interface*, 188–217. Cambridge, U.K.: Cambridge University Press.

Ito, Junko & Armin Mester. 2007. Prosodic adjunction in Japanese compounds. In Yoichi Miyamoto & Masao Ochi (eds.), *Mit working papers in linguistics 55: formal approaches to Japanese linguistics 4*, 97–111. Cambridge, MA: Dept. of Linguistics & Philosophy, MIT.

Ito, Junko & Armin Mester. 2009a. The extended prosodic word. In Baris Kabak & Jaent Grijzenhout (eds.), *Phonological domains: universals and derivations*, 135–194. The Hague: Mouton de Gruyter.

Ito, Junko & Armin Mester. 2009b. The onset of the prosodic word. In Steve Parker (ed.), *Phonological argumentation*, 227–260. London: Equinox.

Ito, Junko & Armin Mester. 2013. Prosodic subcategories in Japanese. *Lingua* 124. 20–40.

Jesney, Karen. 2007. *The Locus of Variation in Weighted Constraint Grammars*. Poster presented at the Workshop on Variation, Gradience and Frequency in Phonology. Stanford, CA: Stanford U. July 2007.

Mascaró, Joan. 2007. External allomorphy and lexical representation. *LI* 38. 715–735.

R Core Team. 2022. *R: A Language and Environment for Statistical Computing*. R Foundation for Statistical Computing. Vienna, Austria. https://www.R-project.org/.

Rubin, Edward J. & Aaron Kaplan. 2022a. *Categorical and Gradient Constraints on Clitic Allomorphy*. Paper presented at the American Meeting on Phononology 2022, October 22.

Rubin, Edward J. & Aaron Kaplan. 2022b. Lexical selection in Bolognese clitic allomorphy. *Isogloss. Open Journal of Romance Linguistics* 8(5). 1–17. https://doi.org/https://doi.org/10.5565/rev/isogloss.223.

Selkirk, Elisabeth. 1984. On the major class features and syllable theory. In Mark Aronoff & Richard T. Oehrle (eds.), *Language sound structure: studies in phonology*, 107–136. Cambridge, MA: MIT Press.

Smolensky, Paul & Matthew Goldrick. 2016. *Gradient Symbolic Representations in Grammar: The Case of French Liaison*. ROA-1286, Rutgers Optimality Archive, http://roa.rutgers.edu.

Vitali, Daniele. 2009. *Dscårret in bulgnaiṡ?* 2nd edn. Bologna: Perdisa.

Zimmermann, Eva. 2019. Gradient symbolic representations and the typology of ghost segments. In Katherine Hout, Anna Mai, Adam McCollum, Sharon Rose & Matthew Zaslansky (eds.), *Proceedings of the 2018 annual meeting on phonology*. Linguistic Society of America.

Proceedings of the 41st West Coast Conference on Formal Linguistics

edited by Nikolas Webster, Yağmur Kiper, Richard Wang, and Sichen Larry Lyu

Cascadilla Proceedings Project   Somerville, MA   2025

Copyright information

ISBN 978-1-57473-483-6 hardback

Ordering information

Orders for the printed edition are handled by Cascadilla Press.
To place an order, go to www.lingref.com or contact:

Cascadilla Press, P.O. Box 440355, Somerville, MA 02144, USA
phone: 1-617-776-2370, fax: 1-617-776-2271, sales@cascadilla.com

Web access and citation information