Session 3B Abstracts

Post-Lexical Tone 3 Sandhi Domain-Building in Huai'an Mandarin: Multiple Domain Types and Free Application

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Based on the production and acceptability data of tone sandhi patterns of the Huai'an dialect of Jianghuai Mandarin (Huai'an, hereafter) at the syntactic level, this paper argues that (i) both disyllabic and trisyllabic tone sandhi domains are basic domains in Huai'an, which differs from the traditional analysis where only disyllabic domain exists in the Mandarin language family and trisyllabic domain is derived, and (ii) as a consequence, both types of domains can be built freely at the post-lexical level as long as all the syllables are exhaustively incorporated.

BACKGROUND: In Standard Mandarin, T3 (low-dipping tone) becomes T2 (high-rising tone) before another T3. According to Chen (2000) and Shih (1997), a trisyllabic sandhi domain only exists at sentence-final position through incorporating a final stranded syllable after left-to-right binary parsing: T3 T3 T3 T3 T3 T3 T3 → (T2 T3) (T2 T3) (T2 T3) T3 → (T2 T3) (T2 T3) (T2 T2 T3). In Huai'an, however, a trisyllabic domain can appear at sentence-initial, sentence-medial and sentence-final positions. Furthermore, all the logical combinations of disyllabic and trisyllabic domains are attested for 6-syllable and 7-syllable utterances as shown in (1), which suggests that both disyllabic and trisyllabic domains are basic domain types in Huai'an.

(1)

	li	tsuŋ	ɕiæ̃	ɕiæ̃	o	tɕiəɯ
	you	always	want	grab	me	wine

"You always want to rob me of wine"

UR   T3 T3 T3 T3 T3 T3
SR1 (T2 T3)(T2 T3)(T2 T3)
SR2 (T2 T2 T3)(T2 T2 T3)

	li	tsuŋ	kæ̃	ɕiæ̃	ɕiæ̃	o	tɕiəɯ
	you	always	dare	want	grab	me	wine

"You always seek to rob me of wine."

UR   T3 T3 T3 T3 T3 T3 T3
SR1 (T2 T2 T3)(T2 T3)(T2 T3)
SR2 (T2 T3)(T2 T2 T3)(T2 T3)
SR3 (T2 T3)(T2 T3)(T2 T2 T3)

METHODS, ANALYSIS AND RESULTS: We conducted two experiments. Experiment I was a production task through PsychoPy2 (Peirce et al., 2019) where 10 speakers (6 male, 4 female, age 22 to 56) pronounced a list of 5-syllable to 7-syllable utterances similar to (1), with each underlying T3 syllable forming a separate word. The counts of the different surface tonal patterns produced are in Table 2. Experiment II was an acceptability judgement task where recordings (by a 25-year-old male native speaker) of all logically possible domain combinations (same as in (1)) for a 6-syllable and a 7-syllable flat-structure loanwords (novel foreign names: mi ka ma ua li er & mi ka ma ua li pɔ er) were presented to 6 participants (1 male, 5 female, age 22 to 51). Since T3 sandhi domain-building processes for flat-structure loanwords and the post-lexical utterances are identical, using loanwords avoids potential syntactic influence. Judgement was given on a scale of 1 to 7 with 1 being completely unacceptable and 7 being completely acceptable. The data of the production task was impressionistically annotated and counted, the results (see Table 1) show that each expected combination is produced in natural speech. The results of the acceptability task (see Table 3) comparing the expected grammatical and ungrammatical forms corroborate our analysis for the T3 sandhi domain-building process as involving either trisyllabic or disyllabic domains at the post-lexical level (Note: more data is being collected).

CONCLUSION: By positing both disyllabic and trisyllabic domains, this analysis gives a succinct analysis of T3 sandhi pattern in Huai'an and removes the parameter of directionality. Furthermore, a lapse-based analysis (Kenstowicz, 1995) involving a binary tone domain with an unparsed syllable is unlikely because it cannot produce the surface representation of (T2 T2 T3) in T3 Sandhi.

This suggests more generally that ternary prosodic units, including ternary stress feet (Prince, 1980), are independent domains in phonology.

Table 1: Experiment I Results: Counts for each combination of 5-syllable, 6-syllable and 7-syllable stimuli, each combination given by multiple participants.

Stimulus	Surface representation	Count
5-syllable	(T2 T2 T3)(T2 T3)	83
	(T2 T3)(T2 T2 T3)	182
6-syllable	(T2 T2 T3)(T2 T2 T3)	65
	(T2 T3)(T2 T3)(T2 T3)	77
7-syllable	(T2 T2 T3)(T2 T3)(T2 T3)	27
	(T2 T3)(T2 T2 T3)(T2 T3)	5
	(T2 T3)(T2 T3)(T2 T2 T3)	6

Table 2: Experiment I: Numbers of 5-syllable, 6-syllable and 7-syllable stimuli.

Stimulus	Examples reported in Table 1	All examples collected from Experiment I	Ambiguous examples	Examples undergoing other rules not focused in this study
5-syllable	265	49x10=490	4	221
6-syllable	142	32x10=320	6	172
7-syllable	38	12x10=120	2	80

Table 3: Experiment II Results: Wilcoxon test results for pairs of grammatical combinations and ungrammatical forms for a 6-syllable and a 7-syllable loanwords.

Stimulus	Pairs compared	Wilcoxon test result
6-syllable	(T2 T2 T3)(T2 T2 T3) ~ *333333	V = 21, p = 0.03
	(T2 T3)(T2 T3)(T2 T3) ~ *333333	V = 15, p = 0.06
7-syllable	(T2 T2 T3)(T2 T3)(T2 T3)~*3333333	V = 21, p = 0.04
	(T2 T3)(T2 T2 T3)(T2 T3) ~*3333333	V = 21, p = 0.04
	(T2 T3)(T2 T3)(T2 T2 T3) ~*3333333	V = 17.5, p = 0.17

Reference

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Gradient similarity and gradient representations in Lezgian laryngeal harmony

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Similarity plays a key role in defining the classes of sounds that interact in phonology (Kaun 1995; Wayment 2009). Moreover, a definition of similarity is crucial to the evaluation of both input-output and surface correspondence in Agreement-by-Correspondence (Rose & Walker 2004). However, the **representational structure** necessary to compute similarity is often left undefined. The current paper encodes similarity as a weighted featural similarity lattice in Gradient Harmonic Grammar (Smolensky et al. 2014; Smolensky & Goldrick 2016). The gradient representational system proposed correctly predicts the behavior of stops in Lezgian, providing a reanalysis of the consonant agreement patterns in Ozburn & Kochetov (2018).

Lezgian. Co-occurring stops in Lezgian generally agree in Laryngeal specifications, e. g. T'↔T' (T'=Ejective, T=Voiceless, T^h=Aspirated, D=Voiced), **except** T^h↔T and T↔D. The challenge is to define similarity as to allow overrepresented but disharmonic T^h↔T and T↔D (1) while penalizing the underrepresented structures in (2).

(1) *Overrepresented laryngeal co-occurrences in Lezgian* (*O*/*E* ≥ 1; Ozburn & Kochetov 2018)

Ejective-ejective	[q'at͡s'un]	'get dirty'	Aspirated-aspirated	[tʃ^{h}ip^h]	'fool'
Voiceless-voiceless	[qaqa]	'ready'	Aspirated-voiceless	[k^{h}ut͡sun]	'to flush'
Voiced-voiced	[midad]	'grieve'	Voiceless-voiced	[et͡sigun]	'put'

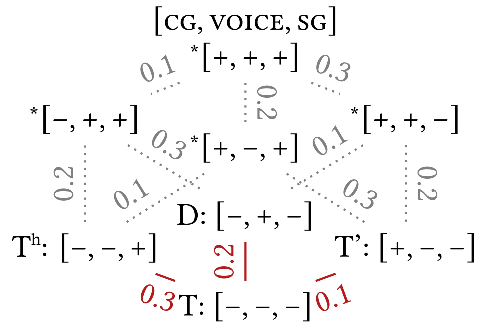
(2) *Underrepresented laryngeal co-occurrences in Lezgian* (*O*/*E* < 1; Ozburn & Kochetov 2018)

T↔T', T'↔T, T'↔D, T'↔T^h, D↔T', D↔T^h, T^h↔D, T^h↔T'

The generalization is that the forms in (2) are too similar to co-occur, resulting in correspondence, which forces agreement. However, the exceptional T^h↔T and T↔D are sufficiently dissimilar to avoid correspondent, and as a result, escape the impetus to agree in Laryngeal features. The basic intuition is that the perceptual distance, w, between [+cg] and [-cg] is smaller than the perceptual distance between [+voice] and [-voice], which is smaller than the difference between [+sg] and [-sg], i.e. $w_{[CG]} < w_{[VOICE]} < w_{[SG]}$.

Similarity metric. Previous similarity metrics treat all ws equivalently (Frisch et al. 2004; Coetzee & Pater 2008), where *Similarity = the number of shared features/total number of features*. As a consequence, these metrics cannot capture gradient differences in similarity across features. For example, the distances between T and D, and T and T' are both one, which incorrectly predicts that their perceptual differences are equal. The metric in the current study defines similarity as the summed weights of their **unshared features** with respect to the feature set ($\mathscr{F}$) and a **weighted lattice** (**w**) on the right: $distance_{\mathbf{w}}(x, y) = \sum_{f \in \mathscr{F}} w_f \cdot \delta_f(x, y)$. The term $\delta_f(x, y)$ is 0 when x and y share the feature f, and 1 elsewhere, which conceptually is the **categorical** distance provided by the lattice structure. The featural weight w_f encodes the **gradient** distance between [+] and [-] feature values. The specific weights in use are $w_{[CG]} = 0.1$, $w_{[VOICE]} = 0.2$, $w_{[SG]} = 0.3$, and the rest featural weights are assumed as 0 at present.

Similarity is computed over a weighted lattice defining phonetic similarity of feature values. The specific weights used are $w_{[\text{CG}]}$: 0.1, $w_{[\text{VOICE}]}$: 0.2, $w_{[\text{SG}]}$: 0.3, as illustrated on the right. The lattice represents the universal structure of a binary feature system, and shows the 8 logically possible combinations of the three Laryngeal features. Unattested stop segments are marked by asterisks. Solid and dashed lines indicate the attested and unattested paths. Weights on the paths correspond to w.



Analysis. Previous work on Agreement-by-Correspondence has highlighted the importance of similarity (Rose & Walker 2004). Like Wayment (2009), the current study incorporates a quantitative similarity metric over which the following constraints operate:

(3) Corr[*Sim.* ≥ k]: if *Sim.* ≥ k, two segments must be in correspondence.

(4) Ident-CC[$w_{\text{Laryngeal}}$]: if two segments are in correspondence, penalize any difference in their Laryngeal features.

(5) Ident-IO[$w_{\text{Laryngeal}}$]: penalize any input-output difference in Laryngeal.

Corr[*Sim.* ≥ k] further produces an ordinally-weighted set of constraints, where $x > y$ indicates that the weight of Corr[*Sim.* ≥ x] is greater than of Corr[*Sim.* ≥ y]. The activation over Laryngeal features $w_{\text{Laryngeal}}$ (w_{LG} henceforth) factors into the calculation of the penalties of Ident-IO[w_{LG}] and Ident-CC[w_{LG}] ($\mathscr{P} = w \times w$; Smolensky & Goldrick 2016). As illustrated in the following tableaux, Corr[*Sim.* ≥ 0.5]≫Ident-CC[w_{LG}]≫Ident-IO[w_{LG}] makes the correct predictions: in (i), /et͡sigun/ cannot trigger laryngeal harmony since the similarity between /t͡s/ and /g/ (<0.5) is too small, in contrast to (ii) where /q/ and /t͡s/ are close enough to be in correspondence and to trigger agreement (/q$_x$at͡s’$_x$un/⟶[q$_x$at͡s’$_x$un]).

Input	Output	Corr[*Sim.* ≥ 0.5] w = 20	Id-CC[w_{LG}] w = 18	Id-IO[w_{LG}] w = 5	Corr[*Sim.* ≥ 0] w = 0.1	$\mathscr{H}$
i. /et͡sigun/	a. [et͡s$_x$ig$_y$un][*Sim.* = 0.47] ☞				1	−0.1
	b. [et͡s$_x$ik$_x$un][*Sim.* = 0.71]			0.2		−1.0
	c. [et͡s$_x$ik’$_x$un][*Sim.* = 0.57]			0.2 + 0.1		−1.5
ii. /qat͡s’un/	a. [q’$_x$at͡s’$_x$un][*Sim.* = 0.64] ☞			0.2		−1.0
	b. [q$_x$at͡s’$_x$un] [*Sim.* = 0.54]		0.1			−1.8
	c. [q$_x$at͡sʰ$_x$un] [*Sim.* = 0.31]		0.3	0.3 + 0.1		−5.6
	d. [q$_x$at͡s’$_y$un] [*Sim.* = 0.54]	1			0.1	−20.1

For any input, the ranking condition guarantees that, the candidates with highest similarity must be in correspondence and trigger the agreement on the surface (iia). Unlike other work in Gradient Harmonic Grammar, The current study argues that gradient featural activity is not present underlyingly (e.g. Zimmerman 2018; Jang 2019; Walker 2019), but defines the representational space over which both input-output and surface similarity are evaluated.

Conclusion. The current study accounts for laryngeal co-occurrence patterns in Lezgian by introducing a gradient featural similarity lattice, over which the intra-featural similarity is evaluated. Moreover, the proposed lattice offers a universal structure to link language-specific phonetics to phonological features.

Optimization Versus Locality in Explaining Optionality in Syllabification of Yavapai

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Introduction: Yavapai is an Upland Yuman language with many underlying consonantal sequences (Sharitan 1983). It syllabifies these consonants to avoid complex onsets or codas to surface. This paper discusses how Optimality Theoretic explanation fails to account for optional realizations of consonant sequences' syllabification. It instead proposes that Input Strictly Local functions (Chandlee 2014) provide a better explanation of the distribution of different syllabifications based on the computational complexity of the functions generating the two optional surface forms.

Data Analysis by OT: Here are some data with underlying consonant sequences:

(1)	/sʔami/ close	(2)	/nβaː/ arrive-pl	(3)	/mlqi/ neck	(4)	/tʔruji/ make hot
	s-ʔami		n-βaː		[ml̩.qi] or		[təʔ.ru.ji] or
	causative+move		plu+arrive		[ml̩.ləq˺.qi]		[təʔ˺.ʔr̩.ru.ji]
	[səʔ˺.ʔa.mi]		[nβ̩.βaː]				

As seen above, Yavapai does not allow complex consonantal onsets or codas to surface. To avoid them, Yavapai forms new syllables based on these consonants instead of deleting consonants or always epenthesizing vowels. For example: /nβ/ becomes [nβ̩.β] where the second consonant [β] is both the nucleus of the first syllable and the onset of the next. However, when the second consonant is a stop, a schwa is epenthesized which together with the stop forms the nucleus of a syllable such as in (1). Since in sonority hierarchy (Dell & Elmedlaoui 1985, 1988, 1989) voiceless stops are the least sonorant segments, they are thus the worst options of being nucleus. Additionally, a schwa cannot form a syllable nucleus on its own and thereby requires a coda consonant. We can motivate this with the notion that schwa is one of the least sonorous vowels (de Lacy 2006: 68) and is thus defective as a nucleus. Informally we can refer to this constraint as $*ə]_\sigma$.

Below are two simplified OT tableaux showing what surface forms OT predicts for the four above. *COMPLEX assigns a violation to any complex onset or complex coda. *NUC/stop assigns a violation to any stop being some syllable's nucleus.

/sʔami/	*COMPLEX	*NUC/stop	DEP(ə)	$*ə]_\sigma$
[sʔa.mi]	!*			
[sʔ̩.ʔa.mi]		!*		
[sə.ʔa.mi]			*	!*
☞[səʔ˺.ʔa.mi]			*	

/mlqi/	*COMPLEX	*NUC/stop	DEP(ə)	$*ə]_\sigma$
[mlqi]	!*			
[ml̩.ləq˺.qi]			!*	
☞[ml̩.qi]				

In the left tableau, the surface form is correctly predicted as the optimal form. However, the right tableau selects only the shorter form [ml̩.qi] as the optimal candidate. The longer one [ml̩.ləq˺.qi] turns out to be harmonically bounded by [ml̩.qi]. A similar situation occurs in the optimization process for /tʔruji/: [təʔ.ru.ji] will be selected as the optimal candidate and the longer surface form [təʔ.ʔr̩.ru.ji] is harmonically bounded by it, since it violates one more constraint *NUC/liq. This is a wrong prediction of the behavior of OT: since the optimization process will choose the well-formed candidate with fewest constraint violations, the longer form which "unnecessarily" creates [ləq˺] inevitably violates more faithfulness constraints, and is therefore a worse candidate.

Problems of OT Analysis:The surface forms' optionality poses two difficult problems for OT: First, since the syllable formed by the second and third consonants is redundant from the view of optimization, the longer form is harmonically bounded by the shorter form. Therefore no OT grammar based on the current set of constraints can account for the optionality. Second, the long form is attested much more than the predicted "optimal form" by OT based on the data in Sharitan's dissertation. Optimization-based grammars thus cannot explain this distribution.

Computational Analysis: The ISL class provides a fine-grained measure of complexity, based on the number of segments used to determine the output: an ISL_k function (which uses k segments) is more complex than an ISL_{k-1} function (Chandlee 2014). We propose that this provide an explanation of how the two forms are generated as well as why the longer surface form is more attested. Since there are two surface forms, there need to be two different functions f_{long} and f_{short} such that when the input is #mlqi, f_{long}(#mlqi) =#ml̩.ləq̚.qi while f_{short}(#mlqi) =#ml̩.qi. Optionality of some lexical items can be explained as both functions being available to these items. But these two functions have different computational complexities: the one generating the longer form is less complex than the other. Intuitively, this explains why the longer form is more attested in Yavapai: **when both surface forms are well-formed based on the syllable phonotactics, the one that is less complex to generate is more frequently attested.** Although the relation between the computational complexity of transformations from underlying form to surface form and optionality of surface forms is not yet discussed much in the literature, the intuitive hypothesis here explains the distribution of surface forms observed in Yavapai.

Here is the intuition behind the different complexities of f_{long} and f_{short}. f_{long} and f_{short} read input segment strings from left to right, and sequentially give output segment(s) based on the corresponding input segment and some fixed number of segments preceding it. In f_{long}, the output of the segment is determined by **three** segments in total. Take the segment /r/ in (4) as an example:

(5) /#tʔruji/

#	t	ʔ	r	u	j	i

[#təʔ̚.ʔr̩.ru.ji]

#	t	əʔ̚	ʔr̩	ru	j	i

(6) /#ʔra/

#	ʔ	r	a

[#ʔr̩.ra]

#	ʔ	r̩	ra

In (5) and (6), /r/'s outputs are different even when the segment before it is the same. In (5), since [r̩] needs an onset but /ʔ/'s output is [əʔ̚] which does not provide [r̩] an onset, the output of /r/ needs to be the complete syllable [ʔr̩]. In (6), since output of /ʔ/ is [ʔ] which can be a syllable's onset, the output of /r/ is [r̩]. Therefore the output of segment /r/ depends on at least two segments before it in f_{long}. For all forms given in Sharitan (1983), the output is always the same when the two segments immediately before it are the same. Therefore, the output of a segment in f_{long} is determined by in total three input segments—its correspondent input segment and the two before it. Thereby f_{long} is an ISL_3 function.

However, the output of each segment in f_{short} needs **four** input segments in total to be determined:

(7) /#tʔruji/

#	t	ʔ	r	u	j	i

[#təʔ̚.ru.ji]

#	t	əʔ̚	λ	ru	j	i

(8) /#ttʔr/

#	t	t	ʔ	r

[#tət̚.ʔr̩]

#	t	ət̚	ʔ	r̩

In (7), the output of segment /r/ is an empty string λ. This is because if the segment after /r/ was #, f_{short}(#tʔr#) would be #təʔ̚.ʔr̩#; but if the next segment was /a/, f_{short}(#tʔra) would be #təʔ̚.ra. So /r/'s correspondent output segment after /#tʔ/ is completely determined by the next segment and its own output is thereby λ. But in (8), the output of /r/ is [r̩] and is irrelevant to segments after it. Therefore although /#ttʔr/ and /#tʔr/ share two segments /ʔr/ before /r/, /r/'s outputs are different. In all forms in Sharitan (1983), the output of a segment is the same if the three segments before it are the same. Therefore the output of a segment is determined by four segments—its correspondent input and three segments before it. f_{short} is therefore ISL_4. Since ISL_4 functions are more complex than ISL_3 functions, f_{short} is more complex than f_{long}.

Conclusion: This paper shows that OT cannot explain the optionality in Yavapai and the surface forms' distribution. ISL functions can account for why the long form should be more commonly attested than the short form since the function generating the former is less complex.

Selected Reference: · Sharitan, Alan. 1983. *Phonology and Dictionary of Yavapai*. Ph.D. Dissertation, University of California, Berkeley. · Chandlee, Jane. 2014. *Strictly Local Phonological Processes*. Ph.D. Dissertation, University of Delaware.

The learnability of abstract underlying segments in OT
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This paper addresses how learners posit abstract underlying segments to resolve contradictions observed in surface forms, and how they can subsequently concretize these abstract underlying segments by setting the segment's presence feature: a learning feature utilized during Inconsistency Detection (ID) that indicates the presence of an underlying segment (Nyman & Tesar, 2019). The testing case here will be a case of elision in French where /ə/ deletes before vowels across morpheme boundaries. In cases where a consonant is between two vowels, elision is blocked and /ə/ surfaces. However, a contradiction arises in the case of [ləazaʁ], as it has an elision-inducing input environment, but an output exhibiting elision blockage (Boersma, 2007). Examples of these mappings are given below:

(i)	[+cons] Context	/lə#gaʁsɔ̃/ → [ləgaʁsɔ̃]	Elision Blocked
(ii)	[+voc] Context	/lə#ɔʁɑʒ / → [lɔʁɑʒ]	Elision
(iii)	Contradiction	/lə#azaʁ/ → [ləazaʁ]	Elision Blocked

The learner must resolve this contradiction somehow; the proposal here is that while [azaʁ] and [ɔʁɑʒ] appear to be phonologically identical, they are not. Since it can be observed that consonantal segments block elision, the learner posits the existence of a consonantal segment in onset position for /azaʁ/. Importantly, however, it would be unproductive to posit a consonant with phonetic features, given the absence of one on the surface and no motivation to delete a consonant in onset position. The learner, therefore, appeals to an abstract segment, namely the ghost consonant, notated *C,* (Kiparsky, 2003): a segment with a [+cons] feature and no other features. Allowing ghost consonants in the phonology requires that these segments be allowed in both input and output representations. This results in a fully-faithful candidate: /lə#*C*azar/ → [lə*C*azar]. Having the ghost consonant notated in the output is not a problem; the ghost consonant is represented in the phonology, but has no phonetic correlate (meaning, for this work, [lə*C*azaʁ] and [ləazaʁ] are phonetically equivalent).

To learn the surfacing alternation of /lə/ in [lə*C*azaʁ] vs. [lɔʁɑʒ], the learner begins by collecting Phonotactic Ranking information (Tesar & Prince, 2003), a set of fully-faithful candidates paired with informative losers. Given the following Markedness, {*VV, *CC, Ons}, and Faithfulness, {Max(C), Max(V), Dep(C), Dep(V)}, constraints, the learner compiles the following support with observed winners, paired with losers that provide ranking information. The observed forms with informative losers are [ɔʁɑʒ] and [kɜlgaʁsɔ̃]:

(iv) Phonotactic Ranking Information

Input	W~L	Ons	*VV	*CC	Max(C)	Max(V)	Dep(C)	Dep(V)
ɔʁɑʒ	ɔʁɑʒ ~ gɔʁɑʒ	L	e	e	e	e	W	e
ɔʁɑʒ	ɔʁɑʒ ~ ʁɑʒ	L	e	e	e	W	e	e
kɜl#gaʁsɔ̃	kɜlgaʁsɔ̃ ~ kɜgaʁsɔ̃	e	e	L	W	e	e	e
kɜl#gaʁsɔ̃	kɜlgaʁsɔ̃ ~ kɜləgaʁsɔ̃	e	e	L	e	e	e	W

After learning from fully faithful mappings, the learner considers unfaithful mappings like: /lə#ɔʁɑʒ/ → [lɔʁɑʒ]. The winner/loser pairs for this candidate as compared to the current, Phonotactic Ranking Information, result in the Non-Phonotactic Ranking information (Tesar, 2006) shown below:

(v) Non-Phonotactic Ranking Information

Input	W~L	Ons	*VV	*CC	Max(C)	Max(V)	Dep(C)	Dep(V)
ɔʁɑʒ	ɔʁɑʒ ~ gɔʁɑʒ	L	e	e	e	e	W	e
ɔʁɑʒ	ɔʁɑʒ ~ ʁɑʒ	L	e	e	e	W	e	e
kɜl#gaʁsɔ̃	kɜlgaʁsɔ̃ ~ kɜgaʁsɔ̃	e	e	L	W	e	e	e
kɜl#gaʁsɔ̃	kɜlgaʁsɔ̃ ~ kɜləgaʁsɔ̃	e	e	L	e	e	e	W
lə#ɔʁɑʒ	lɔʁɑʒ ~ ləɔʁɑʒ	W	W	e	e	L	e	e

lə#ɔʁaʒ	lɔʁaʒ ~ ləgɔʁaʒ	e	e	e	e	L	W	e

After Recursive Constraint Demotion (Tesar & Smolensky, 1995), we achieve the following ranking:

(vi) *VV >> {Dep(C), Dep(V), Max(C)} >> *CC >> Max(V) >> Ons

The learner can confirm that this ranking generates the target output, [lə*C*azaʁ], where the ghost consonant blocks the elision of /ə/, by assuming the following input-output mapping in (vii):

(vii) <u>/lə#*C*azaʁ/ → [lə*C*azaʁ]</u>

/lə#*C*azaʁ/	*VV	Dep(C)	Dep(V)	Max(C)	*CC	Max(V)	Ons
⇒[lə*C*azaʁ]							
[ləazaʁ]	*!			*			*
[lazaʁ]				*!		*	
[l*C*azaʁ]					*!	*	

To concretize this input-output mapping for the purposes of learning, the learner sets its presence features. During presence feature setting, a segment is set to (+) underlyingly if there is paradigmatic evidence through ID that the segment in question must be present underlyingly to achieve the desired output. To test the presence of a segment, the learner sets the segment in question (bold faced and underlined in (b)) to (-) underlyingly, sets all other segments to (+) underlyingly, and then tests the resulting candidate. If consistency is reached, the grammar can generate the desired output, even if the segment is not present underlyingly. If inconsistency is reached, due to contradiction between the candidate and the current candidate set, then the grammar cannot generate the desired output without the segment underlyingly present.

(viii) <u>Setting the presence feature for the ghost consonant</u>

a) /Input/ → [Output] /lə#*C*azaʁ/ → [lə*C*azaʁ]

b) /Input with presence features set for ID/ = testing candidate

/(+,l)(+,ə) # (**<u>-,*C*</u>**)(+,a)(+,z)(+,a)(+,r)/ = /lə#azaʁ/ → [lə*C*azaʁ]

Input	W~L	Ons	*VV	*CC	Max(C)	Max(V)	Dep(C)	Dep(V)
ɔʁaʒ	ɔʁaʒ ~ gɔʁaʒ	L	e	e	e	e	W	e
ɔʁaʒ	ɔʁaʒ ~ ʁaʒ	L	e	e	e	W	e	e
kɜl#gaʁsɔ̃	kɜlgaʁsɔ̃ ~ kɜgaʁsɔ̃	e	e	L	W	e	e	e
kɜl#gaʁsɔ̃	kɜlgaʁsɔ̃ ~ kɜləgaʁsɔ̃	e	e	L	e	e	e	W
lə#ɔʁaʒ	lɔʁaʒ ~ ləɔʁaʒ	W	W	e	e	L	e	e
lə#ɔʁaʒ	lɔʁaʒ ~ ləgɔʁaʒ	e	e	e	e	L	W	e
lə#azaʁ	lə*C*azaʁ ~ lazaʁ	e	e	e	e	W	L	e

There is contradiction so the candidate is inconsistent. The learner now sets the ghost consonant, /*C*/, to (+), and has successfully learned that it must be present underlyingly to achieve the desired output. Not only does attributing elision blockage to the presence of a ghost consonant significantly reduce model complexity of elision (see selected references) it results in a learnable algorithm. The presence feature allows the learner to concretize the ghost consonant as part of the underlying form, resulting in a useful generalization and resolution of segmental uncertainty between an input and output during learning.

<u>Selected References</u>: Boersma, Paul. "Some listener-oriented accounts of h-aspiré in French." *Lingua* 117.12 (2007): 1989-2054. Nyman, Alexandra, and Bruce Tesar. "Determining underlying presence in the learning of grammars that allow insertion and deletion." *Glossa* 4.1 (2019): 1-41. Tranel, Bernard. "French liaison and elision revisited: A unified account within Optimality Theory." *Aspects of Romance linguistics* (1996): 433-455.