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Final /n/ Deletion in Ghayeni Persian: Opacity in Harmonic Serialism and Parallel Optimality Theory

This paper explores the application and non-application of final /n/ deletion in Ghayeni Persian. In this dialect, final /n/ deletion is a productive phonological process whose application in different domains and environments is affected by several opaque counterbleeding and counterfeeding interactions as well as bleeding. This research presents new empirical data about these aspects which could be of general theoretical interest. It is also an attempt to make a contribution to current debate in phonological opacity. In so doing, it adopts Harmonic Serialism (HS) to accommodate counterbleeding opacity. It offers an analysis to survive a pitfall challenging HS in handling counterbleeding opacity in derived words. With regard to counterfeeding opacity, it adopts Parallel Optimality Theory (POT) using Local Constraint Conjunction (LCC). It discusses how POT and HS in particular could treat opaque interactions in Ghayeni dialect. In addition, this paper argues that a candidate which undergoes the same process twice in the same step could also be included in HS's gradualness condition.

Keywords: Phonological Opacity; Bleeding; Counterbleeding; Counterfeeding; Parallel Optimality Theory; Harmonic Serialism; Ghayeni Persian

Introduction

This paper offers an optimality-theoretic account of the occurrence and non-occurrence of final /n/ deletion in Ghayeni Persian whose application in different domains and environments is affected by several opaque counterbleeding and counterfeeding interactions in addition to bleeding. The theoretical machinery utilized in this research builds directly on Optimality Theory's (OT) existing approaches involving a novel combination of theoretical tools. It aimed to discuss how Parallel Optimality Theory (POT) and Harmonic Serialism (HS) in particular could treat these opaque interactions in Ghayeni dialect. That is why OT's other existing approaches such as

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Stratal OT were not applied in this research. This research is intended to make a contribution by addressing certain conditions in which POT and HS might be able to treat opacity. It discusses although according to McCarthy[1] HS is not very successful in treating counterbleeding opacity, it might make it in *derived* words.

Phonological opacity was first defined by Kiparsky[2] "as a measure of how far the context or the consequences of a phonological process may be determined only by examining the surface structure".[3] According to Kiparsky[4] "the concept of opacity comes from the *SPE*[5] tradition: a rule is opaque if the fact that it applied or the context that determined whether it applied is not visible in the surface form".[6] "Although Chomsky[7] do not frame it in these terms, opacity is the crux of his argument against structuralist phonemics".[8]

"The phenomenon of phonological opacity has been the subject of much debate in the Generative Phonology especially following the appearance of OT when phonologists were quick to realize that, in its original version, OT was unable to describe a large set of phonological phenomena previously modelled by means of opaque rules".[9] Phonological opacity is a challenge for parallel OT mainly because it does not allow for intermediate levels of representation. Green[10] states that "opponents of OT[11] that opacity proves OT to be false and that phonology *must* be derivational." According to McCarthy[12] "there have been many proposals for accommodating opacity in OT, they rely on a third level of representation, neither underlying nor surface, as a crucial part of the analysis of opaque alternations. The defining property of a derivation is the presence of this third (or fourth or fifth) level of representation." He[13] adds that "previous attempts to meld OT with serial derivations or their analogues have not been fully successful. The challenge, then, is to make use of the derivational insight without losing hold of OT's essential properties and basic results. " Urek[14] states that "several modifications have been proposed over the years to incorporate opacity in OT. However, any of those approaches is associated with a number of problems, which sometimes prove fatal under closer examination." She adds that "in 'classic' (parallel) OT the Input- Output map has no internal structure and all possible variants are produced by Gen in one step and evaluated in parallel. Precisely this property makes opacity a challenging issue for OT."According to Anttila[15] "most approaches that

[1]McCarthy, "Harmonic serialism and parallelism", 2000.
[2]Kiparsky, "Abstractness, opacity and global rules", 1973.
[3]McCarthy, *Hidden generalizations: phonological opacity in optimality theory*, 2007, 2.
[4]Kiparsky, "Abstractness, opacity and global rules", 1973.
[5]Chomsky and Halle. *The Sound Pattern of English, 1968*.
[6]McCarthy, *Doing Optimality Theory*, 2008a, 270.
[7]Chomsky and Halle. *The Sound Pattern of English, 1968*, 75ff.
[8]McCarthy, *Hidden generalizations: phonological opacity in optimality theory*, 2007, 2.
[9]Bermúdez-Otero, "The acquisition of phonological opacity", 2003.
[10]Green, "Opacity in Tiberian Hebrew: Morphology, not phonology", 2004.
[11]See Chomsky, *The minimalist program*, 1995, McMahon, *Change, chance, and optimality*, 2000.
[12]McCarthy, *Hidden generalizations: phonological opacity in optimality theory*, 2007, 5.
[13]Ibid., 55–56.
[14]Urek, "Overapplication opacity in phonological acquisition", 2013.
[15]Anttila, *Variation and Opacity*, 2006.

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have been proposed to accommodate opacity assume that the problem lies in an inadequate theory of FAITHFULNESS and posit new kinds of faithfulness relations, e.g. Output-Output correspondence,[16] Sympathy,[17] and Turbidity."[18] He adds that "other approaches assume that the problem lies in an inadequate theory of MARKEDNESS and enhance the power of markedness constraints, e.g. Targeted Constraints[19] and Comparative Markedness.[20] Yet Stratal OT[21] assumes that phonological constraints indeed always interact transparently, contrary to appearances, and that noninteractions arise from outside phonology proper, in particular morphology." But Green[22] notes that "the solutions proposed within OT, such as sympathy theory and stratal OT, have proved to be unsatisfying to many OT proponents, who have found these proposals to be inconsistent with the parallelist approach to phonological processes otherwise characteristic of OT." Also Kager[23] believes that "each attempted solution has certain advantages and disadvantages and none of them seems to truly solve the opacity problem." However, as McCarthy[24] states that "opacity is deeply connected with the phonology of a language, and any adequate theory of opacity must recognize this."

As stated above several modifications of the theory have been proposed over the years to incorporate opacity. To this end, this research adopts HS as the derivational implementation of OT[25] to accommodate counterbleeding opacity. As Torres-Tamarit[26] describes HS, "it is a derivational version of OT in which EVAL imposes the same constraint hierarchy in every step of the derivation. In other words, HS is just a version of OT that combines optimization (i.e., constraint interaction) with derivations." McCarthy[27] points out that "after each evaluation, the optimal candidate selected by EVAL is fed back into GEN as a new input, from which a new candidate is constructed. This GEN- EVAL loop continues until there is *convergence*, when the optimum chosen by EVAL is identical to the most

[16]Benua, "Identity effects in morphological truncation", 1995.
[17]McCarthy, "Sympathy and phonological opacity", 1999.
[18]Goldrick, *Turbid output representations and the unity of opacity*, 2000.
[19]Wilson, *Consonant cluster neutralisation and targeted constraints*, 2001.
[20]McCarthy, "Comparative markedness", 2003.
[21]For details of the central hypothesis of Stratal OT see Anttila, *Variation and Opacity*, 2006, that defines it as "phonological ordering reflects morphological ordering. Morphology is divided into three levels called stem level, word level, and postlexical level, and morphological and phonological operations apply in tandem within each level. Opacity arises because word-level processes can mask stem-level processes and postlexical processes can mask both stem-level and word-level processes."
[22]Green, "Opacity in Tiberian Hebrew: Morphology, not phonology", 2004.
[23]Kager, *Optimality theory*, 1999, 377.
[24]McCarthy, *Hidden generalizations: phonological opacity in optimality theory*, 2007, 5.
[25]Prince and Smolensky, *Optimality Theory: Constraint Interaction is Generative Grammar,* 1993/2004, 94–95, McCarthy, "Harmonic serialism and parallelism", 2000, McCarthy, *A Thematic Guide to Optimality Theory*, 2002, 159–163, McCarthy, *Harmony in Harmonic Serialism, 2009,* McCarthy, "An introduction to Harmonic Serialism", 2010.
[26]Torres-Tamarit, *Syllabification and Opacity in Harmonic Serialism*, 2012, 8.
[27]McCarthy, "An introduction to Harmonic Serialism", 2010.

recent input to GEN. At that point, the derivation terminates, and the convergent form is the final output of the grammar."

Regarding counterfeeding opacity, we adopt POT using local constraint conjunction (LCC) originally proposed by Smolensky.[28] It is worth noting that discussing opacity in this research requires showing intermediate representations, although it is less common in OT works. A case of bleeding in which final /n/ deletion is bled by a prior phonological process is discussed as well using local constraint conjunction.

This paper is organized as follows; in the rest of this section after providing general features of Ghayeni phonology, we introduce and analyze final-n deletion in this dialect. In §1, we discuss final-n deletion in the plural marker once it is added to nouns ending in a consonant, nouns ending in vowels /ɑ/ or /e/, and nouns ending in [ou]. In §2, we analyze non-occurrence of final /n/ deletion in Ghayeni Persian in coda clusters including the /nd/ cluster and the glottal + /n/ cluster. Finally, in §3, we discuss both application and non-application of final /n/ deletion in the Ezafe construction including its application in the singular pronoun "in" and the plural pronoun "inɑn", and its non-application in the possessed and modified nouns as well as in nouns with the plural marker [au]. This research is concluded in §4 with a brief summary of some of the article's key points.

Ghayen is a city located in the northwest of South Khorasan province in Iran. A dialect of Persian (an Indo-European language) called "Ghayeni" is spoken in this city. General features of Ghayeni phonology based on Zomorrodian[29] are given below:

- Six vowel phonemes: /i/, /e/, /a/, /u/, /o/, /ɑ/ (Vowel length is not contrastive).
- Twenty-three consonant phonemes: /p/, /b/, /m/, /n/, /f/, /v/, /t/, /d/, /s/, /z/, /l/, /r/, /ʃ/, /ʒ/, /tʃ/, /dʒ/, /k/, /g/, /j/, /χ/, /G/, /ʔ/, /h/.
- Three syllable structures: CV, CVC, CVCC (glottal stop is inserted at the beginning of vowel initial words, and hiatus is resolved by deletion of a vowel or insertion of an intervocalic consonant).
- Stress pattern: The main stress is word-final in nouns, adjectives and adverbs. For the verbs, it depends on morphological and syntactic properties. (Since the main stress is always word-final in nouns, adjectives and adverbs and since it has nothing to do with final /n/ deletion, it is not an issue in the examples presented in this paper).

In Ghayeni dialect final /n/ deletion is a productive phonological process. We have to state explicitly that all of the data in this paper come from Zomorrodian,[30] approved and double- checked by one of the coauthors as a native speaker of Ghayeni Persian. Besides, in this research the underlying representation of Ghayani words is the Ghayani dialect rather than standard Persian although both dialects share the same underlying representation (henceforth UR) in many words especially

[28]Smolensky, *On the internal structure of the constraint component of UG*, 1995.

[29]Zomorrodian, Practical linguistics: Investigating Ghayen's dialect [Zabanshenasiyé amali: Barrasiyé gouyeshé Ghayen], 1989.

[30]Ibid.

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those including underlying final /n/ which originate in Middle Persian spoken during the Sassanid Empire (224–651 AD) as the ancestor of both Ghayeni and Modern Persian.[31] Application and non- application of final-n deletion in this dialect is shown in the data in (1):

(1)

/ʃirin/	→	[ʃiri]	'sweet'	,/ʃirin+i/	→	[ʃirini]	'sweetness'
/suzen/	→	[suze]	'needle'	,/suzen+i/	→	[suzeni]	'needle-like'
/ruʃan/	→	[ruʃa]	'light'	,/ruʃan+i/	→	[ruʃani]	'lightness'
/χun/	→	[χu]	'blood'	,/χun+i/	→	[χuni]	'bloody'
/bɑrɑn/	→	[bɑru]	'rain'	,/bɑrɑn+i/	→	[bɑruni]	'rainy'
/dʒɑn/	→	[dʒu]	'life'	,/dʒɑn+i/	→	[dʒuni]	'of life'

As evidenced in (1) final /n/ in the words on the left deletes, while non-final /n/ in their suffixed versions on the right does not. In addition, despite the productivity of this phonological process in Ghayeni dialect, it is being bled by some processes. In fact one reason we discuss cases of non-application of final-n deletion is to show that final /n/ does synchronically exist in the UR.

Now we introduce the constraints responsible for the occurrence of final /n/ deletion in Ghayeni Persian. Then, in the sections that follow we explore more complex applications and non-applications of this process in different environments in this dialect.

Based on the fact that the underlying /n/ deletes at word final position in Ghayeni Persian, we formalize the markedness constraint '*n]' which bans final [n].It is worth mentioning that just like Ghayeni Persian, Catalan and standard Dutch have a sort of final /n/ deletion. But unlike Catalan[32] and Standard Dutch[33] in which stress and schwa precede the deleted /n/ respectively, final /n/ deletion in Ghayeni Persian is not restricted to stress conditions or the presence of a certain vowel.

According to the ranking in (2), the markedness constraint '*n]' that triggers final /n/ deletion dominates the faithfulness constraint 'MAX' which mandates that every segment in the input has a correspondent in the output.

(2) *n] >> MAX

It is worthy of note that *n], just like other universal phonological constraints, is applicable in other languages. However, the ranking is different in standard Persian as well as in many world languages where final /n/ deletion does not apply i.e., it is MAX that dominates *n] (MAX] >> *n).

The ranking in (2) is capable of accounting for both application and non-application of final /n/ deletion in the words in (1):

[31]We thought it was necessary in some cases to compare Ghayeni dialect to standard Persian.

[32]Faust and Torres-Tamarit, "*Stress and final /n/ deletion in Catalan: Combining Strict CV and OT*", 2017.

[33]Velde and Van Hout, N-deletion in reading style, 2000.

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(3) Final /n/ deletion in Ghayeni Persian

Input: /ʃirin/	*n]	MAX
a.i ☞ ʃiri		*
a.ii ʃirin	*!	
Input: /ʃirini/		
b.i ☞ ʃirini		
b.ii ʃirii		*!

As shown in tableau (3a), candidate (a.i) is optimal as it has not violated the dominant markedness constraint '*n]'. However, since in tableau (3b), candidates have no final [n] they have not violated '*n]'. Then, as in the second round candidate (b.ii) has unlawfully undergone non-final /n/ deletion, candidate (b.i) with no deleted phoneme is chosen as optimal.

1. *The Plural Marker*

In standard Persian, words are commonly pluralized with the suffixes "-hɑ" and "-ɑn". While "-hɑ" is used to pluralize all nouns, "-ɑn" is used to form the plural of human nouns and some other living beings as animals and plants:

(4) Standard Persian

singular	plural	gloss
[doχtar]	[doχtarhɑ/ɑn]	'daughter, girl'
[ʃir]	[ʃirhɑ/ɑn]	'lion'
[deraχt]	[deraχthɑ/ɑn]	'tree'
[miz]	[mizu]	'table, desk'

Two interesting features of Ghayeni Persian are that it lacks the suffix "-hɑ", and the plural suffix "-ɑn" does not surface in plural forms. Instead, "-u" and [au] which are regarded as plural markers appear after consonants and vowels respectively.

Nouns Ending in a Consonant

The plural suffix in the following plural forms seems at first sight to be "-u" in Ghayeni Persian:

(5)

singular	plural	gloss
[doχtar]	[doχtaru]	'daughter, girl'
[ʃir]	[ʃiru]	'lion'
[deraχt]	[deraχtu]	'tree'
[miz]	[mizu]	'table, desk'

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However, we argue that the plural suffix is in fact "-ɑn" which has undergone pre-nasal raising[34] and final /n/ deletion[35]. The former is a common phonological process in the majority of Persian accents and dialects including the standard accent and Ghayeni through which the low vowel /ɑ/ converts to the high vowel [u] in the environment before nasals, as shown in the following examples:

(6)

/nɑn/	→	[nun]	'bread'	, /bɑm/	→	[bum]	'rooftop'
/tehrɑn/	→	[te:run]	'Tehran'	, /tamɑm/	→	[tamum]	'all'
/bɑrɑn/	→	[bɑrun]	'rain'	, /ham.mɑm/	→	[hamum]	'bathroom'

The interaction between pre-nasal raising and final /n/ deletion is shown in the following derivation:

(7)

UR	/doχtar+ɑn/
Pre-nasal raising	doχtarun
Final /n/ deletion	doχtaru
PR	[doχtaru]

Upon the deletion of /n/, the environment that caused the occurrence of pre-nasal raising has disappeared in the phonetic representation (henceforth PR). This is an instance of counterbleeding opacity as defined in Antila[36] because despite the fact that the conditioning environment for pre-nasal raising is not met on the surface, it applies (overapplication). Moreover, if the rules were applied in the opposite order, final /n/ deletion would "bleed" pre-nasal raising by depriving it of the opportunity to apply. This hypothetical derivation is shown in (8):

(8)

Hypothetical derivation	
UR	/doχtar+ɑn/
Final /n/ deletion	doχtarɑ
pre-nasal raising	————
PR	*[doχtarɑ]

In counterbleeding opacity, "an unfaithful mapping occurs for reasons that cannot be explained with classic OT markedness constraints because the conditions that encourage the unfaithful mapping are no longer apparent in surface structure".[37] Discussing HS's difficulty in handling counterbleeding opacity, McCarthy[38] asserts that "despite having derivations with intermediate stages, HS is not very successful in treating

[34]See Miller, "A Holistic Treatment of /ān/ to [un] in Persian", 2011.

[35]Accordingly, all singular nouns have to form the plural by adding"-ɑn". This indicates that the plural suffix "-ɑn" is not limited to pluralizing living beings in Ghayeni Persian.

[36]Anttila, *Variation and Opacity*, 2006.

[37]McCarthy, *Hidden generalizations: phonological opacity in optimality theory*, 2007, 25.

[38]McCarthy, "Harmonic serialism and parallelism", 2000.

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opacity as it runs into problems because of the durability of the constraint hierarchy and the markedness/faithfulness split, basic characteristics that it shares with the parallel implementation of OT." However, he[39] accepts that in a limited and rather arbitrary set of cases, HS can handle this type of opacity. He concludes that HS is worth studying, and may very well reward further examination under assumptions different from those he had entertained in his paper. According to McCarthy,[40] Pruitt,[41] Elfner,[42] and Kimper[43] among others, from an empirical point of view, it has been demonstrated that HS is able to accommodate particular cases of counterbleeding opacity better than POT. Therefore, we have adopted HS to accommodate particular cases of counterbleeding opacity in our research.

Jam & Teymouri[44] propose that the markedness constraint that triggers pre-nasal raising is "*[ɑ]N" which prohibits the sequence of [ɑ] followed by a nasal. However, *[ɑ]N is only accounting for part of the pre-nasal raising phenomenon. It explains why the vowel changes, but not why it changes all the way from /ɑ/ to [u] rather than to [o]. So in order to correct this shortcoming we formalize *[-high]N as defined in (9):

(9) *[-high]N The sequence of a non-high vowel followed by a nasal is prohibited.

The markedness constraint *[-high]N is acoustically motivated. The results of an acoustic salience analysis by Salehi Koopaei[45] indicate that pre-nasal raising occurs because the high vowel + nasal sequence is more perceptible than the low vowel + nasal sequence. So, pre-nasal raising is a listener-oriented phonological process.

While pre-nasal raising is obligatory in most Persian accents and dialects, it exceptionally fails to occur in some words due to different linguistic and non-linguistic reasons. For instance, while /tɑbestɑn/ 'summer' changes to [tɑbestun], /dabestɑn/ 'elementary school' fails to change to *[dabestun]. Furthermore, in some other words its occurrence is optional as an instance of free variation. For example, "Tehran" is optionally pronounced [tehrɑn] and/or [te:run].[46]

IDENT[height][47] is the faithfulness constraint that militates against any change in the value for the feature [high] in an output segment compared with its corresponding

[39]McCarthy, "An introduction to Harmonic Serialism", 2010.

[40]Ibid.

[41]Pruitt, "Iterative foot optimization and locality in stress systems", 2008.

[42]Elfner, *Syllabification and stress–epenthesis interactions in Harmonic Serialism*, 2009.

[43]Kimper, "Non-locality in harmony: Transparency/opacity and trigger conditions", 2011a.

[44]Jam and Teymouri, "Barrasi-ye tabdil-e vāke-ye /ɑ/ be vāke-ye [a:] yā[o]dar lahje-ye ferdos dar chārchoub-enazariye-ye behinegi [An optimality–theoretic account of exceptionality and optionality in pre-nasal raising in Persian], 2014.

[45]Salehi Koopaei, "Barrasi-ye ākoustiki-ye ertegha-ye vāke-ye /ɑ/ be vāke-ye [u] dar bāft-e –n dar zabān-e fārsi-ye moāser [Acoustic analysis for raising /ɑ/ to [u] in the context of –n in contemporary Persian], 2010.

[46]See Jam "Tahlil-e estesnāhā va gounāgouni-ye āzād dar farāyand-e afrāshtegi-ye pish kheyshoumi dar chaÃ§rchoub-e nazariye-ye behinegi. [An optimality-theoretic account of exceptionality and optionality in pre- nasal raising in Persian], 2017, that analyzes exceptionality and optionality in pre-nasal raising using OT and some of its related approaches.

[47]McCarthy and Prince, "Faithfulness and reduplicative identity", 1995, 264.

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segment in the input. The markedness constraint *[-high]N must dominate IDENT [height] to insure pre-nasal raising. Furthermore, in order to prevent the transparent candidate *[doχtarɑ] (in the hypothetical derivation in (8)) from winning (incorrectly)[48] we formalize the morpheme-specific markedness constraint *ɑ]$_{PL}$ which confirms that final [ɑ] is not the plural marker.[49] It is worthy of note that using morpheme-specific constraints like (Edgemost(*um*; L))[50] was common in OT from its emergence.[51] Moreover, with the incorporation of *ɑ]$_{PL}$, our analysis survives a pitfall challenging HS[52] in handling counterbleeding opacity.

Explanation of this counterbleeding interaction between pre-nasal raising and final /n/ deletion requires the incorporation of the abovementioned three constraints in the initial ranking in (2) which yields the following ranking:

(10) *[-high]N >> *ɑ]$_{PL}$ >> *n] >> IDENT[height], MAX, DEP

In this research we have used multi-step tableaux.[53] The semi-circle arrows to the left side of the tableau indicate which form in a given step is selected as the input form for the next step.[54]

In multi-step tableau (11) which includes steps 1, 2, and 3, the word /doχtar+ ɑn/ is analyzed under the ranking in (10). Since this counterbleeding interaction is between two processes, two steps are required before convergence: /doχtar+ɑn/ → [doχtarun] → [doχtaru]. In step 1, the input to GEN is the underlying form /doχtar+ɑn/, and the candidates include faithful [doχtarɑn] as well as three unfaithful [doχtarɑ], [doχtaron] and [doχtarun]. The four candidates are evaluated and the most harmonic one, [doχtarun], becomes the new input to GEN in step 2. The candidates in step 2 include faithful [doχtarun] and unfaithful [doχtaru]. The grammar chooses [doχtaru], which becomes the new input to GEN in step 3. The progression of harmonic improvement from the UR to the output of step 1 to the output of step 2 is obvious. In each step, the winner is more harmonic than the input. Finally, there is convergence in step 3. Underlying /doχtar+ɑn/ has realized all of its potential for harmonic improvement under this grammar, so the output of EVAL and the input to GEN are identical.

[48]Unlike Ghayeni Persian, [doχtarɑ] is correct in the standard spoken accent because"-ɑ"which is the reduced form of the plural marker "-hɑ" realizes after nouns ending in a consonant. As mentioned earlier, Ghayeni Persian lacks "-hɑ" (and its reduced form"-ɑ").

[49]As stated by de Lacy "a constraint like Align ([um]$_{Af}$, L, Stem, L) in Tagalog which takes an affix could be language-specific because that affix does not exist in every language" (p.1509). Accordingly, *ɑ]$_{PL}$ is considered a language-specific constraint.

[50]Prince and Smolensky, *Optimality Theory: Constraint Interaction is Generative Grammar*, 2004, 42.

[51]/-um/ is a morpheme in Tagalog.

[52]McCarthy, *An introduction to Harmonic Serialism*, 2010.

[53]Pruitt, "Stress in Harmonic Serialism. Amherst, 2012, Bretler, "*Deriving bounded tone with layered feet in Harmonic Serialism: The case of Saghala. Glossa*", 2017.

[54]Bretler, "*Deriving bounded tone with layered feet in Harmonic Serialism: The case of Saghala. Glossa*", 2017.

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(11) /doχtar+ɑn/ → [doχtaru]

/doχtar+ɑn/ Step 1	*[-high]N	*ɑ]$_{PL}$	*n]	IDENT[height]	MAX	DEP
☞ a. doχtarun			*	*		
b. doχtarɑ		*!			*	
c. doχtaron	*!		*	*		
d. doχtarɑn	*!		*			
Step 2						
☞ e. doχtaru					*	
f. doχtarun			*!			
Step 3- Convergence						
☞ g. doχtaru						
h. doχtarun			*!			*
i. doχtarɑ		*!		*		

Nouns Ending in /ɑ/ or /e/

One of the features of Ghayeni dialect is that if a singular noun ends in vowel /ɑ/ or /e/, its plural form ends in diphthong [au] which is regarded as a plural marker as evidenced in the data set in (12): (the plural forms in parentheses are standard Persian)

(12)

singular	plural	gloss
[serɑ]	[serau] (sarɑhɑ)	'house'
[gedɑ]	[gedau] (gedɑhɑ)	'beggar'
[χormɑ]	[χormau] (χormɑhɑ)	'date (fruit)'
[perde]	[perdau] (pardehɑ)	'curtain'
[sine]	[sinau] (sinehɑ)	'chest'
[ʃune]	[ʃunau] (ʃunehɑ)	'comb'

A careful examination of the change of /ɑ/ or /e/ to [au] reveals that it occurs through the following derivation:

(13)

UR	/sine+ɑn/	/gedɑ+ɑn/
Pre-nasal raising	sineun	gedɑun
Final /n/ deletion	sineu	gedɑu
Vowel change	sinau	gedau
PR	[sinau]	[gedau]

As shown in the derivation above, this is an instance of counterbleeding opacity because upon the deletion of /n/, the environment that caused the occurrence of pre-nasal raising has disappeared in the PR. Furthermore, pre-nasal raising has created diphthongs "eu" and "ɑu" in the intermediate level. However, since these two diphthongs are absent in Ghayeni Persian, their first vowels change to [a] to

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form [au] which is regarded as a plural marker in this dialect. Note that contrary to languages like English, Persian has no phonemic diphthongs. Moreover, contrary to the unmarked plural marker /ɑn/, [au] is the marked plural marker because as shown in the derivation in (13) it is the result of the application of three phonological processes (it does not exist in the UR as Persian has no phonemic diphthongs). According to Kager[55] in comparison with unmarked properties, marked properties occur in sound systems with less frequent frequency.

Based on the fact that [au] is regarded a plural marker, we formalize the markedness constraint "$[au]_{PL}$":

(14) $[au]_{PL}$ Plural marker diphthong is [au].

Note that $*ɑ]_{PL}$ and $[au]_{PL}$ are not positive and negative versions of each other. They were formalized for different reasons. The negative constraint $*ɑ]_{PL}$ was formalized to be violated by the transparent candidate. As mentioned earlier, the great weakness of the HS[56] in dealing with counterbleeding opacity is how to get rid of the transparent candidate. But the positive constraint $[au]_{PL}$ was formalized to prevent the candidate with a wrong diphthong from winning. Also as the underlying plural marker "-ɑn" includes no diphthong, $[au]_{PL}$ is not at odds with it. Even if $[au]_{PL}$ could affect "-ɑn", since it is not on top of the ranking it cannot rule out the faithful candidate in step 1namely in tableaux (16), (20), and (50) where[au]PL technically becomes decisive in step 3 or 4 (where there is no "-ɑn") to rule out candidates with [ɑu], [ou] or [eu] which are not plural marker diphthongs.

Explanation of this counterbleeding interaction requires the incorporation of $[au]_{PL}$ in the ranking in (10). Moreover, since in the vowel change the [-back] vowel [a] replaces the [+back] vowel /ɑ/, the faithfulness constraint "IDENT [back]" which militates against this vowel change must be added to the ranking which ultimately yields the following ranking:

(15) *[-high]N >> $*ɑ]_{PL}$ >> *n] >> $[au]_{PL}$ >> IDENT[height], IDENT[back], MAX, DEP

In multi-step tableau (16) which consists of 4 steps, the word /gedɑ+ɑn/ is analyzed under the ranking in (15). Since this counterbleeding interaction is between three phonological processes, three steps are required before convergence: /gedɑ+ɑn/ → [gedɑun] → [gedɑu] → [gedau]. In step 1, the input to GEN is the underlying form /gedɑ+ɑn/, and the candidates include faithful [gedɑɑn] and three unfaithful [gedɑɑ], [gedɑon] and [gedɑun]. The four candidates are evaluated, and the most harmonic one, [gedɑun], becomes the new input to GEN in step 2. The candidates in this step include faithful

[55]Kager, *Optimality theory*, 1999, 11.

[56]McCarthy, "An introduction to Harmonic Serialism". *Language and Linguistics Compass*, 2010.

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[gedɑun] and unfaithful [gedɑu]. Step (2) shows that the grammar chooses [gedɑu], which becomes the new input to GEN in step 3. The candidates in this step include faithful [gedɑu] and two unfaithful [gedau] and [gedɑun]. The candidates [gedɑun] and [gedɑu] have violated *n] and $[au]_{PL}$ respectively. Therefore, the grammar chooses [gedau] as the plural form, which becomes the new input to GEN in the convergence step in which the output of EVAL and the input to GEN are identical.

(16) /gedɑ+ɑn/ → [gedau]

/gedɑ+ɑn/ Step 1	*[-high]N	*ɑ]$_{PL}$	*n]	[au]$_{PL}$	IDENT[height]	IDENT [back]	MAX	DEP
a. ☞ gedɑun			*	*	*			
b. gedɑɑ		*!		*			*	
c. gedɑon	*!		*	*	*			
d. gedɑɑn	*!		*	*				
Step 2								
e. ☞ gedɑu				*			*	
f. gedɑun			*!	*				
Step 3								
g. ☞ gedau						*		
h. gedɑu				*!				
i. gedɑun			*!	*				*
Step 4- Convergence								
j. ☞ gedau								
k. gedɑu				*!		*		
l. gedaun			*!					*

Nouns Ending in /ou/

Another feature of Ghayeni dialect is that nouns ending in [ou] are singular while the same nouns ending in [au] are Plural:

(17)

singular	plural	gloss
[ʃou]	[ʃau]	'night'
[ʔou]	[ʔau]	'water'
[gou]	[gau]	'cow'
[dʒou]	[dʒau]	'barley'
[polou]	[polau]	'cooked rice'

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A closer look reveals that [au] replaces /ou/ in the plural form through the following derivation:

(18) UR /ʃou+ɑn/

UR	/ʃou+ɑn/
Pre-nasal raising	ʃou.un
Hiatus resolution & final /n/ deletion	ʃou
Vowel change	ʃau
PR	[ʃau]

As shown above, the consecutive occurrences of pre-nasal raising, hiatus resolution and final /n/ deletion change the plural /ʃou+ɑn/ to "ʃou" which is the same as its singular form, as if nothing happened. However, since in Ghayeni Persian [-au] is regarded as a plural marker, it has to replace /ou/ to differentiate the plural from the singular. This is imposed by the markedness constraint $[au]_{PL}$ through changing /o/ in /ou/ to [a].

Persian in general does not allow onsetless syllables and hiatus. Resolving hiatus requires the incorporation of the markedness constraint "ONSET"[57] in the ranking in (19):

(19) *[-high]N >> *ɑ]$_{PL}$ >> ONSET >> *n] >> [au]$_{PL}$ >> IDENT[height], IDENT[back], MAX, DEP

In multi-step tableau (20) which consists of 4 steps, the word /ʃou+ɑn/ is analyzed under the ranking in (19). This counterbleeding interaction is between four phonological processes. But since hiatus resolution and final /n/ deletion occur unrelatedly at the same level of representation, three steps are required before convergence: /ʃou +ɑn/ → [ʃou.un] → [ʃou] → [ʃau]. In step 1, the input to GEN is the underlying form /ʃou+ɑn/, and the candidates include faithful [ʃou.ɑn] and four unfaithful [ʃou.ɑ], [ʃou.on], [ʃou.un] and [ʃoun]. The five candidates are evaluated and the most harmonic one, [ʃou.un], becomes the new input to GEN in step 2. The candidates set at step 2 includes [ʃoun] and [ʃou]. The grammar chooses [ʃou], which has not violated "*n]". Then [ʃou] becomes the new input to GEN in step3. The candidates in step 3 include [ʃau], [ʃou] and the [ʃoun]. The grammar chooses [ʃau] as the plural form, which becomes the new input to GEN in step 4. Finally, there is convergence in step 4; underlying /ʃou+ɑn/ has realized all of its potential for harmonic improvement under this grammar, so the output of EVAL and the input to GEN are identical.

[57]Prince and Smolensky, *Optimality Theory: Constraint Interaction is Generative Grammar*, 1993/2004.

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(20) /ʃou+ɑn/ → [ʃau]

/ʃou+ɑn/ Step 1	*[-high]N	*ɑ]$_{PL}$	ONSET	*n]	[au]$_{PL}$	IDENT [height]	IDENT [back]	MAX	DEP
< a. ☞ ʃoun				*	*			*	
b. ʃou.un			*!	*	*	*			
c. ʃou.ɑ		*!	*		*			*	
d. ʃou.on	*!		*	*	*	*			
e. ʃou.ɑn	*!		*	*	*				
Step 2									
< f. ☞ ʃou					*			**	
g. ʃoun				*!	*			*	
Step 3									
< h. ☞ ʃau						*	*		
i. ʃou					*!				
j. ʃoun				*!	*				*
Step 4- Convergence									
k. ☞ ʃau									
l. ʃou					*!	*	*		
m. ʃaun				*!					*

2. *CODA CLUSTERS.* As we mentioned in the introduction, this paper aimed to discuss both the occurrence and non-occurrence of final /n/ deletion in Ghayeni Persian. To this end, this section explores two environments where this process fails to occur. Moreover, the data are regarded as additional evidence for the existence of final /n/ in the UR.

/nd/ Cluster

Ghayeni Persian has the postnasal /d/ deletion rule which deletes /d/ when it is preceded by /n/ within a coda cluster:

(21)

/band/	→	[ban]	'rope'	, /Gand/	→	[Gan]	'sugar cube'
/tond/	→	[ton]	'fast'	, /boland/	→	[bolan]	'high'
/ɢusfand/	→	[ɢusfan]	'sheep'	, /ɢand/	→	[ɢan]	'stinky'

After the application of postnasal /d/ deletion, it seems that the environment is ready for final /n/ deletion. But final /n/ is not deleted if it becomes final through /d/ deletion. Although the conditioning environment for final /n/ deletion is met on the surface, it fails to apply (underapplication). This is an instance of counterfeeding opacity, as defined in Antila.[58] The PRs in (21) fail to undergo final /n/ deletion because this process is incapable of affecting the output created by the postnasal /d/

[58]Anttila, "Variation and Opacity", 2006.

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deletion rule. This implies that final /n/ deletion has to apply before postnasal /d/ deletion. In other words, final /n/ deletion has priority over postnasal /d/ deletion. This priority prevents the occurrence of final /n/ deletion, though its conditioning environment is met on the surface.

(22) Counterfeeding interaction between final /n/ deletion and postnasal /d/ deletion

UR	/band/
Final /n/ deletion	———
Postnasal /d/ deletion	ban
PR	[ban]

The markedness constraint that triggers postnasal /d/ deletion is *nd] defined in (23):

(23) *nd]

The word final sequence of [n] followed by [d] is prohibited.

On the first attempt we incorporated *nd] in the initial ranking in (2) in the hope that it would explain this counterfeeding interaction. But as depicted in tableau (24), candidate (b) whose coda cluster is totally deleted is incorrectly selected as optimal over opaque (a). So the desired output [ban] is unattainable with just these three constraints.

(24) Incorrect analysis of counterfeeding between final /n/ deletion and final /d/ deletion

Input: /band/	*nd]	*n]	MAX
a. ban		*!	*
b. ☹ ba			**
c. band	*!		

As shown in tableau (24) upon the application of both rules in candidate (b), the whole coda cluster has disappeared and subsequently the word has got damaged. In order to solve this problem we use a local constraint conjunction consisting of two locally conjoined (anti-deletion) MAX constraints ranked above *n] to ensure that the opaque candidate whose /n/ is not deleted is more harmonic than the transparent one which is damaged due to the deletion of two segments. This is a fact that /n/ never deletes when it is followed by another segment in the input, even if that segment is deleted later by a phonological process. The local constraint conjunction proposed in (25) includes MAX-[n] and MAX-[d] which militates against the whole coda cluster deletion. It is worthy of note that in each of the three instances of counterfeeding opacity as well as in one instance of bleeding interaction discussed in this paper we are dealing with two deletion processes within the same syllable domain which could be dealt with using locally conjoined MAX constraints.

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(25) Local Constraint Conjunction

MAX[[n] & [d]]$_{coda}$ One violation is assigned for a candidate that violates both MAX-[n] and MAX-[d]. The domain for this constraint is the coda.

The ranking in (26) explains the counterfeeding opacity in the examples in (21):

(26) *nd] >> MAX[[n] & [d]]$_{coda}$ >> *n] >> MAX

Tableau (27) demonstrates that the opaque candidate (a) which has only undergone postnasal /d/ deletion is optimal.

(27) Counterfeeding opacity: no /n/ deletion

Input: /band/	*nd]	MAX[[n] & [d]]$_{coda}$	*n]	MAX
c. ☞ ban			*	*
b. ba		*!		**
c. band	*!			

Glottal +/n/ Cluster

Ghayeni Persian has a glottal consonant deletion rule which deletes /h/ or /ʔ/ within a coda cluster. The application of glottal deletion creates a context in which the other consonant in the cluster including final /n/ has to remain to preserve the coda. Otherwise the whole coda cluster would disappear and subsequently the word would get harmed. This is an instance of bleeding order; although the conditioning environment for both glottal deletion and final /n/ deletion is met in the UR, the latter fails to apply because the application of glottal deletion creates a context in which final n- deletion can no longer apply. This distinct realization of word-final /n/ is represented by the examples in (28):

(28)

/pahn/	→	[pa:n]	'wide'	, /laʔn/	→	[la:n]	'curse'
/sahn/	→	[sa:n]	'courtyard'	, /taʔn/	→	[ta:n]	'sarcasm'
/rahn/	→	[ra:n]	'mortgage'	, /ʃaʔn/	→	[ʃa:n]	'dignity'

As we see in the examples above, upon the loss of the glottal consonant the vowel /a/ is lengthened. This is an instance of compensatory lengthening (CL) which occurs when the mora of a deleted segment survives and links another segment.[59] However, as

[59]Moren, *Distinctiveness, Coercion and Sonority: A Unified Theory of Weight*, 2001, 8–10, Kavitskaya, Compensatory Lengthening: Phonetics, Phonology, Diachrony, 2002, 171–176.

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compensatory lengthening has nothing to do with the bleeding of final n- deletion, it is ignored in our discussion.[60]

The markedness constraint that triggers glottal loss in syllable coda is *Coda-glottal stated in (29):

(29) *Coda-glottal Glottal consonant is prohibited in syllable coda.

Here again local constraint conjunction MAX[[glottal] & [n]]$_{coda}$ militates against the whole coda cluster deletion. The bleeding of the final /n/ deletion rule by the glottal consonant deletion rule is due to the dominance of *Coda- glottal and MAX[[glottal] & [n]]$_{coda}$ over *n] represented in the ranking in (30).

(30) *Coda-glottal >> MAX[[glottal] & [n]]$_{coda}$ >> *n] >> MAX
(31) Glottal deletion bleeds final /n/ deletion

Input: /pahn/	*Coda- glottal	MAX[[glottal] & [n]]$_{coda}$	*n]	MAX
a. ☞ pa:n			*	*
b. pa:		*!		**
c. pah	*!			*
d. pahn	*!		*	

3. *The Ezafe Construction*. In Persian, the possessive form of nouns and also modification of nouns by adjectives are commonly introduced using Ezafe vowel /-e/, an enclitic which is attached to the noun being possessed or modified. In Ghayeni Persian, Ezafe vowel has a key role in creating different opaque interactions regarding final /n/ deletion discussed in the following four sections.

Possessed and Modified Nouns

In Ghayeni Persian, if a singular or a plural noun ending in /n/ is a possessee or is modified by an adjective, final /n/ deletion fails to occur:

(32)

[nu**n** dʒou]	[kouʃu**n** sa:de]
bread barley	shoes simple
'barley bread'	'simple shoes'
[ruGa**n** zard]	[maʃi**n** mɑ]
oil yellow	car us
'yellow oil'	'our car'

[60]Kambuzia, *Vājshenāsi:rouykardhā-ye ghā'edeh bonyād*. [Phonology: Rule- Based Approaches], 2006, 214-247, and Jam, *Nazariye-ye behinegi va kārbord-e ān dar tabyin-e farāyandhā-yevāji-ye zabān-e fārsi*. [Optimality Theory and Its Application in Explaining Phonological Processes of Persian], 2009, 119-143, offer autosegmental and optimality-theoretic accounts of compensatory lengthening in Persian respectively.

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As seen in the examples in (32), although the conditioning environment for final /n/ deletion is met on the surface, it fails to apply (underapplication). This is an instance of counterfeeding opacity which is more challenging than the one discussed in section "/nd/ Cluster" because due to our access to the UR in that section, we knew that the existence of /d/ at the end of those words prevented final /n/ deletion. But in the examples in (32), we have no access to the UR. However, we know there must be a reason why it failed to apply. That is, just like the words in (21) in which the existence of final /d/ prevented final /n/ deletion, we infer that the words in (32) must end in a hidden Ezafe enclitic. A closer look reveals that this morpheme is later deleted at an intermediate level. According to Ghomeshi,[61] Ezafe which literally means 'addition' is the unstressed vowel /-e/ that links together elements belonging to a single constituent. It appears between an adjective and its complement, between a preposition and its complement, and more generally between any two items that have some sort of connection. Zomorrodian[62] asserts that in Ghayeni Persian Ezafe does not appear after words ending in /n/ (p. 50). Accordingly, the UR of the words in (32) would be the following:

(33)

/nun+e # dʒou/	/kouʃun+e #sa:de/
bread + *Ez* barley	shoes + *Ez* simple
/ruGan+e #zard]	/maʃin+e #mɑ]
oil + *Ez* yellow	car + *Ez* us

As seen in the following derivation, the Ezafe deletion rule in [ruGanzard] is incapable of feeding final /n/ deletion because it has no priority over final /n/ deletion:

(34) Counterfeeding interaction between final /n/ deletion and Ezafe deletion

UR	/ru.Ga.ne zard/
Final /n/ deletion	————
Ezafe deletion	ru.Ga.n zard
Resyllabification	ru.Gan zard
PR	[ru.Gan zard]

The markedness constraint that triggers Ezafe vowel deletion is *ne_{Ez} defined in (35):

(35) *ne_{Ez} The sequence of /n/ followed by Ezafe [e] is prohibited.

The local constraint conjunction provides a straightforward solution to counterfeeding opacity in which the candidate whose Ezafe vowel is only deleted is intended to win. The LCC that we have used is MAX[[n] & [e_{Ez}]]$_{\sigma}$.

[61]Ghomeshi, "Non-Projecting Nouns and the Ezafe Construction in Persian", 1997.

[62]Zomorrodian, Practical linguistics: Investigating Ghayen's dialect. [Zabanshenasiyé amali: Barrasiyé gouyeshé Ghayen], 1989.

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(36) Local Constraint Conjunction

MAX[[n] & [e_{Ez}]]$_{\sigma}$ One violation is assigned for a candidate that violates both MAX-[n] and MAX -[e_{Ez}]. The domain for this constraint is the syllable.

The markedness constraint NUCLEUS/V (Tranel, 1996) triggers resyllabification:

(37) NUCLEUS/V Nuclei must be filled with vowels rather than consonants.

This constraint is never violated in Persian, and has consequently been awarded a high rank. The ranking in (38) explains the counterfeeding opacity in the above-mentioned examples: (38) ONSET, NUCLEUS/V>> *ne_{Ez} >> MAX[[n] & [e_{Ez}]]$_{\sigma}$ >> *n] >> MAX

Tableau (39) demonstrates that the opaque candidate (a) whose Ezafe vowel is only deleted is optimal.

(39) counterfeeding between final /n/ deletion and Ezafe deletion

Input: /ruGane zard/	ONSET	NUCLEUS/V	*ne_{Ez}	MAX[[n] & [e_{Ez}]]$_{\sigma}$	*n]	MAX
a. ☞ ru.Gan zard					*	*
b. ru.Ga zard				*!		**
c. ru.Ga.e zard	*!					*
d. ru.Ga.n zard		*!			*	*
e. ru.Ga.ne zard			*!			

The Singular Pronoun "in"

In the following words, at first glance it seems that the final vowel [i] is a morpheme meaning "his/her'.

(40)

singular	gloss	plural	gloss
[doʃˈmani]	'his/her enemy']	[doʃmaˈnuni]]	'his/her enemies'
[maːˈʃini]	'his/her car'	[maʃiˈnuni]	'his/her cars'
[ˈmizi]	'his/her table'	[miˈzuni]	'his/her tables'

But the problem is that this morpheme does not have such a meaning in Persian. A closer look reveals that it is in fact the Persian pronoun "in" (meaning 'this') whose last /n/ is deleted together with the preceding Ezafe vowel. Also, in plural examples the plural suffix "-ɑn" has undergone pre-nasal raising. Accordingly, the UR of the words in (40) would be the following:

(41)

/doʃman+e #in/	/doʃman+ɑn+e #in/
enemy +*Ez* him/her	enemy +*pl*+*Ez* him/her

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/maʃin+e#in/	/maʃin+ɑn+e #in/
car+ *Ez*him/her	car + *pl* +*Ez* him/her
/miz+e#in/	/miz+ɑn+e #in/
table+ *Ez*him/her	table+ *pl* +*Ez* him/her

Given the derivation "/doʃman+ɑn+e #in/ → [doʃmanuni]" for instance, if we look at its PR we will find the following four facts which suggest that this derivation is not opaque:

a) The consonant [n] at the end of [doʃman] is not deleted. Since it is not the last segment in the PR, the conditioning environment for its deletion is not met.
b) The plural suffix is [un] rather than *[ɑn]. Pre-nasal raising has happened because its conditioning environment is met.
c) There is no Ezafe vowel [e] after the plural suffix [un] because due to the existence of [n] in this suffix, the conditioning environment for Ezafe vowel deletion is met.
d) As expected, the underlying final /n/ is not realized in the PR.

The following ranking explains these four facts:

(42) *[-high]N >> *ne_{Ez} >> *n] >> IDENT[height], MAX, DEP

Tableau (43) demonstrates that the candidate (a) which has undergone pre-nasal raising, Ezafe vowel deletion and final /n/ deletion is optimal.

(43) Pre-nasal raising, Ezafe vowel deletion and final /n/ deletion

Input:/doʃman+ɑn+e+in/	*[-high]N	*ne_{Ez}	*n]	ID[height]	MAX
a. ☞ doʃmanuni				*	**
b. doʃmanunin			*!	*	*
c. doʃmanunein		*!	*	*	
d. doʃmanunei		*!		*	*
e. doʃmanonei	*!	*		*	*
f. doʃmanɑni	*!				**
g. doʃmanɑnin	*!		*		*
h. doʃmanɑnei	*!	*			*
i. doʃmanɑnein	*!	*	*		

The Plural Pronoun "inɑn"

In the following words, the final morpheme [inu] means 'their'.

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(44)

singular	gloss	plural	gloss
[doʃmaninu]	'their enemy'	[doʃmanuninu]	'their enemies'
[maʃininu]	'their car'	[maʃinuninu]	'their cars'
[mizinu]	'their table'	[mizuninu]	'their tables'

Given "[maʃinuninu]" for instance, now we know that [maʃin] (an English loanword) means "car", and [-un-] is in fact the plural suffix /ɑn/ whose vowel underwent pre-nasal raising. There remains [-inu] which has to mean "their" or "they/them". In Persian the word "inɑn" means "they/them". Regarding our previous analyses, it is not difficult to infer that [-inu] is the phonetic realization of /inɑn/ which underwent pre-nasal raising and final /n/ deletion consecutively. Accordingly, the UR of the words in (44) would be the following:

(45)

/doʃman+e# inɑn/	/doʃman+ɑn+e# inɑn/
enemy + *Ez* them	enemy + *pl* +*Ez* them
/maʃin+e# inɑn/	/maʃin+ɑn+e# inɑn/
car+ *Ez* them	car + *pl* +*Ez* them
/miz+e# inɑn/	/miz+ɑn+e# inɑn/
table+ *Ez* them	table+ pl +Ez them

The processes involved in the conversion of /maʃin+ɑn+e #inɑn/ to [maʃinuninu] is shown in the following derivation:

(46)

UR	/maʃin+ɑn+e# inɑn/
Pre-nasal raising (applied twice)	maʃinuneinun
Final /n/ deletion	maʃinuneinu
Ezafe vowel deletion	maʃinuninu
PR	[maʃinuninu]

As shown in the derivation in (46), there are two simultaneous applications of pre-nasal raising followed by final /n/ deletion and Ezafe vowel deletion. And just like the case of [doχtaru] in the derivation in (7), upon the deletion of /n/, the environment that triggered pre-nasal raising at the end of the word has disappeared in the PR. This is another instance of counterbleeding opacity between the second occurrence of pre-nasal raising and final /n/ deletion because despite the fact that the conditioning environment for pre-nasal raising is not met on the surface, it applies (overapplication). Moreover, if the rules were applied in the opposite order, final /n/ deletion would "bleed" pre-nasal raising by depriving it of the opportunity to apply.

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As Torres-Tamarit[63] notes, "GEN in HS is restrained by a gradualness condition[64] on candidate generation by which candidates can introduce only one single "modification" with respect to the latest input." The notion of gradualness requirement on GEN in HS is tied to faithfulness constraints, such that a single change in HS is equivalent to an unfaithful mapping.[65] In other words, the gradualness requirement only allows one "modification" or one change only, from an input form to each candidate in the candidate set. In HS as formulated by McCarthy[66] and subsequent works, as well as by Torres-Tamarit,[67] unrelated processes have to take place at different steps.

However, as depicted in the derivation in (46) since maʃin**u**nein**u**n has undergone pre-nasal raising twice, it is two changes away from the input. If, in compliance with the gradualness condition that every candidate must only be one "modification" or one change away from the input, instead of maʃin**u**nein**u**n we include maʃin**u**nein**ɑ**n and maʃin**ɑ**nein**u**n as two candidates in step 1, both will violate *[-high]N and there will be no winner in this step. Therefore, HS would fail to analyze this counterbleeding opacity at the very first step. But if with regard to this fact that both "modifications" are identical we consider them one change, then we can include maʃin**u**nein**u**n in step 1. This way our analysis survives the challenge. Since similar cases may be found in other languages, it would not be impossible that a candidate which undergoes the same process twice in the same step could also be included in the standard definition of gradualness condition. However, as HS is one of the latest versions which needs to be cross-linguistically attested much more work/data is necessary.[68]

In multi-step tableau (47) under the ranking in (42), three steps are required before convergence: /maʃin+ɑn+e# inɑn/→ [maʃinuneinun] → [maʃinuneinu] → [maʃinuninu]. Therefore, in step 1, the input to GEN is the underlying form /maʃin+ɑn+e# inɑn/. As displayed, candidates (b), (c) and (d) (the faithful candidate) have fatally violated the undominated constraint *[ɑ]N because they failed to undergo pre-nasal raising. Thus, candidate (a) that has undergone two occurrences of pre-nasal raising, is selected as the input to GEN in step 2. In this step, the faithful [maʃinuneinun] violates *n], for it has final [n]. Hence, candidate (a) that has undergone final /n/ deletion is selected as the input to GEN in step 3. In step 3, the faithful [maʃinuneinu] violates *ne_{Ez} for having the forbidden sequence of /n/ followed by Ezafe [e]. Therefore, candidate (a) that satisfies this constraint is selected as the input to GEN in step 4 (convergence). Finally, there is convergence in step 4. Under-

[63]Torres-Tamarit, Francesc. *Syllabification and Opacity in Harmonic Serialism*, 2012.

[64]McCarthy, *Hidden generalizations: phonological opacity in optimality theory*, 2007, 2.

[65]Elfner, Emily. *Syllabification and stress-epenthesis interactions in Harmonic Serialism*, 2009.

[66]McCarthy, John. J. *Doing Optimality Theory*, 2008a, McCarthy, "An introduction to Harmonic Serialism". *Language and Linguistics Compass*, 2010.

[67]Torres-Tamarit, Francesc. *Syllabification and Opacity in Harmonic Serialism*, 2012.

[68]Previous literature address the issue of a single process applying in different *loci*: McCarthy, "The gradual path to cluster simplification", 2008b, 310–311, McCarthy, "The serial interaction of stress and syncope", 519–520, McCarthy, "An introduction to Harmonic Serialism", 2010, 6–7, Kimper, "Locality and globality in phonological variation", 2011b, McCarthy, "The theory and practice of Harmonic Serialism", 2016, 61.

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lying /maʃin+ɑn+e# inɑn/ has realized all of its potential for harmonic improvement under this grammar, so the output of EVAL and the input to GEN are identical.

(47) /maʃin+ɑn+e# inɑn/→ [maʃinuninu]

/ma:ʃin+ɑn+e#inɑn/ Step 1	*[-high]N	*ne$_{Ez}$	*n]	IDENT [height]	MAX	DEP
≺ a. ☞ ma:ʃinuneinun		*	*	**		
b. ma:ʃinaneinon	*!	*	*	*		
c. ma:ʃinaneina	*!	*			*	
d. ma:ʃinoneinan	*!*	*	*	*		
e. ma:ʃinaneinun	*!	*	*	*		
f. ma:ʃinaninan	*!*		*		*	
g. ma:ʃinuneinan	*!	*	*	*		
h. ma:ʃinaneinan	*!*	*	*			
Step 2						
≺ i. ☞ ma:ʃinuninun					*	
j. ma:ʃinuneinu		*!	*		*	
k. ma:ʃinuneinun		*!				
Step 3						
≺ l. ☞ ma:ʃinuninu					*	
m. ma:ʃinuninun			*!			
Step 4- Convergence						
n.☞ ma:ʃinuninu						
o. ma:ʃinuninun			*!			*
p. ma:ʃinuneinu	*!	*				*
q. ma:ʃinaninu	*!			*		
r. ma:ʃinunina	*!			*		
s. ma:ʃinanina	*!*			**		

Nouns with Plural Marker [au]

In subsections 2.2 and 2.3, we argued how the Ghayeni plural marker [au] is made. In the examples in (48) and those shown later in (52), this plural marker changes to [a] when the word to which it is attached is a possessee:

(48)

[serau]	'houses'	[seran mɑ]	'our houses'
[perdau]	'curtains'	[perdan mɑ]	'our curtains'
[sinau]	'chests'	[sinan mɑ]	'our chests'
[ʃunau]	'combs'	[ʃunan mɑ]	'our combs'

Based on our previous analyses the UR of these possessees would be the following:

(49)

/serɑ+ɑn+e # mɑ/ house+*pl*+*Ez*# us	'our houses'	/perda+ɑn+e# mɑ/ curtain+*pl*+*Ez* # us	'our curtains'
/sine+ɑn+e # mɑ/ chest+*pl*+*Ez* # us	'our chests'	/ʃɑne+ɑn+e # mɑ/ comb+*pl* +*Ez*# us	'our combs'

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The processes involved in the conversion of /seɾɑ+ɑn+e# mɑ/ to [seran mɑ], according to our analysis, are shown in the following derivation:

(50)

UR	/seɾɑ+ɑn+e+mɑ/
Pre-nasal raising	seɾɑune mɑ
Final /n/ deletion	———
Ezafe vowel deletion	seɾɑun mɑ
Vowel change	seraun mɑ
Monophthongization	seran mɑ
PR	[seran mɑ]

As seen in the PR [seran mɑ], although the conditioning environment is ready for final /n/ deletion, it fails to apply. This is an instance of counterfeeding opacity. This phonetic representation fails to undergo final /n/ deletion because this process is incapable of affecting the output created by the Ezafe vowel deletion rule. As noted earlier regarding the data in section 4, final /n/ deletion has to apply before the Ezafe vowel deletion. This priority prevents the occurrence of final /n/ deletion, though its conditioning environment is met on the surface.

The application of pre-nasal raising plus Ezafe vowel deletion results in "seɾɑun mɑ". But, as "ɑu" is not regarded a plural marker, its first vowel converts to [a]to yield "seraun mɑ". Now the question raised is "why would "seraun mɑ" change to [seran mɑ]?" Studying Ghayeni Persian reveals that this dialect never allows the sequence of a diphthong followed by [n]. This is the effect of the markedness constraint "*Diph[n]" whose satisfaction is obtained either from monophthongization or /n/ deletion. Since final /n/ deletion has already lost its chance to apply, monophthongization takes place. The ranking in (52) explains the counterfeeding opacity in the examples in (48):

(51) *[-high]N >> *ne_{Ez} >> *Diph[n] >> MAX[[n] & $[e_{Ez}]]_{\sigma}$ >> *n] >> $[au]_{PL}$ >> IDENT[height], IDENT[back], MAX

Now we address the following examples:

(52)

[ʃau]	'nights'	[ʃan mɑ]	'our nights'
[ʔau]	'waters'	[ʔan mɑ]	'our waters'
[gau]	'cows'	[gan mɑ]	'our cows'
[dʒau]	'barley grains'	[dʒan mɑ]	'our barley grains'

Based on our previous analyses the UR of these possessees would be the following:

(53)

/ʃou+ɑn+e# mɑ/ night+*pl*+*Ez* # us	'our nights'	/ou+ɑn+e# mɑ/ water+*pl*+*Ez* # us	'our waters'
/gou+ɑn+e # mɑ/ cow+*pl*+*Ez* # us	'our cows'	/dʒou +ɑn+e# mɑ/ barley + *pl* +*Ez*# us	'our barley grains'

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The processes involved in the conversion of /ʃou+ɑn+e# mɑ/ to [ʃan mɑ], according to our analysis, are shown in the following derivation:

(54)

UR	/ʃou+ɑn+e # mɑ/
Pre-nasal raising	ʃou.u.ne mɑ
Final /n/ deletion	———
Hiatus resolution & Ezafe vowel deletion	ʃou.n mɑ
Resyllabification	ʃoun mɑ
Vowel change	ʃaun mɑ
Monophthongization	ʃan mɑ
PR	[ʃan mɑ]

As seen in the derivation in (54), there is no serial interaction between unrelated processes of hiatus resolution and Ezafe vowel deletion which occur simultaneously at two different points at the same level. The ranking in (55) which is the result of incorporating *ONSET in the ranking in (51) explains the counterfeeding opacity in the words in (52) as well as those in (49).

(55) *[-high]N >> *ONSET, NUCLEUS/V >> *ne_{Ez} >> *Diph[n] >> MAX[[n] & $[e_{Ez}]]\sigma$ >> *n] >> $[au]_{PL}$ >> IDENT[height], IDENT [back], MAX

Tableau (56) demonstrates that the opaque candidate (a) is optimal.

(56) Counterfeeding between final /n/ deletion and Ezafe deletion in a plural form

Input: /ʃou+ɑn+e#mɑ/	*[-high]N	ONSET	NUCLEUS/V	*ne_{Ez}	*Diph[n]	MAX[[n] & $[e_{Ez}]]\sigma$	*n]	$[au]_{PL}$	ID [height]	ID [back]	MAX
a. ☞ ʃan mɑ							*	*	*	*	***
b. ʃau mɑ						*!			*	*	***
c. ʃou mɑ						*!		*			***
d. ʃaun mɑ					*!		*		*	*	**
e. ʃoun mɑ					*!		*	*			**
f. ʃou.n mɑ			*!		*		*	*			**
g. ʃou.ne mɑ				*!	*			*			*
h. ʃou.un mɑ		*!					*	*	*		*
i. ʃou.u.ne mɑ		*!		*				*	*		
j. ʃou.o.n mɑ	*!	*	*				*	*	*		*
k. ʃou.o.ne mɑ	*!	*		*				*	*		
l. ʃou.ɑ.ne mɑ	*!	*		*				*			

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Conclusion

The theoretical machinery utilized in this research built directly on OT's existing approaches involving a novel combination of theoretical tools. This paper explored the application and non-application of final /n/ deletion in different domains and environments in Ghayeni Persian. This productive phonological process is affected by several opaque counterbleeding and counterfeeding interactions as well as bleeding. The results of the study confirmed previous research that classic or parallel optimality theory is incapable of handling counterbleeding opacity. Therefore, HS was adopted to accommodate this type of opacity even though preventing the transparent candidate from winning (incorrectly) is a challenge for HS. However, thanks to the existence of the plural suffix in our data, with the incorporation of the morpheme-specific markedness constraint *ɑ]$_{PL}$, our analysis survived the pitfall. So this analysis or its implications might extend to other cases/analyses where *derived* words undergo counterbleeding. More precisely, the transparent candidate could be ruled out if one of its morphemes which has unlawfully undergone a phonological process could be singled out by a morpheme-specific markedness constraint whose index refers to that morpheme. However, this claim needs to be explored through further research in other languages.

We discussed three cases of counterfeeding opacity in which /n/ never deletes when it is followed by another segment in the input, even if that segment is deleted by the application of a phonological process. In order to deal with this challenge we adopted POT using local constraint conjunction (LCC).

As another instance of non-occurrence of final /n/ deletion in Ghayeni Persian we addressed a case of bleeding interaction whereby word-finally /n/ surfaces if it is preceded by a glottal consonant within a coda cluster. In this environment, the glottal consonant deletes which consequently bleeds final /n/ deletion. Since in the bleeding order both rules theoretically have an equal chance to apply we used local constraint conjunction to dispose of the candidate which has undergone both final /n/ deletion and glottal deletion in defiance of the bleeding order.

Finally we argued that if in compliance with the gradualness condition that every candidate must only be one change away from the input, we include maʃin**u**nein**ɑ**n and maʃin**ɑ**nein**u**n as two candidates in step 1, both will violate *[-high]N and there will be no winner in this step. Therefore, HS would fail to analyze this counterbleeding opacity. But if with regard to this fact that both "modifications" are identical we consider them one change, then we can include maʃin**u**nein**u**n in step 1. This way our analysis survives the challenge. We concluded that as similar cases may be found in other languages, it would not be impossible that a candidate which undergoes the same process twice in the same step could also be allowed for in the standard definition of gradualness condition. However, as HS is one of the latest versions which is still not cross-linguistically well attested much more work/data is necessary.

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