THE NEED FOR INDEXED MARKEDNESS: EVIDENCE FROM SPOKEN PERSIAN[*]

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1.   Introduction

Since the advent of Optimality Theory (Prince and Smolensky 1993/2004), there have been proposals that only faithfulness constraints can be indexed to account for exceptions (Fukazawa 1999, Itô and Mester 1999, 2001, among others). However, this paper through an investigation of pre-nasal vowel raising in spoken Persian (Miller 2011, Rohany 2012), shows that both indexed faithfulness and markedness constraints are required to account for exceptional blocking and specifically exceptional triggering of a phonological process (Pater 2009, Jurgec 2010, Jurgec and Bjorkman 2018). This paper extends this generalization to lexical exceptions where the exceptional triggering of a process can be captured via indexed markedness constraints. Finally, the paper concludes that it is by use of both indexed faithfulness and markedness constraints that we can present a unified grammar that accounts for the regular pattern as well as exceptions.

The rest of the paper is arranged as follows. Section 2 discusses Persian vowel and consonant inventory as well as the differences between written and spoken Persian with the focus on pre-nasal vowel raising as a distinctive element. Section 3 addresses the regular pattern of pre-nasal vowel raising and discusses that there are phonological factors which systematically block the raising alternation. The section includes the discussion of the constraints to account for the environments where raising occurs and where it is inhibited by the phonological blockers. Section 4 addresses the phonological exceptions. In this section exceptional raising and blocking which call for employing indexed faithfulness and markedness constraints will be discussed. Section 5 addresses the lexical factors which systematically block the operation. The relevant constraints of these blockers will be discussed as well. The rest of section 5 discusses the exceptions of the lexical blocking factors which show cases of exceptional triggering. It will be shown that in order to account for this type of exceptionality, it is required to use indexed markedness constraints. Section 6 concludes the paper.
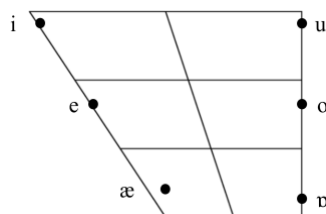
2.   Persian

2.1   Vowel and consonant inventory

This subsection introduces the inventory of Persian vowels and consonants which are shown in (1) and (2), respectively.

(1) Persian vowel inventory

(Majidi and Ternes 1999: 124)

The [+low, +back] vowel in (1) is [+round] whereas others, including Hodge (1957), Modaressi (1979), Jahangiri (1980), Rohany (2012), do not consider this vowel as [+round] and use [–round, +back] vowel [ɑ] in their studies on Persian; hence, in order to be consistent with the major body of literature, [ɑ] is used in this paper.[1]

(2) Persian consonant inventory

	bilabial	labiodental	alveolar	post alveolar	palatal	velar	glottal
plosive	p b		t d			k g	ʔ
nasal	m		n				
fricative		f v	s z	ʃ ʒ		x ɣ	h
affricate				tʃ dʒ			
trill			r²				
approximant					j		
lat. approx.			l				

(Majidi and Ternes 1999: 124)

2.2   Spoken and written Persian

This subsection briefly discusses the differences between spoken and written Persian. Spoken Persian is used in daily spoken communications, in informal audio/video/text message exchanges and in media.[3] However, written Persian is used in formal contexts and registers such as administrative texts, literary and academic books and writings.

There are various morphosyntactic and phonological differences between written and spoken Persian (see Kalbasi 2001). One of the phonological distinguishing factors which is the main concern of this study is pre-nasal vowel raising. In spoken Persian /ɑ/ raises to [u] when it immediately precedes a nasal consonant, whereas this alternation does not occur in written Persian, as shown in (3).[4]

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[1] For further discussion in this regard, see Jones (2019).

[2] In Persian /r/ varies with [ɾ] and [ɹ] (Majidi and Ternes 1999: 125).

[3] Standard (spoken) Persian, informal/vernacular/Tehrani Persian are other names used for this variety of Persian in the literature. I use the cover term spoken Persian.

[4] See Rohany (2012) for the reasons of ɑ~u alternation and not *ɑ~o alternation.

(3) Pre-nasal vowel raising in spoken Persian

WRITTEN PERSIAN	SPOKEN PERSIAN	GLOSS
ɑrɑm	ɑrum	peaceful
xɑne	xune	home
d͡ʒɑnevær	d͡ʒunevær	animal
bɑdɑm	bɑdum	almond

The evidence that shows in this alternation the underlying form is /ɑ/ which surfaces as [u] pre-nasally is Arabic loans used in spoken Persian. Arabic loans show this pre-nasal raising alternation when used in spoken Persian; however, the same loans resist raising when used in written Persian. The following examples in (4) illustrate more.[5]

(4) Arabic loans in spoken and written Persian

IN ARABIC	IN WRITTEN PERSIAN	IN SPOKEN PERSIAN	GLOSS
ħam:a:m	hæm:ɑm	hæmum	bath
ħara:m	hærɑm	hærum	haram
musalma:n	mosælmɑn	mosælmun	Moslem
ħajwa:n	hejvɑn	hejvun	animal
duk:a:n	dok:ɑn	dok:un	shop
tama:m	tæmɑm	tæmum	end

The occurrence of raising in the Arabic loans when used in spoken Persian and the blockage of the raising in the same words when used in written Persian can justify the existence of this alternation in these words.

Note that Pre-nasal raising does not occur in all environments. As mentioned earlier, there are phonological, morphological and lexical factors which systematically block this alternation.[6] In the following section the regular pattern of pre-nasal raising, the phonological blockers as well as their relevant constraints will be addressed.

3. Regularity in raising and phonological blocking

This section begins with the introduction of the constraints motivated by the default patterning of pre-nasal raising. Then the phonological factors which block the alternation will be addressed. The constraints which are specific to these blockers will be discussed subsequently. The section ends with an argument ranking which is able to predict the default patterning of raising and its systematic phonological blockers.

3.1 context-free constraints

As shown earlier, in spoken Persian, /ɑ/ raises to [u] when it immediately precedes a nasal consonant. Hence, configurations [ɑn] and [ɑm] are avoided, which is the effect of the

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[5] Vowels /a/ and /a:/ in Arabic loans are respectively mapped as [æ] and [ɑ] in Persian.

[6] It is beyond the scope of this study to discuss the morphological blockers. For further discussion, see Ariyaee (2018).

markedness constraints *ɑn and *ɑm that are introduced in (5) and (6), respectively (it will be discussed later why there are two distinct constraints for each sequence and not a unified constraint such as *ɑN for both).

(5)   *ɑn: assign one violation for every output with [ɑn] sequence.

(6)   *ɑm: assign one violation for every output with [ɑm] sequence.

    In addition, the general faithfulness constraint IDENT(LO) is required which motivates the blockage of raising. This is shown in (7).

(7)   IDENT(LO): assign one violation for every input segment whose output correspondent has a mismatched value of [±low].

    Since this faithfulness constraint is frequently violated by words that undergo pre-nasal raising operation, it is dominated by the markedness constraints. The following tableau in (8) illustrates this constraint ranking (n.a. stands for "not applicable").

(8)		*ɑn	*ɑm	IDENT(LO)
/zendɑn/ 'prison'	☞[zendun]		n.a.	*
	[zendɑn]	*!	n.a.	
/kodɑm/ 'which'	☞[kodum]	n.a.		*
	[kodɑm]	n.a.	*!	

    The ranking shown in (8) accounts for the raising operation and not for the phonological blocking. In the following subsection the phonological blockers and their relevant constraints will discussed.

3.2   Phonological blockers

I posit that the blockers of the /ɑn/ and the /ɑm/ sequences are different (cf. Modaressi 1979, Jahangiri 1980, Kahn and Bernstein 1981, Miller 2011, Rohany 2012). Thus, their related constraints under the influence of these factors are different from each other. That is why at the beginning of this section separate markedness constraints for each sequence were introduced. This will be discussed in more detail later. The rest of this section discusses the blockers of words with the /ɑm/ and the /ɑn/ sequences. The constraints for each blocker will be introduced and discussed as well. First, the phonological blocking factors of the /ɑm/ sequence and then the blocker of the /ɑn/ sequence will be addressed.

3.2.1 Blockers of the /ɑm/ sequence

One environment where the raising alternation does not occur is when the /ɑm/ sequence is part of a monosyllabic word, as shown in (9).

(9) Blockage of raising in monosyllabic words with [ɑm] sequence

UNDERLYING FORM	SURFACE FORM		GLOSS
/ʃɑm/	[ʃɑm]	*[ʃum]	supper
/dɑm/	[dɑm]	*[dum]	cattle, trap
/vɑm/	[vɑm]	*[vum]	loan
/rɑm/	[rɑm]	*[rum]	tame
/xɑm/	[xɑm]	*[xum]	raw

Another environment where the /ɑm/ sequence resists raising is in multisyllabic words if /ɑ/ and /m/ are not in the same syllable, as shown in (10).

(10) Blockage of raising in multisyllabic words

UNDERLYING FORM	SURFACE FORM		GLOSS
/æ.lɑ.mæt/	[æ.lɑ.mæt]	*[æ.lu.mæt]	sign
/xɑ.me/	[xɑ.me]	*[xu.me]	cream
/ɑ.mɑ.de/	[ɑ.mɑ.de]	*[u.mɑ.de]	ready
/bɑ.mi.je/	[bɑ.mi.je]	*[bu.mi.je]	okra
/dɑ.mæn/	[dɑ.mæn]	*[du.mæn]	skirt

Given the above raising blockage in specific positions, I suggest that two positional faithfulness constraints are required. One positional faithfulness constraint for the monosyllabic words and another for multisyllabic items. Such positions in which a process is blocked are phonological privileged positions which play a central role in the phonology of languages. Positional privilege is manifested in different patterns of phonological asymmetries, one of which is positional resistance to processes which apply elsewhere (Beckman 1998). Segments in prominent positions very rarely undergo phonological processes. Hence, in spoken Persian a phonological privileged position is in words with an /ɑm/ sequence where the trigger (/m/) and the target (/ɑ/) are in separate syllables. The other privileged position is the monosyllabic words with an /ɑm/ sequence where the application of the raising is inhibited.

Given that, I present two positional faithfulness constraints, one for multisyllabic words and another for monosyllabic items shown in (11) and (12), respectively.

(11) IDENT(LO)/_]σ: assign one violation mark for every input segment whose output correspondent is at the end of a syllable and has a mismatched value of [±low].

(12) IDENT(LO)/(σ)ᵥᵥ: assign one violation mark for every input segment whose output is in a monosyllabic word and has a mismatched value of [±low].

Each phonological asymmetry arises from a single pattern of constraint interaction in which positional faithfulness constraints outrank context-free faithfulness and markedness constraints (Beckman 1998:2). Hence, the positional faithfulness constraints in (11) and (12) dominate the general markedness constraint *ɑm. By transitivity, they outrank the general faithfulness IDENT(LO) which is shown in the tableau in (13).

(13)

		IDENT(LO)/_]ₒ	IDENT(LO)/(σ)w	*am	IDENT(LO)
/dɑ.mæn/ 'skirt'	☞[dɑ.mæn]		n.a.	*	
	[du.mæn]	*!	n.a.		*
/ʃɑm/ 'supper'	☞[ʃɑm]	n.a.		*	
	[ʃum]	n.a.	*!		*

These two constraints do not dominate the *ɑn constraint since lexical items with an /ɑn/ sequence are not sensitive to these two blocking factors and thus words with this sequence undergo the alternation. In (14) there is a list of monosyllabic words containing the /ɑn/ sequence in which the pre-nasal vowel /ɑ/ undergoes the alternation.

(14) Raising in monosyllabic words with /ɑn/ sequence

UNDERLYING FORM	SURFACE FORM	GLOSS
/nɑn/	[nun]	bread
/dɑn/	[dun]	seed
/d͡ʒɑn/	[d͡ʒun]	soul
/rɑn/	[run]	leg

Likewise, in (15) there are items with the /ɑn/ sequence in which the trigger (/n/) and the target (/ɑ/) are in separate syllables, yet the raising is not blocked.

(15) Raising in multisyllabic words with /ɑ/ and /n/ in separate syllables

UNDERLYING FORM	SURFACE FORM	GLOSS
/æs.rɑ.ne/	[æs.ru.ne]	afternoon tea
/xɑ.ne/	[xu.ne]	home
/d͡ʒɑ.ne.vær/	[d͡ʒu.ne.vær]	animal
/ʃir.vɑ.ni/	[ʃir.vu.ni]	tin roof
/t͡ʃe.rɑ.qɑ.ni/	[t͡ʃe.rɑ.qu.ni]	decoration with lamps
/zæ.nɑ.ne/	[zæ.nu.ne]	womanly

Every time the /ɑn/ sequence raises to [un] in either monosyllabic words or in multisyllabic lexical items with /ɑ/ and /n/ in separate syllables, one of the positional faithfulness constraints is violated. Hence, *ɑn constraint dominates IDENT(LO)/_]ₒ and IDENT(LO)/(σ)w. And by transitivity, *ɑn dominates *ɑm, as shown in (16).

(16)

		*ɑn	ID(LO)/_]ₒ	ID(LO)/(σ)w	*ɑm	ID(LO)
/dɑ.mæn/ 'skirt'	☞ [dɑ.mæn]	n.a.		n.a.	*	
	[du.mæn]	n.a.	*!	n.a.		*
/ʃɑm/ 'supper'	☞ [ʃɑm]	n.a.	n.a.		*	
	[ʃum]	n.a.	n.a.	*!		*
/nɑn/ 'bread'	☞ [nun]		n.a.	*	n.a.	*
	[nɑn]	*!	n.a.		n.a.	
/d͡ʒɑ.ne.vær/ 'animal'	☞ [d͡ʒu.ne.vær]		*	n.a.	n.a.	*
	[d͡ʒɑ.ne.vær]	*!		n.a.	n.a.	

The above argument ranking which highlights the dominance of the *ɑn constraint over *ɑm clarifies the point that there should be separate markedness constraints for the /ɑn/ and the /ɑm/ sequences and not one unified constraint for both. If there were one markedness constraint such as *ɑN (N = [m] and [n]), this constraint would not be able to capture the above argument ranking and thus could not predict words with the /ɑn/ sequence are insensitive to the positional faithfulness constraints. The rest of the section discusses the phonological blocking factor for the /ɑn/ sequence.

3.2.2 Blocker of the /ɑn/ sequence

Raising in words with an /ɑn/ sequence is inhibited if the sequence is immediately followed by [u], as shown in (17).

(17) Raising blockage in /ɑn/ sequence

UNDERLYING FORM	SURFACE FORM		GLOSS
/zɑnu/	[zɑnu]	*[zunu]	knee
/xɑnum/	[xɑnum]	*[xunum]	lady
/qɑnun/	[qɑnun]	*[qunun]	law
/oqjɑnus/	[oqjɑnus]	*[oqjunus]	ocean

This shows that the language seems not to allow too much vowel harmony in one word (Modaressi 1978:83). This blockage of raising could be due to the satisfaction of the Obligatory Contour Principle (OCP) (Leben 1973) where having consecutive identical elements is forbidden. Steriade (1995) interprets the OCP as a constraint against the repetition of a feature. Furthermore, Meyers (1997) formulates his language-dependent "OCP!" as a feature value [F] which should not appear twice inside a specified domain and posits that dissimilation is the result of the OCP. Thus, in spoken Persian the assimilation of two low back vowels in the domain of a word where one appears pre-nasally and the other appears post-nasally is banned.

Given the blockage of the raising in words with the /ɑnu/ sequence, the undominated markedness constraint *unu is introduced to account for the resistance of pre-nasal raising. The following tableau in (18) shows the ranking of *unu constraint with regards to the aforementioned constraints.

(18)

/zɑnu/	*unu	*ɑn	IDENT(LO)
☞[zɑnu]		*	
[zunu]	*!		*

The argument ranking which shows the regular phonological blocking factors of the /ɑm/ and the /ɑn/ sequences is as follows in (19).

(19) Argument ranking for phonological blockers
*unu >> *ɑn >> IDENT(LO)/_]σ, IDENT(LO)/(σ)w >> *ɑm >> IDENT(LO).

This constraint ranking can only predict the occurrence or the blockage of raising in words that follow the default phonological patterning of pre-nasal operation. This grammar is unable to account for the exceptional triggering and blockage of raising. It also does not capture exceptional triggering in lexical exceptions which will be discussed in section 5.

In the following section the need for both indexed markedness and faithfulness constraints when there is exceptionality will be addressed.

4.   Phonological exceptions

This section provides an analysis to account for exceptionality by use of indexed constraints. The motivation for constraint indexation is to come up with a unified grammar that captures both the default and the override.

In the literature of Optimality Theory one of the methods to account for such exceptional patterning is to introduce constraints that are indexed to a specific word class. For example, there are indexed constraints for roots (McCarthy and Prince 1993, Jurgec and Bjorkman 2018), loanwords (Itô and Mester 1995, 2001), nouns (Smith 2001), specific lexical items and morphemes (Pater 2000) or exceptional suffixes (Pater 2009). Pater (2000) argues that the basic theory of OT does not provide any means of relativizing the constraints to a specific set of items. Hence, he proposes that constraints can be multiply instantiated in the constraint hierarchy: in a general version and in a lexically indexed version. In addition, Jurgec (2010) uses indexed markedness and faithfulness constraints to account for the exceptional patterning of loanwords in in Slovenian. Likewise, Jurgec and Bjorkman (2018) use indexed constraints to account for the non-local morphologically derived environment effects (MDEEs).

Along these lines, in this study indexed constraints are employed in order to resolve the ranking paradoxes caused by exceptional set of items. The motivation for indexing constraints is that the phonologically motivated argument ranking presented in (19) only accounts for the regular pattern. It does not capture exceptions and thus cannot resolve the ranking paradoxes.

To account for the exceptions, we need both indexed faithfulness and markedness constraints as spoken Persian has two different classes of exceptionality: exceptional blocking and exceptional triggering of the pre-nasal raising alternation. This section discusses these two exceptional cases and argues that indexed faithfulness and markedness account for exceptional blocking and exceptional triggering, respectively.

The following subsection addresses exceptional blocking and indexed faithfulness, followed by the discussion of exceptional triggering and indexed markedness.

4.1   Exceptional blocking

The class of exceptional blockers includes lexical items that do not have any phonological blocking factors, yet the raising operation does not apply. In (20) there is a list of items which are expected to undergo the alternation but raising is inhibited in them.

(20) Words which should undergo raising but don't

UNDERLYING FORM		SURFACE FORM		GLOSS
/ælʔɑn/	→	[ælʔɑn]	*[ælʔun]	now
/ænd͡ʒɑm/	→	[ænd͡ʒɑm]	*[ænd͡ʒum]	do (something)
/d͡ʒobrɑn/	→	[d͡ʒobrɑn]	*[d͡ʒobrun]	compensation
/sælɑm/	→	[sælɑm]	*[sælum]	hello
/pærvɑne/	→	[pærvɑne]	*[pærvune]	butterfly
/eʔdɑm/	→	[eʔdɑm]	*[eʔdum]	capitalization

This exceptional blockage causes ranking paradoxes. In order to account for the exceptions and resolve the ranking paradox, an indexed faithfulness constraint is required. The source of such paradox is that in the default situation *ɑn and *ɑm dominate IDENT(LO), as shown in (19). However, words with exceptional resistance to raising in (20), require the ranking reversal which is IDENT(LO) dominate *ɑn and *ɑm. The argument ranking for the regular pattern as well as the constraint ranking for exceptional blocking are shown in (21).

(21) Comparison of constraint ranking in default and exceptional blocking cases

	EXAMPLE				RANKING
Default pattern	/rɑn/	→[run]		'leg'	*ɑn >> IDENT(LO)
	/bɑdɑm/	→[bɑdum]		'almond'	*ɑm >> IDENT(LO)
Exceptional blocking	/ælʔɑn/	→[ælʔɑn],	*[ælʔun]	'now'	IDENT(LO) >> *ɑn
	/sælɑm/	→[sælɑm],	*[sælum]	'hello'	IDENT(LO) >> *ɑm

In order to resolve this ranking paradox, the undominated indexed faithfulness constraint IDENT(LO)EB is introduced to account for the exceptional blockage of raising which is shown in (22) (index EB stands for "exceptional blocking").

(22)		IDENT(LO)EB	*ɑn	*ɑm	IDENT(LO)
/sælɑmEB/	☞[sælɑm]		n.a.	*	
	[sælum]	*!	n.a.		*
/ælʔɑnEB/	☞[ælʔɑn]		*	n.a.	
	[ælʔun]	*!		n.a.	*

This indexed faithfulness constraint resolves the ranking paradox caused by the exceptional blockers. In order to resolve a different issue of ranking paradox caused by the class of exceptional triggering items, I suggest employing indexed markedness constraints which is addressed in the following subsection.

4.2 Exceptional triggering

This class of exceptions includes words with the /ɑm/ sequence that due to the existence of the phonological blockers should not undergo the raising process, yet they do, as shown in (23). Recall that in words with the /ɑm/ sequence raising is inhibited in

monosyllabic items as well as in multisyllabic words whose /ɑ/ and /m/ are in separate syllables. That is why the items in (23) are cases of exceptional triggering.

This class of exceptions does not include any words with the /ɑn/ sequence indicating the blocking factor of this sequence without any exceptions blocks all the raising alternations.

(23) Words which shouldn't undergo raising but do

UNDERLYING FORM	SURFACE FORM	GLOSS
/bɑm/	[bum]	roof
/ɑ.mæd/	[u.mæd]	came
/dɑ.mɑd/	[du.mɑd]	groom

The argument ranking shown in (19) which accounts for the regular pattern of raising and blocking does not capture the exceptional raising in the items displayed in (23). The reason is that in the regular situation the positional faithfulness constraints ID(LO)/_]$_\sigma$ and ID(LO)/(σ)$_w$ dominate the markedness constraint *ɑm. Yet, the mappings in (23) with exceptional raising entail that *ɑm dominate ID(LO)/(σ)$_w$ and ID(LO)/_]$_\sigma$. Hence, the exceptional triggering items call for ranking reversals causing ranking paradoxes. This ranking paradox is shown in (24) where the argument ranking for the regular pattern as well as the constraint ranking for exceptional raising are compared with each other.

(24) Comparison of constraint ranking in default and exceptional raising

	EXAMPLE			RANKING
default pattern	/hɑ.me.le/ /ʃɑm/	→[hɑ.me.le], →[ʃɑm],	*[hu.me.le] 'pregnant' *[ʃum] 'supper'	ID(LO)/_]$_\sigma$ >> *ɑm ID(LO)/(σ)$_w$ >> *ɑm
exceptional triggering	/ɑ.mæd/ /bɑm/	→[u.mæd] →[bum]	'came' 'roof'	*ɑm >> ID(LO)/_]$_\sigma$ *ɑm>>ID(LO)/(σ)$_w$

In order to resolve this ranking paradox, indexed markedness constraints are motivated to be employed (Pater 2009, Jurgec 2010, Jurgec and Bjorkman 2018). Thus, I introduce the undominated indexed markedness constraint *ɑm$_{ET}$ to account for exceptional triggering of raising, as shown in (25) (the index ET stands for "exceptional triggering").

(25)

		*ɑm$_{ET}$	ID(LO)/(σ)$_w$	ID(LO)/_]$_\sigma$	*ɑm	ID(LO)
/ɑ.mæd$_{ET}$/	☞[umæd]		n.a.	*		*
	[ɑmæd]	*!	n.a.		*	
/bɑm$_{ET}$/	☞[bum]		*	n.a.		*
	[bɑm]	*!	*	n.a.	*	

The argument ranking in (25) shows that in order to come up with one unified language that is able to account for the regularities and irregularities, besides indexing the

faithfulness, it is required to index the markedness constraints. This call for indexing the markedness constraints is extended to lexical exceptions as well.

The following section introduces different lexical factors as the regular blocking elements of the pre-nasal vowel raising. Then, the exceptions to this generalization and the ranking paradoxes they cause will be addressed. Finally, it is shown how the indexed markedness is able to capture such irregularity.

5. Lexical factors and pre-nasal raising

In section 3 the phonological factors which showed the regular blockage of the pre-nasal raising alternation as well as the constraint ranking were discussed. In section 4 two different classes of exceptional items which caused ranking paradoxes for the argument ranking were addressed. By motivating indexed faithfulness and indexed markedness constraints, the ranking paradoxes were resolved.

Likewise, in this section the regular pattern of raising blockage by lexical factors and their respective constraints will be discussed. The exceptions of the lexical blocking which show exceptional triggering will be addressed subsequently. These exceptions would cause ranking paradoxes for the argument ranking which accounts for the regular pattern of lexical blocking. The proposed solution is employing the indexed markedness.

5.1 Lexical blockers

This subsection focuses on the items in which the raising alternation is blocked as they belong to one (or more than one) of the three lexical categories that will be discussed.

The three classes of lexical items that resist raising are proper names (26), foreign words (27) and novel items (28).

(26) Blockage of raising in proper names

	PROPER NAMES			GLOSS
/hanije/	→	[hanije]	*[hunije]	female name
/pedrɑm/	→	[pedrɑm]	*[pedrum]	male name
/rɑmsær/	→	[rɑmsær]	*[rumsær]	city name
/ilɑm/	→	[ilɑm]	*[ilum]	city/province name

(27) Blockage of raising in foreign words[8]

	FOREIGN WORDS			SOURCE LANGUAGE	GLOSS
/restorɑn/	→	[restorɑn]	*[restorun]	French	restaurant
/kɑmjon/	→	[kɑmjon]	*[kumjon]	French	truck
/ɑnlɑjn/	→	[ɑnlɑjn]	*[unlɑjn]	English	online
/mɑnitor/	→	[mɑnitor]	*[munitor]	English	monitor
/estekɑn/	→	[estekɑn]	*[estekun]	Russian	teacup
/vɑn/	→	[vɑn]	*[vun]	Russian	bathtub

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[8] Unlike the Arabic loans which undergo the pre-nasal raising alternation, non-Arabic loans (entitled as foreign words in this study) resist undergoing the process. For further discussion, see Ariyaee (2019).

(28) Blockage of raising in novel items

		NOVEL ITEMS		GLOSS
/zæbanʃenɑs/	→	[zæbanʃenɑs]	*[zæbunʃenɑs]	linguist
/særɑne/	→	[særɑne]	*[særune]	per capita
/rɑjɑne/	→	[rɑjɑne]	*[rɑjune]	computer
/pɑrkbɑn/	→	[pɑrkbɑn]	*[pɑrkbun]	parking lot guard

Note that the raising alternation in these words does not interact with the phonological structure meaning even if the pre-nasal /ɑ/ does not have any phonological restrictions for the raising process, the alternation is still blocked. Hence, the argument ranking shown in (19) which motivates the raising in the above items incorrectly predicts the undesired output. This incorrect prediction is shown in (29).

(29)			*ɑn	*ɑm	ID(LO)
/i.lɑm/	💣*	[ilum]	n.a.		*
	☹	[ilɑm]	n.a.	*!	
/vɑn/	💣*	[vun]		n.a.	*
	☹	[vɑn]	*!	n.a.	
/rɑjɑne/	💣*	[rɑjune]		n.a.	*
	☹	[rɑjɑne]	*!	n.a.	

In (29) the selection of the wrong candidate (shown with 💣*symbol) by the above argument ranking is due to a ranking paradox. In the default situation *ɑn and *ɑm dominate ID(LO) whereas the desired outputs in (29) call for the reversal of the ranking which is ID(LO) dominate the markedness constraints *ɑn and *ɑm. In order to resolve the ranking paradox, for each lexical category one undominated faithfulness constraint indexed for its relevant category of items is introduced. That is, to capture the blockage of the alternation in proper names, the indexed faithfulness IDENT(LO)PROPER is introduced. Similarly, IDENT(LO)NOVEL (Pater 2000) and IDENT(LO)FOREIGN (Itô and Mester 1995) are employed to account for the raising inhibition in novel and foreign items, respectively. The updated argument ranking is shown in (30).

(30)		ID(LO)PROPER	ID(LO)FOREIGN	ID(LO)NOVEL	*ɑn	*ɑm
/i.lɑmPROPER/	[ilum]	*!	n.a.	n.a.	n.a.	
	☞[ilɑm]		n.a.	n.a.	n.a.	*
/vɑnFOREIGN/	[vun]	n.a.	*!	n.a.		n.a.
	☞[vɑn]	n.a.		n.a.	*	n.a.
/rɑjɑneNOVEL/	[rɑjune]	n.a.	n.a.	*!		n.a.
	☞[rɑjɑne]	n.a.	n.a.		*	n.a.

The motivation for dominating the indexed faithfulness constraints over the markedness constraints is to predict that proper names, foreign and novel words in the output are faithful to the input in terms of the pre-nasal vowel features. Yet, there are exceptional proper names, foreign and novel words which are not faithful. These

exceptions undergo the alternation and thus cause ranking paradoxes. The following subsection addresses such exceptions and suggests a solution for the ranking paradox.

5.2   Lexical exceptions

The lexical blocking factors are not exceptionless. There are proper names, novel items and foreign words which undergo the pre-nasal raising process. A sample of such items is shown in (31).

(31) Exceptions of lexical blockers

	EXAMPLE	LEXICAL CATEGORY	GLOSS
/ʃemirɑn/	→ [ʃemrun]	proper name	'a county in Tehran'
/atæʃneʃɑn/	→ [atæʃneʃun]	novel item	'firefighter'
/t͡ʃæmedɑn/	→ [t͡ʃæmedun]	foreign word (Russian)	'suitcase'

The exceptional triggering of the alternation in (31) cause ranking paradoxes for the argument ranking in (30). The ranking paradox is that in the regular situation the faithfulness constraints indexed for each lexical category outrank the markedness constraints; however, the exceptional raising in (31) entail that the markedness constraints dominate the indexed faithfulness constraints. Hence, the exceptional triggering items call for ranking reversals resulting in ranking paradoxes. This ranking paradox is shown in (32) where the argument ranking for the regular pattern and the constraint ranking for the exceptional raising are compared with each other.

(32)   Comparison of constraint ranking in default and exceptional raising cases

	EXAMPLE				RANKING
Default pattern	/gilɑn/	→[gilɑn],	*[gilun]	'Gilan'	ID(LO)PROPER>>*ɑn
	/ʃans/	→[ʃans],	*[ʃuns]	'chance'	ID(LO)FOREIGN>>*ɑn
	/rajane/	→[rajane],	*[rajune]	'computer'	ID(LO)NOVEL>>*ɑn
Exceptional triggering	/ʃemirɑn/	→[ʃemrun]		'Shemiran'	*ɑn>>ID(LO)PROPER
	/t͡ʃæmedɑn/	→[t͡ʃæmedun]		'suitcase'	*ɑn>>ID(LO)FOREIGN
	/atæʃneʃɑn/	→[atæʃneʃun]		'firefighter'	*ɑn>>ID(LO) NOVEL

In order to resolve this ranking paradox, indexed markedness constraints are required. Thus, I employ the undominated indexed constraint *ɑn$_{ET}$ for the items which exceptionally undergo the alternation, as shown in (33).

(33)		*ɑn$_{ET}$	ID(LO)PROPER	ID(LO)FOREIGN	ID(LO)NOVEL
/ʃemirɑn$_{ET}$/	[ʃemrɑn]	*!		n.a.	n.a.
	☞[ʃemrun]		*	n.a.	n.a.
/t͡ʃæmedɑn$_{ET}$/	[t͡ʃæmedɑn]	*!	n.a.		n.a.
	☞[t͡ʃæmedun]		n.a.	*	n.a.
/atæʃneʃɑn$_{ET}$/	[atæʃneʃɑn]	*!	n.a.	n.a.	
	☞[atæʃneʃun]		n.a.	n.a.	*

The above constraint ranking shows that in order to account for the exceptions of the lexical blockers, which show exceptional triggering of a process, it is required to index markedness constraints.

This section showed that we can account for the blockage of a process in certain lexical categories by indexing faithfulness constraints specific to those categories (Pater 2000, Itô and Mester 1995). Importantly, it was shown that in order to capture the exceptional triggering of that process among those lexical categories, it is required to employ indexed markedness constraints.

6.   Conclusion

There are accounts on the indexation of constraints which posit that only faithfulness constraints can be indexed (Fukazawa 1999, Itô and Mester 1999, 2001, among others). This paper casts doubt on this claim by providing data from spoken Persian which show two different types of exceptions: exceptional blocking and exceptional triggering of the phonological alternation of pre-nasal vowel raising. The existence of such exceptions would cause ranking paradoxes. And it was shown that by employing indexed faithfulness constraints, we can account for the exceptional blocking and hence resolve the ranking paradox. In addition, it was proposed that in order to account for the exceptional triggering and resolve the ranking paradox caused by these exceptions, it is required to employ the indexed markedness constraints (Pater 2009, Jurgec 2010, Jurgec and Bjorkman 2018). The call for the indexed markedness was reinforced when the paper extended this proposal to exceptions of the lexical blockers of pre-nasal raising.

To conclude, this paper showed that it is through both types of indexed constraints that a unified grammar can be presented to account for the regular pattern as well as the exceptional blocking and exceptional triggering of a process.

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