Research Article

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Sonority Sequencing Principle in Sabzevari Persian: A Constraint-Based Approach

Abstract: This study sheds light on the relationship between the Sonority Sequencing Principle (SSP) and syllable structure in Sabzevari, a Persian vernacular spoken in the Sabzevar area of Northeast Iran. Optimality Theory (OT), as a constraint-based approach, is utilized to scrutinize sonority violation and its repair strategies. The results suggest that obedience to the SSP is mandatory in Sabzevari, as shown through the treatment of word-final clusters in Standard Persian words which violate the SSP. These consonant clusters are avoided in Sabzevari by two phonological processes: vowel epenthesis and metathesis. Vowel epenthesis is motivated by final consonant clusters of the forms /fricative+coronal nasal/, /plosive+bilabial nasal/, /fricative+bilabial nasal/, /plosive+rhotic/, /fricative+rhotic/, and /plosive+lateral/. Metathesis, as another repair strategy for sonority sequencing violations, occurs when dealing with final consonant clusters of the forms /plosive+fricative/ and /fricative+lateral/.

Keywords: Sabzevari syllable structure; SSP violation; vowel epenthesis; metathesis; Optimality Theory (OT)

1 Introduction

Studies conducted on sonority demonstrate a significant role in the organization of syllables in natural languages (Clements 1990; Laks 1990; Klein 1990). Consonants and vowels in most languages are combined to form syllables while other sonorant consonants can represent nuclei in languages including English (Treiman et al., 1993; Ridouane 2008), German (Roach 2002; Ridouane 2008), Czech (Roach 2002; Ridouane 2008), and Barber (Ridouane 2008).[1] Their arrangement is such that sonority is highest at the peak and drops from the peak towards the margins (Clements 1990). In other words, sonority takes the shape of a mountain where the peak is associated with the vowel and the "slopes" of the mountain are associated with consonants. This generalization is known as the Sonority Sequencing Principle (Sonority Sequencing Generalization). The SSP is violated in some languages such as Russian, Arabic, Persian, and Hebrew, although it is a universal tendency Selkirk (1984); Clements (1990). Some languages tolerate violation of the SSP such as Abaza (Allen 1956), Cambodian (Huffman 1972), English (Clements 1990), Ewe (Clements 1990), French (Clements 1990), German (Clements 1990), Klamath (Barker 1963), Kota (Emeneau 1944), Ladakhi (Koshal 1979), Mohawk (Michelson 1988), Pashto (Bell & Saka 1983), and Russian (Clements 1990)

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[1] Ridouane (2008) states that the /l/ in English can represent a nucleus in the word *bottle* [bɒ.t**l**] and /r/ can be a nucleus in the word *Brno* [b**r**.no] in Czech and /n/ can similarly be a nucleus in a German word [ha.bn] 'to have'. Likewise, in Tashlhiyt Barber, Ridouane (2008) indicates that /r/ and /l/ can be employed as nuclei in the word [**r**.glʁ] 'I have locked'. Interestingly, in Tashlhiyt Barber, Ridouane (2008) posits that any second member of any consonant cluster, whether a sonorant or obstruent, can be employed as a nucleus, e.g. [ta.z**n**.kʷ**t**]

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while others follow this principle through repair strategies including vowel epenthesis and metathesis; hence, Hannahs (2013) states that the repair strategies of vowel epenthesis and metathesis are used to abide the SSP in Welsh, whereas metathesis is the only strategy used in Judeo-Spanish to follow the same principle (Bradley 2007). These repair strategies are investigated in the next section with reference to Persian varieties.

This paper is intended to shed light on how conformity to the SSP in Sabzevari is accomplished with reference to Optimality Theory (OT) as a framework. To achieve this aim, it is necessary to address the following questions: **"**How is conformity with the SSP achieved in Sabzevari?**", "**To what extent are vowel epenthesis and metathesis applied in this dialect?**",** and **"**How can we account for vowel epenthesis and metathesis in Sabzevari using OT?**"**

The next section pertains to previous studies on SSP violation and repair strategies with reference to Persian varieties. Following that is a section providing background knowledge about the phonology of Sabzevari. Section 4 includes the relationship between syllable structure and the Sonority Sequencing Generalization (SSG), plus investigation of the syllable type CVCC, which can contain a word-final cluster violating the SSP. Section 5 covers how data from Sabzevari were gathered, followed by section 6 which is given over to the data analysis and discussion using OT as an analytical framework. The conclusion summarizes this paper and its findings.

2 Literature Review

The SSP in Persian has been considered by scholars including Ahmadkhani (2010), Aldaghi and Tavakoli (2011), Zahedi, Alinezhad, and Rezai (2012), and Mobaraki (2013). Aldaghi and Tavakoli (2011) state that word-final clusters such as /-hn/, /-hr/, and /-zn/ are broken up by vowel epenthesis in the Sabzevari dialect, e.g., pahn→ pah**e**n 'wide'. Mobaraki (2013:114), who works on fortition in the Persian phonological system, examines how some word-final clusters of the form /fricative+m/ that yield sonority reversal are adapted in the Sabzevari dialect through the internal insertion of the vowel [o], as follows:

(1)

a. /zaχm/	[za.χ**o**m]	'wound'
b. /ʔesm/	[ʔe.s**o**m]	'name'
c. /paʃm/	[pa.ʃ**o**m]	'wool'
d. /toχm/	[to.χ**o**m]	'seed'
e. /nazm/	[na.z**o**m]	'discipline'
f. /χaʃm/	[χa.ʃ**o**m]	'rage'

According to the examples in (1), Mobaraki (2013) observes that word-final clusters of the form /fricative+m/, which do not comply with the SSP, motivate the insertion of the vowel [o] in the Sabzevari dialect. Descriptively, he presents the process of insertion of the vowel [o] between the members of word-final clusters as shown below:

(2)
ø → [o] /CVC1_____ C2#   where C2 > C1 in sonority scale and C2=m (bilabial nasal)
$$\text{(Mobaraki 2013:115)}$$

With respect to Mobaraki's (2013) findings, he does not refer to OT. Therefore, we do not know what his analysis of the insertion of the vowel [o] would look like in the OT framework. The process of insertion is not restricted to the vowel [o]; in fact, the vowel [e] can be seen as the default epenthetic vowel in Persian

Shademan (2002); Rahbar (2009).[2] Furthermore, Mobaraki (2013) does not investigate the role of vowel harmony in determining the identity of epenthetic vowels in this dialect. Therefore, this study investigates this phenomenon using OT as a framework.

Vowel epenthesis is not the only repair strategy used to conform to the SSP in this variety of Persian: metathesis, as a phonological process, is another way to potentially achieve conformity to the SSP. For instance, Ahmadkhani (2010:16) states that synchronic metathesis in Modern Persian occurs merely to observe the SSP. He notes that word-final clusters of the forms /plosive+fricative/, /plosive+liquid/, and /fricative+liquid/, which violate the SSP, are avoided by metathesis rather than vowel epenthesis in Modern Persian. Consider the following examples:

(3)

a. /lu<u>ks</u>/	**[lu<u>sk</u>]**	'luxurious'
b. /bo<u>ks</u>/	[bo<u>sk</u>]	'punch'
c. /ʔa<u>ks</u>/	[ʔa<u>sk</u>]	'photo'
d. /pu<u>dr</u>/	[pu<u>rd</u>]	'powder'
e. /qo<u>fl</u>/	[qo<u>lf</u>]	'lock'

Aldaghi and Tavakoli (2011) also indicate metathesis as one of the phonological processes present in the Sabzevari dialect. They list some examples from this dialect that show metathesis without demonstrating the reason for this phenomenon, and without referring to any phonological framework to analyse the data they obtained.

Zahedi, Alinezhad, and Rezai (2012:78), who work on Sandaji Kurdish, observe that metathesis is used to avoid the sonority reversal constituted by some final consonant clusters of the forms /-fl/ and /-ks/ in borrowed words, as shown in the examples below:

(4)

a. /qo<u>fl</u>/	[qo<u>lf</u>]	'lock'
b. /ʕa<u>ks</u>/	[ʕa<u>sk</u>]	'photo'

The above studies show that vowel epenthesis and metathesis are repair strategies used to avoid the sonority sequencing violations that stem from some word-final clusters, mostly involving sonority reversal. However, these studies have not fully discussed the treatment of sonority violation in Sabzevari in light of OT. Aldaghi and Tavakoli's (2011) work on phonological processes in Sabzevari is mostly descriptive; they mainly list words from Sabzevari Persian and how these words are produced by speakers. Some words have epenthetic vowels while others are shown with metathesis, without any explanation of why these processes happen. Moreover, the authors do not refer to any theoretical framework to analyse this phenomenon. Mobaraki (2013) demonstrates the insertion of the vowel [o] between the members of word-final clusters that violate the SSP when the second member of these clusters is a bilabial nasal, using rule-based phonology. However, firstly, Mobaraki (2013) does not refer to OT, so we do not know what his analysis of the insertion of the vowel [o] would look like in the OT framework. Secondly, the insertion of the vowel [e] may also be seen in this dialect since it is the default epenthetic vowel in Persian Shademan (2002); Rahbar (2009). Thirdly, Mobaraki (2013) does not investigate the role of vowel harmony in determining the identity of epenthetic vowels in Sabzevari Persian. Therefore, the limitations of Aldaghi and Tavakoli (2011) and Mobaraki's (2013) works are addressed here.

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2 Meaning that [e] is most commonly used for epenthesis in this language, compared to other vowels.

3 Sabzevari Persian

Sabzevari Persian is a dialect spoken in Sabzevar, which is located in Northeast Iran, in the Khorasan Razavi province. Most people in Sabzevar and the neighboring villages speak this dialect, while varieties of Turkish and Kurmanjj are prevalent in more northern villages Aldaghi & Tavakoli (2011).

3.1 The Sabzevari Consonant Inventory

The table below shows the twenty-three consonants found in Sabzevari, conventionally represented by place and manner of articulation:

Table 1: Manners and places of articulation of consonants in Sabzevari (Aldaghi and Tavakoli 2011: 293)

	Bilabial	Labio-dental	Dental	Alveolar	Post-alveolar	Palatal	Velar	Uvular	Pharyngeal	Glottal
Plosives	p b		t d				k g	q		ʔ
Fricatives		f v		s z	ʃ ʒ			χ		h
Affricates					ʧ ʤ					
Nasals	m			n						
Trills				r						
Laterals				l						
Glides						j				

The next subsection presents the vowels found in Sabzevari.

3.2 The Vowel Inventory in Sabzevari

Aldaghi & Tavakoli (2011:294) state that Sabzevari has five short vowels, /i/, /e/, /a/, /o/, and /u/, and two long vowels, /uː/, and /ɑː/. Consider the following examples:

(5)

Sabzevari input	Sabzevari output	Meaning
a. /busi/	[bu̲.si̲]	'kiss'
b. /bezɑːt/	[be̲.zɑ̲ːt]	'ill-natured'
c. /ʧu/	[ʧu̲]	'wood'
d. /ʤo/	[ʤo̲]	'soul'
e. /buːm/	[bu̲ːm]	'roof'
f. /χaːne/	[χa̲.na̲]	'home'

Table 2: Long and short vowels in Sabzevari are shown in the vowel chart below:

	Front	Mid	Back
High	i		u,u:
Mid-High	e		o
Mid-Low			
Low	a		ɑ:

Sabzevari has also six diphthongs: /ai/, /ei/, /oi/, /ao/, /ui/, and /ou/. These diphthongs are illustrated in the following examples:

(6)

Sabzevari input	Sabzevari output	Meaning
a. /mai/	[mai]	'wine'
b. /peivan/	[pei.van]	'link'
c. /doijom/	[doi.jom]	'second'
d. /kaoʃ/	[kaoʃ]	'shoe'
e. /tou/	[tou]	'fever'
f. /murbui/	[mur.bui]	'Morbouy' (A desert plant with yellow flowers)

In conclusion, Sabzevari has thirteen vowels: five short vowels and two long vowels plus six diphthongs. The next subsection addresses how the underlying form is determined in Sabzevari.

3.3 How to determine the input in Sabzevari Persian?

Ferguson (1959), Jeremias (1984), and Rossi (2015) use the term *diglossia* in Persian to describe the socio-linguistic situation in Persian-speaking countries. Standard Persian and Colloquial Persian are two distinct language systems in each Persian-speaking region Ferguson, (1959); Jeremias, (1984); Rossi, (2015). Standard Persian is known as the prestigious language system mainly used for formal education, high literature, and formal speech, while Colloquial Persian (henceforth CP) is typically low-prestige since it is used as the means of everyday communication.[3] Standard Persian is different from Colloquial in terms of vocabulary, pronunciation, and grammar Rossi (2015).

Mohanan (1992) points to the alternation across formal and informal speech being an equally good argument for morphological alternation with reference to Singapore English. This alternation can be accounted for by postulating the phonemic /test/ for both styles and deleting the final consonant in informal speech Mohannan (1992), i.e. [test] in formal speech and [tes] in informal speech. The basis of alternation across formal and informal speech can be found in Sabzevari Persian when accounting for complex codas that constitute sonority reversal. This statement can be summarised as follows:

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3 Rossi (2015) states that people are more exposed to Colloquial Persian (Informal Persian) than Standard Persian since the colloquial variety is used in everyday speech in informal situations. In other words, Rossi (2015) notes that people use their own local dialect in everyday speech (informal situations).

(7)

Phonemic representation	Realization	Gloss
/fekr/	[fekr] (formal)	'thinking'
	[fe.k**e**r](informal)	
/setr/	[setr] (formal)	'veil'
	[se.t**e**r](informal)	
/qofl/	[qofl] (formal)	'lock'
	[qolf] (informal)	
/katf/	[katf] (formal)	'shoulder'
	[kaft] (informal)	

Following Mohanan's (1992) statement, the input is the Sabzevari one which has two realisations, depending on formal and informal speech. For instance, the inputs /fekr/, /setr/, /qofl/, and /katf/ have formal and informal realisations. The formal realisation is immune to any phonological processes and is faithful to the input while phonological processes are seen in the informal realisation, as shown in the table above.[4]

Within the framework of OT, Prince and Smolensky (1993) introduce the principle of *Lexicon Optimization* as a means of determining the correct underlying representation:

Lexicon Optimization

Suppose that several different inputs I_1, I_2, ... , I_n, when parsed by a grammar G lead to corresponding outputs O_1, O_2, ..., O_n, all of which are realised as the same phonetic form φ - these inputs are all phonetically equivalent with respect to G. Now one of these outputs must be the most harmonic, by virtue of incurring the least significant violation marks: suppose this optimal one as labelled O_k. Then the learner should choose, as the underlying form for φ, the input I_k (Prince and Smolensky 1993:192).

In light of the above principle, Yip (1996), Kager (1999), and Kim (2002) agree that the the chosen underlying form is the one that maps onto the surface form with the least significant faithfulness violations. For further demonstrations, the following tables evaluate the candidates of the inputs /fekr/ and /katf/ in Sabzevari Persian using the constraints of ONSET, MAX-IO (No deletion) McCarthy and Prince (1995), LINEARITY (no metathesis) McCarthy and Prince (1995), ALIGN-RIGHT (the right edge of the input must align with the right edge of the output) McCarthy and Prince (1993), and DEP-IO (No epenthesis) McCarthy and Prince (1995):

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4 Mace (2003) states that the Standard pronunciation of Persian is used by Persian native speakers, regardless of their education, in formal situations, while the colloquial pronunciation is used by native speakers of Persian for everyday speech.

Table 3: ONS>>MAX-IO>>LINEARITY>> ALIGN-RIGHT>>DEP-IO

	ONS	MAX-IO	LINEARITY	ALIGN-RIGHT	DEP-IO
/fekr/					
a. ☞fekr					
b. fe.ker					*
c. fek		*!		*	

	ONS	MAX-IO	LINEARITY	ALIGN-RIGHT	DEP-IO
/katf/					
a. ☞katf					
b. kaft			*!	*	
c. ka.t̪if					*

The next subsection is devoted to the types of syllables in Sabzevari Persian.

3.4 The Syllable Structure of Sabzevari Persian

Persian language and its varieties, including Sabzevari Persian, use five syllable structures: CV, CVV, CVC, CVVC, CVCC (Elwell-Sutton 1976; Hayes 1979; Windfuhr 1979; Darzi 1991; Amini 1997; Bijankhan 2000; Hall 2007; Rahbar 2012; Heidarizadi 2014). Two crucial points pertaining to the syllable structure of Sabzevari are discussed in this subsection, i.e. obligatoriness and optionality of constituents in Sabzevari syllable structure plus syllable weight. By looking at the five syllable types in Sabzevari, onsets and nucleus are obligatory constituents while single as well as complex codas are optional since they are available in some syllable types and are absent in others. The table 4 below shows the syllable types in Sabzevari with examples.

Table 4: Syllable structure in Sabzevari Persian

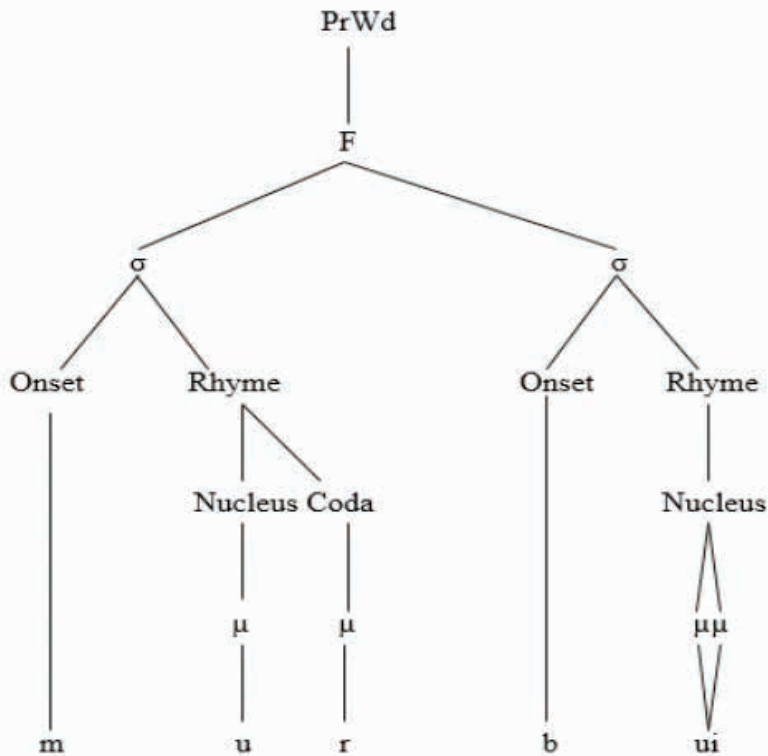| Syllable Structure	Example	Gloss
a. CV	[d͡ʒo]	'soul'
b. CVC	[mur.bui]	'Morbouy' (A desert plant with yellow flowers)
c. CVV	[mai]	'wine'
d. CVVC	[bu:m]	'roof'
e. CVCC	[dust]	'friend'

With regard to the syllable weight as the second crucial point, CV is the only light syllable in Modern Persian which is also light cross-linguistically (Clements and Keyser 1983). Heavy syllables are CVV and CVC which are biomoraic. Consider the following representations of light and heavy syllables (Note that PrWd stands for a prosodic word, and F stands for a foot):
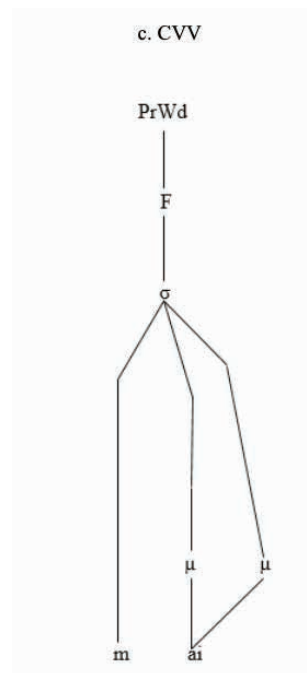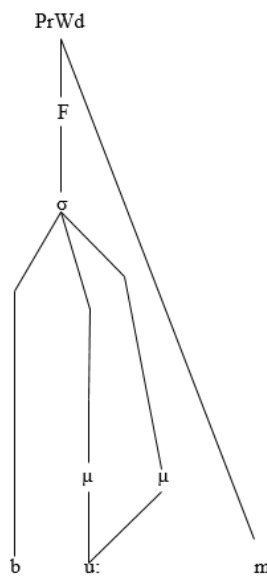
(8)

a. CV

σ

μ

ʤ   o

b. CVC

PrWd

F

σ   σ

Onset   Rhyme   Onset   Rhyme

Nucleus Coda   Nucleus

μ   μ   μμ

m   u   ɾ   b   ui

c. CVV

PrWd

|

F

|

σ

μ   μ

m   aɪ

The CVVC syllable is considered to be heavy in the final position where the final consonant is labelled as extrasyllabic, i.e. outside the syllable domain. Consider the following representation of [bu̱ːm] 'roof':

(9)

PrWd

F

σ

μ   μ

b   uː   m

The above statement is supported by Rahbar (2012) who states that the underlying CVVC in modern Persian is heavy due to the peripheral consonant being extrasyllabic. Likewise, the CVCC syllable is heavy in the final position because the peripheral consonant is considered to be extrasyllabic as shown in the representation of [dust] 'friend' below:
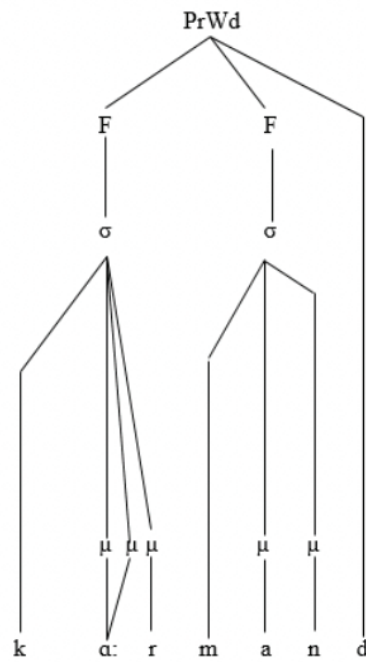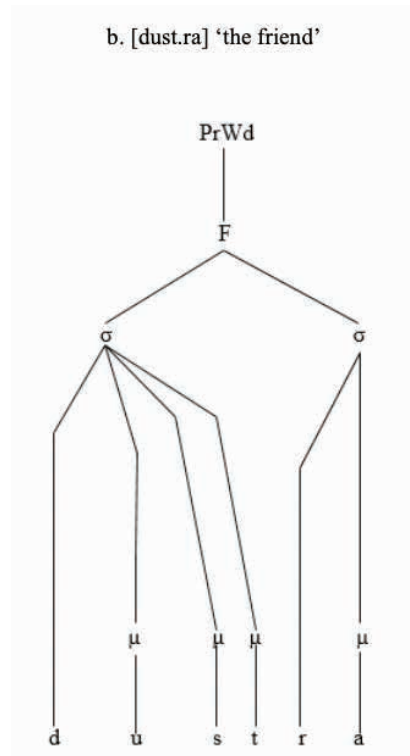
(10)
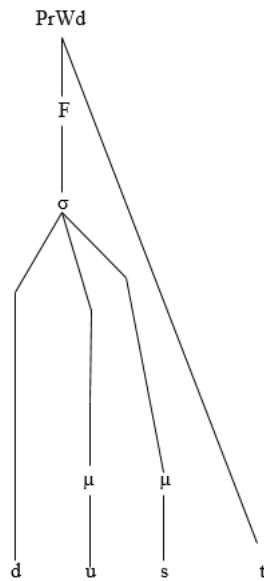
On the other hand, CVVC and CVCC syllables are superheavy in the non-final position where extrasyllabicity is blocked, as shown in the representations of [kɑːr.mand] 'employee' and [dust.ra] 'the friend' below:
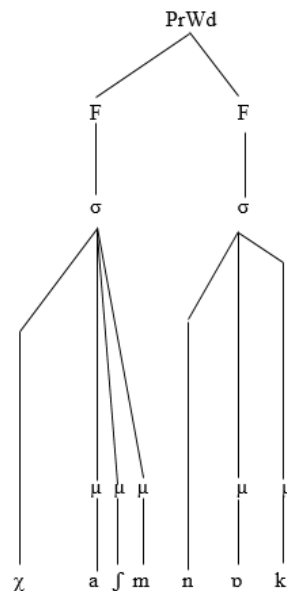
(11)

a. [kɑːr.mand] 'employee'

b. [dust.ra] 'the friend'

This statement is also supported by Rahbar (2012) who indicates to the CVCC syllable being superheavy in the non-final position where the final consonant is immune to extrasyllabicity as seen in the representation of /χaʃm.nɒk/ 'angry' below:

(12)

In conclusion, this subsection elucidates the syllable structure of Sabzevari Persian regarding the obligatoriness and optionality of constituents in syllables plus the syllable weight. Onsets and nuclei, either simple or complex, are obligatory in Sabzevari syllable structure, compared to codas. With regard to

the syllable weight, CV is a light syllable while CVC and CVV are heavy syllables. CVVC and CVCC are heavy syllables in the final position where the final consonant is assigned as extrasyllabic. On the other hand, these syllables are superheavy in the non-final position where final consonants are refrained from being extrasyllabic. A complex coda in the syllable type CVCC may show SSP violation.[5] Before addressing the SSP in Sabzevari Persian and OT, it is necessary to briefly discuss the Sonority Sequencing Generalization, which shows the relationship between syllable structure and the Sonority Hierarchy.

4 The Sonority Sequencing Generalization (SSG)

Syllable structure is linked to the Sonority Hierarchy by the principle of the Sonority Sequencing Generalization (SSG). Selkirk's (1984) SSG stems from Jespersen's (1904) idea of associating syllable well-formedness with sonority-related ordering of the classes of sounds, as follows:
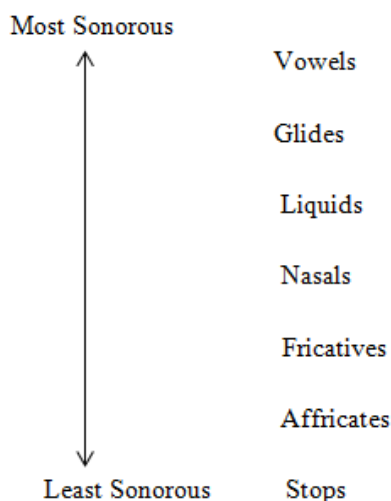
> Sonority Sequencing Generalization (Selkirk 1984):
>
> The sonority of segments must decrease towards the edges of a syllable, where the sonority of segments is defined by the following scale of decreasing sonority:
>
> vowels – liquids – nasals – fricatives – stops or plosives

Based on Selkirk's (1984) Sonority Sequencing Generalization, Carr (1993) outlines the two factors that determine the sonority of sounds: the degree of obstruction of the vocal tract when producing the sound and the voicing of the sound. Accordingly, plosives have a high degree of obstruction, which makes them less sonorous than fricatives. Voiced obstruents are more sonorous than their voiceless counterparts. The hierarchy of sonority of the obstruent class reads as follow: Voiced fricative>>voiceless fricative>>voiced stop>>voiceless stop. Mobaraki (2013), who works on fortition in the Persian phonological system, adheres to Carr's (1993) work and presents the sonority hierarchy pertaining to Sabzevari Persian as follows:[6]

(13)   Sonority Hierarchy of Sabzevari Persian Mobaraki (2013:115)

Most Sonorous

↑   Vowels

                     Glides

                     Liquids

                     Nasals

                     Fricatives

                     Affricates

↓
Least Sonorous   Stops

In conclusion, this section has addressed the principle of the SSG, which concerns the association of syllable well-formedness with sonority-related ordering of the classes of sounds. In other words, the principle of SSG

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5 Syllable appendix is the notion of the SSP violation which is accepted in Sabzevari Persian.
6 The same sonority hierarchy was initially used by Pawelec (2012:184) who investigated the structure of consonant clusters in Polish involving so-called trapped sonorants in syllable onsets.

relates to the Sonority Hierarchy, in which sounds are distributed according to different classes of sonority. This section also confirms the sonority hierarchy of Sabzevari Persian as presented by Mobaraki (2013), showing the differences in sonority values between fricatives and plosives. The next section addresses how data were gathered.

5 Research Method

The current study investigates how conformity to the SSP in Sabzevari Persian is achieved in light of OT. To that end, three procedures were employed: First, the data in this study were extracted from existing literature specific to Sabzevari Persian, as well as other related varieties of Persian. Second, I consulted 10 Sabzevari speakers, two women and eight men, within the age range of 25 to 32 years old, about the data that have been harvested from the extant literature. The final procedure is specific to the analysis of the data elicited from extant literature using OT as shown in the following section.

6 Data Analysis and Discussion

Sections 3 and 4 discuss the syllable structure of Sabzevari Persian and the SSG. Section 3 demonstrates that all syllable types in Sabzevari have single onsets, so there is no possibility of violation of the SSP in the onset position; word-initial clusters are not tolerated by Sabzevari even if they comply with the SSP. However, some word-final clusters in CVCC syllables might reveal a form of sonority violation, i.e., sonority reversal. To understand sonority violation, it is important to refer to the SSG, as in section 4, where sonority is illustrated with reference to the sonority hierarchy of Sabzevari Persian (Mobaraki 2013). This section is intended to demonstrate the Sonority Sequencing Principle in Sabzevari Persian in light of OT.

As illustrated in the literature review in section 2, Aldaghi and Tavakoli (2011) and Mobaraki (2013) mention some words in the Sabzevari dialect which show vowel epenthesis and metathesis. Vowel epenthesis and metathesis are phonological processes that—in derivational theories—are accounted for by means of phonological derivations. Thus, they, by definition, cannot be present in the underlying representations. It is declared in the same section that these scholars have not yet addressed the reason for vowel epenthesis and metathesis in Sabzevari. Furthermore, in these works, vowel epenthesis and metathesis are not accounted for using OT. Therefore, the aim of this section is to investigate how the SSP violation is avoided in Sabzevari using vowel epenthesis or metathesis with reference to OT as an analytical framework. The first part of this section is specific to using vowel epenthesis to avoid SSP violation and the second part addresses using metathesis as a repair strategy for SSP violation. The following examples show how sonority reversal in Sabzevari, which results from some word-final clusters, is avoided by vowel epenthesis:

(14)   SSP Violation and Vowel Epenthesis in Sabzevari Persian

	Sabzevari Input	Sabzevari Output	Meaning
I)	a. /fekr/	[fe.k**e**r]	'thinking'
	b. /ʃeʔr/	[ʃe.ʔ**e**r]	'poetry'
	c. /setr/	[se.t**e**r]	'veil'
	d. /zekr/	[ze.k**e**r]	'to mention'
	e. /zebr/	[ze.b**e**r]	'rough'
	f. /mesr/	[me.s**e**r]	'Egypt'
	g. /ʃokr/	[ʃo.k**e**r]	'thank'
	h. /feʔl/	[fe.ʔ**e**l]	'verb'
	i. /ʔezn/	[ʔe.z**e**n]	'permission'
	j. /zehn/	[ze.h**e**n]	'mind'

II)		a. /matn/	[ma.t**e**n]	'text'
		b. /batn/	[ba.t**e**n]	'abdomen'
		c. /rokn/	[ro.k**e**n]	'pillar'
		d. /pahn/	[pa.h**e**n]	'photograph'
		e. /vazn/	[va.z**e**n]	'weight'
		f. /nazr/	[na.z**e**r]	'vow'
		g. /qahr/	[qa.h**e**r]	'subjugating'
		h. /hozn/	[ho.z**e**n]	'grief'
		i. /lahn/	[la.h**e**n]	'tone'
III)		a. /toχm/	[to.χ**o**m]	'seed'
IV)		a. /hatm/	[ha.t**o**m]	'fisting'
		b. /taʔm/	[ta.ʔ**o**m]	'flavour'
		c. /razm/	[ra.z**o**m]	'battle'
		d. /ʔesm/	[ʔe.s**o**m]	'name'
		e. /fahm/	[fa.h**o**m]	'understanding'
		f. /zaχm/	[za.χ**o**m]	'wound'
		g. /ʔazm/	[ʔa.z**o**m]	'resolution'

In the examples in (14), the word-final clusters create sonority reversal where sonority ascends within the coda, meaning that the curve created is not consistent with the SSP. Vowel epenthesis creates a new sonority peak which results in a new sonority sequence, and the syllable structure is repaired. In (14-I, II, III, IV), the identity of vowel epenthesis is different. In (14-I, II), the epenthetic vowel [e] is used to comply with the SSP while in (14-III, IV) the epenthetic vowel [o] is used for the same purpose. For the sake of harmony, the identity of vowel epenthesis is determined by the second member of the word-final cluster as well as the stem vowel. In (14-I), the epenthetic vowel [e] is determined by the stem vowel /e/ and the second member of a word-final cluster which has the [+coronal] feature. The epenthetic vowel [e] has a [+coronal] feature which makes it harmonic to the following consonant that has the same feature. This statement is supported by Rahbar (2009), who mentions the term '*harmony within stems*', which suggests that the epenthetic vowel [e] between two consonants is determined by the stem vowel /e/. However, Rahbar (2009) does not indicate the role of the second members of word-final clusters in the identity of an epenthetic vowel. The spreading of the stem vowel depends on harmony with the peripheral members of word-final clusters. Accordingly, in (14-I), the epenthetic vowel [e] occurs when the stem vowel is /e/ and the following consonant is of the [+coronal] feature. In (14-II), the epenthetic vowel [e] is not determined by the stem vowel /a/, whereas it is determined by the second member of the word-final cluster of the feature [+coronal]. In other words, the epenthetic vowel [e] shown in (14-II) is the result of the failed assimilation of the vowel [e] to [a]. Therefore, the identity of the vowel [e] in this case is determined by the peripheral member of the word-final cluster. Rahbar (2009) states that the epenthetic vowel [e], which is inserted between two consonants, is the result of failed assimilation of the vowel [e] to [a] in English loanwords in Persian, e.g. /plæn/→ [p**e**.lan]. In (14-III), the identity of the epenthetic vowel [o] relies on the stem vowel /o/ and the following consonant of the feature [+labial]. Simply, the spreading of the stem vowel /o/ occurs when the peripheral consonant is of the feature [+labial]. The epenthetic vowel [o] in (14-IV) is determined by the presence of a consonant of the [+labial] feature.[7] Let us consider the sonority representations of /pahn/ and [pa.hen].

---

[7] For the sake of harmony, Rahbar (2009) states that the epenthetic vowel [i] is the result of assimilation of the vowel [e], as a default epenthetic vowel, to [i] when the stem vowel is /i:/ with reference to English loanwords in Persian, e.g. /fri:zər/→ [f**i**rizer]. Similarly, according to Rahbar (2009), the epenthetic vowel [u] is the result of assimilation of the vowel [e] to [o] when the stem vowel is /u:/ with reference to English loanwords in Persian, e.g., /blu:/→ [b**u**.lu].
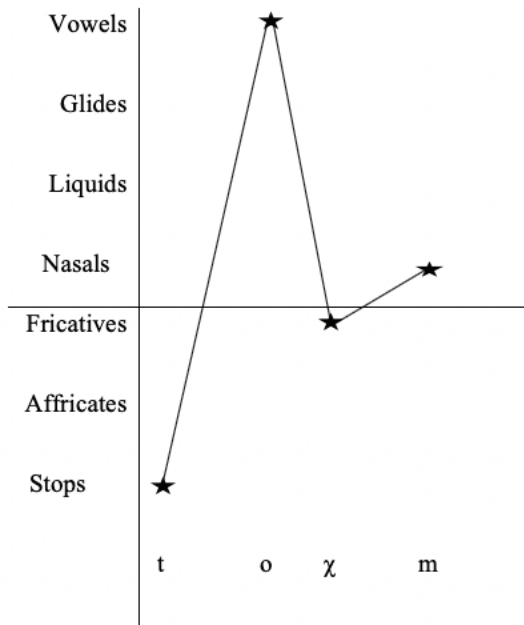
(15)
a. Sabzevari input: /pahn/ 'wide'
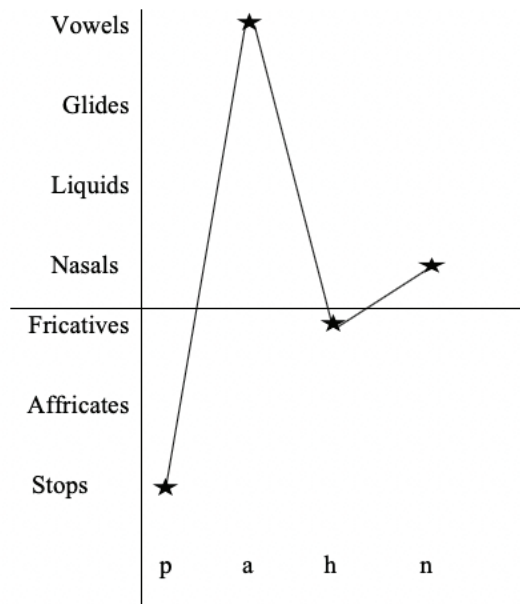
b. Sabzevari output: [pa.hen] 'wide'
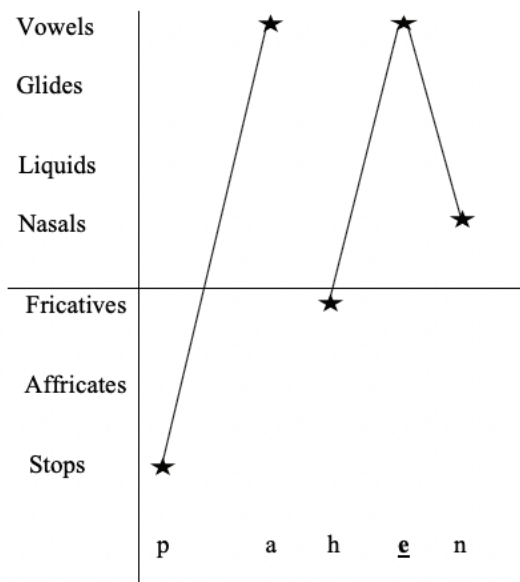
The sonority representations in (15) show how the epenthetic vowel [e] is motivated by a consonant cluster of the form /fricative+n/. The following sonority representation shows how the epenthetic vowel [o] is motivated by a consonant of the form /fricative+m/.

(16)
a. Sabzevari input: /toχm/ 'seed'

b. Sabzevari output: [to.χ**o**m] 'seed'
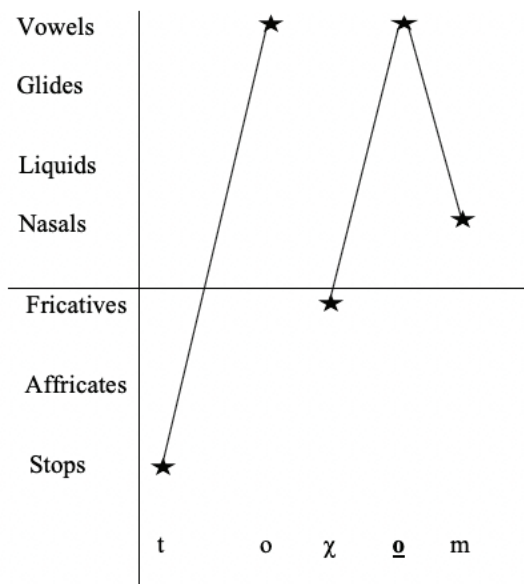
In the theoretical framework of OT, vowel epenthesis in Sabzevari can be accounted for as a means of avoiding SSP violation. Consider the following OT constraints:

(17)   OT constraints:

a.   MAX-IO (McCarthy & Prince 1995:16):
         Every segment of S_1 has a correspondent in S_2.

b.   Sonority Sequencing Principle (SSP) (Selkirk 1984:116):
         Sonority increases towards the syllable peak and decreases towards the syllable margins.

c.   LINEARITY "No metathesis" (McCarthy and Prince 1995:123):
         S_2 is consistent with the precedence structure of S_1, and vice versa.

d.   DEP-IO (McCarthy & Prince 1995:16):
         Every segment of S_2 has a correspondent in S_1 (S_2 is "dependent on" S_1).

e.   Syllable Contact (SYLLCON)[8]   Bat-El (1996:302):
         The onset of a syllable must be less sonorous than the last segment in the immediately preceding syllable.

The above constraints are used in the following table to evaluate the candidates of the input /qahr/ 'subjugating'.

Table 5: MAX-IO, SSP, SYLLCON>>LINEARITY>>DEP-IO

/qahr/	MAX-IO	SSP	SYLLCON	LINEARITY	DEP-IO
a. qahr		*!			
b. qah	*!				
c. qarh				*!	
d. ☞ qa.h<u>e</u>r					*
e. qah.r<u>e</u>			*!		*

The set of OT constraints in table (5) successfully identifies candidate (d), which is the desired output, as the optimal output, while (c), as the most challenging candidate, is eliminated due to violation of the LINEARITY constraint. The rest of candidates also fail to be optimal due to the violation of MAX-IO, SSP, and SYLLCON. The next table is particular to evaluate the candidates of the input /pahn/ 'photograph'.

---

8 Bat El (1996) proposed this constraint based on the Syllable Contact Law introduced by Vennemann (1988).

Table 6: MAX-IO, SSP, SYLLCON>>LINEARITY>>DEP-IO

/**pahn**/	MAX-IO	SSP	SYLLCON	LINEARITY	DEP-IO
a. pahn		*!			
b. pah	*!				
c. panh				*!	
d. pa.h**e**n					*
e. pa.h**o**n					*
f. pa.h**u**n					*
g. pah.n**e**			*!		*

The table (6) fails to determine the optimal candidate of the input /pahn/ since candidates (d), (e), and (f) violate the same constraint which is DEP-IO. Candidates (a), (b), and (c) violate the constraints MAX-IO, SSP, and LINEARITY. The peripheral epenthesis in candidate (g) results in the violation of SYLLCON as well as DEP-IO. To determine candidate (d) as optimal, another constraint is introduced below to eliminate the challenging candidates (e) and (f):

(18)
a. EPENTHETIC VOWEL-CONSONANT HARMONY [Place]
An epenthetic vowel and the following consonant within the same syllable must share the same place feature.

The above constraint is ranked higher than DEP-IO to eliminate candidates with epenthetic vowels which do not share the feature of place with the following consonants within the same syllable. Consider the following set of ranking constraints:

(19)
MAX-IO>>SSP>>SYLLCON>>LINEARITY, EPENTHETIC VOWEL-HARMONY [Place]>>DEP-IO

The set of ranking constraints in (19) is to evaluate the candidates of the input /pahn/ in the following table:

Table 7: MAX-IO>>SSP>>SYLLCON>>LINEARITY, EPENTHETIC VOWEL-HARMONY [Place]>>DEP-IO

/**pahn**/	MAX-IO	SSP	SYLLCON	LINEARITY	EPENTHETIC VOWEL-CONSONANT HARMONY [Place]	DEP-IO
a. pahn		*!				
b. pah	*!					
c. panh				*!		
d. ☞ pa.h**e**n						*
e. pa.h**o**n					*!	*
f. pa.h**u**n					*!	*
g. pah.n**e**			*!			*

The EPENTHETIC VOWEL-CONSONANT HARMONY [Place] constraint helps to determine candidate (d) as the optimal output since the epenthetic vowel [e] shares its place feature with the following consonant, i.e., [+coronal]. Candidates (e) and (f) fail to satisfy the same constraint since the epenthetic vowels in these candidates do not share place features with the following consonants. The place feature of these epenthetic vowels is [+labial] while the following consonant has the [+coronal] feature. The following table is to evaluate the candidates of the input /toχm/ 'seed':

Table 8: MAX-IO, SSP, SYLLCON>>LINEARITY, EPENTHETIC VOWEL-CONSONANT HARMONY [Place]>> DEP-IO

/toχm/	MAX-IO	SSP	SYLLCON	LINEARITY	EPENTHETIC VOWEL-CONSONANT HARMONY [Place]	DEP-IO
a. toχm		*!				
b. toχ	*!					
c. tomχ				*!		
d. to.χ**o**m						*
e. to.χ**u**m						*
f. to.χ**a**m					*!	*
g. toχ.m**o**			*!			*

There is no optimal candidate determined by table (8) since candidates (d) and (e) equally violate the DEP-IO constraint. Candidates (a), (b), (c), (f) and (g) fail to be optimal due to violation of the MAX-IO, SSP, SYLLCON, LINEARITY, and EPENTHETIC VOWEL-CONSONANT HARMONY [Place] constraints. The problem with the table above pertains to the challenging candidate (e) being compliant with the EPENTHETIC VOWEL-CONSONANT HARMONY [Place] constraint, since the epenthetic vowel [u] shares the feature of [+labial], the place feature, with the following consonant [m]. Therefore, there should be a constraint outranking DEP-IO in order to prevent candidate (e) from being optimal. This constraint is introduced below:

> (20)
> DEP [+high]
> A vowel that does not have an input correspondent must not be [+high].

The above constraint is added to the following set of ranking constraints as the one that outranks DEP-IO, as follows:

> (21)
> MAX-IO>>SSP>>SYLLCON>>LINEARITY>> EPENTHETIC VOWEL-CONSONANT HARMONY [Place], DEP [+high]>> DEP-IO

The above set of ranking constraints in (21) is used to evaluate the candidates of the input /toχm/ in the following table:

Table 9: MAX-IO, SSP, SYLLCON>>LINEARITY, EPENTHETIC VOWEL-CONSONANT HARMONY [Place], DEP [+high]>> DEP-IO

/toχm/	MAX-IO	SSP	SYLLCON	LINEARITY	EPENTHETIC VOWEL-CONSONANT HARMONY [Place]	DEP [+high]	DEP-IO
a. toχm		*!					
b. toχ	*!				*		
c. tomχ				*!			
d. ☞ to.χom							*
e. to.χum						*!	*
f. to.χam					*!		*
g. toχ.mo		*!					*

The DEP [+high] constraint helps to determine candidate (d) as the optimal output since the epenthetic vowel in this candidate is [-high], while the epenthetic vowel [u] in candidate (e) is of the feature [+high], leading to the violation of the new constraint. Therefore, this candidate is eliminated from being optimal.

The tendency to conform to the SSP also motivates metathesis in Sabzevari. As expressed in the literature review in section 2, Aldaghi and Tavakoli (2011) descriptively highlight metathesis as being one of the phonological processes in Sabzevari without any justification of why this process occurs. By virtue of the SSP, word-final clusters of the forms /plosive+fricative/ and /fricative+lateral/ are subject to metathesis in Sabzevari. This behavior is also found in Modern Persian Ahmadkhani (2010) and Sandaji Kurdish (Zahedi, Alinezhad, and Rezai 2010), where metathesis targets final consonant clusters of the forms /plosive+fricative/ and /fricative+lateral/. Consider the following examples of metathesis in Sabzevari:
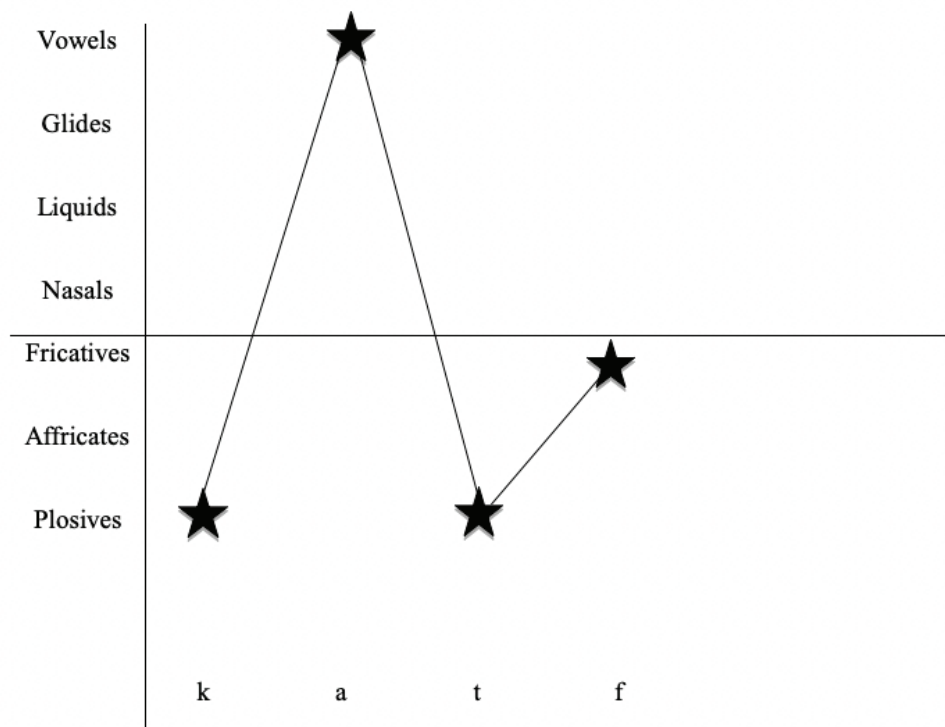
(22)   Metathesis in Sabzevari

	Sabzevari input	Sabzevari output	Gloss
I)	a. /me**sl**/	[me**ls**]	'like'
	b. /bo**χl**/	[bo**lχ**]	'stinginess'
	c. /qo**fl**/	[qo**lf**]	'lock'
	d. /te**fl**/	[te**lf**]	'child'
	e. /va**sl**/	[va**ls**]	'joining'
	f. /ba**zl**/	[ba**lz**]	'munificence'
	g. /ʔa**zl**/	[ʔa**lz**]	'grace'

II)

|			
a. /ha**ds**/	[ha**sd**]	'guess'
b. /ma**ks**/	[ma**sk**]	'pause'
c. /na**bz**/	[na**zb**]	'pulse'
d. /ʔa**ks**/	[ʔa**sk**]	'photo'
e. /ka**tf**/	[ka**ft**]	'shoulder'
f. /bo**ks**/	[bo**sk**]	'punch'
g. /lu**ks**/	[lu**sk**]	'luxurious'
h. /lo**tf**/	[lo**ft**]	'mercy'
i. /ma**dh**/	[ma**hd**]	'compliment'
j. /ʃe**bh**/	[ʃe**hb**]	'similar'

The final consonant clusters in the Sabzevari input in (22) undergo metathesis due to the second members of these clusters being more sonorous than the first. In other words, sonority reversal constituted by the word-final clusters in the Sabzevari input in (22) is solved by metathesis rather than vowel epenthesis due to the identity of the members of these clusters. Apparently, word-final clusters in Sabzevari inputs comprising /plosive +fricative/ and /fricative+lateral/ motivate metathesis in Sabzevari in order to conform to the SSP. To illustrate this phenomenon, let us consider the sonority representations of /katf/ as Sabzevari input and [kaft] as Sabzevari output:

(23)
a. Sabzevari input: /katf/ 'shoulder'

b. Sabzevari output: [kaft] 'shoulder'
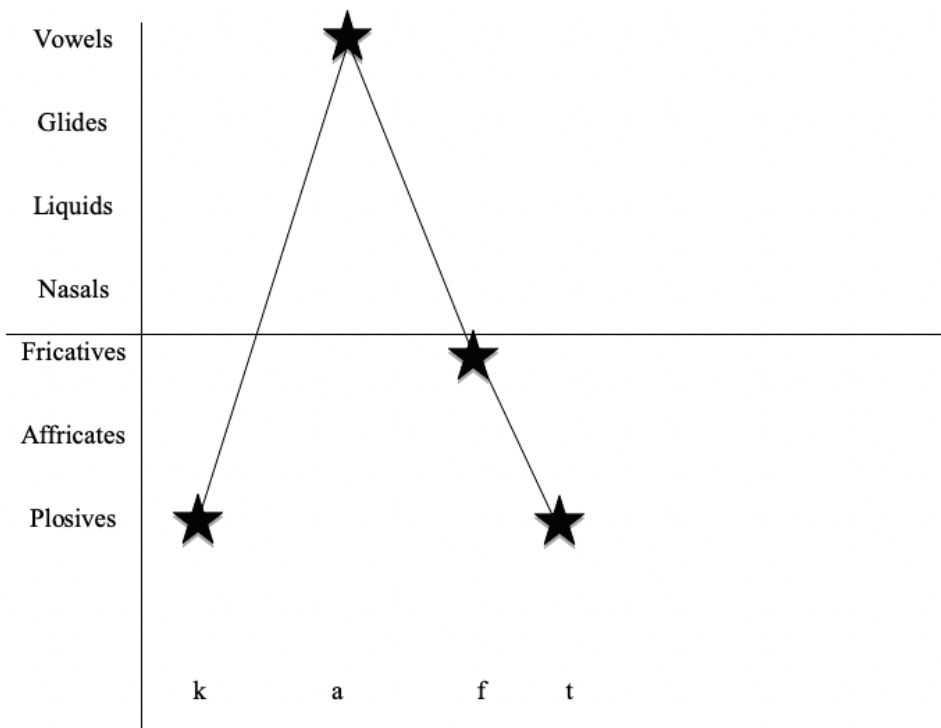
The sonority representations in (23) show metathesis as a phonological process triggered by the sonority reversal constituted by a consonant cluster of the form /plosive +fricative/. This also applies to /fricative+lateral/ clusters, as shown in the sonority representations of /qofl/ 'lock' in the Sabzevari input and [qolf] 'lock' in the Sabzevari output:

(24)
a. Sabzevari input: /qofl/ 'lock'
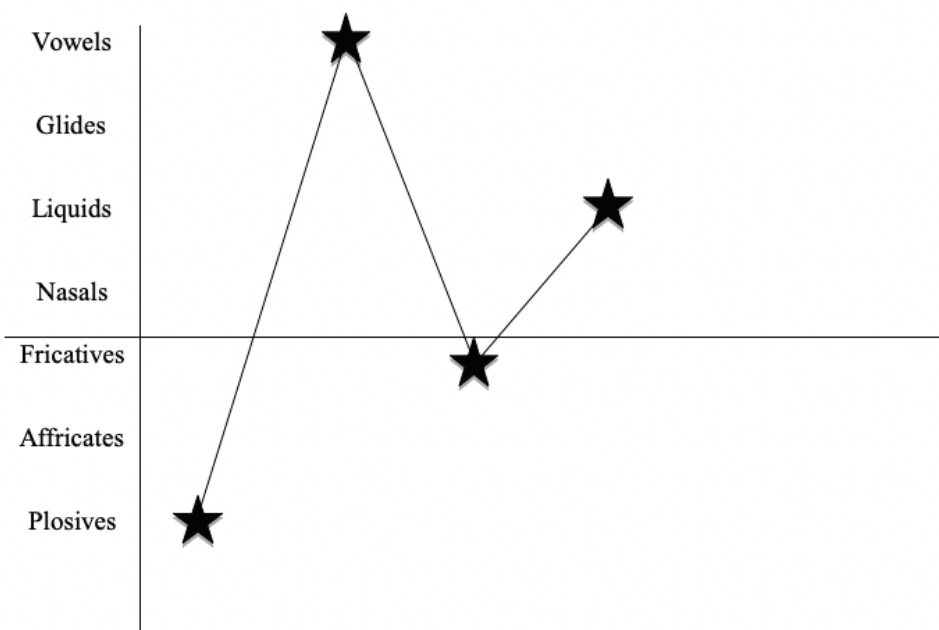
b. Sabzevari output: [qolf] 'lock'
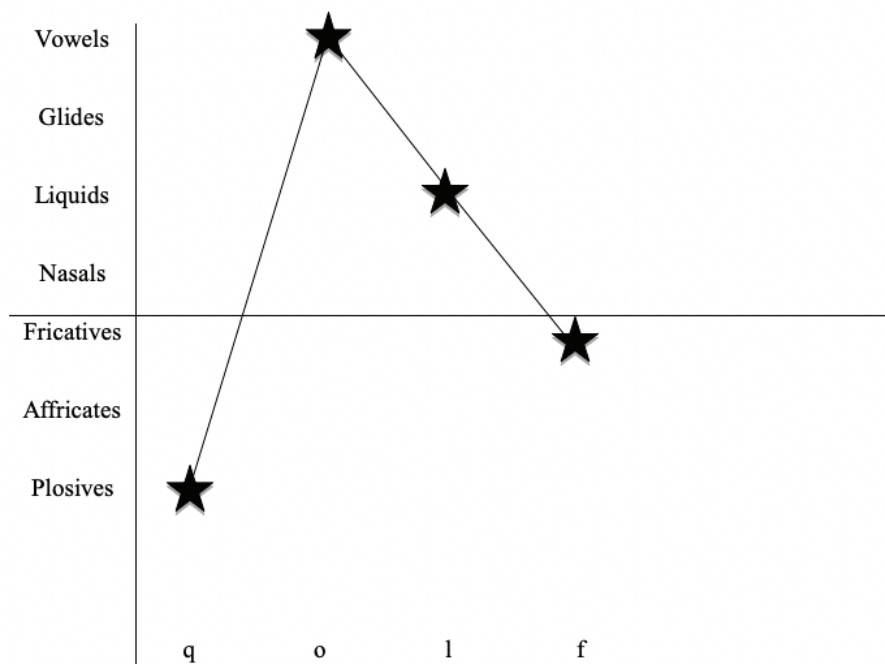
SSP violation and metathesis in Sabzevari can also be accounted for using OT. The candidates of the input /katf/ 'shoulder' undergo evaluation in the next table:

Table 10: MAX-IO, SSP, SYLLCON>>LINEARITY, EPENTHETIC VOWEL-CONSONANT HARMONY [Place], DEP [+high]>> DEP-IO

/katf/	MAX-IO	SSP	SYLLCON	LINEARITY	EPENTHETIC VOWEL-CONSONANT HARMONY [Place]	DEP [+high]	DEP-IO
a. katf		*!					
b. kat	*!						
c. kaft				*!			
d. ka.t**e**f					*!		*
e. kat.f**e**			*!				*
f. ☞ka.t**o**f							*

Candidate (f), as the wrong output, has been distinguished as optimal since it avoids the violation of MAX-IO, SSP, SYLLCON, LINEARITY, and EPENTHETIC VOWEL-CONSONANT HARMONY [Place] constraints,

compared to the rest of candidates. For example, the peripheral epenthesis in candidate (e) yields sonority rising across a syllable boundary which consequently leads to the violation of the SYLLCON constraint. On the other hand, the insertion of the vowel [e] internally in candidate (d) helps to avoid the violation of the SYLLCON constraint but it results in the violation of EPENTHETIC VOWEL-CONSONANT HARMONY [Place] since the feature of the epenthetic vowel [e] is [+coronal] while the feature of the following consonant is [+labial], i.e. no vowel-consonant harmony. Candidate (c), as the desired output, fails to be optimal due to the violation of the LINEARITY constraint. The deletion of the peripheral segment in candidate (b) leads to the violation of MAX-IO. Candidate (a) is restrained from being subject to any phonological processes and its word-final cluster yields the violation of the SSP constraint. There should be a constraint that helps to determine candidate (c) as optimal and eliminates candidate (f) from being optimal Consider the following OT constraints:

(25)
CONTIG C-Fricative[9]
An adjacent Consonant and Fricative sequence standing in correspondence in the input form a contiguous string, as does the corresponding portion in the output.

The above constraint outranks LINEARITY in the following set of ranking constraints in order to prevent candidate (f) from being optimal:

(26)
MAX-IO, SSP, SYLLCON, CONTIG C-Fricative>> LINEARITY, EPENTHETIC VOWEL-CONSONANT HARMONY [Place], DEP [+high]>>DEP-IO

The set of ranking constraints in (26) is used to evaluate the candidates of the input /katf/ in the following table:

Table 11: MAX-IO, SSP, SYLLCON, CONTIG C-Fricative>>LINEARITY, EPENTHETIC VOWEL-CONSONANT HARMONY [Place], DEP [+high]>>DEP-IO

/katf/	MAX-IO	SSP	SYLLCON	CONTIG C-Fricative	LINEARITY	EPENTHETIC VOWEL-CONSONANT HARMONY [Place]	DEP [+high]	DEP-IO
a. katf		*!						
b. kat	*!							
c.☞ kaft					*			
d. ka.t**e**f				*!		*		*
e. kat.f**e**			*!					*
f. ka.t**o**f				*!				*

9 CONTIG C-Fricative is derived from the CONTIG C-Stop constraint introduced by Karim (2010:27). He came up with this constraint through his personal communication with Suzanne Urbanczyk. C represents a plosive consonant in this constraint. In this case, internal vowel epenthesis that breaks up a consonant cluster of the form /plosive+fricative/ violates this constraint.

The violation of the CONTIG C-Fricative constraint results in the elimination of candidates (d) and (f) from being optimal. On the other hand, the peripheral epenthesis in candidate (e) helps to satisfy CONTIG C-Fricative as well as the SSP constraint. However, this type of epenthesis leads to sonority rising across the syllable boundary, which consequently violates the SYLLCON constraint. Therefore, this candidate fails to be optimal. Candidate (c) is identified as optimal since it has no violation of the MAX-IO, SSP, SYLLCON, and CONTIG C-Fricative constraints. The candidates of the input /qofl/ 'lock' are evaluated in the next table:

Table 12: MAX-IO, SSP, SYLLCON, CONTIG C-Fricative>>LINEARITY, EPENTHETIC VOWEL-CONSONANT HARMONY [Place], DEP [+high]>> DEP-IO

/qofl/	MAX-IO	SSP	SYLLCON	CONTIG C-Fricative	LINEARITY	EPENTHETIC VOWEL-CONSONANT HARMONY [Place]	DEP [+high]	DEP-IO
a. qofl		*!						
b. qof	*!							
c. qolf					*!			
d. ☞ qo.f<u>e</u>l								*
e. qof.l<u>e</u>			*!					*
f. qo.f<u>o</u>l						*!		*

Candidate (d), the wrong output, is identified as optimal because it satisfies the MAX-IO, SSP, SYLLCON, LINEARITY, and EPENTHETIC VOWEL-CONSONANT HARMONY [Place] constraints. The deletion of a peripheral consonant in candidate (b) triggers the violation of MAX-IO. The SSP constraint is subject to violation by candidate (a). The peripheral epenthesis in candidate (e) results in rising sonority across a syllable boundary which eventually violates the SYLLCON constraint. Candidate (c), as the desired output, permits metathesis to avoid the violation of the SSP which, on the other hand, violates LINEARITY. The internal insertion of the vowel [o] in candidate (f) is to avoid the violation of SSP but this epenthetic vowel results in the violation of EPENTHETIC VOWEL-CONSONAONT HARMONY [Place]. In order to determine candidate (c) as optimal, there should be another constraint which excludes candidate (d) and this constraint should be more highly-ranked than LINEARITY. Therefore, the following constraint can solve this problem:

(27)
CONTIG C-Lateral[10]
An adjacent Consonant and Lateral sequence standing in correspondence in the input form a contiguous string, as does the corresponding portion in the output.

The above constraint is added in the following set of ranking constraints, outranking LINEARITY, to identify candidate (c) as optimal:

---

10 CONTIG C-Lateral is derived from the CONTIG C-Stop constraint introduced by Karim (2010:27). He came up with this constraint through his personal communication with Suzanne Urbanczyk. C represents a fricative consonant in this constraint. In this case, vowel epenthesis that breaks up a consonant cluster of the form /fricative+lateral/ violates this constraint.

(28)

MAX-IO, SSP, SYLLCON, CONTIG C-Fricative, CONTIG C-Lateral>>LINEARITY, EPENTHETIC VOWEL-CONSONANT HARMONY [Place], DEP [+high] >>DEP-IO

The set of OT ranking constraints in (28) is used to evaluate the candidates of the input /qofl/ in the following table:

Table 13: MAX-IO, SSP, SYLLCON, CONTIG C-Fricative, CONTIG C-Lateral >>LINEARITY, EPENTHETIC VOWEL-CONSONANT HARMONY [Place], DEP [+high] >>DEP-IO

/qofl/	MAX-IO	SSP	SYLLCON	CONTIG C-Fricative	CONTIG C-Lateral	LINEARITY	EPENTHETIC VOWEL-CONSONANT HARMONY [Place]	DEP [+high]	DEP-IO
a. qofl		*!							
b. qof	*!								
c.☞ qolf						*			
d. qo.f**e**l					*!				*
e. qof.l**e**			*!						*
f. qo.f**o**l					*!		*		*

The CONTIG C-Lateral constraint is shown in the table above to eliminate candidate (d) from being optimal and conversely distinguish candidate (c) as optimal. Other candidates are not deemed optimal since they violate the MAX-IO, SSP, and SYLLCON constraints.

Unlike Sabzevari informal speech, the treatment of the SSP violation is different when dealing with the Sabzevari formal speech; hence, the SSP violation is tolerated in the Sabzevari formal speech while it is avoided in the informal speech of the same dialect, as demonstrated in subsection 3.3. different OT ranking constraints are used to account for formal and informal speech of Sabzevari based on the treatment of the SSP violation. consider the following tables for the formal speech's realization of the SSP violation:

Table 14: MAX-IO, DEP-IO, SYLLCON, CONTIG C-Fricative, CONTIG C-Lateral >>LINEARITY, EPENTHETIC VOWEL-CONSONANT HARMONY [Place], DEP [+high] >>SSP

/qahr/	MAX-IO	DEP-IO	SYLLCON	CONTIG C-Fricative	CONTIG C-Lateral	LINEARITY	EPENTHETIC VOWEL-CONSONANT HARMONY [Place]	DEP [+high]	SSP
a. ☞ qahr									*
b. qah	*!								
c. qarh						*!			
d. qa.h<u>e</u>r		*!							
e. qah.r<u>e</u>		*!	*						

The set of OT constraints in table (14) successfully determines candidates (a), which is the formal output, as optimal since it concurs with MAX-IO, DEP-IO, SYLLCON, and LINEARITY while these constraints are liable to violation by the rest of candidates. Therefore, these candidates are eliminated from being optimal. The same set of OT constraints in table (13) is used to evaluate the candidates of the input /pahn/ 'photograph' in the following table:

Table 15: MAX-IO, DEP-IO, SYLLCON, CONTIG C-Fricative, CONTIG C-Lateral >>LINEARITY, EPENTHETIC VOWEL-CONSONANT HARMONY [Place], DEP [+high]>>SSP

/pahn/	MAX-IO	DEP-IO	SYLLCON	CONTIG C-Fricative	CONTIG C-Lateral	LINEARITY	EPENTHETIC VOWEL-CONSONANT HARMONY [Place]	DEP [+high]	SSP
a. ☞ pahn									*
b. pah	*!								
c. panh						*!			
d. pa.h<u>e</u>n		*!							
e. pa.h<u>o</u>n		*!					*		
f. pa.h<u>u</u>n		*!					*	*	
g. pah.n<u>e</u>		*!	*						

Candidate (a), as the official output, has been distinguished as optimal since it avoids the violation of MAX-IO, DEP-IO, and LINEARITY as faithfulness constraints. Candidate (b) violates MAX-IO due to the deletion of the

peripheral consonant [n]. Candidates (d), (e), (f), and (g) equally violate the DEP-IO constraint. Therefore, these candidates fail to be optimal. Candidate (c) permits metathesis to avoid the violation of the SSP, however, this metathesis leads to the violation of the LINEARITY constraint. Consequently, this candidate is not eligible to be optimal as well. The candidates of the input /toχm/ 'seed' are evaluated in the next table:

Table 16: MAX-IO, DEP-IO, SYLLCON, CONTIG C-Fricative, CONTIG C-Lateral >>LINEARITY, EPENTHETIC VOWEL-CONSONANT HARMONY [Place], DEP [+high]>>SSP

/toχm/	MAX-IO	DEP-IO	SYLLCON	LINEARITY	EPENTHETIC VOWEL-CONSONANT HARMONY [Place]	DEP [+high]	SSP
a. ☞toχm							*
b. toχ	*!				*		
c. tomχ				*!			
d. to.χ**o**m		*!					
e. to.χ**u**m		*!				*	
f. to.χ**a**m		*!			*		
g. toχ.m**o**		*!	*				

The DEP-IO constraint in the table (16) is subject to violation by candidates (d), (e), (f), and (g). For this reason, these candidates are eliminated from being optimal. Candidates (b) and (c) permit segment deletion and metathesis which consequently result in the violation of MAX-IO and LINEARITY. Therefore, both candidates fail to be optimal. The constraints violated by candidates (b), (c), (d), (e), (f), and (g) are, on the other hand, satisfied by candidate (a). As a result, this candidate has been chosen as optimal. The next table is devoted to evaluate the candidates of the input /katf/ 'shoulder'.

Table 17: MAX-IO, DEP-IO, SYLLCON, CONTIG C-Fricative, CONTIG C-Lateral >>LINEARITY, EPENTHETIC VOWEL-CONSONANT HARMONY [Place], DEP [+high]>>SSP

/katf/	MAX-IO	DEP-IO	SYLLCON	CONTIG C-Fricative	CONTIG C-Lateral	LINEARITY	EPENTHETIC VOWEL-CONSONANT HARMONY [Place]	DEP [+high]	SSP
a.☞ katf									*
b. kat	*!								
c. kaft						*!			
d. ka.t<u>e</u>f		*!		*			*		
e. kat.f<u>e</u>		*!							
f. ka.t<u>o</u>f		*!		*					

Candidate (b) allows segment deletion to conform to the SSP constraint but this deletion yields the violation of MAX-IO. For this reason, this candidate is not determined as an optimal output. Candidate (c) permits metathesis to comply with the SSP. However, this metathesis violates the LINEARITY constraint which results in the elimination of this candidate from being optimal. The DEP-IO constraint is prone to violation by candidates (d), (e), and (f). Consequently, these candidates are not distinguished as optimal. Accordingly, candidate (a) which avoids the violation of the above-mentioned constraints is determined as optimal. The candidates of the input /qofl/ 'lock' are evaluated in the next table:

Table 18: MAX-IO, DEP-IO, SYLLCON, CONTIG C-Fricative, CONTIG C-Lateral >>LINEARITY, EPENTHETIC VOWEL-CONSONANT HARMONY [Place], DEP [+high]>>SSP

/qofl/	MAX-IO	DEP-IO	SYLLCON	CONTIG C-Fricative	CONTIG C-Lateral	LINEARITY	EPENTHETIC VOWEL-CONSONANT HARMONY [Place]	DEP [+high]	SSP
a. ☞ qofl									*
b. qof	*!								
c. qolf						*!			
d. qo.f__e__l		*!				*			
e. qof.l__e__		*!							
f. qo.f__o__l		*!				*	*		

Candidate (a) has been identified as an optimal output because it concurs with MAX-IO, DEP-IO, and LINEARITY. Conversely, candidates (d), (e), and (f) violate the DEP-IO constraint. Candidate (b) violates MAX-IO due to the deletion of the peripheral segment [l]. Metathesis in candidate (c) leads to the violation of the LINEARITY constraint.

To sum up, Sabzevari, as one of the Persian vernaculars, is shown in this study as a dialect that cannot tolerate the sonority reversal constituted by some word-final clusters in Standard Persian. Metathesis and vowel epenthesis are used in this dialect as repair strategies for sonority reversal. These processes are motivated by sonority sequencing violation and the identity of word-final clusters. For example, vowel epenthesis is provoked by word-final clusters of the forms /fricative+rhotic/, /plosive+nasal/, /plosive+liquid/, /nasal+rhotic/, /plosive+nasal/, and /fricative+nasal/, which clearly violate the SSP. The epenthetic vowel [e] is inserted between members of word-final clusters that violate the SSP where the second member has a [+coronal] feature, for the sake of harmony, as the epenthetic vowel [e] shares a [+coronal] feature with the following consonant. Similarly, the epenthetic vowel [o] is inserted between the members of SSP-violating word-final clusters where the second member has a [+labial] feature, for harmony purposes. Metathesis targets word-final clusters of the forms /plosive+fricative/ and /fricative+lateral/, which also disobey the SSP. OT is shown to be an analytical framework that is capable of accounting for metathesis and vowel epenthesis as motivated by sonority in Sabzevari. The formal and informal realization of the SSP violation in Sabzevari is different in light of OT; hence, the difference is peculiar to the DEP-IO and SSP constraints. The set of OT constraints particular to the formal speech has the DEP-IO constraint outranking SSP and vice versa in the informal realization in the same dialect.

7 Conclusion

This research addressed the following questions: How is conformity with the SSP achieved in Sabzevari? To what extent are vowel epenthesis and metathesis applied in this dialect? How can we account for vowel epenthesis and metathesis in Sabzevari using OT? Conformity to the SSP is mandatory in Sabzevari and the violation of this constraint triggers vowel epenthesis and metathesis. In other words, sonority reversal in some word-final clusters in the Sabzevari input is treated by vowel epenthesis and metathesis in the Sabzevari output. Vowel epenthesis is stimulated by word-final clusters of the forms /fricative+coronal

nasal/, /plosive+bilabial nasal/, /fricative+bilabial nasal/, /plosive +rhotic/, /fricative+rhotic/, and /plosive+lateral/, which do not fit the SSP. Metathesis is provoked by sonority reversal found in word-final clusters of the forms /plosive+fricative/ and /fricative+lateral/. OT has been shown as a framework which is capable of addressing the treatment of SSP violation in Sabzevari Persian. This study has depicted the difference in ranking constraints between the formal and informal speech in Sabzevari which is peculiar to the ranking of DEP-IO and SSP constraints. The DEP-IO constraint in Sabzevari formal speech outranks SSP, compared to the informal Sabzevari speech.

Acknowledgments

References

Ahmadkhani, Mohammad Reza. 2010 Phonological metathesis in Persian: Synchronic, diachronic, and the optimality theory. Pazhuhesh-e Zabanha-ye Khareji Journal 56. 5-24. http://www.linguisticsnetwork.com/wp-content/uploads/Khareji-2009-Phonological-metathesis-in-Persian-Synchronic-diachronic-and-the-optimality-theory2.pdf

Aldaghi, Anita, Tavakoli, Nastaran. 2011 Major phonetic processes in Sabzevari Dialect. Theory and Practice in Language Studies 1(3). 292-301.

Allen, W. Sidney. 1956. Structure and system in the Abaza verbal complex. Transactions of the Philological Society 55(1). 127-176. https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1467-968X.1956.tb00566.x

Barker, Muhammad Abd-al-Rahman. 1963. Klamath dictionary. Berkeley and Los Angeles: University of California Press.

Bat-El, Outi. 1996. Selecting the best of the worst: the grammar of Hebrew blends. Phonology 13(3). 283-328. http://www.outibatel.com/wp-content/uploads/2010/12/Bat-El-1996-selecting-the-best-of-the-worst-the-grammar-of-Hebrew-blends.pdf

Bell, Alan, Saka, Mohamed M. 1982. Reversed sonority in Pashto initial clusters. Journal of Phonetics 11(3). 259-275. https://asa.scitation.org/doi/pdf/10.1121/1.2019680

Bradley, Travis G. 2007. Constraints on the metathesis of sonorant consonants in Judeo-Spanish. Probus 19 (2). 171-207.

Carr, Philip. 1993. Phonology. Basingstoke: Macmillan.

Clements, George N. 1990 The role of the sonority cycle in core syllabification. Papers in laboratory phonology 1. 283-333.

Emeneau, Murray B. 1944. Kota texts. Oakland: University of California Press.

Ferguson, Charles A. 1959. Diglossia. Word 15(2). 325-340. https://www.tandfonline.com/doi/pdf/10.1080/00437956.1959.11659702

Hannahs, Stephen J. 2013. The phonology of Welsh. Oxford: Oxford University Press.

Huffman, Franklin E. 1972. The boundary between the monosyllable and the disyllable in Cambodian. Lingua 29. 54-66. https://www.sciencedirect.com/science/article/pii/002438417290006X

Jeremiás, Éva M. 1984. Diglossia in persian. Acta Linguistica Academiae Scientiarum Hungaricae 34(3/4). 271-287. https://core.ac.uk/download/pdf/35147483.pdf#page=281

Jespersen, Otto. 1904. Lehrbuch der Phonetik [Textbook of Phonetics]. Leipzig: BG Teubner.

Kager, René. 1999. Optimality Theory. Cambridge: Cambridge University Press.

Karim, Khaled. 2010. Vowel epenthesis in Bangla: An Optimality Theory analysis. Working Papers of the Linguistics Circle 20(1). 26-36. web.uvic.ca/index.php/wplc/article/download/5670/2196

Kim, Jin-hyung. 2002. Lexicon optimization reconsidered. Language Research 38.31–50. http://s space.snu.ac.kr/bitstream/10371/86197/1/2.%202225609.pdf

Klein, Marc. 1993. La syllabe comme interface de la production et de la r´eception phoniques [The syllable as an Interface of Sound Production and Reception]. In B. Laks & M Plénat (eds.), De natura sonorum: Essais de phonologie. Paris: Presses Universitaires de Vincennes. 101-141.

Koshal, Sanyukta. 1979. Ladakhi grammar. Delhi, Varanasi and Patna: Motilal Banarsidass.

Laks, Bernard, Plénat, Marc. (eds.) 1993. De natura sonorum: Essais de phonologie [From Natura Sonorum: Essays of Phonology]. Paris: Presses Universitaires de Vincennes.

Mace, John. 2015. Persian Grammar: For reference and revision. London: Routledge.

McCarthy, John J., Prince, Alan. 1993. Generalized alignment. In Yearbook of morphology 1993, 79-153. Dordrecht: Springer. https://scholarworks.umass.edu/cgi/viewcontent.cgi?article=1011&context=linguist_faculty_pubs

————. 1995. Faithfulness and reduplicative identity. In J. Beckman, L. Dickey, and S. Urbanczyk (eds.), Papers in Optimality Theory 18, 249-384. Amherst: Graduate Linguistics Student Association. https://scholarworks.umass.edu/cgi/viewcontent.cgi?article=1009&context=linguist_faculty_pubs

Michelson, Karin. 1988. A comparative study of Lake-Iroquoian accent. Dordrecht: Kluwer Academic.

Mobaraki, Mahmoud. 2013. Fortition in Persian Phonological System. Journal of Education and Practice.

Mohanan, Karuvannur Puthanveettil. 1992. Describing the phonology of non-native varieties of a language. World Englishes 11(2-3). 111-128. https://scholarbank.nus.edu.sg/handle/10635/52423

Pawelec, Przemysław. 2012. The Sonority Sequencing Generalization and the Structure of Consonant Clusters with Trapped Sonorants in Polish. Anglica Wratislaviensia 50. 183-195.

Prince, Alan, Smolensky, Paul. 1993. Optimality Theory: Constraint interaction in generative grammar. Boulder: MS, Rutgers University and University of Colorado.

Rahbar, Elham Rohany.2009. On contrasts in the Persian vowel system. Toronto Working Papers in Linguistics 31. https://twpl.library.utoronto.ca/index.php/twpl/article/view/6092/3093

Rahbar, Elham Rohany. 2012. Aspects of Persian phonology and morpho-phonology. Toronto: University of Toronto Ph.D. thesis.Ridouane, Rachid. 2008. Syllables without vowels: phonetic and phonological evidence from Tashlhiyt Berber. Phonology 25(2). 321-359. https://halshs.archives-ouvertes.fr/halshs-00382862/file/Ridouane-Phonology25.pdf

Roach, Peter. 2002. A little encyclopaedia of phonetics. http://www.freeinfosociety.com/media/pdf/4599.pdf

Rossi, Adriano. 2015. Diglossia in Persian. Acta et studia 13. 211-219.

Selkirk, Elisabeth. 1984. On the major class features and syllable theory. In M. Aronoff & R. Oehrle (eds.), Language sound structure, 107-136. Cambridge, Mass.: MIT Press.

Shademan, Shabnam. 2002. Epenthesis Vowel Harmony in Farsi. California: University of California MA dissertation.

Treiman, Rebecca, Berch, Denise, Tincoff, Ruth, Weatherston, Sarah. 1993. Phonology and spelling: The case of syllabic consonants. Journal of Experimental Child Psychology 56(3). 267-290.

Vennemann, Theo. 1988. Preference Laws for Syllable Structure. Berlin: Mounton De Gruyter.

Yip, Moira. 1996. Lexicon optimization in languages without alternations. In Current trends in phonology: Models and methods, vol. 1, ed. by Jacques Durand and Bernard Laks, 757–788. Manchester, U.K.: University of Salford, European Studies Research Institute.

Zahedi, Muhamad Sediq, Alinezhad, Batool, Rezai, Vali. 2012. The Sonority Sequencing Principle in Sanandaji/Erdelani Kurdish: An Optimality Theoretical Perspective. International Journal of English Linguistics 2(5).72-84.