

The Sonority Sequencing Principle in Qassimi Arabic: An Optimality Theoretical Framework

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Abstract

The syllable structures in some languages are governed by the Sonority Sequencing Principle (SSP), which states that the syllable center constitutes the most sonorous sound and decreases toward both margins (Clements, 1990). In light of this, the current paper investigates how conformity to the SSP is achieved in Qassimi Arabic (QA), which is a dialect spoken in the central region of Saudi Arabia, particularly in the Al-Qassim region. The relationship between QA consonant clusters (CCs) and their conformity to the SSP were analyzed through optimality theory (OT). The results revealed that the interaction of constraints ONSET, SSP, *i] σ, COMPLEX, MAX-IO, and DEP-IO are responsible for the arrangement and combination of segments in structuring the QA syllables. The syllable structure is absolutely governed by the SSP such that when the coda cluster complies with the SSP, the application of vowel epenthesis in coda clusters is blocked, whereas when an SSP violation occurs, a vowel (either [i], [a], or [u]) is consistently epenthesized and enforced in the cluster to satisfy the SSP.

Keywords: consonant cluster, sonority, optimality theory, QA, epenthesis

Introduction

Consonant clusters (CCs) are uncommon in world languages (Maddieson, 1999), as the edges of the syllable in most languages tend to be simple. However, in languages that permit CCs, certain universal principles govern the segmentation within and across a syllable. One such principle is sonority, which determines whether certain segments are allowed in the language's syllables. Based on these principles, it is possible to evaluate language-specific consonant combinations and the occurrence of repair mechanisms, such as epenthesis.

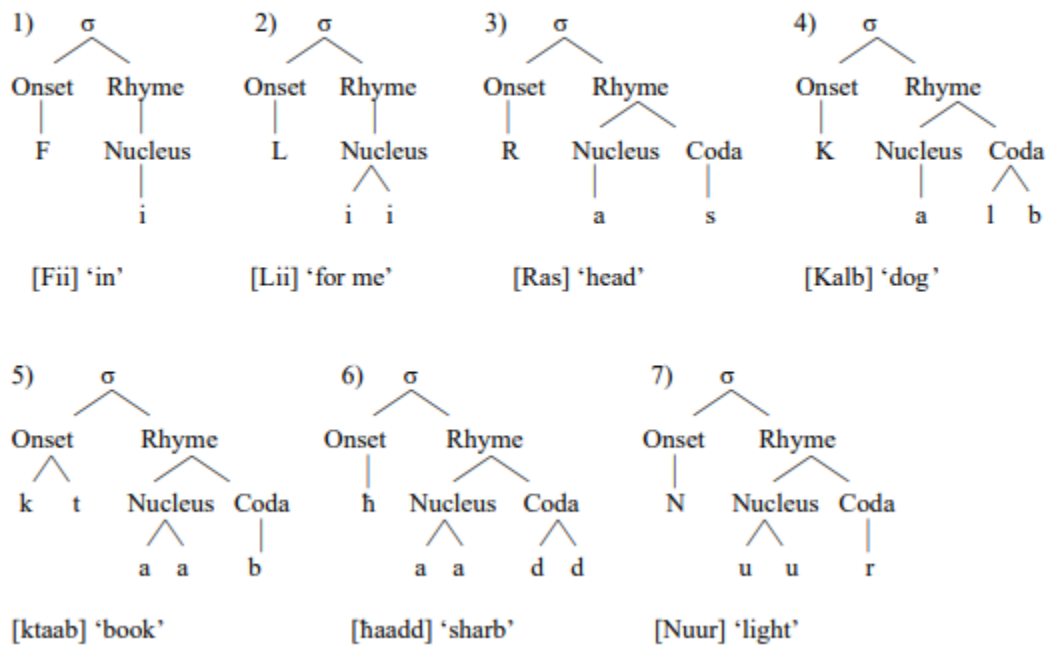
According to Selkirk (1984), the term "sonority" can be defined as the degree of openness. More open sounds are also more sonorous; meaning that high vowels are the most, and stops are the least sonorous. The sonority sequencing principle (SSP) dictates that the segments in a syllable be ordered based on sonority, where the syllable's peak is most sonorous and its margins are least sonorous. In other words, SSP states that syllables are formed by the combination of vowels and consonants across languages; the syllable center constitutes the highest peak (nucleus) and decreases toward both edges (Clements, 1990).

Syllable Structure of Qassimi Arabic

This section presents a brief overview of Qassimi Arabic syllable structure. Alhoody and Aljutaily (2020) showed some characteristics of QA syllable structures and demonstrated that QA is a quantity-sensitive dialect that determines the stress position through syllable heaviness. Moreover, QA has seven-syllable structures that always start with onset since onsetless syllables are prohibited in QA. The syllable structures of QA are illustrated in (1).

(1) Syllable Structure of Qassimi Arabic (Alhoody & Aljutaily, 2020).

(1) 1-CV 2-CVV 3-CVC 4-CVCC 5-CCVVC 6-CVVCC 7-CVVC



Theoretical Framework

Optimality theory (OT), essentially a development of generative grammar, is popular among phonologists. OT was created with phonological problems in mind, and focuses on formal descriptions of universal principles. It was introduced by Prince and Smolensky (1993) and has been developed by many others, most notably McCarthy and Prince (1995). Unlike earlier models, OT entirely abandons the notion of rewriting rules, dissociating 'triggers' and 'repairs', which helps to explain conspiracies (i.e., various processes triggered by a single output-oriented goal). Furthermore, OT excludes derivations by replacing them with parallelism. All constraints

of some structures are evaluated within a single hierarchy. This formal representation of the syllable structure of optimality reveals that the **generator** function (Gen) takes input and generates an infinite number of potential candidates. In turn, these candidates are evaluated (EVAL) through a hierarchy filter, which will discriminate among them and determine the optimal result, as illustrated below.

Input → GEN → candidate set → EVAL (constraints) → Optimal Output

The current paper comprises seven sections, including this section (introduction) with its subsections on the syllable structure of Qassimi Arabic, and the theoretical framework. Section two reviews the related literature. Section three describes the methodology with its subsections on sonority within the OT framework, and the data collection. Section four briefly explains the general phonological background of Qassimi Arabic. Section five presents the data analysis. Section six shows the paper's conclusion. Finally, the last section provides suggestions and recommendations for future studies.

Review of Related Literature

Generally speaking, following the development of OT, investigations have largely focused on sonority in the phonology field. For instance, Boudlal's (2001) study of Casablanca Moroccan Arabic analyzed the syllabification of non-derived nouns within OT. He demonstrated how schwa insertion is conditioned by the sonority of a root's second and third consonants. To illustrate, the schwa is inserted before the second consonant of the root if it has a higher sonority than the third (e.g., [dərbala] 'dirty clothes', [təlfaza] 'TV') and before the third consonant if it has a higher sonority than the second (e.g., [msəmna] 'a kind of bread'). Smirkou (2020) examined the violation of SSP in French nominal loans to Moroccan Arabic and stated schwa epenthesis is implemented as a repair strategy to break biconsonantal coda clusters that violate SSP (e.g., livʁ → lifər 'book').

Several studies have analyzed the relationship between the sonority and the syllable structure in various Saudi dialects. For example, Alghmaiz (2013) analyzed sonority distance in Najdi Arabic (NA) syllables, with a focus on initial CCs. The results demonstrated that not all consonant articulations could be grouped together in initial CCs. NA speakers tend to insert a vowel when the CCs involve a sequence of stop and glide or fricative and glide. Alghmaiz (2013) utilized sonority distance to explain these restrictions. The structure between fricatives and glides is characterized by three intervals, which account for insertion and block deletion. Likewise, the stop and glide sequence results in four intervals which motivate insertion. Jarrah (2013) showed that in Madina Hijazi Arabic (MHA), sonority plays a vital role in final CCs and that "consonant clusters in MHA obey the SSP constraint in decreasing the sonority of the second member of the cluster to become less sonorous than the first one" (e.g., talj 'ice', P.8).

Ingham (1994) conducted a descriptive analysis of NA, and indicated that the vowel epenthesis for a coda cluster occurs only when the second consonant violates sonority sequencing in NA; for instance, *ħaml* surfaces as *ħamil* 'burden'. Alkhonini (2014) attempted to confirm Ingham's (1994) generalization through a focus exclusively on coda CCs in NA. He first presented an

explanation based on sonority for vowel epenthesis breaking the CCs and then examined whether the pronunciation of NA speakers would affect the pronunciation of Classical Arabic (CA) data. His results showed two restricted cases in which word-final CCs in NA are allowed. The first case is when the sonority decreases, the second case is when they are equal in sonority, except when the final segments are nasal. In other words, Alkhonini (2014) stated that vowel insertion occurs predictably when coda CCs increase in sonority in NA, and his study confirmed the findings of Ingham (1994). The main difference between the Ingham and Alkhonini studies is that Ingham claimed that the inserted vowel is either [i], [u] or [a], as in *fiftikum* ‘I saw you’, *baduw* ‘bedouins’ and *faḥam* ‘coal’, respectively, whereas Alkhonini stated that it is a [ə], as in *samān* ‘cooking fat’. The correlation between sonority and epenthesis in NA informs the main concern in the present study.

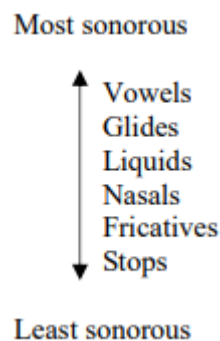
However, as far as the researcher is aware, no study has yet focused primarily on the SSP in QA within the OT framework. Thus, this empirical study aims to shed light on QA coda CCs in relation to their conformity to the SSP from an optimality-theoretic perspective. This background informs the following research question: How is conformity with the SSP achieved in QA?

Methodology

Sonority Within the OT Framework

The syllable structure is linked to the sonority hierarchy by the SSP. According to Carr (1993), two factors determine the sonority of sounds: the degree of obstruction of the vocal tract during the production of the sound and the voicing of the sound. Therefore, plosives tend to have a high degree of obstruction, making them less sonorous than fricatives. Additionally, due to the lack of “a fixed, physical basis for characterizing sonority in language-independent terms”, it has not been possible to “explain the nearly identical nature of sonority constraints across languages” (Clements, 2006, P. 2). Nonetheless, most phonologists agree on a universal sonority scale, in which the most sonorous segments are vowels, followed by glides, liquids, nasals, fricatives, and stops. (Blevins, 1995; Butt, 1992; Clements, 1990). In this study, the researcher adopted the universal sonority scale proposed by Clements (1990, p. 305) as represented in (2). The discussion section will explain the arguments in favor of this hierarchy.

(2) Universal Sonority Scale



Given the seven-syllable patterns presented above in (1), six essential universal constraints regarding QA syllable shape are needed to account for epenthesis in QA as a means of avoiding the violation of SSP, these constraints are illustrated in (3) and (4).

(3) Markedness Constraints:

- a) ONSET: “A syllable must have an onset” (Kager, 1999)
- b) COMPLEX: “A syllable edge must consist of a single consonant only”. (Kager, 1999)
- c) SSP: “Sonority increases towards the syllable peak and decreases towards the syllable margins”. (Jarrah, 2013)
- d) *i] σ : “high short unstressed vowel in an open syllable is banned”. (Rakhieh, 2009)

(4) Faithfulness Constraints:

- a) MAX-IO: “Input segments must have output correspondents” No deletion.
- b) DEP-IO: “Output segments must have input correspondents” No insertion.

Data Collection

The analyses in the current study focused on data selected from two sources. First, the study relied primarily on data collected from previous research, including theses, journal articles, and papers. Another major source of data for this the paper is the researcher who is a native speaker of QA. The investigated data are listed in Table 1.

Input	Output	Transition
naml	namıl	Ants
badw	baduw	Bedouins
naħl	naħal	Bees
ħaml	ħamıl	Burden
t ^ʕ ıfl	t ^ʕ ıfıl	Child
fahm	faham	Coal
bard	bard	Cold
kalb	kalb	Dog
səhl	səhıl	Easy
dʒamr	dʒamır	Embers
ʔakl	ʔakıl	Food
ʃaʕr	ʃaʕar	Hair
ʕadl	ʕadıl	Justice
ʕılm	ʕılm	Knowledge
ʕagl	ʕagıl	Mind
fırn	fırn	Oven
Naħl	naħal	Palm trees
ħafıl	ħafıl	Party
ʕıt ^ʕ r	ʕıt ^ʕ ır	Perfume

gıdr	gıdır	Pot
Nahr	nahar	River
Habl	habıl	Rope
Hukm	hukum	Ruling
Raml	ramıl	Sand
Bahr	baħar	Sea
ʔamn	ʔammn	Security; safety
ʃakl	ʃakıl	Shape
ʃams	ʃams	Sun
barg	barg	Thunder
sʕifr	sʕıfir	Zero

Table 1. Data set

General Phonological Background of Qassimi Arabic

QA is considered a sedentary dialect. As with other sedentary dialects of NA, however, it is considered linguistically a Bedouin type. Although QA is a dialect of NA, Ingham (1994) clarified the distinction between “the speech of the sedentary population”, like central Najd and Al-Qassim regions’ dialects, and “the speech of the main Bedouin tribes of those regions” (p. 4). In the lay perception of these dialects, the term Qassimi dialect is exclusively used in reference to the spoken language of the sedentary population rather than to the spoken language of the Bedouin tribes in a given area of Najd. Due to this distinction, the present study focuses on the sedentary people of the Al-Qassim region, not the Bedouin tribes.

Consonant Inventory in Qassimi Arabic

Table 2 illustrates the consonant inventory of QA (Alhoody & Aljutaily, 2020), that is consists of 29 consonants. QA phonemes are shown both in their place and manner of articulation where the top sounds are voiceless and the bottom are voiced.

Table 2. Qassimi Arabic Consonants (Alhoody & Aljutaily, 2020)

	Bilabial	Labiodentals	Dental	Alveolar (Emphatic)	Alveopalatal	Palatal	Velar	Uvular	Pharyngeal	Glottal
Stop	b			t d tʕ			k g		q	ʔ
Fricative		f	θ ð ðʕ	s z sʕ	ʃ		X ʁ		ħ ʕ	h
Affricative				ts dz	dʒ					
Nasal	m			n						
Liquid				r l						

Glide

w

j

Analysis

Epenthesis in Coda Clusters

In linguistics, epenthesis refers to the insertion of a vowel or consonant at onset or coda clusters as a form of syllable repair. Vowel insertion may occur in coda clusters as a repair strategy in QA syllables that violates SSP as shown in (5):

- (5)
1. /səhl /→ [səhɪl] ‘easy’
 2. /faħm/→ [faħam] ‘coal’
 3. /baħr/→ [baħar] ‘sea’
 4. /ħukm/ → [ħukum]‘ruling’
 5. /ʃakl /→ [ʃakɪl] ‘shape’
 6. /ʔakl/→ [ʔakɪl] ‘food’

As illustrated by the data in (5), it is apparent that one of the repair strategies employed by QA to resolve SSP violation is vowel epenthesis; either [a], [ɪ], or [u] is inserted to break the CCs as in /baħr/→ [baħar] ‘sea’, /ʃakl /→ [ʃakɪl] ‘shape’, and /ħukm/ → [ħukum]‘ruling’. Following Ingham (1994), the vowel is not part of the underlying representation but is assumed to be epenthetic, which occurs when the final clusters involve sonorant segments (e.g., r, l, m). In contrast, as shown by the second data set in (6), when coda CCs satisfy the SSP, the epenthesis is blocked in the clusters.

(6)

1. /bard/→ [bard] ‘cold’
2. /ʕilm/→ [ʕilm] ‘knowledge’
3. /barg/→ [barg] ‘thunder’
4. /ʃams/→[ʃams] ‘sun’
5. /kalb/→[kalb] ‘dog’

Alkhonini (2014) highlighted that epenthesis does not occur within coda CCs that consist of a liquid-nasal sequence, as in /ʕilm/ → [ʕilm] ‘knowledge’, but it does occur when such clusters have a nasal-liquid sequence as in /naml/ → [naml] ‘ants’. An elegant explanation of this examination was provided using the SSP, and this study is in line with his overall findings.

The Analysis of Epenthesis in QA Through OT

In this subsection, I seek to shed some light on how epenthesis in QA initial clusters can be analyzed according to the OT framework. Tableau 1 evaluates the candidates of the input /baħr/ ‘sea’ based on the following constraints, where the symbol ‘☹’ means the suboptimal candidate.

Tableau 1. MAX-IO >> DEP-IO >> SSP >> *i] σ

/baħr/	MAX-IO	DEP-IO	SSP
☹ a) baħr			*
b) ba.ħar		*!	
c) b.ħir	*!	*!	
d) baħ.run		*!*	

Tableau 1 shows four possible candidates, in which (a) is incorrectly selected as a suboptimal candidate. Candidate (b), which is the real winner, is nonetheless penalized by the epenthesized vowel. Thus, it violates the DEP-IO constraint. MAX-IO eliminates (c) for lacking a correspondent for the segment [a] in the output. Candidate (d) violates DEP-IO for inserting [u] and [n] in the second syllable. Therefore, the constraint SSP that outranks DEP-IO and MAX-IO is the solution for the ranking argument in order for EVAL to select the real optimal with epenthesis. The output must satisfy this high ranked constraint to avoid any sonority violation as can be seen in Tableau 2.

Tableau 2.					SSP >> *i]	
σ >>	/baħr/	SSP	*i] σ	MAX-IO	DEP-IO	MAX-IO
IO >> DEP-						IO
	a) baħr	*!				
	b) baħ.ru		*!		*	
	→ c) ba.ħar				*	
	d) b.ħir			*	*	

As shown in Tableau 2, candidate (c) is selected as optimal since it incurs no violation of high ranked constraints, although it does satisfy the SSP at the expense of violating the lower-ranked constraint DEP-IO. In contrast, candidates (a), and (b) fatally violate the SSP, and *i]σ conditions. Candidate (a) involves a fatal violation of the SSP, as the pharyngeal fricative [ħ] precedes the higher sonorous liquid [r]. Candidate (b) contains a high short vowel in open syllables, and candidate (d) is penalized for not having [a] segment in the output. Tableau 3 illustrates the next input /bard/ ‘cold’, and its interaction with the constraints.

/bard/	ONSET	SSP	*i]σ	MAX-IO	DEP-IO
→a) bard					
b) bar.dɪ			*!		*
c) bar.id	*!				*
d) bar				*	*

Tableau 3. ONSET >> SSP>>*i]σ >> MAX-IO>> DEP-IO

Tableau 3 shows an example of a cluster that satisfies the SSP constraint, in which (a) is considered the optimal candidate. Candidate (b) incurs a fatal violation of *i]σ for having a high short unstressed vowel in open syllables. Candidate (c) is eliminated because it begins with the vowel [ɪ] in the second syllable, while (d) is eliminated for deleting the [d] segment in the output. In Tableau 4, the candidates of the input /ħukm/ ‘ruling’ are evaluated.

/ħukm/	ONSET	SSP	*i]σ	COMPLEX	MAX-IO	DEP-IO
→a) ħukum						*
b) ħukm		*!				
c) ħuk.mɪ			*!			**
d) ħkum				*!	*	*
e) al.ħukum	*!					*

Tableau 4. ONSET >> SSP >>*i]σ >> COMPLEX>>MAX-IO>> DEP-IO

As illustrated by Tableau 4 above, (b) is eliminated for violating the SSP since the nasal [m] is more sonorous than the stop closer to the nucleus. Candidate (c) encounters the fatal violation of a high short vowel in open syllables. Candidate (d) is eliminated for having a complex onset. Candidate (e) contains segments of the definite article “the”, making it a strong candidate, but it nonetheless violates the highly ranked ONSET constraint; therefore, it is grounded for beginning with a vowel. Consequently, the candidate (a) is chosen as optimal with one minimal violation. The final example to consider is the input /ʕilm/ ‘knowledge’. The candidates are presented in Tableau 5.

Tableau 5. ONSET >> SSP >>*i]σ >> COMPLEX>>MAX-IO>> DEP-IO

/ʕilm/	ONSET	SSP	*i]σ	COMPLEX	MAX-IO	DEP-IO
a) ʕilm				*!		

b) ʕilm.un	*!		**
c) ʕil		*	
→d) ʕilm			
e) ʕi.lam		*!	*
g) ʕil.man			**
h) al.ʕilm	*!		*

In Tableau 5, candidate (a) fatally violates COMPLEX due to its biconsonantal clusters in the onset position. Candidate (b) is eliminated for not having an onset, while (c) violates the MAX-IO constraint. Candidate (e) is grounded by *i] σ for having a high short vowel in open syllables, while another possible candidate, (g), has a minimal violation of DEP-IO and is thus less preferable. Candidate (h) involves a fatal violation of ONSET. Consequently, candidate (d) is selected as optimal.

Conclusion

This paper examines the conformity of SSP in QA coda clusters within the framework of OT. **The findings show that SSP obedience is mandatory in QA coda clusters.** The words that conform to the SSP in QA input, show no changing in their syllable structure as in /barg/ → [barg] ‘thunder’. In contrast, when the coda CCs violate the SSP, the clusters are broken down by inserting either the [ɪ], [a], or [u] vowel and then resyllabified to preserve the SSP as in /ʃakl / → [ʃakɪl] ‘shape’, / naχl/ → [naχal] ‘palm trees’, and / ʔukm/ → [ʔukum] ‘ruling’.

Suggestions and Recommendations

Due to the limitation of the scope in this paper, other interesting phenomena were left unexplored for future investigation, including conformity of SSP in QA onset CCs, and several aspects related to explaining the conditions that determine the quality of epenthetic vowels and their environments in a word.

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Appendices

Table 1. Abbreviations used in the paper

Abbreviation	Full form
CA	Classical Arabic
CCs	Consonant clusters

EVAL	Evaluated
GEN	Generator
MHA	Madina Hijazi Arabic
NA	Najdi Arabic
OT	Optimality Theory
QA	Qassimi Arabic
SSP	Sonority sequencing principle

Table 2. Symbols used in this paper

Symbols	Meaning
*	Constraint violation
!	Fatal violation
/ /	Input
>>	More highly-ranked
→	Optimal candidate, or leads to
[]	Output
☹	Suboptimal candidate
σ	Syllable
.	Syllable boundary