A Non-linear Analysis of Segmental Harmony in Algerian Wadi Souf Dialect

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Received 5/10/2021 Accepted 20/11/2021

Abstract:
The present study discusses some phonological processes of segmental harmony in Algerian Wadi Souf dialect. The data were collected from natural recorded speech of fifty native speakers of this dialect. Moreover, one of the researchers added some examples since she is a native speaker of this dialect. This research adopts the non-linear phonological theory. The findings showed that this theory can provide an adequate analysis for segmental harmony. It is also found that non-adjacent sibilants can spread the feature of anteriority bi-directionally. The anterior sibilants /z/ and /s/ spread the feature [+anterior] to the non-anterior sibilant /ʒ/, and it is realized as [z]. Moreover, raising and fronting vowel harmony occurs in both CaCi:C adjectives that are realized as CiCi:C and the imperfect prefix of jaCCiC and jaCCi verbs that are realized as jiCCiC and jiCCi. Raising and rounding vowel harmony occurs in the imperfect prefix of jaCCuC triconsonantal verbs that are realized as juCCuC.

Keywords: long-distant assimilation, nonlinear phonology, sibilant consonant harmony, vowel harmony, Algerian Wadi Souf dialect.
تحليل لا خطي للتناغم المقطعي في لهجة وادي سوف الجزائرية

كوثر نصبة

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ملخص:

تناولت هذه الدراسة بعض العمليات الفونولوجية للتناغم المقطعي في لهجة وادي سوف الجزائرية. تم جمع البيانات من خطاب مسجل لخمسين متحدثًا متحدثًا آليًا للهجة. فضلا عن ذلك، أضاف أحد الباحثين بعض الأمثلة بما أن هذه اللهجة هي لهجتها الأم. يتبنى هذا البحث النظرية الفونولوجية غير الخطي. تظهر النتائج أن هذه النظرية قادرة أن توفر تحليلًا كافياً لكل من مماثلة الأصوات الساكنة وال المتحركة. كما وجد أن تناغم الأصوات الساكنة، في هذه اللهجة، يحدث كعملية مماثلة صوتية بعيدة الأثر داخل الكلمة ذاتها. الأصوات الساكنة ذات الصغير تنشر ميزة الأمامية [anterior+] للصوت غير أمامي /z/ و/θ/ و/θ/ و/θ/ ، بينما تم التفاقم بين الأصوات المتحركة في كل من jaCCiCi CiCiC وjaCCiCi CiCiC C المدركة كـ CiCiC والتي يتم إدراكها كـ [θ] و/θ/ و/θ/ وتلك التي تدرك كـ [θ]. يتم نصب ورفع حروف العلة في البادئة الناقصة لأفعال juCCuCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCjCCiCجامعة الأردنية/ الأردن
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1. Introduction

Segmental harmony is a widespread phenomenon in many languages in the world. It includes consonant harmony, vowel harmony, and consonant-vowel harmony. Consonant harmony can be defined as any assimilatory influence of a consonant on another consonant or assimilatory consistency constraint between two consonants where these two sounds can be separated by other intervening segment (s) that are unaffected by the assimilation (Hansson, 2010). It could be stated that this definition is narrow enough to highlight the difference between consonant harmony and other assimilatory processes such as the assimilation in consonant clusters. Moreover, Rose (2011) proposed another definition for consonant harmony. It is an assimilation of either articulatory or acoustic features between two or more discrete consonants where the intervening segments are not affected. Rose considered this process as a long-distant assimilation of consonants. This definition excludes types of long-distance harmony that involve vowel-consonant interaction as nasal harmony and emphasis harmony. There are several types of consonant harmony examined in different languages in the world as coronal harmony (Okello et al., 2016; Walker, and Mpiranya, 2006), nasal harmony (Hyman, 1995; Piggott and Van der Hulst, 1997; Walker, 2011), laryngeal harmony (Hansson, 2001; Mackenzie, 2012), liquid harmony (Cohn, 1992; Hansson, 2010), and dorsal harmony (Lee, 2009).

On the other hand, vowel harmony can be defined as a process by which two or more vowels agree in one or more features. Elramli and Maiteq (2019: 38) defined this process as “a system of phonological organization where all vowels must agree, i.e., harmonize in terms of their features within some spans in spoken utterances.” It can take the form of backness harmony (linebaugh, 2007), height harmony (Herzallah, 1999), rounding harmony (Abu-salim, 1986), or tongue root advancement / retraction harmony (Green and Hantgan, 2019).

The present study discusses two types of segmental harmony, namely, consonant harmony and vowel harmony in Algerian Wadi Souf dialect. It considers these types of processes as long-distant assimilations by which a sound spreads a feature (s) to another non-adjacent sound.

2. The Locale of the Study

“Souf”, “Wadi Souf”, or “El Oued” is the prefecture number thirty-nine according to the Algerian administrative division issued in 1984 (The Official Gazette of the Republic of Algeria, 1984: 150). It is known by the
name of ‘A thousand domes and a dome’. Wadi Souf is located in the upper southeast of Algeria. It is about 513 square km to the north of Algiers, the capital of Algeria. It is surrounded by Biskra and Tbessa to the north, El djelfa to the west, Tunisia to the east, and Ouregula to the south. Historically speaking, this region was inhabited by several genes in the past such as Berber, Annabeth, Canaanites, Roman, Venal, and French (Alawamer, 2007). Souf is famous by its agricultural wealth; it is considered as an important source of agricultural products especially the date of ‘Daglat Nour’ and the peanuts.

3. Literature Review

Researchers tackled the process of harmony throughout different eras and from different perspectives. Beeler (1970) analyzed sibilant harmony within the word, of both apical sibilants and blade sibilants, in Chumash languages of Southern California. He found cases where root morphemes contain two sibilants as in /osos/ ‘heel’, /ʃomʃ ‘cradle board’, /ʃoʃ ‘gopher snake’. Furthermore, some affixes also contain sibilants as in s- for 3rd person. subject, -ʃ- for dual, and -waʃ for perfective. The existence of sibilants in both roots and affixes triggers the process of harmony. This process in Chumash languages is regressive and it is related to the type of sibilant word-finally. When the final sibilant is blade, the other preceding sibilants assimilate to have the same feature, and if it is apical, they also become apical. Those languages show an exception in sibilant harmony. The results of his study showed that the initial –s which the third person singular subject in the verb síʃk̛ij in ‘my body aches’ has not necessarily been affected by the following -ʃ. In this verb, both forms, either with sibilant harmony or without, are acceptable.

Abu-Salim (1986) proved that non-linear phonology can explain vowel harmony in an adequate way. He found that vowel harmony in Palestinian Arabic is governed by metrical and segmental boundaries. When high front vowels are dominated by a foot marked [+round] or when they occur within the segmental domain of vowel harmony which comprises the stem and the preceding prefixes, they acquire the feature [+round]. In Palestinian Arabic, vowel harmony occurs bi-directionally. The regressive vowel harmony as in /yú-drus/ ‘he studies’, and the progressive vowel harmony as in /ʃúrus/ ‘wedding’. Moreover, some verbs show an alternation between a CVCC form and the surface form CCVC. To achieve the CCVC surface form, three phonological processes take place, namely, stress assignment, metathesis, and regressive harmony. Furthermore, Kenstowicz (1981) provided another
A Non-linear Analysis of Segmental …….. Kaouther Nesba, Prof. Radwan Mahadin

explanation for this alternation. He claimed that it starts by a regressive harmony of the leftmost vowel, and it becomes /u/. Then, short high vowels in unstressed open syllables in non-final positions are deleted which gives a chance to syncope the penultimate vowel. Subsequently, the vowel /i/ is inserted before the last consonant cluster. This inserted /i/ is realized as /u/ by a progressive harmony process.

In the same line, Harrama (1993) discussed the morphological structure of ‘Al-Jabal’ dialect of Libyan Arabic. To support the claim that morphology and phonology interact, he analyzed major phonological processes in the dialect. He found that, in this dialect, the perfective forms of some verbs of the pattern /CiCiC/ are derived from the classical Arabic pattern /CaCiC/. The surface structure of those verbs is realized by a vowel harmony process. Subsequently, the pattern /CiCiC/ surfaces as /CCiC/ as a result of a stress shift and a syncope process for the third person masculine singular. For example, /sámiʕ/ → /símiʕ/ → /simiʕ/ ‘he heard’. It is also found that the pattern /CCiC/ also occurs when some verbs are attached to the subject suffix of the shape /-C (V)/ as in /fíríḥ+it/ → / fírḥit/ → / firḥit/ ‘she became happy’.

Walker and Mpiranya (2006) discussed coronal harmony in Kinyarwanda. This process affects alveolar sibilants /s/ and /z/ in either obligatory adjacent syllables or optionally in non-adjacent syllables. It is triggered by pre-palatal sibilants /ʃ/ or /ʒ/. The researchers claimed that the intervening segments are unaffected by this process. In this language, the harmony is merely regressive, and it is blocked by coronal stops, palatals, and /ts/. The targets of Kinyarwanda’s consonant harmony are subject to the “similarity effect” that affects only fricatives. For example (ibid: 343):

(1) - úzuz- + i-e → [úʒuże], * [úzuže] ‘fill+ perfective’
- sákuζ- + i-e → [sákuže] ~ [sákuže] ‘shout+ perfective’

Similarly, Hansson (2010) tackled different types of consonant harmony. He provided an example of sibilant consonant harmony in the Athapaskan language Navajo that affects two sibilant sets: [+anterior] /s,z,ts,ts’, dz/ and [-anterior] /ʃ, ʒ, tj, tj’, dʒ/. Harmony is triggered by anticipatory assimilation when a morpheme concatenation occurs near a sibilant. That is to say, the rightmost sibilant in the root determines the [+anterior] feature of the preceding sibilant. Moreover, if the stem contains no sibilant or it contains a [-anterior] sibilant, the 1 sg possessive prefix is released as /ʃi-/ . Whereas, when the stem a [+anterior] sibilant, the /ʃ/ in the
prefix assimilates to surface as /si-/ as in /ʃi –taʔ/ ‘my father’ and /ʃi-tʃiːn/ ‘my nose’. This sibilant harmony can occur in the case of suffix harmonizing; the trigger can occur in the prefix as well.

Zellou (2010) analyzed consonant harmony in Moroccan Arabic consonant harmony as a product of language contact with the neighboring Berber languages. She found that, in Moroccan dialect, consonant harmony occurs regressively between coronal sibilants of a stem. These consonants undergo a spreading of the [+ distributive] feature, converting the place of anterior alveolar fricatives to post-alveolar. The trigger is always the voiced post-alveolar fricative [ʒ] and acts on a preceding voiced or voiceless anterior alveolar fricative [s,z]; for example, [zuʒ] → [ʒuʒ] ‘two’ and [siʒən] → [ʃiʒən] ‘prison’ (ibid: 3).

In the same vein, Lahrouchi (2018) also discussed sibilant harmony in Moroccan Arabic as a shared feature with Amazigh. In Moroccan Arabic, sibilant harmony is a long process whereby /s/ and /z/ agree in voice and anteriority with post-alveolar /ʃ/ and /ʒ/, e.g. /zuʒ/ → [ʒuʒ] ‘two’ and /zlliʒ/ → [ʒelliʒ] ‘title’ (ibid: 48). The long distant harmony optionally assimilates the word-initial sibilant into [ʃ] or [ʒ]. This sibilant harmony takes place in the stem only, and in the definite article, which undergoes the process by assimilating to the first constant of the stem (e.g. /l-sfærʒəl/ → [ʃʃfærʒəl] ‘quince’). On the other hand, in Amazigh, the sibilant harmony process targets the causative prefix, when immediately preceding the stem. The sibilant consonants in the causative prefix and in the stem of the verb become attuned in voicing and anteriority.

In a recent study, Lyskawa and Ranero (2021) discussed sibilant harmony in Santiago Atitlán dialect of Tz’utujil (Mayan). They found that such type of harmony is obligatory and asymmetric since only [+anterior] sibilants are the triggers and [-anterior] sibilants fail to assimilate with a [+anterior]. It is progressive in its nature; only [-anterior] sibilants following a [+anterior] sibilant stimulate assimilation. However, harmony is not triggered by [-anterior] sibilant (s) preceding it. For instance, in the case when the causative morpheme /-ɓaa/ separates the trigger and the target (ibid: 270):

\[1\] /ʃ-at-in-ts'uʔ-ɓaa/ → [ʃatitts'uʔɓaa] ‘I sat you down.’
\[2\] /ʃ-in-ts'uʔ-ɓaa-ʃ-a/ → [ʃints'uʔɓaaʃa] /*[ʃints'uʔɓaaʃa] ‘I was sat down.’

In this dialect, sibilant harmony does not necessarily occur in adjacent morphemes. They provided an example about the /ʃ/ segment in the
nominalizer /-ʃik/ that is target for the harmony process as illustrated below (ibid: 271):

(3) 1. /ruu-sɪk′-ʃɪk/ → [rɪsk'sɪk] / *[rɪsk'ʃɪk] ‘his calling’

As a matter of fact, reviewing the literature reveals the rarity of sibilant consonant harmony in the world’s languages especially in the Arabic context. This process is not well documented as the other types of harmony as stated by Hansson (2010). It also reveals that vowel harmony is discussed by very few studies in the Arabic dialects as Kenstowicz (1981) and Abu-Salim (1986) in Palestinian Arabic. It becomes clear crystal that the processes of segmental harmony are not studied in the Algerian dialects, namely, in Wadi Souf dialect. Therefore, the present study aims to fill this gap by examining sibilant consonant harmony and vowel harmony that are manifested in Wadi Souf dialect by the application of the nonlinear approach, more specifically, the X-skeleton model and the Feature Geometry model.

4. Methods
4.1. Sample
The sample of the present study composes fifty native speakers of Wadi Souf dialect who are inhabitants of the region. Those participants were selected from different areas in Wadi Souf such as Guemar, Sidi Oun, Al Bayadda, Debila, Hassi Khalifa, and Zegoum. We selected purposefully twenty-five males and twenty-five females whose age ranges from nine to seventy-five years old of different educational backgrounds to make those variables neutral factors. Moreover, one of the researchers, as a native speaker of the dialect, contributed by providing some examples to the data.

4.2. Data collection
The data were elicited from recordings of family meetings and conversations with acquaintances in different situations such as the hospital and the supermarket. The total duration of those recordings is ten hours. The participants tackled various topics as traditions, food, clothes, and education. The data were collected for one month; from June 3rd, 2021, till July 2nd, 2021, by the use of a sophisticated Smartphone to clearly capture the sounds and the phonological aspects.

4.3. Data analysis
The researchers listened carefully to each recording several times. Then, we selected the words and phrases that display phonological
processes. We transcribed them following the broad transcription following the International Phonetic Alphabet (IPA) symbols and translated them into English. We selected the examples that have segmental harmony processes. Then, the obtained data were analyzed according to the non-linear phonology, namely, the X-skeleton and Feature Geometry models.

5. Framework

Nonlinear phonology is one of the most prominent theories in the arena of phonology. The focal point of this theory is the hierarchal structure of the phonological units. One of its approaches is Autosegmental Phonology. The latter was first proposed by Goldsmith (1976) to discuss tone in tone languages especially African languages. Then, it was expanded to handle more phonological phenomena such as harmony and syllable structure. In nonlinear Phonology, phonological representations are deemed as complex structures rather than simple ones as stated in linear phonology. Phonemic representation is described as consisting of two or more tiers that are linked by different associations: one-to-many, many-to-one, and one-to-one (Mahadin 1994:49-50) as shown below in (4):

\[
\begin{align*}
\text{(4)} & \quad \begin{array}{c}
\text{a.} \\
i
\end{array} \quad \begin{array}{c}
\text{v} \\
v
\end{array} \quad \begin{array}{c}
\text{b.} \\
t
\end{array} \quad \begin{array}{c}
\text{c} \\
\text{t}
\end{array} \\
\text{c.} \quad \begin{array}{c}
\text{c}
\end{array} \quad \begin{array}{c}
\text{t}
\end{array}
\end{align*}
\]


\[
\begin{align*}
\text{(5)} & \quad \begin{array}{c}
\sigma
\end{array} \\
\text{C} \quad \text{V} \\
\text{segment} \quad \text{segment} \quad \text{segmental tier}
\end{align*}
\]

The segmental tier contains features that enable the identification of a segment articulated in the phonological representation. On the other hand, the CV tier or timing tier contains units that indicate the length of segments in this representation. This timing tier makes up the baseline of the
structure; it is often given the label ‘skeleton’ referring to its function in sound structure (Roca and Johnson, 1999). Those tiers were given other names; the timing tiers are known as the quantity tiers, while the segmental tier or the melody tier is referred to as the quality tier (Spencer, 1996).

One of the benefits of nonlinear phonology is its success to provide an elegant way to analyze assimilation, unlike the traditional linear view. In the traditional view of The Sound Pattern of English SPE (Chomsky and Halle, 1968), assimilation is described linearly as copying a feature (s) and reforming rules. In other words, one segment is changed to become more identical to another adjacent one. However, according to the Non-linear phonology, assimilation is a feature spreading process by which "a feature of a segment spreads to an adjacent segment rather than deleting such a segment" (Spencer 1996:201). Put differently, non-linear approaches as the Autosegmental and Feature Geometry approaches represent assimilation by linking the spreading feature of one segment (the source) to the temporal tier of another one (the target) by association lines. Hence, it solves the problem of explaining all types of assimilation including harmony.

Moreover, this approach contributed to analyze long vowels by its permission of one-to-many associations. In this fashion, long vowels are analyzed as a set of unordered features associated to two abstract timing units whereas short vowels are associated with one timing unit as illustrated in the diagrams below (Roca and Johnson, 1999: 227):

Moreover, the Autosegmental approach thrived to expound the behavior of fake and true germination. As the representation of long vowels, true germination has a bundle of segmental features linked to two timing units; therefore, it cannot be broken by vowel insertion. Unlike true
gemination, fake gemination has two melody tiers associated to two timing slots (Spencer, 1996). This approach also proved its ability to highlight the difference between affricates and a sequence of two consonants; a plosive and a fricative. From a non-linear perspective, affricates are represented by the association of one timing unit related to two segmental tiers, whereas sequences of two consonants are represented by the linking of two-timing units to two melodic slots.

To illuminate the feature [+syllabic] and to solve the problem of glides; whether they are branched to C or V, an amendment of the CV model was proposed by Levin (1985). This researcher treated both C and V as a sequence of empty positions as Xs. The Xs represent timing units without vocalic or consonantal specifications. Each X slot can be filled by either a consonant or a vowel as specified by the constraints of the language and the Autosegmental principles as illustrated below:

![Diagram](7)

The Autosegmental phonology was expanded to include the organization of distinctive features. The feature geometry model states that features are organized in a hierarchal structure in a tree. Features are hieratically assorted into class nodes as root and a set of features that share the parent node (Kenstowicz, 1994). Several proposals were yielded to represent the major class features whether they are directly associated to the root node (e.g., Sagey 1986) or they occur within the root model (e.g., Schein and Steriade, 1986; and McCarthy, 1988).

In the same spirit, to support the feasibility of the Autosegmental phonology to deal with different phonological phenomena, the present study adopts the X-skeleton model due to its applicability to analyze glides and compensatory lengthening. It also uses the Feature Geometry approach, namely, McCarthy (1994) model because of its applicability to explain Semitic gutturals as it considers the latter as a separate natural class owing to the fact that they are articulated by a constriction in the same place in the vocal tract as summarized in the following diagram in (8):
6. Results and discussion

6.1. Sibilant consonant harmony

The obtained data elucidate the existence of one of the consonant harmony processes that is sibilant harmony in this dialect. The latter refers to a long distant assimilation that affects only sibilants like fricatives and affricates. Languages that manifest sibilant harmony can be divided into three sets according to the type of harmony; firstly, symmetric harmony that is triggered by either [+anterior] or [–anterior] segments, secondly, asymmetric harmony that is triggered by only [–anterior] segments, and thirdly, asymmetric harmony that is triggered [+anterior] segments only (Kosa, 2010). The following examples illustrate such type of harmony in Wadi Souf dialect:

(9)

<table>
<thead>
<tr>
<th>Underlying Form</th>
<th>Surface Form</th>
<th>Gloss</th>
<th>Underlying Form</th>
<th>Surface Form</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>/ʒaːzuːz/</td>
<td>[ zaːzuːz]</td>
<td>‘old woman’</td>
<td>/ziːnas/</td>
<td>[ ziːnas]</td>
<td>‘genus’</td>
</tr>
<tr>
<td>/zaːnaːza/</td>
<td>[zaːnaːza]</td>
<td>‘obsequies’</td>
<td>/zaːlaːs/</td>
<td>[zaːlaːs]</td>
<td>‘unattached zipper’</td>
</tr>
<tr>
<td>/jaːzuz/</td>
<td>[ jaːzuz]</td>
<td>‘Permitted’</td>
<td>/zaːzaːz/</td>
<td>[zaːzaːz]</td>
<td>‘butcher’</td>
</tr>
<tr>
<td>/jaːzuːz/</td>
<td>[ jaːzuːz]</td>
<td>‘to remove the wool’</td>
<td>/zaːz/</td>
<td>[zaːz]</td>
<td>‘nuts’</td>
</tr>
<tr>
<td>/zaːbz/</td>
<td>[ zaːbz]</td>
<td>‘trousseau’</td>
<td>/jaːzaz/</td>
<td>[jaːzaz]</td>
<td>‘he is unable’</td>
</tr>
<tr>
<td>/ziːz/</td>
<td>[ ziːz]</td>
<td>‘two’</td>
<td>/zaːwaːz/</td>
<td>[zaːwaːz]</td>
<td>‘marriage’</td>
</tr>
</tbody>
</table>

As it can be noted from the examples in (9) above, the palatal-alveolar /ʒ/ sound becomes the alveolar /z/ when the words contain another /z/ or /s/ sounds. Thus, we can say that non-anterior sibilant consonant becomes anterior when another anterior exists in the word either within the same syllable or in another one. This process cannot occur in words such as /ʒabād/ ‘to pull’ or /ʒamāl/ ‘a camel’ since there is no anterior sibilant in the word. Therefore, it can be said that the existence of an anterior sibilant in
the word is one of the conditions of this harmony. This process is explained in the following diagram in (10):

One of the proposed mechanisms to analyze harmony is autosegmental feature spreading. A schematic illustration of harmony in the word [ʕazuːz] ‘old woman’ as spreading of a feature is given in (11) below:

Therefore, locality becomes a paramount snag in all spreading-based analyses (Hansson, 2010). The segment that has the [+F] is called the trigger, and the segment that is harmonized is the target. One might suggest that (12) below is the real case of consonant harmony process:
As seen, the (12) representation violates one of the most important principles in the Autosegmental approach that is ‘No Line Crossing’. The latter states that crossing association lines among the varying tiers during the ‘mapping process’ is not allowed (Mahadin, 1994). Therefore, we assume that the consonant harmony process could not produce representations such as in (12). This assumption led many phonologists (such as Hansson, 2010; Rose, 2011; and Hyman, 2014; to name but a few) to consider the (x2) segment(s) that is unrelated to the feature spreading as ‘transparent’.

With the intention of the consonant harmony in (11) to be possible, according to Hansson (2010), the target elements must first be well defined, as the X2 segments are not targeted. The feature [F] spreads to X1, not to both X2 and X1. Moreover, all transparent intervening segments must be unstated on the relevant tier; otherwise, harmony will be blocked as in (12). In this harmony, non-sibilant consonants and all vowels are transparent. These segments do not block and do not participate in the harmony.

Autosegmental approach tries to preserve one of its main principles that is considering assimilation as a local process in that “the source and the target of the assimilatory feature have to be adjacent to each other and this consequently supports the crossing lines prohibition” (Spencer, 1996: 201) as exemplified below:

(13)

If we consider consonant harmony as a long-distant type of assimilation as it is deemed by many phonologists such as Rose (2011) and Hansson (2010), this raises the question that how can we respect the locality principle while the spreading process is long? Hansson (2010) provided an answer to this question. He suggested that harmony is relativized to some particular class of ‘legitimate target’ segments. On account of the spreading feature does not skip any legitimate target, locality is maintained. In the case of Wadi Souf dialect, /ʒahaːz/ ‘trousseau’ becomes [zhaːz]. As it can be noticed, the /z/ segment affects only the legitimate target segment /ʒ/ since it
is a non-anterior sibilant sound, whereas the /h/ and /a/ segments are not targeted in this type of consonant harmony process. Therefore, no association lines are crossed since this long distant assimilation may spread the feature [F] from /z/ to /ʒ/ across the intervening /h/ and /a/, as in (14), as the latter do not appertain to the targets.

In this dialect, consonant harmony can occur in syllables boundaries as shown in (14) or within the same syllable as in the monosyllabic word /ʒuːz/ ‘nuts’ → [zuːz]. This example can be represented as below in (15):

Harmony can operate in a leftward (regressive) or rightward (progressive) directions, or bidirectionally (Rose, 2011). All examples about the consonant harmony process mentioned above are regressive. However, in Wadi Souf dialect, this process can also be progressive as in /zuːʒ/ → [zuːz] ‘two’ or in /zawaːʒ/ → [zwaːz] ‘marriage’. The diagram (16) below is the autosegmental representation of sibilant harmony in/zuːʒ/ ‘two’ that is realized as [zuːz]:

160
With the application of the Feature Geometry approach, the representation of consonant harmony process where the voiced non-anterior sibilant /ʒ/ becomes the voiced anterior [z] in the verb /jaʒuːz/ ‘permitted’ which is realized as [jzuːz] is diagrammed as below in (17):

Another case of anterior consonant harmony takes place when the voiced non-anterior sound /ʒ/ assimilates to [z] in the existence of the voiceless anterior sibilant /s/ as a trigger in the word such as in the noun /ʃibz/ ‘gypsum’ which is realized as [zibz]. In this case, we can notice the occurrence of two phonological processes that are sibilant harmony accompanied by voice assimilation. These two processes take place simultaneously as represented in the diagram (18) below:
6.2. Vowel harmony

The obtained data elucidate the existence of another type of harmony that is vowel harmony. This process occurs in this dialect in different positions and in the form of two types, namely, raising and fronting harmony and rounding and fronting harmony.

6.2.1. Raising and fronting harmony

Height harmony can be defined as long-distance assimilation that affects the height of the vowels, either by raising or lowering. According to Rose and Walker (2011), the harmony of raising is more cross-linguistically common than lowering. In Wadi souf dialect, the vowel /a/ in adjectives of the form CaCi:C is raised as a result of the effect of the high front long vowel /i:/ This process takes place simultaneously with the process of fronting because the vowel /a/ is [+back] [-high] [+low], whereas the vowel /i:/ is [-back] [+high]. Thus, the output of those adjectives becomes CiCi:C. The following examples provide a glimpse of this process:

(19)

The data in (19) show that the high front long vowel /i:/ spreads the feature of height and fronting to the non-high vowel /a/ and hence, the latter is realized as [i]. That is to say, the vowel /i:/ in the second syllable affects the vowel /a/ in the first open syllable. The vowel /i:/ is the source and the vowel /a/ is the target. Therefore, we can say, in Wadi Souf dialect, this process of harmony in CaCi:C adjectives is usually regressive. From a nonlinear perspective, this process can be explained in the following diagram:
As we mentioned in the discussion of consonant harmony, to respect the issues of locality and the ‘No Line Crossing’ autosegmental principle, we will follow Hansson (2010) proposal of ‘legitimate target’ segments. In the case of vowel harmony in Wadi Souf dialect, all consonants are transparent and illegitimate targets; therefore they can be skipped by the spreading feature \([F]\) without any violation of any autosegmental principle as it is shown below in (21):

A more nuanced analysis by the use of the Feature Geometry approach, the representation of the vowel harmony process where the vowel \(/a/\) is realized as \([i]\) in the adjective \(/kari:m/\) that is realized as \([kiri:m]\) ‘generous’ is explained as shown below in (22):
It is worthy to mention that adjectives of the form jvcvc and wvcvc are exception in this rule of harmony. In such type of words, the vowel /a/ in the first syllable does not assimilate to become /i/. For example,

\[
\begin{array}{|c|c|}
\hline
\text{Underlying Form} & \text{Surface Form} \\
\hline
/wasiʕ/ \rightarrow [waseʕ] & \text{‘wide’} \\
/wadidayh / \rightarrow [wadədəh] & \text{‘clear’} \\
/jabis/ \rightarrow [jabetes] & \text{‘crusty’} \\
\hline
\end{array}
\]

In Wadi Souf dialect, raising and fronting harmony of vowels also takes place in the perfective form of some tri-consonantal verbs of the pattern jaCCiC and of defective weak verbs of the pattern jaCCi. The condition of the occurrence of this process in those verbs is the existence of sound /i/ in the root of their imperfective form. In such case, the vowel /a/ in the prefix is affected by the vowel /i/ in the root. Accordingly, it can be said that those verbs in their imperfective form display an alternation between
the underlying forms jaCCiC and jaCCi to their surface forms jiCCiC and jiCCi as shown below:

(24) \[ \begin{align*}
\text{jaCCiC} & \rightarrow \text{jiCCiC} \\
\text{jaCCi} & \rightarrow \text{jiCCi}
\end{align*} \]

Raising and fronting vowel harmony in imperfective form of some verbs in Wadi Souf dialect is illustrated in the following examples in (25):

(25)

\begin{center}
\begin{tabular}{ccc}
Underlying & Surface & Gloss \\
\hline
jaCCiC & jiCCiC & he burns' \\
jaCCi & jiCCi & he ignores' \\
ja-ħrig & ji-ħrig & he grills' \\
ja-ʕari & ji-ʕari & he walks' \\
ja-ḫiki & ji-ḫiki & he cries' \\
ja-ʔarif & ji-ʔarif & he knows' \\
ja-ʔarī & ji-ʔarī & he runs'
\end{tabular}
\end{center}

In light of the x-skeleton model, vowel harmony in the verb /ja-ħrig/ ‘he burns’ that is realized as [ji-ħrig] is represented as follows in (26):

In Wadi Souf dialect, this long-distance assimilation process in those verbs is regressive as exemplified in the representation of the verb /ja-ʕari/ ‘he runs’ that is realized as [jiʕari] as shown in (27). It is notable to mention that consonants are transparent as we heretofore claimed in our discussion of vowel harmony in adjectives.
With a more focus on the features of both vowels, this process can be explained by the use of the Feature Geometry model as follows in (28):

6.2.2. Raising and rounding harmony

The second type of vowel harmony found in the data is raising and rounding harmony. This result is in line with Kenstowicz (1981) and Abu-Salim (1987) in Palestinian Arabic dialect and Watson (1995) in Yemeni Arabic dialects that the vowel of the imperfect prefix of some verbs displays
a vowel harmony of rounding. In Wadi Souf dialect, this process takes place simultaneously with raising harmony by which the low unrounded vowel /a/ is realized as the high rounded vowel /u/ as illustrated in the following examples in (29) below:

(29)

<table>
<thead>
<tr>
<th>Underlying Form</th>
<th>Surface Form</th>
<th>Gloss</th>
<th>Underlying Form</th>
<th>Surface Form</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>/ja-d'rub/</td>
<td>[judd'rub]</td>
<td>‘he hits’</td>
<td>/ja-jkur/</td>
<td>[juk[kur]</td>
<td>‘he thanks’</td>
</tr>
<tr>
<td>/ja-dxul/</td>
<td>[juddxul]</td>
<td>‘he enters’</td>
<td>/ja-grus/</td>
<td>[jugrus]</td>
<td>‘he tweaks’</td>
</tr>
<tr>
<td>/ja-xur/</td>
<td>[juxuxur]</td>
<td>‘he goes out’</td>
<td>/ja-frub/</td>
<td>[jufrub]</td>
<td>‘he drinks’</td>
</tr>
<tr>
<td>/ja-skut/</td>
<td>[jusikut]</td>
<td>‘he shuts up’</td>
<td>/ja-hrub/</td>
<td>[juhrub]</td>
<td>‘he escapes’</td>
</tr>
<tr>
<td>/ja-ktub/</td>
<td>[juktub]</td>
<td>‘he writes’</td>
<td>/ja-hrub/</td>
<td>[juhrub]</td>
<td></td>
</tr>
<tr>
<td>/ja-ydur/</td>
<td>[juydur]</td>
<td>‘he betrays’</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A glance at the above examples in (29) shows that the vowel /a/ in the prefix in the imperfective form of jaCCuC tri-consonant verbs is affected by the vowel /u/ in the root. The latter spreads the features of [+round] [+high] to the unrounded vowel in the prefix by regressive long-distant assimilation. Therefore, it can be stated that the underlying form of the imperfective form of this type of verbs is surfaced as juCCuC. This process in the verb /ja-ktub/ ‘he writes’ that is realized as [juktub] is illustrated below in (30):
Similarly, the representation of the imperfective form of the verb /ja-dxul/ ‘he enters’ that is realized as [judxul] is illustrated by the x-skeleton model as follows in (31):

In terms of the Feature Geometry approach, the alternation between /a/ and [u] in this rounding harmony process accompanied by raising harmony process can be explained as below in (32):
7. Conclusion

The current study discusses the process of harmony as one of the intriguing phonological phenomena in Algerian Wadi Souf Arabic dialect. It provides support for the proficiency of nonlinear phonology, namely, the Autosegmental and Feature Geometry approaches to analyze this type of processes. The obtained findings show that Wadi Souf dialect displays a sibilant consonant harmony. This harmony, in this dialect, differs from the one that occurs in Moroccan Arabic dialects, anterior sibilants spread the feature [+anterior] to the other non-anterior sibilants in the same word even if they are non-adjacent. This long-distant assimilation can be either progressive or regressive. Furthermore, it is also found that Wadi Souf dialect manifests vowel harmony in both some adjectives and some verbs. That is to say, in this dialect, vowel harmony affects both the vowels in the stem and in suffixes unlike in Libyan Arabic as it was found in Abumdas (1985). Raising and fronting vowel harmony takes place in both CaCi:C adjectives that are realized as CaCi:C and the imperfect prefix of jaCCiC and jaCCi that are realized as jiCCiC and jiCCi. Raising and rounding vowel harmony occurs in the prefix in the imperfective form of jaCCuC triconsonantal verbs that is realized as juCCuC. Moreover, it is worthy to mention that Wadi Souf dialect is one of the unstudied Arabic dialects in Algeria. Therefore, future research can tackle other types of assimilatory and non-assimilatory processes in this dialect and in other Algerian Arabic dialects as they form a fecund space for further phonological studies.

References


