A Non-Linear Analysis of Foreign English Words in Standard Arabic

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Abstract:
This study aimed to analyze the foreign English loanwords in Standard Arabic within the framework of a non-linear phonology (autosegmental phonology). The analysis of the data focused on selected phonological processes such as: consonantal substitutions including voicing, devoicing, velarization, fortition. Moreover, it covers the phonological process of assimilation, comprising palatalization, labialization, nasalization, and vowel harmony. Furthermore, vowel lengthening and shortening phonological processes were identified in the collected data. The sample of the study is collected from six sources: Said (1976), Zughoul and Hussein (1993), Al-Saqqa (2001), Mukkaram (2006), Salem (2015), and Abu Guba (2016). Finally, the study showed that autosegmental theory provides an adequate analysis in explaining certain phonological processes when dealing with English loanwords.

Keywords: English loanwords, autosegmental phonology, consonantal substitutions, assimilation.
تحليل لا خطي للكلمات الإنجليزية الدخيلة في اللغة العربية الفصحى

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1. Introduction

The linguistic repertoire of any language can be divided into native and non-native words (also known as loanwords or borrowed words). The process of borrowing has attracted investigation by many researchers and has been identified in nearly all countries. Bloomfield (1933: 444) defined borrowing as “the adoption of features which differ from those of main tradition”. He classified them into three types: cultural borrowing, intimate borrowing, and dialect borrowing. On the other hand, Paradis (1997: 419) considered loanwords to be foreign words that are used in the borrowing language, particularly in a monolingual community, and whose form has been adjusted to fit the rules and constraints of the recipient language.

The reason behind the spread of this particular phenomenon is the rapid development occurring across different fields of knowledge. This development has made it difficult for languages to catch up with all the newly emerged technical and cultural terms, leading to the need for borrowing (Hussein and Zughoul, 1993: 215). Trask (1996: 18) also justified the need for borrowing by pointing out the “gap” which appears in the lexicon of the borrowing language. Moreover, other linguistic factors that might affect the adaptation process, such as prestige and attitude, degree of bilingualism, and frequency of use, should be taken into consideration (Abu Guba, 2017: 33).

Arabic is considered to be one of the languages that has retained its identity for a very long period of time and has been known as a donor to many languages, such as Spanish and some African languages. It has also borrowed from other languages, including English, French, and Persian. Anttila (as cited in Mahadin, 1996) classified loanwords into two main types, adopted and adapted, depending on the manner in which they are used in the borrowing language. Adopted refers to the use of the same form of the word that exists in the donor language without any change. For example, [fils] , [siga:r] and [ba:r] and are adopted words. On the other hand, adapted words are adjusted to become closer to the fundamental linguistic forms of the recipient language, such as the English word /gæs/ becoming [ɣaːz] in Arabic.

2. Framework

This section will present one theory which was chosen to analyze the data, the theory being autosegmental theory, a nonlinear approach. The reason behind choosing this particular framework is the adequacy of this theory in analyzing these loanwords in a simple and clear way.
2.1 Autosegmental phonology

Chomsky and Hale (1968) proposed Generative phonology, and it was a dependable theory for phonetic and phonological analysis before the emergence of autosegmental phonology. Spencer (1996: 147) stated that until the mid-1970s rules were only written in the linear format, and even in the present day it is still used in informal descriptions of data. For instance, the devoicing process indicates a voiced sound becomes voiceless at the end of an environment, or if it is preceded or followed by voiceless sound, and it can be shown as follows (Spencer, 1996: 147):

{v ð z} voiceless/ voiceless

Therefore, the general shape of linear representation of phonological processes should be as follows:

X Y/ A____ B (ibid: 148)

indicating that X becomes Y in the context or environment of A __B. This type of environment in phonological process can be “a segment, a string of segments, the edge of a syllable, a morpheme, or a word or so on” (ibid). Such rules were called ‘rewriting’ rules because X gets written as Y.

While this linear theory accounts for a great many phonological phenomena, various shortcomings became apparent, such as its deficiency in describing suprasegmental features like tone, intonation, stress, and its inadequacy to capture certain assimilatory processes, in particular nasal homorganic assimilation. There was, therefore, the need for a new model suitable for the description of different phonological processes in a systematic and simple manner. Autosegmental phonology emerged as a solution to the problems found in the classical version of generative phonology, and the structure of representation thus changed from linear to hierarchal.

Goldsmith first originated autosegmental theory in his PhD dissertation (1976: 2), considering it “a direct descendant of the theory of generative phonology”. Autosegmental phonologists assume that phonological representations are composed of several parallel, independent tiers. This assumption contradicts generative phonology, in which a linear framework represents phonological processes. Katamba (1993: 156) justified the choice of title for this model, claiming that phonological representations consist of segments - such as tone, stress, vowels- and these segments are found on autonomous tiers. In other words, these segments cannot occupy the same place, they should not follow a linear sequence. Although these tiers are independent, they are not isolated.

As mentioned earlier, the phonological representation of autosegmental
phonology is composed of tiers. Each tier represents certain segments. For instance, consonants and vowels, which belong to the segmental tier, appear on a separate tier from tone and stress. The skeletal tier or (CV tier) links these phonological representations together. The role of association lines is to link the tonal tier to the segmental tier through the skeletal tier (ibid: 156).

Autosegmental phonology is similar to any other theory, it has certain principles and rules that govern the phonological processes. Goldsmith (1976) identified the most important principles in autosegmental phonology. The first condition is the Obligatory Contour Principle (OCP) which indicates that two identical consonants are not permitted to be in a sequence. Therefore, this sequence will be presented by one -to- many association lines. The second principle forbids the crossing of association lines during the mapping process. The third principle clarifies the idea of assimilation as a spreading process in which a feature of a segment spreads to the adjacent segment. The fourth principle is called linking constraint, in which each segment is linked to an association line, etc.

2.2 X-slot theory

The X-slot model and the moraic melody are two related theories, both established years ago. Many researchers have compared these two theories in attempts to show the superiority of one over the other. In this section, X-slot theory will be clarified and identified in a simple and clear manner, showing its principles and syllabification as well.

The X-slot theory was first originated by Kaye and Lowen Stamm in 1984. These researchers developed the CV theory presented by McCarthy (1979) to establish a new model named the X-slot. The difference between these two theories lies in the idea of specifying a feature. In other words, “instead of defining the skeleton in terms of [+ consonantal], Kaye and Lowen-Stamm (1984) and Levin (1985) propose a sequence of empty positions or slots labeled as simple points or Xs.” (Kenstowicz, 1994:426). Moreover, the development of the feature tree also brought about a need for a new model.

This theory acts in the same manner as previous theories that are made of syllabic skeletons, meaning that segments that are found in the segmental or the melodic tier are linked to the segments of the skeleton, taking into consideration the Universal Association Convention (Watson, 2012:51). This particular principle indicates that segments should be associated one to one and from the leftmost to the rightmost. For example, in the Arabic word
bint ‘girl’ the segment /b/ is associated with the leftmost slot, and /i/ is positioned with the latter skeletal place. This type of association cannot be accomplished without the existence of UAC (ibid).

\[
(1) \quad \begin{array}{cccc}
\text{b} & \text{in} & \text{t} & \text{b} \quad \text{innn} \\
\end{array}
\]

\[(CVCC) \quad | \quad | \quad | \quad | \quad | \quad | \]

Another principle for the X-slot theory is the Wellformedness Principle. This principle indicates that crossed association lines are forbidden (Hayes 1986:323). According to Watson this principle suggests: “where M falls to the left of M and X falls to the left of X, the following is ill-formed” (Watson, 2002:51):

\[
(2) \quad \begin{array}{cccc}
\text{X}_{a} & \text{X}_{b} & \text{M}_{i} & \text{M}_{ii} \\
\end{array}
\]

This principle guarantees that each element found, whether in the segmental tier or the melodic tier, is associated to the skeletal tier in the same order. For example, each element in the word bint ‘girl’ will be associated to four skeletal positions. Similarly, this principle assures that the result is [bint] not any other outcome such *[tinb] or *[tibn].

The syllabification process in the X-slot theory depends heavily on the weight of the syllable. For example, if the syllable is light, such as CV syllables, the V will be linked to one position under the rhyme. On the other hand, if the syllable is heavy, such as CVC and CVV, the syllabification will be different. Both elements VC and VV will be linked to two positions under the rhyme. It is crucial to understand that the nucleus of the syllable is occupied by syllable peaks under the nucleus branch. Drawings below are used to illustrate how CV and CVV, CVC syllables are syllabified using the X-slot theory (ibid:53):

Syllabification of CV syllable (3) :
Syllabification of CVV and CVC syllables (4):

As it is apparent from drawing number 4, in the CVV syllable, the V elements are associated with two-v slots under the nucleus which belongs to the rhyme. Whereas, in the CVC syllable, the C element is linked directly to the rhyme. In other words, each templatic position corresponds to a melodic position. There is no way to have an empty slot in the melodic tier; all positions should be filled.

3. Literature review

Many studies have been conducted into different aspects of loanwords. Zughoul (1978) investigated loanwords in the Eastern province of Saudi Arabia, focusing on the reasons behind borrowing these words. One of these reasons identified is the linguistic poverty of Arabic with regard to technical and scientific terms, which caused an immediate need to absorb new terms. Lack of education has also contributed to the increase of borrowed words. The sample consisted of more than two hundred borrowed words and was divided into ten major areas. He attempted a linguistic analysis that included phonological and morphological perspectives. Phonetically, he found that new sounds, such as /p/, /g/ and /v/, have found their way into the Saudi dialect. Although this research is considered to be a pioneer study in lexical interference, Zughoul’s work does not offer a clear picture of the phonology of loanwords, it concentrated only on the segmental changes from the source language to the target language. Moreover, having been published in 1978, this study obviously cannot cover
all new loanwords which have entered Arabic since then.

Al-Saqqa (2001) aimed at analyzing English loanwords used in written advertisements at the phonological, morphological and semantics level. The study identified 692 loanwords and classified them into two main types: proper nouns and common nouns. When dealing with phonology she listed the consonantal changes and vowel substitution of loan words. Moreover, she focused on many processes, including voicing, devoicing, deletion, and emphatics, and in some cases, she justified the reason behind these changes. For instance, the sound /t/ is emphasized as [T] when it occurs before or after a back vowel, as in [bo:T/] for /bu:t/ boot. Applying the same logic to vowels, she listed vowel substitutions and merely mentioned the phonological context that triggered these changes. For example, the low central vowel /ʌ/ is changed into [a:] before the emphatic /S/ as in [ba:S] for /bʌs/ bus. Again, however, these justifications are superficial and cannot account for phonological processes, and the study lacks even the phonological rules that clarify the environment of changes.

Loanwords have attracted studies in other Arabic dialects as well, such as Bahumaid’s (2015) work on Yemeni Arabic. In his study, the data were collected from both oral and printed sources. However, this study differs from others in that its focus is not limited to loanwords from English, but also those borrowed from Persian, French, Italy, etc. The study collected 125 which were used in studies that were published on Hadhrami Arabic. The data was analyzed phonologically, morphologically, and semantically to uncover the changes undergone by loanwords when used in Arabic. When analyzing the phonology section, certain processes have appeared in the analysis including sound nativization, the pharyngealization, gemination, metathesis and some consonants as well as the insertion of a vowel to break the word-initial consonant cluster. As with previous studies, Bahumaid only tackled the issue from a segmental point of view rather than dealing with it in a deeper way.

Salem (2015) explored English loanwords in formal and informal domains in Jordanian Arabic. The aim of the study is to examine these words in terms of distribution, frequency, and integration. The data were collected from three different sources: conversation, newspapers, and computer-mediated communication. He attempted to analyze the data from the perspectives of different fields, such as sociolinguistics, semantics, morphology, and phonology. In the phonology section, he classified phonological changes that loanwords undergo into four types: “1. Substitution of sounds that are not part of the Arabic phonological system,
2. Substitution of consonants and vowels that exist in the Arabic phonological system, 3. Addition of segment and features, 4. deletion of sounds.” (ibid: 99)

Another relevant study, conducted by Abu Guba (2016), examined syllable structure and syllabification in both native and loanwords in Amman Arabic. The data consisted of 408 loanwords collected from previous studies and from the Meriam Webster dictionary. In the study, twelve monolingual Arabic speakers were asked to pronounce the selected words using pictures, and then repeat them using frame sentences. Results showed that syllables that have simple onsets and codas are better analyzed by classic OT, whereas syllables that consist of complex margins are accounted for by Stratal OT. The study also revealed a tendency toward unmarkedness. In other words, faithfulness to the source input is violated in order to satisfy the unmarked output. A number of phonological processes, such as epenthesis and deletion, are used to render the adapted form less marked. As the only study that deals with the syllable structure of loanwords, this work might be beneficial, although the framework used are different from the current study.

Al-Athwary (2017) investigated the phonological modifications made to English loanwords in Arabic. For this purpose, over than 300 of English loanwords were analyzed. The data were collected from Arabic newspapers, some Arabic magazines, textbooks, and dictionaries. Results have shown that at the syllabic level, mechanisms like cluster simplification, syllabic consonant conversion and gemination existed when examining the data. Moreover, it has been noted that most of the regular adaptation at the syllable level, were motivated by linguistic constraints inherited in the phonological system of Arabic language rather than extra -linguistic motivations.

4. Methodology

The study aimed to analyze loanwords in Standard Arabic using autosegmental phonology which was proposed by Goldsmith (1976)). The data of the study have been collected from two different sources. Firstly, and principally, from previous studies that addressed the issue of borrowing: Said (1976), Zughoul and Hussein (1993), Al-Saqqa (2001), Mukkaram (2006), Salem (2015), and Abu Guba (2016). The reason for choosing the latter two studies is that they were the most recent, updated studies examining this issue. Secondly, several different dictionaries were used to find the source
The process of collecting the data started with the gathering of all loanwords cited in the aforementioned studies. The source language for these loanwords was then confirmed as English, rather than other languages. The loanwords were transcribed phonetically according to their pronunciation, whether in English or Standard Arabic, using IPA symbols. Finally, the two phonological forms were compared in order to detect the phonological processes that manifested in these loanwords and caused these changes.

It is crucial to mention that loanwords were classified based on the phonological processes that appeared in the collected data, such as voicing, devoicing, vowel harmony, assimilation. It is worth noting that most of the borrowed words were nouns, and that verbs were the least common. Furthermore, the researcher focused only on loanwords that could be traced back to the English language, excluding any words with a different origin.

5. Results and discussion

This section presents a significant number of phonological processes that have been analyzed using autosegmental theory, particularly the x-skeleton framework proposed by Goldsmith (1976) and Mahadin (1982). The section is divided into four parts; each part provides a repair strategy supported with multiple examples, one of which is selected for further explanation. Section 5.1.1 deals with consonantal substitutions including voicing, devoicing, velarization, fortition. Section 5.1.2 covers the phonological process of assimilation, comprising palatalization, labialization, nasalization, and vowel harmony. Section 5.1.3 explains the vowel lengthening phonological process. Section 5.1.4 presents vowel shortening including syncope and apocope.

5.1 Different phonological repair strategies

5.1.1 Consonantal substitution

Many loanwords have undergone phonological repair strategies in order to fit into the Arabic system. Voicing and devoicing processes are considered the most important phonological processes that appeared in the collected data. They mainly affect the segmental level of the sound. The reason for this particular phonological process is that certain phonemes are not found in Arabic, existing only as allophones. It was therefore necessary to use the closest sounds or phonemes to be able to pronounce them in a similar way to the donor language. This section will be named consonantal
substitution since it will be restricted to consonants.

5.1.1 Voicing

According to Finegan (1994:83) voicing is “the result of air being forced through a narrow aperture (called the glottis) between two folds of muscle (the vocal cords) in the larynx”. This feature is similar to devoicing when it comes to the place of articulation, the only difference lies in the vibration that exists in the larynx. The substitution process mainly occurs when we have an optimal sound that matches the non-existing phoneme. Thus, the speaker tries as much as possible to choose the sound closest to that in the recipient language. This phonological process has also appeared in the spoken form. For instance, Zughoul (1979) has examined the errors that manifested for Arabic speaking learners of English. Similarly, these speakers have tended to voice and devoice certain sounds in their speech due to the lack of some phonemes.

5.1.1.a. Voicing the sound /p/

The first phoneme that will be examined is the sound /p/, which is voiced to become /b/. Several examples from Standard Arabic will be examined below. The first column presents English gloss, the second English transcription, and the third Arabic transcription after alternation. Examples are as follows:

<table>
<thead>
<tr>
<th>English</th>
<th>English transcription</th>
<th>Arabic transcription</th>
</tr>
</thead>
<tbody>
<tr>
<td>panadol’</td>
<td>/panado:l/</td>
<td>/banado:l/</td>
</tr>
<tr>
<td>pendulum</td>
<td>/pɛnd<em>sa</em>le<em>ma</em></td>
<td>/ bande:lu:</td>
</tr>
<tr>
<td>parachute</td>
<td>/pa<em>ra</em>fu:*t/</td>
<td>/bara:fu:</td>
</tr>
<tr>
<td>panorama</td>
<td>/pana:ra*ma/</td>
<td>/ banura:ma:</td>
</tr>
<tr>
<td>‘plastic’</td>
<td>/pla*stik/</td>
<td>/bla:stk/</td>
</tr>
</tbody>
</table>

As is shown in the above examples, the bilabial stop /p/ has been altered to its equivalent sound present in Arabic, namely the bilabial stop /b/. The only distinctive feature that differentiates between these two sounds is [ + voiced]. Although Arabic lacks the phoneme /p/ and deals with it as a variant, it has managed to find a simple way to pronounce these words by substituting the sounds /p/ with /b/. This particular finding conforms with many earlier studies, such as Salem (2015), Sa’aïda (2015), and Bahumaid (2016). Each language has its own phonetic system, but eventually in certain cases the same phonological process is applied. We see, for instance, in Othman’s 2005 research on Yemeni Arabic, that /p/ to /b/ alteration occurs in the word ‘pasha’ /pa:ʃa:/ becoming /baːʃaː/. This phonological process can be explained simply using a rule as follow:
The rule states that the voiceless /p/ is altered to become the sound /b/ in all positions: initially, medially, and finally. The English word ‘plastic’ can be analyzed using the x-skeleton as follows: Example (1):

As seen from the example, the two consonants /p/ and /l/ have been syllabified in the English form in the onset of the first syllable, since they do not violate any constraint. It is known that the English language accepts up to three consonants in the onset. However, these consonants should not violate the sonority sequencing generalization (SSG). This principle indicates that “in any syllable, there is a segment constituting a sonority peak that is preceded or followed by a sequence of segments with progressively decreasing sonority values” (Spencer, 1996:89). The second syllable applies the same method of syllabifying two consonants in the coda for the same reason. Furthermore, both vowels /æ/ and /ɪ/ in the first and the second syllable occupy the nucleus of each syllable.

On the other hand, many alternations appear in the Arabic form, such as the voiceless /p/ becoming the voiced /b/. Since Arabic does not allow more than one consonant to be found in the onset, a vowel epenthesis has arisen to separate the consonant /b/ from the liquid /l/, using the vowel /ɪ/. Moreover, the liquid /l/ has been syllabified as the onset of the second syllable and a vowel lengthening has appeared, changing the short back vowel /æ/ to the long vowel /aː/. Finally, the /s/ has been syllabified in the coda of the second syllable, whereas the /t/ has been syllabified as the onset of the third syllable to respect Arabic language constraints. In summary, three phonological processes have appeared: voicing, vowel epenthesis, and vowel shortening.

5.1.1.2 Devoicing

Another phonological process present in the collected data is devoicing.
Again, this process deals with the segmental level of the sound. However, this phonological process is the opposite of the voicing process: a voiced sound is rendered voiceless. As with voicing, the reason behind the devoicing process is the absence of certain sounds, necessitating their replacement in Standard Arabic.

5.1.2.a Devoicing the sound /z/

A phonological process reversing that seen in the earlier section appeared in the collected data: the voiced alveolar fricative /z/ changing to voiceless alveolar fricative /s/. Only two examples were detected. These examples will also be organized in three columns: English gloss, English transcription, and Arabic transcription, below:

<table>
<thead>
<tr>
<th>English word</th>
<th>English transcription</th>
<th>Arabic transcription</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘physiology’</td>
<td>/fiznladʒ/</td>
<td>/fisjul:j/a/</td>
</tr>
<tr>
<td>‘bilharzia’</td>
<td>/bil ha:rzia/</td>
<td>/balha:rsia/</td>
</tr>
</tbody>
</table>

The alternation related to the devoicing can be stated as the following rule:

\[
\begin{array}{c}
+ \text{voiced} \\
+ \text{con} \\
- \text{cont} \\
- \text{son} \\
+ \text{ant}
\end{array} \rightarrow - \text{voiced} / \{ - \text{v} \} \\
\]

The rule states that the voiced /z/ becomes the voiceless /s/ when it is followed by a vowel.

The word ‘bilharzia’ will be presented using x-skeleton theory as follows:

Example (2):

As we can see, the voiced /z/ has changed to the voiceless /s/, showing a devoicing phonological process. Moreover, the quality of the vowel /I/ has
changed to become /a/ in the Arabic form. No other phonological processes have appeared in this particular example; even the number of syllables in both forms remains the same.

5.1.1.3 Velarization

Unlike the devoicing process, the process known as velarization or pharyngealization occurs due to the existence of two phonemes corresponding to the same phoneme. One of these phonemes is found in the donor language and the other is similar to it but exists in the recipient language (El-Khalil, 1983:31). The reason behind this particular phonological process is to maintain the linguistic purity of the recipient language. For example, the sound /t/ when borrowed into the Arabic language is velarized or becomes an emphatic sound represented as /T/.

This change applies in specific circumstances: if the sound is preceded or followed with a back vowel, then it becomes velarized. Any other environment blocks this change from occurring. In other words, if the alveolar stop exists in an initial position and is not followed by a back vowel, then the phonological process does not happen. Velarization appeared vividly in two sounds: the alveolar stop /t/ that changes to the emphatic /T/, and the alveolar fricative /s/ which changes to the emphatic /S/. Examples are shown below represented in the same order as previous sections:

<table>
<thead>
<tr>
<th>English word</th>
<th>English transcription</th>
<th>Arabic transcription</th>
</tr>
</thead>
<tbody>
<tr>
<td>stable</td>
<td>/steb(a)l/</td>
<td>شابُل/</td>
</tr>
<tr>
<td>atlantic</td>
<td>/atlantik/</td>
<td>آتلانتيک/</td>
</tr>
<tr>
<td>atlas</td>
<td>/atlas/</td>
<td>آتلاس/</td>
</tr>
<tr>
<td>salon</td>
<td>/sələn/</td>
<td>سالون/</td>
</tr>
<tr>
<td>sauce</td>
<td>/səs/</td>
<td>ساوسه/</td>
</tr>
</tbody>
</table>

The rule of velarization can be expressed as follows:

- voiced
  + cord.
  - cent.
  - son
  + ant.
- emphatic

The rule states that the voiceless stop /t/ becomes emphasized if it is followed by a back or a central vowel.

The word ‘salon’ will be presented using x-skeleton as follows:
Example (3):

As is seen in the example, the voiceless alveolar fricative /s/ has been altered to become the emphatic /S/ since it is followed by the low back vowel /a:/o. Moreover, the word has been subjected to vowel lengthening in both syllables. In the first syllable the low central unrounded vowel /æ/ has been changed to the long low back unrounded vowel /a:/o. Also, in the second syllable the mid central unrounded /ɒ/ has been altered to the long high front rounded /u:/o. Both long vowels have been associated with two v-slots.

5.1.1.4 Fortition

Another example that shows a phonemic substitution is the rendering of the sound /ϴ/ to become /t/. It is important to note that this is not a voicing or devoicing phonological process, because both sounds are voiceless and share many distinctive features such as [-sonorant], [+coronal], [+anterior]. Since they share so many features, the sound /t/ is considered the optimal candidate for replacement. This phonological process is called fortition or stopping, where it applies to consonants only to increase the degree of stricture (Spencer, 1996:60). A further commonly known aspect of this phonological process is that it appears in initial and middle position, in contrast to lenition. Examples are shown below and ordered in the same manner of previous sections:

<table>
<thead>
<tr>
<th>English word</th>
<th>English transcription</th>
<th>Arabic transcription</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘cathedral’</td>
<td>/kæθdrəl/</td>
<td>/kaθḍrəːl/</td>
</tr>
<tr>
<td>‘menthol’</td>
<td>/mɛnθəʊl/</td>
<td>/mɛntoʊl/</td>
</tr>
<tr>
<td>‘thermos’</td>
<td>/θərmos/</td>
<td>/θARMʊs/</td>
</tr>
</tbody>
</table>

The loanword ‘menthol’ is expressed using x-skeleton theory as follows:

Example (4):
As shown by the drawings, both English and Arabic forms consist of two syllables only. The first syllable in both forms is syllabified in the same manner with the bilabial /m/ in the onset of the first syllable. The vowel /I/ occupies the nucleus, and the nasal /n/ is found in the coda. When it comes to the second syllable the word has undergone two phonological processes. Firstly, fortition indicated by the alternation of the phoneme /ϴ/ to become /t/; secondly, vowel lengthening of the vowel /o/ to become long /o:/ in the Arabic form using two association lines. This particular process will be discussed in later sections.

5.1.2 Assimilation

Assimilation is considered the most common phonological process in all languages. Linear phonological approaches have viewed assimilation as simply the tendency of a sound to become similar to another sound, whether coming before or after it. Katamba (1989:80) has defined assimilation as “a modification of a sound in order to make it more similar to some other sound in its neighborhood”. However, autosegmental theory has a different view regarding assimilation: that it is spreading features rather than changing a feature (Goldsmith, 1976). Assimilation differs in terms of voicing, place of articulation, and manner of articulation. There are five types of assimilation: palatalization, labialization, nasalization, vowel harmony, nasal homorganic assimilation.

Most, but not all, types of assimilation are present in the collected data, and therefore, most of them will be analyzed. The first type to be discussed is palatalization.

5.1.2.1 Palatalization

Palatalization can be explained as a sound which is non-palatal being palatalized when it is followed either by a high front vowel /I, i:/ or a glide /j/. Mainly it triggers velar consonants /k/and /g/. According to Katamba (1989:86) palatalization occurs “when there is some slight anticipatory fronting of the part of the tongue that makes contact with the roof of the mouth”. The process of palatalization varies from one language to another. For instance, in other languages it could be mid vowel (ə) or high mid vowel or before all vowels which are high.
Palatalization is not only restricted to velar consonants /k,g/ but may also extend to alveolar consonants. Usually, alveolar consonants are palatalized when they are found in final position of a word and followed by a word that starts with an alveo-palatal consonant. For example, ‘miss you’ /mIs ju:/ becomes /mIʃ ju:/, ‘hit you’ /hIt ju:/ becomes /hItʃ ju:/ . Thus, in this case palatalization applies to alveolar consonants, not to velar consonants (ibid).

From the collected data only three examples were found that indicate palatalization. In English, the word ‘romantic’ is pronounced /rəʊmæntɪk/, whereas in Arabic it is pronounced /romænsl/. As observed in the example the velar /k/ changes to /s/, the reason for this alternation being that the velar consonant is palatalized when followed by the high front vowel /l/. Examples are shown below ordered as in previous sections:

<table>
<thead>
<tr>
<th>English word</th>
<th>English transcription</th>
<th>Arabic transcription</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘romantic’</td>
<td>/rəʊmæntɪk/</td>
<td>/romænsl/</td>
</tr>
<tr>
<td>‘diplomatic’</td>
<td>/dɪpləmətɪk/</td>
<td>/dɪblu:ma:st/</td>
</tr>
<tr>
<td>‘Atlantic’</td>
<td>/æləntɪk/</td>
<td>/ʌlTʌst/</td>
</tr>
</tbody>
</table>

The word ‘romantic’ will be analyzed using x-skeleton as follows: Example (5):

Multiple phonological processes appear in this example. In the Arabic and English forms, the word consists of the same number of syllables. In both forms the liquid /r/ is syllabified in the onset of the first syllable. However, in the Arabic form the diphthong /əʊ/ has been shortened to become the short back vowel /o/, and instead of being associated to two v-slots it is associated to one v-slot only. Regarding the second syllable the only change occurs to the quality of the vowel /æ/ becoming /a/. Concerning the third syllable the consonant /t/ has been deleted in the Arabic form, and the velar consonant /k/ has been palatalized since it is followed by the high front vowel /l/. 
5.1.2.2 Labialization

Labialization is considered a type of assimilation. It can be defined as a lip rounding that occurs before the consonant is fully pronounced (Katamba, 1989:87). Moreover, it is presented by utilizing a consonant that is raised by \( w \) as follows: \( /c^w/ \). In English there are many examples that manifest this phonological process, such as ‘pool’ /p\(^w\)ʊl/, ‘two’ /t\(^w\)u:/ and finally ‘got’ /g\(^w\)ɒt/. Regarding the current study, many examples of labialization are present in the collected data, outlined below and arranged as in previous sections:

<table>
<thead>
<tr>
<th>English word</th>
<th>English transcription</th>
<th>Arabic transcription</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘buckle’</td>
<td>/b(^k)kl)/</td>
<td>/b(^k)kl)/</td>
</tr>
<tr>
<td>‘potash’</td>
<td>/p(^t)e)/</td>
<td>/b(^t)a)/</td>
</tr>
<tr>
<td>‘turbine’</td>
<td>/t(^r)b)/</td>
<td>/t(^r)b)/</td>
</tr>
<tr>
<td>‘dollar’</td>
<td>/d(^l)r)/</td>
<td>/d(^l)r)/</td>
</tr>
<tr>
<td>‘sugar’</td>
<td>/(^g))a)/</td>
<td>/(^g))a)/</td>
</tr>
</tbody>
</table>

The word ‘potash’ will be presented using autosegmental phonology as follows:

Example (6):

As noted from the example, the onset of the first syllable has been voiced, changing from the voiceless /p/ to the voiced /b/. Moreover, the consonant /b/ in the Arabic form has been labialized as well. The short low back vowel /\(\)ʊ/ has been lengthened in the Arabic form and has been associated to two tiers instead of one. Furthermore, the second syllable has been exposed to vowel lengthening, changing /æ/ to the long vowel /a:/.

Finally, the coda in the English form /ʃ/ has been altered to become the voiced consonant /s/. In summary, the example shows three phonological processes: voicing, labialization, and vowel lengthening.

5.1.2.3 Nasalization

According to Katamba (1989:93) nasalization is “a process whereby an oral segment acquires nasality from neighboring segment”. It is a result of lowering the soft palate when producing a sound and allowing the air to pass through the mouth. It is important to understand that the soft palate consists of soft tissue that can be raised and lowered when producing a nasal sound.
When the soft palate is lowered, it closes the oral cavity and air is directed through the nasal cavity. For example, the vowel in the English word ‘man’ /mæn/ is nasalized since it is followed by a nasal sound. The diphthong /aI/ in the word ‘my’ /maI/ is also nasalized since it is preceded by a nasal consonant /m/.

Concerning the current study, many collected examples show this particular phonological process. Again, the first column indicates English glossing, the second column English transcription, and the third column Arabic transcription accompanied with alternations. The collected examples are as follows:

<table>
<thead>
<tr>
<th>English word</th>
<th>English transcription</th>
<th>Arabic transcription</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘sponge’</td>
<td>/spʌndʒ/</td>
<td>/ṣafanj/</td>
</tr>
<tr>
<td>‘tuna’</td>
<td>/tuːna/</td>
<td>/tuːn/</td>
</tr>
<tr>
<td>‘ton’</td>
<td>/tʌn/</td>
<td>/Tɔn/</td>
</tr>
<tr>
<td>‘sandal’</td>
<td>/ˈsændəl/</td>
<td>/sandal/</td>
</tr>
<tr>
<td>‘Franc’</td>
<td>/fʁɛŋk/</td>
<td>/fʁeŋk/</td>
</tr>
<tr>
<td>‘cautεen’</td>
<td>/kætʃi:n/</td>
<td>/kæntʃi:n/</td>
</tr>
<tr>
<td>‘canvas’</td>
<td>/ˈkænvəs/</td>
<td>/kænvəs/</td>
</tr>
<tr>
<td>‘lamp’</td>
<td>/læmp/</td>
<td>/læmb/</td>
</tr>
</tbody>
</table>

The word ‘tuna’, represented using autosegmental phonology, is as follows:

Example (7):

In this example, in both the English and Arabic words the vowel is nasalized since it is followed with the nasal consonant /n/. As noted, the /t/ in both forms is syllabified as the onset of the first syllable. In contrast, in the Arabic form the long high back round vowel /u:/ has been shortened to become /ʊ/ associated with one association line only. Moreover, the English form consists of two syllables, whereas the Arabic only one: the /ʊ/ of the second syllable has been deleted in the second syllable. In addition, a germination for the nasal /n/ appears in the Arabic form. In summary, this word provides examples of the following phonological processes: nasalization, vowel shortening, vowel deletion and germination.
5.1.2.4 Vowel harmony

According to Spencer (1996:58) vowel harmony is a type of assimilation that is found mainly between vowels and exists in many languages. The main concept of this phonological process is that all vowels in the same word should agree at least in one feature, whether that is backness, roundness, highness. In vowel harmony basically, regardless of the consonant, all vowels should agree in certain features. This phonological process plays a significant role in many languages, such as Turkish, Russian, and Hungarian. For instance, in the Turkish words ‘diʃim’, ‘evim’, it is observed that the vowels in the stem and the suffix agree in front and rounding features.

The collected data include examples of vowel harmony following alteration into the Arabic form. The first column represents the English gloss, the second represents the English transcription. The third represents the Arabic transcription after adding a suffix, whether this suffix refers to gender or number. Examples found are as follows:

<table>
<thead>
<tr>
<th>English word</th>
<th>English transcription</th>
<th>Arabic transcription after suffix added</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘list’</td>
<td>/List/</td>
<td>/li:ʃah/ (fem)</td>
</tr>
<tr>
<td>‘doctor’</td>
<td>/doktar/</td>
<td>/duktar/ (masc)</td>
</tr>
<tr>
<td>‘tactic’</td>
<td>/taktik/</td>
<td>/takt kat/ (fem plural)</td>
</tr>
<tr>
<td>‘cheques’</td>
<td>/tiʃkəs/</td>
<td>/fi:kat/ (fem plural)</td>
</tr>
</tbody>
</table>

The word ‘List’ is presented using x-skeleton, as follows:

Example (8):

As seen in the example, the word contains only one syllable in English. However, its Arabic form has been altered to become the two-syllable /li:ʃah/. Also apparent in the example is that the high front unrounded vowel /i/ in the English has been lengthened to become the long vowel /i:/.

Furthermore, it has been associated to two v-slots in the Arabic form. Moreover, there is syllable addition with the inclusion of the feminine suffix [ah]. The vowels /a/ and /i:/ agree in one distinctive feature, [- round] leading to a vowel harmony. To conclude, two phonological processes appear in the example: vowel lengthening and vowel harmony.
5.1.3 Vowel lengthening

Spencer (1996:67) defined vowel lengthening as a phonological process in which a short vowel becomes long under certain circumstances. For example, the vowel /I/ in ‘bit’ /bIt/ is longer than in ‘bid’ /bId/ because usually in English the vowel is slightly longer before obstruent compared to other positions. Many examples have been conducted comprising different types of lengthened vowels such as /i:/, /a:/, /o:/, or /u:/.

Examples are shown below, ordered as in previous sections:

<table>
<thead>
<tr>
<th>English word</th>
<th>English transcription</th>
<th>Arabic transcription</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘dolphin’</td>
<td>/dɔlfɪn/</td>
<td>/dulfi:n/</td>
</tr>
<tr>
<td>‘static’</td>
<td>/stætɪk/</td>
<td>/sta:ti:kt/</td>
</tr>
<tr>
<td>‘gas’</td>
<td>/ɡæs/</td>
<td>/va:z/</td>
</tr>
<tr>
<td>‘dollar’</td>
<td>/ˈdɒlər/</td>
<td>/dula:r/</td>
</tr>
<tr>
<td>‘police’</td>
<td>/ˈpɒliːs/</td>
<td>/bu:liːs/</td>
</tr>
<tr>
<td>‘gallon’</td>
<td>/ˈɡælən/</td>
<td>/gælən/</td>
</tr>
</tbody>
</table>

Vowel lengthening can be also presented using x-skeleton, as in the following example using ‘dolphin’:

Example (9):

It can be noted from the example that each vowel is linked to the nucleus of each syllable. It is also apparent that the short high back unrounded vowel /I/ in the English form is presented using a one-to-one association line in the x-skeleton. On the other hand, in the Arabic form it is presented as a sequence of two identical short vowels using one-to-many. In other words, “long vowels are represented as two x-slots to one vowel slot”, Mahadin (1994:66). In addition, a change is observed in the quality of the vowel /ɒ/, which has been changed from the short low back unrounded /ɒ/ to the high front rounded vowel /u/. Finally, no changes have occurred regarding the consonants. It is important to understand that the sound /I/ and the sound /I/ cannot be syllabified in the onset of the second syllable since they do not respect the sonority sequencing principle (Spencer, 1996:89).

4.1.4 Vowel shortening

Vowel shortening is a process in which a long vowel becomes short
vowel. According to Kambuziya et al (2017:374) vowel shortening refers to “a process in which the length of a vowel is shortened in a specific phonological environment”. Certain phonological processes are related to vowel shortening, such as syncope and apocope. The difference between syncope and apocope lies in the idea of whether we are losing a segment in the word or a whole syllable.

This section will present examples for English loanwords that have undergone vowel shortening. Again, the first column presents the English gloss, the second column the English transcription, and the third column the Arabic transcription for the altered words. Examples are as follows:

Example (10) presents vowel shortening:

<table>
<thead>
<tr>
<th>English word</th>
<th>English transcription</th>
<th>Arabic transcription</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘meter’</td>
<td>/ˈmitər/</td>
<td>/mitr/</td>
</tr>
<tr>
<td>‘tuna’</td>
<td>/ˈtuna/</td>
<td>/Tunn/</td>
</tr>
<tr>
<td>‘calcic’</td>
<td>/ˈkælkɪk/</td>
<td>/kils/</td>
</tr>
<tr>
<td>‘gargle’</td>
<td>/ˈɡɑːrgɡl/</td>
<td>/ˈɡarɡɡal/</td>
</tr>
</tbody>
</table>

Example (10) presents vowel shortening:

In this example we see the number of syllables decreasing from two in the English form to one in the Arabic. First, in both forms the voiceless /k/ has been syllabified in the onset of the first syllable. Second, the long low back rounded /a:/ is attached to two association lines in the English form, whereas in Arabic it has been shortened, leading to syllabification to one-to-one association line only. Furthermore, the liquid /l/ has been syllabified in the coda of the first syllable since the sound /l/ and the sound /s/ cannot be syllabified together in order to respect the sonority scale principle. Regarding the syllable /Ik/, it is noted that it has been missed in the last syllable, manifesting apocope. Finally, the voiceless /s/ has been syllabified as the coda of the first syllable in the Arabic form since the nucleus is deleted.

Conclusion

In conclusion, this paper explains selected phonological processes present in the collected data using autosegmental theory, in particular the x-skeleton proposed by Kaye and Lowen-Stamm (1984) and Levin (1985).
The manner in which each phonological process interacts with the x-skeleton in a different way was outlined, and the study focused on the idea of the adequacy of autosegmental theory to explain certain phonological processes. Moreover, it highlights the superiority of autosegmental theory over linear phonological approach especially when dealing with assimilation phonological process.

References
Kambuziya, A et al. (2017). Vowel shortening in Persian: A phonological


