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English (Fowakis & Port, 1986)

many languages. It has been widely studied in hence, is a well known natural phenomenon in between which it is inserted. Stop epenthesis, between the first consonant and the second one variability occurs to make the transition easier they are known as emergent stops. Such phonetic R., Hammarberg, R. : 1979). To Ojala (1997) stop or "intrusive" consonants (Ali, I., Daniloff, is predictable, too. It results into what are called McCarty and Prince (1993). Phonetic variability stop [?] to Lombardi (1997) , and [t] to and well-formedness constraints". It is a glottal independently motivated inventory constraints Vanux (2002) points " ... from the interaction of consonant in a given language is predictable as phonologically, an epenthetic only phonetically conditioned but also consonants. The epenthesis of a consonant is not variability in a language is the epenthesis of One of the great significant results of phonetic

Introduction:

factor in the perception of these segments too.

articulation of both sounds is similar, epenthesis process is not likely to occur. Frequent cluster proves an influential show that epenthetic segment does occur if the duration between the two sounds is long, however, when the place of produced with "tasken". This indicates the environment we propose for epenthetic segment to occur. The results hand, and obstruents \b, t, k, s\ at onset position of the next syllable on the other hand. Furthermore \m\ should be list of four Arabic words written in Arabic orthography with a nasal sound \m\ at coda position of a syllable, on one This paper attempts to investigate the production and the perception of epenthetic stops in Arabic, if any. To do this, a

Abstract

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Epenthetic Stop Sounds in Arabic

production and perception as well. These were tested experimentally by means of rules. 3. to explain the phenomenon with the help of potentially occur, and, 2. to predict the environment where they can then to classify them. 1. to identify epenthetic stops in Arabic, if any. The objectives are as follows:
This paper attempts to investigate the production and the perception of epenthetic stops in Arabic. This paper attempts to investigate the production and the perception of epenthetic stops in Arabic. thoroughly investigated in Arabic. knowledge, this phenomenon has not been & Weber (2002). However, to the researcher in German (Alber, 2001), and in Dutch (Warner

Methods:

A list of four Arabic words written in Arabic orthography was introduced to an Arabic native speaker. The four Arabic words were produced with a pause "Tasken" on the last sound of the second syllable of the first word followed by a morpheme, with which it makes a cluster. The

monitoring experiment was carried out using the production of the word items by the native speaker as stimuli to the listeners to perceive these segments. The listeners were also asked to respond whenever they heard any stop sound. The words are listed in the table below:

Table (1)

s	k	t	d	m
Kum sink [ʔ]	kareem kum [ʔ]	Kareem ti [ʔ]	kareem di no eben	

listeners may perceive can be seen not only at the syllable boundaries within one word, but at morpheme boundary, too. The environment delimits taking into consideration:

Place of articulation:

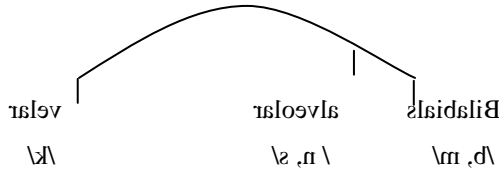
The place of articulation as indicated is the bilabial nasal [m] at the coda position of the first syllable and the obstruent sound in the next syllable on the onset position. The obstruents are variable. It is either the bilabial [p] or the alveolar [t] and [s] or the velar sound [k]. The following figure shows how these sounds are arranged from front to back. The arrangement of sounds in the above figure is helpful when accounting for duration between the two segments [m], on one hand, and [p t k ʔ] on the other hand.

words were naturally produced. Five BA students at Yarmouk University were instructed to listen carefully to the words. The listeners were all native speakers of Arabic. The recording took place at the language laboratory of the YU Center of Hearing and Speaking. A phoneme

In table (1), the 4 Arabic words show the cluster between the mp mt mk and ms. Epenthetic stop is listed below each example. Whenever there is no epenthetic segment, it is indicated as "no eben". The epenthetic segments are indicated as they were heard by the listeners.

As shown above, the words were arranged in a way with a nasal sound at left of the table and the obstruents [ʔ], [t], [k] and [s] on the top. This indicates the environment we propose for epenthetic segment to occur. Epenthetic segment is expected to be heard when there is a cluster between a nasal sound and an obstruent split across syllable boundaries. Fowakis and Port (1988) point that such position is a significant position in determining epenthetic stops at surface forms. Warner & Weber (2002) point, too, that this cluster provides an environment where the speakers may produce epenthetic stops. However, the clusters they investigate happen to be within the same word.

Arabic differs from the languages mentioned above in the case that epenthetic segments that



voiced obstruent sound can also be used... Shinyā (2002) declares, "It is likely to appear, though less commonly, when the obstruent is voiced". So as to be able to identify if there is an epenthetic segment or not, the researcher first identified the duration between the invisable bilabial nasal \m\ and the second sound, the variable sound segment, the obstruent \p, k, s, \). The duration is listed in table 2 :

Table (2)

The word	Duration
Krem pi	0.0408 sec
Krem ti	0.1116 sec
Krem kum	0.1323 sec
Kum sinak	0.1109 sec

segments occur since the transition period is not so long to let the process to take place. This explains the non response made by the listeners when they were asked to respond whenever they heard (\p\ or none). This can be expressed in the following rule: no ebn→[+ x place of articulation] 2 [+ x place of articulation]. This rule indicates that when the place of articulation is similar for both sounds epenthesis process is not likely to occur. Listeners who monitored for either [\p\ or none] perceive the epenthetic stop [\p\] quite often for the \m\ cluster with the three obstruent \k, k, s, \).

Phonation:

While the first segment is the voiced sound, \m\, the second segment is either the voiced \p\ or the voiceless \k, s, \. Most commonly, an epenthetic segment can be perceived when the obstruent is voiceless. To this, Fourakis and Port (1986) state that the suitable position for epenthetic segment to occur frequently is when it follows a nasal and precedes a voiceless obstruent. However, \p\ as a

Analysis and findings:

Production and perception

When analyzing the phonetic duration of the two segments acoustically, we found that in m cluster with the bilabial \p\, the duration is at its least in contrast with the duration of the other sound segments . It is 40.8 msec. However, the duration of the last three sounds seems to be gradual in range. It is 110.9 msec for \s\ and 111.6 msec for \k\ and 132.3 msec for \k\, The duration of mp is likely to be less than the other three segments because the place of the articulation of the two segments is similar. Hence, no epenthetic

variability in duration between one segment and one from another, from the least to the most. This indicates the fact that the closer the segment is to the nasal the less, the further the more. The "kareembkum" and "kumbsinak" is more frequent than in "kreem(d)ti". This is first. Secondly, it is the place of the articulation that affects in the range of the duration to be different perceived in frequent cluster than in infrequent cluster as an influential factor affecting segment perception. An epenthetic segment may be easily cluster at medial position plays a significant role and finally the *mr*. This shows how frequent response from the listeners. Then the *ms* cluster However, *mk* cluster shows high range of

nasal". Each item was evaluated acoustically for presence of epenthetic segment at syllable boundary depending on the different types of duration as shown in figure 2:

stop with same place of the articulation of the formed and this results into an epenthetic oral "The velum closes before the consonant is the missing (Ohala, 1997). He (1997) states, (2002). Articulatorily, the insertion arises from epenthetic segment to occur (Warner & Weber, 2002). Hence, [ʌb] in

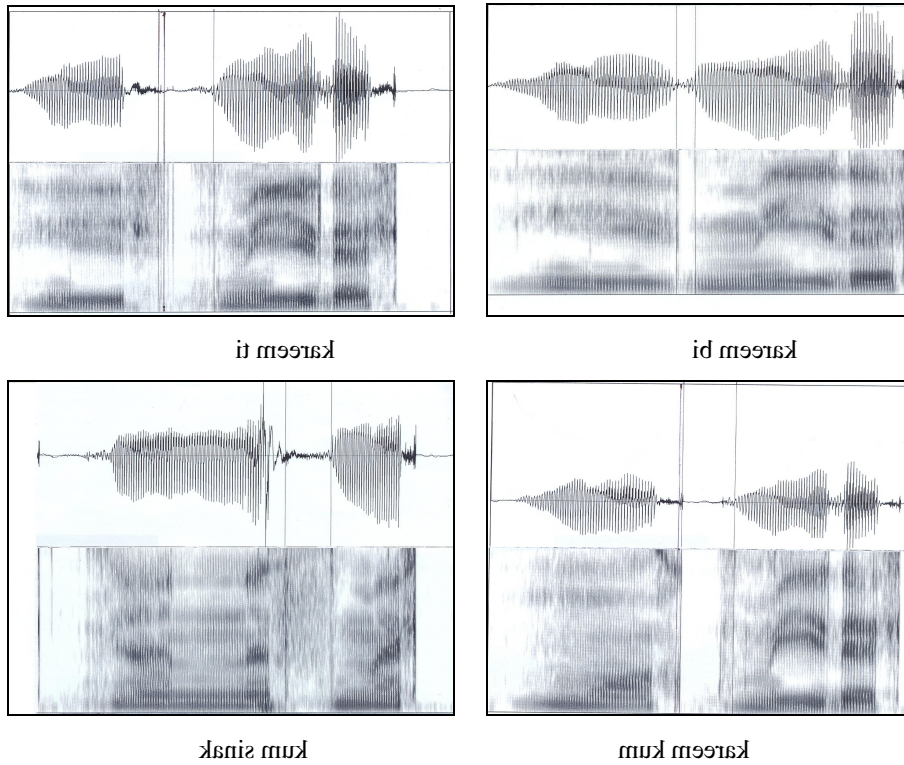


Figure (2). The duration between m and \ p t k s

This rule indicates that [v] is inserted as an epenthetic segment if \m is at one syllable and the obstruents \t, k, s\ are at the next syllable.

Conclusion:

In this paper we have seen that epenthetic segment is likely to occur in Arabic. Most commonly, it could be perceived when the nasal \m\ makes a cluster with the obstruents \t, k, s\ at syllable boundaries and \m\ should be produced with "laxness". The real cause to do this is to facilitate ease of articulation. It seems that [v] is the epenthetic segment that was perceived by the listeners. Moreover, tendency of clusters plays a significant role as an influential factor affects segment perception. Epenthetic stops may be easily perceived in frequent clusters than in infrequent clusters.

The general tendency of m cluster with these obstruents \t, k, s\ moves towards the choice of the bilabial sound [v] as an epenthetic segment. \v\ shares the [place] feature with \m\, the previous segment. This is confirmed by Clement (1987) who states that an epenthetic segment shares its place feature with the previous segment. However, it is quite difficult to specify the notion place of articulation. Ohala (1997) states that only listeners and linguists were able to associate it with that of the nasal.

This process will not occur unless these sounds have a cluster with the previous sound at a syllable boundary. This can be indicated in the following rule:

$$\emptyset \rightarrow \text{v} \text{ "an epenthetic segment" } \text{m} \neq - \neq \{s, t, k\}.$$

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