ABSTRACT

INVESTIGATING WHAT MIGHT DETERMINE THE QUALITY OF THE EPENTHETIC VOWEL

This thesis investigates why different languages use different vowels for epenthesis even when they have the same vowel systems. The first task is examining the possibility that the epenthetic vowel is determined by its frequency in the language. Vowel frequencies of three languages with different vowel systems are examined. The results indicate that frequency does not predict the epenthetic vowel. The second task is to model the epenthetic vowel in a number of languages systems by using vowel features as constraints from an optimality theoretic point of view.

Ali Salman Alelaiwi
May 2014
INVESTIGATING WHAT MIGHT DETERMINE THE QUALITY OF THE EPENTHETIC VOWEL

by
Ali Salman Alelaiwi

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Arts in Linguistics in the College of Arts and Humanities California State University, Fresno May 2014
APPROVED

For the Department of Linguistics:

We, the undersigned, certify that the thesis of the following student meets the required standards of scholarship, format, and style of the university and the student’s graduate degree program for the awarding of the master’s degree.

Ali Salman Alelaiwi  
Thesis Author

Chris Golston (Chair)  
Linguistics

Brian Agbayani  
Linguistics

Sean Fulop  
Linguistics

For the University Graduate Committee:

Dean, Division of Graduate Studies
AUTHORIZATION FOR REPRODUCTION
OF MASTER’S THESIS

X_______ I grant permission for the reproduction of this thesis in part or in its entirety without further authorization from me, on the condition that the person or agency requesting reproduction absorbs the cost and provides proper acknowledgment of authorship.

__________ Permission to reproduce this thesis in part or in its entirety must be obtained from me.

Signature of thesis author:__________________________________________________________
ACKNOWLEDGMENTS

My endless thanks go to Dr. Chris Golston. He is the main reason I am writing my paper on phonology and it would not have been accomplished without his knowledge and guidance. No time did I leave him without new insights whether philosophical, universal or phonological. He needs to be immortalized here as he is in my memory.
TABLE OF CONTENTS

LIST OF TABLES ........................................................................................................... vi
LIST OF FIGURES ......................................................................................................... vii
CHAPTER 1: INTRODUCTION ...................................................................................... 1
CHAPTER 2: VARIATION IN THE APPLICATION OF EPENTHESIS ......................... 4
  Reasons for Epenthesis ............................................................................................. 4
  Types of Epenthesis ................................................................................................ 5
CHAPTER 3: THE FREQUENCY HYPOTHESIS ............................................................ 7
  Arabic ....................................................................................................................... 8
  Japanese .................................................................................................................. 9
  Interim Conclusion ................................................................................................ 14
CHAPTER 4: CONSTRAINT MODELING FOR THE EPENTHETIC VOWEL ............. 15
  Three Vowel Systems ............................................................................................ 21
  Five Vowel Systems .............................................................................................. 23
CHAPTER 5: CONCLUSION ....................................................................................... 29
LIST OF TABLES

Table 1. The Number of Syllables for Each Arabic Vowel .................................. 8
Table 2. The Number of Syllables for Each Japanese Vowel................................. 10
Table 3. The Number of Syllables for Each Japanese Vowel................................. 11
Table 4. The Number of Syllables for Each Korean Vowel ................................. 13
LIST OF FIGURES

Page

Figure 1. The percentage of each Arabic vowel......................................................... 9
Figure 2. The percentage of each Japanese vowel ..................................................... 11
Figure 3. The percentage of each Japanese vowel ..................................................... 12
Figure 4. The percentage of each Korean vowel....................................................... 13
CHAPTER 1: INTRODUCTION

Vowel epenthesis is the insertion of a certain vowel in an utterance. In most cases, vowel epenthesis is a process that occurs in order to produce utterances that satisfy the structural requirements of a given language. A common case is to fix a certain input that has been borrowed from a language that has structures that are considered to be illegal in the borrowing language. For example, when borrowing from English, Korean epenthesizes the vowel [ɨ] in order to avoid structures such as CVC as in (1):

(1) Korean epenthesis:
   Bus → [pəsɨ]
   Gas → [kasɨ]
   Rove → [lopɨ]

   In a similar way, Japanese inserts a vowel in order to avoid syllable types the language does not allow. The epenthesized vowel can be one of three vowels depending on the previous consonant: the vowel [i] after the palatal affricates [ʧ, ʤ], the vowel [o] after coronal stops and the vowel [u] everywhere else. The choice of the epenthetic vowel will be addressed thoroughly in a later section.

(2) Japanese epenthesis (Monahan et al., 2009):
   Festival → [fesutibaru]
   Pitch → [pit.ti]
   Christmas → [kurisumasu]
   McDonald’s → [makudonarudó]

To put it in an optimality theory perspective (Prince & Smolensky, 1993), each language system has its own way of ranking constraints even if those constraints are universal. According to optimality theory, there are two sets of
universal constraints, faithfulness constraints and markedness constraints; both are relevant to our discussion of epenthesis. Faithfulness constraints assure that the output obtained is identical to the input provided, whereas markedness constraints assure that the output obtained does not have structures that are disallowed in the language. Epenthesis arises when a certain language borrows words from a different language that ranks the same constraints differently. As a result, both markedness constraints and faithfulness constraints will be at work. If the input does not have structures that are marked in the borrowing language phonology, then:

(3) Input = output

If the input has structures that are marked, then they will be fixed according to what is allowed in the borrowing language phonology. As a result:

(4) Input ≠ output

Some markedness constraints are ranked higher than faithfulness constraints when borrowing words from other languages.

(5) Markedness constraints >> Faithfulness constrains

For example, Japanese has a predominantly CVX syllable structure which allows consonants in coda position only if they are nasals or the first part of a geminate. So when a word such as [pitʃi]'pitch’ is borrowed from English, the markedness constraint OKCoda will out rank that part of faithfulness that bans epenthesis.

OKCoda: Codas are allowed if they are nasals, the first half of a geminate or if they have the same place of articulation as the following sound.

An illustration can be seen in (6):
(6)

<table>
<thead>
<tr>
<th></th>
<th>OKCODA</th>
<th>FAITHFULNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>[pɪtʃ]</td>
<td>*!</td>
</tr>
<tr>
<td>b.</td>
<td>[pɪt.tʃi]</td>
<td>*</td>
</tr>
</tbody>
</table>

Candidate ‘b’ is the winner because candidate ‘a’ has an illegal structure. This thesis aims at investigating why different languages use different vowels for epenthesis. The first possibility is that the epenthetic vowel is determined by its frequency in the language. Failing to find a predictive account, I will resort to just modeling the epenthetic vowels in the examined languages by using vowel features as constraints from an optimality theoretic point of view.
CHAPTER 2: VARIATION IN THE APPLICATION OF EPENTHESIS

Reasons for Epenthesis

Epenthesis is not a process that is activated merely when words are adopted from a language with a different phonology; it may have other functions. In Mono, a Niger-Congo language spoken in the Congo, an epenthetic vowel is added to certain native roots because this language requires lexical words to have a minimum of two syllables or moras. Examples are shown in (7):

(7) Epenthesis in Mono roots (Olson, 2003):

- [ʒi] → [ʼiʒi] ‘tooth’
- [bè] → [ebbè] ‘liver’
- [mà] → [amà] ‘mouth’
- [ndà] → [andà] ‘house’

In each of the words a vowel is added to the root; however, when the root is used to form a longer word, vowels are not epenthesized. Combining the words [mà+ndà] results in [màndà] where epenthesizing a vowel results in ungrammaticality *[àmàndà].

Most accounts of epenthesis focus on examining the structures of a given language in order to see its motivation. Donselaar and colleagues (1999) examine the influence of epenthesis in Dutch on perception and they suggest that epenthesizing a vowel can enhance the perception of the surrounding consonants particularly if the preceding consonant is a liquid. They reach this conclusion after designing a number of tasks in which the participants showed a faster reaction time in cases of epenthesis such as in [bal(ə)k] compared to [balk] “beam”. They indicate that speakers epenthesize in this case in order to help the perception of the listeners.
There is an interestingly peculiar case of epenthesis in Scots Gaelic. In this language and contrary to what we have seen earlier, there are cases of vowel epenthesis without a clear motivation. Examples of epenthesis in this language can be seen in (8):

(8) Vowel epenthesis in Scots Gaelic (Oftedal, 1956):

darbhaidh → [mara.i] ‘will kill’
duirgh → [duri] ‘fishing lines’
aithnichidh → [envi] ‘will recognize’

In this language, a lot of words still have the epenthetic vowel even when the consonants that triggered the epenthesis have been deleted historically. For such an unusual case Hall (2011) indicates that a possible interpretation might be that epenthesis may have been triggered due to consonants that are present underlingly that have been removed through a separate process.

**Types of Epenthesis**

Languages vary in terms of how they epenthese vowels. The first possibility involves having vowels with a fixed and predictable quality and environment. Examples of such languages are Spanish with [e], Korean with [i] and Maltese with [i]. The second possibility is languages that have a copy vowel epenthesis where an epenthetic vowel copies the quality of a nearby vowel. An example of such a language is Welsh, where consonant clusters in final position are broken up by copying the preceding vowel. Examples can be seen in (9).

(9) Copy vowel epenthesis in Welsh (Awbery, 1984):

[gwadn] → [gwa:dan] ‘sole’
[kevn] → [ke:ven] ‘back’
[pudr] → [pu:dur] ‘rotten’
Interestingly, Farsi can have the two mentioned possibilities. It epenthesizes either the vowel \([e]\) as in (9):

(9) Epenthesis of \([e]\) in Farsi (Shademan, 2003):

- Florida \(\rightarrow\) \([\text{fe}l\text{orid}a]\)
- Blonde(Fr) ‘blond’ \(\rightarrow\) \([\text{be}l\text{ond}]\)
- Flottasion(Fr) ‘flotation’ \(\rightarrow\) \([\text{fe}l\text{otasijon}]\)

Or it copies the following vowel as in (10):

(10) Copy vowel epenthesis in Farsi (Shademan, 2003):

- Plisse(Fr.) ‘pleats’ \(\rightarrow\) \([\text{pi}l\text{ise}]\)
- Groupe(Fr) ‘group’ \(\rightarrow\) \([\text{gu}r\text{up}]\)
- Chrome \(\rightarrow\) \([\text{ko}r\text{om}]\)

Shademan (2003) suggests that in Farsi the copy vowel is the result of feature spreading from the subsequent vowel. When the feature spreading is blocked, the insertion of \([e]\) occurs.

---

1 (Fr) indicates that the words are borrowed from French.
CHAPTER 3: THE FREQUENCY HYPOTHESIS

This thesis examines what determines the epenthetic vowel in a given language. The first possibility is that the epenthetic vowel is determined by its frequency in a given language. This assumption comes from a connectionist perspective. According to Cockayne (2008), connectionist models are networks of artificial neurons and synapses that aim to simulate the minimum level of processing in the brain, characterized by patterns of electro-chemical activity that may be expressed mathematically. Thus, the most frequent element will be the default element since it is results in a lower processing level in the brain. An application of this connectionist view is the formation of the past tense in English. The past tense is formed by adding the morpheme [d] to the verb. This is applied as the default to all verbs including new unfamiliar ones without the need for accessing the memory. However, English has a number of irregular verbs that do not behave in the same way. For those limited unproductive cases, it is suggested that they are memorized as a list of exceptions (Marcus et al., 1995). Evidence is provided from children’s overgeneralization when they produce an error such as “breaked” due to their failure to retrieve the correct irregular form from their memory. Another piece of evidence comes from people who suffer from Alzheimer’s disease, where it has been observed that they suffer from word finding problems due to their overall memory impairment. However, their grammatical abilities are relatively preserved. They can produce regular past forms without any problems compared to the irregular ones. And, similar to children, they tend to overgeneralize the addition of the [d] to irregular forms (Ullman et al., 1993). So far English seems to provide a plausible evidence in favour of the connectionist perspective, however, Marcus et al. (1995) found that
the addition of the suffix [t] for making the participle in German is the default case similar to the [d] in the English past tense and it shows the same behaviour in instances of novel words or in cases of children’s overgeneralization. Nevertheless, in terms of frequency, it has been found that the [t] for making the participle in German applies to only a small percentage of verbs in German. This suggests that frequency is not the only factor at work here. In order to test whether frequency has a role in determining the epenthetic vowel, the frequency of the vowels of three languages has been measured.

**Arabic**

Arabic has three short vowels [a, i, u] and their long counterparts [a:, i:, u:]. When words are borrowed from other languages that have consonant clusters that are not allowed in Arabic, those structures fixed by inserting the vowel [i] as in (11):

(11) “Eighths” [etθs] → [ʔitθis]

“Next” [nəkst] → [nikist]

In order to see the frequency of each vowel, five hundred syllables have been transcribed. The data were obtained from texts written in standard Arabic and lectures given in standard Arabic\(^1\). Table 1 and Figure 1 show the results.

<table>
<thead>
<tr>
<th>Vowel</th>
<th>/a/</th>
<th>/i/</th>
<th>/u/</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>312</td>
<td>102</td>
<td>86</td>
</tr>
</tbody>
</table>

---

\(^1\) No distinction was made between short and long vowels because the focus was on the quality not the duration.
From Table 1 and Figure 1, it can be seen that the vowel [a] is the most frequent vowel in the Arabic. The vowel [i] comes second in frequency whereas the vowel [u] is the least frequent. This, however, is not what was expected. The assumption was that the most frequent vowel will be used for epenthesis. Here the Arabic epenthetic vowel, which is [i], has a much lower frequency than the vowel [a].

Japanese

Japanese has five vowels. The vowels [o], [i] and [u] are used for epenthesis. The vowel [o] is inserted after dental stops as in (14):

(14) Street  \rightarrow [sutorito]

Batman  \rightarrow [batorman]

The vowel [i] is inserted after the palatal affricates as in:
(15) Catch $\rightarrow$ [kat.tʃi]
    Pitch $\rightarrow$ [pit.tʃi]

Whereas [u] is used everywhere else as in (16):

(16) Taxi $\rightarrow$ [takʊʃi]
    Sense $\rightarrow$ [sensu]$^2$

A number of three hundred syllables have been investigated to see the frequency of each vowel. A point to be noted is that Japanese has three writing systems; Kanji, Katakana and Hiragana. Kanji is a writing system that is adopted from Chinese where symbols are used to represent meaning. On the other hand, Katakana and Hiragana are both syllabary systems where symbols are used to represent the syllables or moras that make up a word. The difference is that Katakana is used for writing foreign words whereas the Hiragana system is used for writing native words. This latter distinction has been useful in order to avoid borrowed words in which consonant clusters have been already avoided by inserting the epenthetic vowels.

The data were obtained from everyday conversations and TV shows and they were transcribed into IPA. The frequency of each vowel can be seen in Table 2 and Figure 2:

<table>
<thead>
<tr>
<th>Vowel</th>
<th>[a]</th>
<th>[o]</th>
<th>[i]</th>
<th>[e]</th>
<th>[u]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>94</td>
<td>61</td>
<td>54</td>
<td>49</td>
<td>42</td>
</tr>
</tbody>
</table>

---

$^2$ Example are from Kay, G. (1995).
From Table 2 and Figure 2, it can be seen that [a] is the most frequent vowel, the vowel [o] comes second and [i] is the third frequent. This would have been significant except for the fact that the epenthesis of the vowel [o] is limited to certain environments. Again, this is not what was expected. The vowel [u], the most epenthesized vowel in Japanese, came as the least frequent. However, in conversations, there are a lot of particles that are used in Japanese that has the vowel [a] such as the topic marker [wa] and the question marker [ka]. In order to make sure that this high frequency of the vowel [a] was not obtained because of the use of such particles, another set of three hundred syllables have been analyzed that were obtained from single Japanese native words. The results are shown in Table 3 and Figure 3.

### Table 3. The Number of Syllables for Each Japanese Vowel

<table>
<thead>
<tr>
<th>Vowel</th>
<th>[a]</th>
<th>[o]</th>
<th>[i]</th>
<th>[u]</th>
<th>[e]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>90</td>
<td>73</td>
<td>56</td>
<td>47</td>
<td>34</td>
</tr>
</tbody>
</table>
From the second set of syllables, as Table 3 and Figure 3 indicate, it can be seen that no significant change has occurred. The vowel [a] is still the most frequent. The only difference is between the vowels [u] and [e] where they shift places in terms of frequency.

**Korean**

Korean has ten vowels (Lee and Ramsey, 2000), and the vowel used for epenthesis is [i] (Kim and Kochetov, 2011). Example words are:

(21) Hit → [hiti]

Street → [sitiriti]

A number of four hundred syllables have been analyzed to see the frequency of each vowel. The transcribed data were obtained from the UCLA
Phonetics Lab [http://archive.phonetics.ucla.edu]. The results are shown in Table 4 and Figure 4.

**Table 4. The Number of Syllables for Each Korean Vowel**

<table>
<thead>
<tr>
<th>Vowel</th>
<th>[a]</th>
<th>[i]</th>
<th>[ɨ]</th>
<th>[o]</th>
<th>[ɛ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>120</td>
<td>69</td>
<td>44</td>
<td>36</td>
<td>32</td>
</tr>
<tr>
<td>Vowel</td>
<td>[u]</td>
<td>[ʌ]</td>
<td>[e]</td>
<td>[ə]</td>
<td>[ø]</td>
</tr>
<tr>
<td>Number</td>
<td>29</td>
<td>23</td>
<td>22</td>
<td>20</td>
<td>5</td>
</tr>
</tbody>
</table>

**Figure 4. The percentage of each Korean vowel**

From Table 4 and Figure 4 it can be seen that the most frequent vowel in Korean is [a]. It occurred in 30% of the syllables compared to only 11% for the vowel [i] that is used for epenthesis. This again is consistent with what has been found in the other two languages, that frequency is not necessary a feature of the epenthetic vowel.
Interim Conclusion

From the three languages examined, it can be concluded that the frequency of the vowel in a given language does not predict whether it is used for epenthesis. If frequency really had a role to play, the vowel [a] should have been used for epenthesis since it was the most frequent in all three languages. This indicates that a connectionist perspective cannot be adopted to account for vowel epenthesis. This is in accordance of what has been found in German morphology where it has been found that the [t] for making the participle in German applies to only a small percentage of verbs in German; nevertheless, it behaves as the default case similar to the [d] in the English past tense.
Lombardi (2003) tries to prove that the differences in epenthetic vowels are not arbitrary and she provides an account for the variation among languages by using ranked markedness constraints. She suggests that the choice of the epenthetic vowel depends on the vowel system of a certain language where it is going to be the least marked one. In terms of markedness, she states that the vowels [ɨ] and [ə] are the least marked because they are both back and unrounded. As a result, if [ɨ] is present in one language, it will be epenthetic. If [ɨ] is not present and the schwa is, then the schwa is going to be epenthetic. If neither [ɨ] nor [ə] is present, the vowel [i] is going to be the epenthetic vowel. So in a five-vowel system [i, a, e, o, u], she suggests that the epenthetic vowel will be either [i] or [a] depending on the particular ranking of features of a given language, however, the universal ranking that she starts with is shown in (24):

(24) *LOW >> *NONLOW >> +ROUND >> -ROUND >> FRONT >> BACK >> MID

In the case where *LOW >> *NONLOW, then [i] will be the epenthetic vowel as in (25):

(25)

<table>
<thead>
<tr>
<th>[gas]</th>
<th>*LOW</th>
<th>*NONLOW</th>
<th>*FRONT</th>
<th>*BACK</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. [gasi]</td>
<td></td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>b. [gasa]</td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

However, if in this particular language *NONLOW >> *LOW, then the optimal vowel will be [a] as it can be seen in (26):
(26)

<table>
<thead>
<tr>
<th></th>
<th>[gas]</th>
<th>*NONLOW</th>
<th>*LOW</th>
<th>*FRONT</th>
<th>*BACK</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>[gasi]</td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td>[gasa]</td>
<td></td>
<td>*</td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>

Using the same ranking mentioned in (24) and applying it to five vowel systems, the generalization will still be true and [i] will be the epenthetic vowel as in (27):

(27)

<table>
<thead>
<tr>
<th></th>
<th>[gas]</th>
<th>*LOW</th>
<th>*NONLOW</th>
<th>*+ROUND</th>
<th>*-ROUND</th>
<th>*FRONT</th>
<th>*BACK</th>
<th>*MID</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>[gasi]</td>
<td></td>
<td></td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td>[gasa]</td>
<td>*!</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td>[gasu]</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d.</td>
<td>[gaso]</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>e.</td>
<td>[gase]</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td>*!</td>
</tr>
</tbody>
</table>

Such a generalization may seem to be valid in accounting for a number of languages. Arabic for example has the three vowels [a, i, u] and uses the vowel [i] for epenthesis. If the same constrains are applied as (28) shows, the optimal vowel for epenthesis will be [i].
However, in languages with a five vowel system, the least marked vowel is not always the optimal one. Applying the same to a language like Spanish where it has the exact same vowels as in Maltese, for example, will result in (29):

As the sad face shows in (29), the winner will be [gasi] even though the actual epenthetic vowel is [e]. The problem raised here is that regardless of how the constraints are ranked, the vowel [e] cannot be obtained by using the same
constraints. Even if the constraints it violates (*NONLOW, *-ROUND, *FRONT and *MID) were ranked the lowest, [i] is going to be optimal. This is referred to as harmonic bounding (McCarthy, 2008) where a certain candidate is impossible to be obtained under any imaginable ranking. Here, [e] is harmonically bounded because there will be always candidates that have less fatal violations, i.e., they bound how good it can be. Furthermore, the assumption that the epenthetic vowel should be the least marked one is inadequate bearing in mind that there are languages such as Japanese that epenthesizes [u] even though there are less marked vowels. Maddieson (1984) indicates that [u] is considered to be the most marked vowel and [e] is considered to be the second most marked; nevertheless, we see languages that uses both of epenthesis.

It can be seen that predictions based on the notion of markedness can result in contradictions or leaving some cases without a valid explanation. For example, if the assumption is that the epenthetic vowel should be the least marked, having languages that have the same vowels, yet use different vowels for epenthesis should be fatal. Unfortunately, such cases do exist. Japanese, Spanish and Maltese, for example, are languages that have the same vowels [i, e, a, o, u]; nevertheless, the epenthetic vowel in Japanese is [u], in Spanish [e] and in Maltese [i]. Hume and Bromberg (2005) say that one of the issues of markedness is that it can be used as evidence to provide support for certain views and when it fails to do so, what is left is going to be labeled as exceptional or irrelevant. They conclude that markedness is not a scientific concept.

Presumably, markedness should be universal across languages and the purpose of epenthesis should be producing unmarked segments. McCarthy and Prince (1994) use the term “the emergence of the unmarked” to refer to cases in which a certain language may allow for marked structures while in other cases
those structures will be banned where the unmarked structures emerge. An example is a phenomenon in Nootka where syllables are allowed to have codas. However, in the process of reduplication, the reduplicated syllables should be CV resulting in unmarked codaless syllables (McCarthy & Prince, 1994). This can be seen in (30):

(30) Reduplication in Nootka (Stonham, 1990:19, 131; Shaw, 1992):

\[
\begin{array}{l}
\text{[čičims.'i:ħ]} \quad \rightarrow \text{‘hunting bear’} \\
\text{[wa:wa:s.čiħ]} \quad \rightarrow \text{‘naming where’}
\end{array}
\]

Becker and Potts (2011) explain such cases by saying that the ranking in (31) is at work here:

(31) F1 >> M >> F2

In (31), M stands for markedness which is dominated by a faithfulness constraint F1 that blocks the activity of M resulting in marked structures. In other situations where F1 is not relevant, M becomes active again resulting in unmarked structures. They also add that M can violate other faithfulness constraints of lower ranking referred to in (31) as F2.

However, this does not seem to apply to the process of epentheses where a particular language may epenthesize a marked vowel even when it has a less marked one in its vowel system.

Also, there are cases where it seems that reaching an agreement upon what is marked can be problematic. One way of predicting marked patterns is by examining the children’s process of language acquisition. The acquisition of the unmarked sounds will come before the marked ones and the acquisition of the marked ones presupposes the acquisition of the unmarked (Jakobson, 1971). For instance, coronal sounds are assumed to be acquired prior to the dorsals and the
acquisition of dorsals implies the acquisition of coronals. However, this is not always the case. de Lacy (2006) suggests that the data obtained from children’s acquisition should not be used as absolute measures for markedness. He uses the study of Beckman and colleagues (2003) as evidence. They found that children acquiring Japanese made more than twice the errors when producing [t] by producing it as [k] instead, compared to the errors for [k] being pronounced as [t]. This is contrary to the idea that the marked back consonant [k] is likely to be pronounced as the front consonant [t]. Thus, markedness should be viewed as just an expression of general tendencies that can be relative and should not be taken as absolutes. Golston (1996) suggests that every feature in a language, such as front or back, has a constraint against it in grammar. According to such a view, all surfaced vowels are basically marked. And as has been shown earlier, the suggestion that the least marked should be epenthetic does not hold where languages epenthesize a certain vowel regardless of the availability of a less marked one. So instead of leaving some languages behind and wondering why they epenthesize a more marked vowel, a set of constraints need to be provided that is able to model the optimal vowel in those languages without making unrealistic predictions. Seeing that the choice of the epenthetic vowel seems to be arbitrary and there is no valid way of predicting it, I suggest that using the five well established vowel features (high, mid, low, front and back) as seen in (32) could account for the chosen vowel in a particular language and avoid the issues in the Lombardi (2003) treatment.

(32)

\begin{align*}
*\text{HIGH} & \rightarrow \text{No high vowels} \\
*\text{Mid} & \rightarrow \text{No mid vowels} \\
*\text{LOW} & \rightarrow \text{No low vowels}
\end{align*}
*FRONT → No front vowels
*BACK → No back vowels

It is worth mentioning that those constraints will be ranked lower than faithfulness constraints because if this is not the case, no vowels will be available at a given language given that all their features are marked.

**Three Vowel Systems**

In three vowel systems, it is most likely that the system will consist of [i, a, u]; nevertheless, it is not necessary that different languages will use the same vowel for epenthesis. Arabic is an example of a language that has a three vowel system and it uses [i] for epenthesis.\(^1\) By applying the use of vowel features in (32), the epenthetic vowel in Arabic can be modeled as in (33):

\[
\begin{array}{|c|c|c|c|c|}
\hline
\text{[gas]} & *\text{BACK} & *\text{MID} & *\text{LOW} & *\text{HIGH} & *\text{FRONT} \\
\hline
\text{a. [gasi]} & & & * & & * \\
\hline
\text{b. [gasa]} & & *! & * & & \\
\hline
\text{c. [gasu]} & *! & & & * & \\
\hline
\end{array}
\]

As can be seen from the tableau above, if the features are ranked where *\text{BACK} and *\text{MID} are the highest, *\text{BACK} eliminates the vowel [u] and *\text{MID} eliminates the vowel [a]. As a result, [i] is obtained as the optimal vowel for epenthesis and other violations do not matter.

\(^1\) Some Arabic dialects may have a different vowel for epenthesis such as Mecca dialect where they epenthesize /a/. (Abu-Mansour, 1987). The present analysis will require a different constraint-ranking for such dialects, of course.
An example of another three vowel language is Axininca Campa. This language has the same vowels as Arabic (Payne, 1981); however it uses [a] for epenthesis instead of [i]. By using the same features in (32), [a] can be obtained as in (34):

(34)

<table>
<thead>
<tr>
<th></th>
<th>*HIGH</th>
<th>*MID</th>
<th>*BACK</th>
<th>*FRONT</th>
<th>*LOW</th>
</tr>
</thead>
<tbody>
<tr>
<td>[gas]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. [gasi]</td>
<td>*!</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. [gasa]</td>
<td></td>
<td>*</td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>c. [gasu]</td>
<td>*!</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

By changing the ranking and making *HIGH the highest, both vowels [i] and [u] will be excluded and the violation of *MID will not make a difference as long as *HIGH is satisfied.

Amuesha (a language spoken in Peru) has the three vowels [e, o, a]. There was no evidence of a specified epenthetic language in the literature that I know of for this language; however, if any of its three vowels turns out to be used for epenthesis, it can be modeled using the same feature constraints as the following:

(35) If it is [a], then:

<table>
<thead>
<tr>
<th></th>
<th>*FRONT</th>
<th>*BACK</th>
<th>*MID</th>
<th>*HIGH</th>
<th>*LOW</th>
</tr>
</thead>
<tbody>
<tr>
<td>[gas]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. [gasa]</td>
<td></td>
<td>*</td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>b. [gaso]</td>
<td>*!</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>c. [gase]</td>
<td>*!</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
(36) If it is [o], then:

<table>
<thead>
<tr>
<th></th>
<th>*LOW</th>
<th>*FRONT</th>
<th>*MID</th>
<th>*HIGH</th>
<th>*BACK</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.[gasa]</td>
<td>*!</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.[gaso]</td>
<td></td>
<td>*</td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>c.[gase]</td>
<td></td>
<td>*!</td>
<td>*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(37) If it is [e], then:

<table>
<thead>
<tr>
<th></th>
<th>*BACK</th>
<th>*LOW</th>
<th>*FRONT</th>
<th>*MID</th>
<th>*HIGH</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.[gasa]</td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.[gaso]</td>
<td></td>
<td>*!</td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>c.[gase]</td>
<td></td>
<td></td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

As can be seen from the above tableaus, any of the vowels that exist in Amuesha can be used as an epenthetic vowel and still be obtained by the same constraints. This shows the strength of this analysis in terms of modeling, yet it does not predict anything\(^2\).

**Five Vowel Systems**

Those same constraints will be applied to languages with the five vowel system [i, a, u, o, e] due to being the most common. Those same feature

\(^2\) It is worth mentioning that there are cases where a language epenthesizes a vowel that is not in its vowel system. An example is Hebrew where a schwa can be epenthesized in open syllables (Lombardi, 2003).
constraints with different ranking should be able to fashion the real life winner. If the language uses [i] for epentheses then the constraints ranking should be:

*LOW >> *BACK >> *MID >> *FRONT >> *HIGH

This can be seen in tableau (38):

(38)

<table>
<thead>
<tr>
<th></th>
<th>[gas]</th>
<th>*LOW</th>
<th>*BACK</th>
<th>*MID</th>
<th>*FRONT</th>
<th>*HIGH</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>[gasi]</td>
<td></td>
<td></td>
<td></td>
<td>!</td>
<td>*</td>
</tr>
<tr>
<td>b.</td>
<td>[gasa]</td>
<td>!</td>
<td></td>
<td></td>
<td>!</td>
<td>*</td>
</tr>
<tr>
<td>c.</td>
<td>[gasu]</td>
<td></td>
<td>!</td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>d.</td>
<td>[gaso]</td>
<td>!</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>e.</td>
<td>[gase]</td>
<td></td>
<td>!</td>
<td>*</td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>

The vowel [a] is eliminated by ranking the constraint *LOW the highest. The constraint *BACK excludes both back vowels [u] and [o]. Finally, [e] is excluded by ranking the constraint *MID higher than *FRONT and *HIGH resulting in [i] as the winner. The ranking shown in (38) gets us languages such as Maltese, Zulu and Tongan that use [i] for epentheses.

On the other hand, if the language uses [a] for epentheses then the constraint ranking should be:

*HIGH >> *FRONT >> *BACK >> *MID >> *LOW

This ranking gets us languages with [a] epentheses as it can be seen in tableau (39):
The constraint *HIGH will eliminate both high vowels [i] and [u]. The constraint *FRONT will result in the exclusion of the vowel [e]. Finally, [o] will be excluded by ranking the constraint *BACK higher than *MID and *LOW resulting in [a] as the winner. It is worth mentioning that the reranking of *FRONT and *BACK will make no difference as long as they are higher than *MID and *LOW.

In the case of a language where the epenthetic vowel is [e], then the constraints ranking should be:

*HIGH >> *BACK >> *LOW >> *FRONT >> *MID

This ranking as tableau (40) shows will result in the vowel [e] as optimal.

(40)
The constraint *HIGH will exclude both high vowels [i] and [u]. The vowel [o] will be eliminated by the constraint *BACK. Finally, the vowel [a] will be eliminated by ranking *LOW higher than *FRONT and *MID. This ranking will result in [e] as optimal. This ranking in (40) will give us languages with [e] epenthesis such as Spanish, modern Hebrew and Basque.

If the language uses [u] for epenthesis then the constraints ranking should be the following:

*FRONT >> *MID >> *LOW >> *HIGH >> *BACK

This can be seen in tableau (41):

<table>
<thead>
<tr>
<th></th>
<th>*FRONT</th>
<th>*MID</th>
<th>*LOW</th>
<th>*HIGH</th>
<th>*BACK</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. [gasi]</td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. [gasa]</td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. [gasu]</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>d. [gaso]</td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e. [gase]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The constraint *FRONT will exclude both front vowels [i] and [e]. The remaining vowels [a] and [o] will be both eliminated by ranking *MID second in height which results in [u] as optimal. Here it can be seen that [u] can be obtained without the need for using constraints used by Lombardi such as *+ROUND or *-ROUND. The ranking in the above tableau models languages with [u] epenthesis such as in West Norwegian south of Bergen and Japanese. It is worth mentioning that there is another language ‘Tangale’ that uses the vowel [u] for epenthesis,
nevertheless, this language does not fit under the five vowel classification. This language has the nine vowels [i, ɪ, ʊ, u, e, ɛ, ɔ, o, a].

The last case in five vowel systems is when the language uses [o] for epenthesis. If this is the case then the constraints ranking should be:

*FRONT >> *HIGH >> *LOW >> *MID >> *BACK

This can be seen in tableau (43):

<table>
<thead>
<tr>
<th>[gas]</th>
<th>*FRONT</th>
<th>*HIGH</th>
<th>*Low</th>
<th>*MID</th>
<th>*BACK</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. [gasi]</td>
<td>*!</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.[gasa]</td>
<td></td>
<td>*!</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c.[gasu]</td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>d.[gaso]</td>
<td></td>
<td>*!</td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>e.[gase]</td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>

By ranking the constraint *FRONT the highest, both front vowels [i] and [a] will be eliminated. The constraint *HIGH excludes the high vowel [u]. The remaining vowel [a] is excluded by ranking *LOW higher than *MID. This ranking results in [o] as optimal. However, no language with five vowel system that I know of uses merely the vowel [o] for epenthesis. Mavakhalan uses [o] for epenthesis, but this language has the seven vowels [i, e, ɛ, a, ɔ, o, u]. There is also Japanese which uses the vowel [o] for epenthesis in limited environments, namely after coronal stops as in (44):

(44) Street → [sutoritorio]
Batman → [batorman]
Lovins (1973) and Katayama (1998) suggest that Japanese uses the vowel [u] for epenthesis because of the fact that it is the least sonorant among its vowel system. Here the vowel [o] is epenthesized only after coronal stops which are the lowest in the sonority hierarchy and [u] in everywhere else. This is similar to the case of Dutch (Donselaar et al., 1999) where it has been found that purpose of epenthesis was to enhance the perception of the surrounding consonants, it could be the same here where the epenthesis of [u] is blocked in order for a certain amount of sonority to be maintained.
CHAPTER 5: CONCLUSION

This thesis shows that, so far, there is no way of accounting for what
determines the selection of the epenthetic vowel in a certain language. In chapter
3, the possibility that the epenthetic vowel is the most frequent vowel was
examined in three languages. Contrary to what might be assumed if a
connectionist perspective was adopted, no relationship has been found between
frequency and the epenthetic vowel. This was true for all three languages. Those
findings indicate that frequency is not a valid consideration for predicting or
accounting for the epenthetic vowel. Knowing that there is no way for predicting,
in Chapter 4, I resort to non-predictive analysis that is contrary to Lombardi
(2003) suggests. I show that the epenthetic vowel is not necessary the least marked
in a given vowel system. Furthermore, I suggest that no absolute predictions can
be made. I show that feature constraints can be used to model the epenthetic vowel
in various languages, yet make no predictions about the particular epenthetic
vowel in a given language.
REFERENCES


