Phonological Adaptation of English Loanwords into Qassimi Arabic: An Optimality-Theoretic Account

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Abstract

Within the field of loanword phonology, this study enhances our understanding of the role played by the contrastive features of the borrowing language in shaping the segmental adaptation patterns of loanwords from the source language. This has been achieved by performing a theoretical analysis of the segmental adaptation patterns of English loanwords into Qassimi Arabic, a dialect spoken in the region of Qassim in central Saudi Arabia, using an Optimality-Theoretic framework.

The central argument of this study assumes that the inputs to QA are fully-specified English outputs, which serve as inputs to QA. Then, the native grammar of QA allows only the phonological features of inputs to surface that are contrastive in QA. Thus, redundant or non-contrastive phonological features in QA are eliminated from the outputs. The evidence behind the argument that the contrastive features of QA segments play a main role in the adaptation process emerges from adapting the English segments that are non-native in QA. For instance, English lax vowels /ɪ/, /ʊ/, /æ/ are adapted as their tense counterparts in QA [i], [u] and [a]. I have argued that the reason for this adaptation lies in the fact that the feature [ATR] is not a contrastive feature within the QA vowel inventory. Therefore, dispensing with the value of the input feature [-ATR] culminates in the tense vowels appearing at the surface level.

To identify the contrastive features of QA phonological inventory, I rely on the Contrastive Hierarchy Theory proposed by Dresher (2009). This theory suggests that phonological features should be ordered hierarchically to obtain only the contrastive features of any phonological inventory. This is achieved by dividing any inventory into subsets of features until each segment is distinguished contrastively from all others. Therefore, the features of QA segments are built initially into a contrastive hierarchy model. Within this hierarchy, features are created and ordered according to one or more of the following motivations: Activity, Minimality and Universality. Finally, the contrastive hierarchy of QA segment inventory is converted into OT constraints. The ranking of these constraints is sufficient to account for the evaluations of the segmental adaptation patterns of loanwords from English into QA. For instance, based on the contrastive hierarchy of QA, /b/ is contrastively specified as [-sonorant, +labial, -continuant]. In the adaptation of English consonants, the English input segment /p/ is mapped consistently to [b] in the QA. In this case, the contrastive hierarchy of QA consonant inventory contains the co-occurrence constraints *[αVoice, +labial] and *[αCoronal, +labial], which filter the input features if the input is fully-specified [-sonorant, +labial, -coronal, -continuant, -voiced, …], and permits only the contrastive features [-sonorant, +labial, -continuant] to surface.

Dedication

To my mother Latifah,

To the soul of my father Mohammad,

To my wife and children,

To my brothers and sisters

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List of Abbreviations

QA	Qassimi Arabic
MHA	Madina Hijazi Arabic
OT	Optimality Theory
AA	Ammani Arabic
UHA	Urban Hijazi Arabic
TCRS-LM	The Theory of Constraints and Repair Strategies-Loanword Model
TCRS	The Theory of Constraints and Repair Strategies
CHT	Contrastive Hierarchy Theory
MC	Mandarin Chinese
P-map	Perceptual-Map
NA	Najdi Arabic
MSA	Modern Standard Arabic
CA	Classical Arabic
SDA	Successive Division Algorithm

Chapter 1: Introduction

The adaptation of loanwords has received much attention in several languages, including Cantonese (Silverman 1992; Yip 1993, 2002), Korean (Kang 2003; Kim and Kochetov 2011), Fijian (Kenstowicz 2003), Japanese (Smith 2006; Kubozono 2006), French (Paradis and LaCharité 2001), Fula (Paradis and LaCharité 1997), Selayarese (Broselow 1999, 2009), Huave (Davidson and Noyer 1997; Broselow 2009), and Arabic, e.g. Cairene Arabic: (Hafez 1996; Galal 2004); Madinah Hijazi Arabic: (Jarrah 2013); Ammani Arabic: (Abu-Guba 2016); Urban Hijazi Arabic: (Aloufi 2016).

When a language (L1) borrows a word from another language (L2), this word might agree with the phonotactic constraints of L1; then, it is adapted faithfully or it may violate the L1 constraints. In this case, modifications are made to ensure conformity with the borrower language's phonotactic constraints; however, these modifications tend to be minimal so they maintain the input of the L2 as faithfully as possible (Kenstowicz 2010). The modifications could occur on the segmental (phoneme substitutions), phonotactic (syllable structure), or prosodic (stress and tone level), depending on the type of violation of the borrowed word. At the segmental level, foreign sounds tend to be matched to the closest sounds available in the borrowing language's inventory (e.g. Jacobs and Gussenhoven 2000; Kang 2003; Alder 2006; Peperkamp *et al*. 2008). At the phonotactic level, foreign syllables that are illicit in the grammar of the borrowing language tend to be repaired by vowel epenthesis, re-syllabification, or deletion so they conform to the native phonology (e.g. Steriade 2001; Fleischhacker 2001; Kenstowicz 2003; Boersma and Hamann 2009; Broselow 2015). At the prosodic level, if the position of foreign stress violates the stress rules of the native language, it can be repaired by shifting the stress or deleting or inserting segments to keep the input stress intact (Davidson and Noyer 1997; Broselow 1999, 2009; Peperkamp and Dupoux 2003; Rice 2006; Kenstowicz 2007; Kang 2010; Davis *et al*. 2012).

Since this study is concerned with the modifications targeting the segmental level, there is a consensus among scientists that an L2 sound is mapped to its closest L1 sound (Paradis and LaCharité 2011). However, researchers disagree on the nature of this closeness. In other words, is this closeness triggered by phonetic or phonological factors? This disagreement also includes whether perception plays a role in the adaptation process. Therefore, there has been much debate about whether the modifications on loanwords are derived from phonological or phonetic representations, and the extent to which perception affects loanword nativisation, with the emergence of three prominent approaches. Advocates of the first approach argue that the nativisation of loanwords occurs completely in perception, and loanword adaptations are ‘phonetically-minimal transformations’ (Peperkamp 2005: 1). Supporters of this view argue that the input of loanwords is merely acoustic signals misperceived by speakers of the borrower language (Peperkamp and Dupoux 2002, 2003; Peperkamp 2005; Rose and Demuth 2006; Peperkamp *et al.* 2008). In this case, borrowers have no access to the donor language phonology. Furthermore, the grammar of the borrowing language has no involvement in the adaptation process. For instance, a Japanese speaker perceives the English word *cream* as [kɯ.ɾiː.mɯ], rather than the English pronunciation /kɹiːm/ (Peperkamp and Dupoux 2003).

The second approach argues that phonological details impact significantly on the process of loanword adaptation. Accordingly, this view is concerned with production (phonological details) and neglects perception (phonetic details) (Hyman 1970; Itô and Mester 1995; Ulrich 1997; Paradis and LaCharité 1997, 2001; Paradis and Prunet 2000; Davidson and Noyer 1997; Jacobs and Gussenhoven 2000; LaCharité and Paradis 2005; Uffmann 2006; Paradis and Tremblay 2009; among others). For instance, in demonstrating the effect of the phonological representations on loanwords adaptation, Uffmann (2006) investigated the quality of the inserted vowels in loanwords across several languages and found it was determined by three phonological processes: vowel harmony, vowel assimilation and default vowel epenthesis. According to this analysis, the notion of perception is not involved in determining the quality of inserted vowels.

The third approach takes a position between those of the extreme two approaches (phonetic and phonological views) and suggests that phonological and phonetic representations could affect the adaptation process of loanwords (Silverman 1992; Yip 1993; Kenstowicz 2003; Steriade 2001; Kang 2003; Kenstowicz 2007; Yip 2006; Broselow 2009; Boersma and Hamann 2009; among others). Crucial to this view is the nature of the input. According to Kenstowicz (2010: 1), this approach is ‘typically couched in the Optimality Model, [it] agrees with [the phonetic approach]…that the input is the surface representation of the donor language but argues that adaptation also takes into account the phonological categories and constraints of the native system as well as possible orthographic effects to achieve the best match’.

Based on the previous studies that demonstrate the effect of borrowing language constraints on the adaptation process, this study analyses a total of 400 English loanwords adapted into Qassimi Arabic (QA), a dialect spoken in the region of Qassim in central Saudi Arabia, to discover the segmental adaptation patterns. The results reveal that QA works like other languages in preserving

English segments that are available in the QA inventory and modifying other segments that are illicit in QA. This study finds that the English segments /b/, /f/, /t/, /d/, /θ/, /s/, /z/, /ʃ/, /dʒ/, /k/, /g/, /h/, /n/, /m/, /w/, /j/, /l/ and /r/ predominantly are preserved faithfully in QA as they are licit consonants in QA. However, English consonants /p/, /v/, /tʃ/, /ʒ/ and /ŋ/ typically are mapped to the QA consonants [b], [f], [ʃ], [dʒ] and [n], respectively. Moreover, the results reveal that the English vowels /i(ː)/ and /uː/ are usually maintained in QA as they are unmarked in QA. Conversely, the English vowels, which are marked in QA, /ɪ/, /eɪ/, /e/, /æ/, /ə/, /ʊ/, /əʊ/, /ɑ/, /ɒ/, /ʌ/, /ɜː/, are mapped to the QA vowels [i], [eː], [i], [a], [a], [u], [oː], [a], [u], [a] and [eː], respectively. Finally, the surface of diphthongs is not permitted in QA. Therefore, English loanwords containing diphthongs are adapted in QA with glide-formation strategy. In other words, the first vowel of the English diphthongs /a/ is preserved, while the second, /ɪ/ and /ʊ/, are replaced in QA by the corresponding coronal and labial glides [j] and [w].

While observing the adaptation patterns of English segments that are foreign in QA, a fundamental question arises: which factors determine how foreign consonants and vowels in English loanwords are adapted in QA? The phonological analysis of this study proposes that the segmental adaptation patterns of English loanwords in QA are based crucially on the contrastive features of the QA segments. In other words, the study assumes that the inputs to QA are fully-specified English outputs. Moreover, the QA phonology system concentrates on maintaining the input features, which are contrastive in QA, at the expense of redundant or non-contrastive features in the input. For instance, the feature [voice] is not contrastive within the labial consonant in QA; thus, QA speakers adapt the English voiceless and voiced bilabial stops, /p/ and /b/, as the QA voiced bilabial stop [b]. Furthermore, since the feature [continuant] is not contrastive among the [-anterior] consonants in QA, the English fricative and non-fricative consonants, /ʃ/ and /tʃ/, are adapted typically in QA as the fricative consonant [ʃ]. Likewise, the adaptation of the English consonants, /ʒ/ and /dʒ/. Since QA does not contrast the existing consonant /dʒ/ with another consonant in the feature [continuant], the English consonants, /ʒ/ and /dʒ/, are mapped to QA consonant [dʒ]. In other words, this adaptation occurs because the [continuant] feature is not contrastive within the [-anterior] consonants in QA. Therefore, QA speakers preserve the contrastive feature [-anterior] and dispense with the non-contrastive feature [continuant].

In summary, the analysis of this study's results broadens our understanding of the effect of the borrowing language's contrastive features in loanword phonology. In particular, the core argument of this study is that the underlying contrastive QA features form the adaptation patterns of English segments into QA.

1.1 Previous studies on Arabic loanword phonology

Although several studies have been conducted to investigate how foreign words are adapted in Arabic (Butros 1963; Al-Khalil 1983; Heath 1989; Hafez 1996; Galal 2004; Al-Saqqaf 2006; Abdullah and Daffar 2006; Jarrah 2013; Abu-Guba 2016; Aloufi 2016; among others), most of them, with the exception of (Galal 2004; Jarrah 2013; Abu-Guba 2016; Aloufi 2016), were more likely descriptive or concerned with the general linguistic adaptation patterns without providing a solid phonological analysis of the adaptation patterns, as indicated by Abu-Guba (2016). Therefore, this section aims to review briefly the relevant studies that analysed the segmental adaptation of foreign words into Arabic from a theoretical phonological perspective.

The primary focus of Jarrah's study (2013) was to analyse the adaptation patterns of syllable structures alongside the stress distributions of English loanwords adapted into Madina Hijazi Arabic (MHA) in an Optimality-Theoretic framework. The researcher included a brief description of the segmental change in English loanwords without going in-depth to analyse them into a phonological framework. The researcher discovered that the adaptation processes are motivated largely by the phonological representations of MHA, such as vowel epenthesis and resyllabification, to repair illicit syllable structures.

Abu-Guba (2016) conducted a comprehensive study to analyse the phonological adaptation of English loanwords in Ammani Arabic (AA). The researcher utilised a total of 407 English loanwords adapted and used by AA monolingual native speakers. Although the main focus of his study was to analyse the syllable patterns and stress distributions of English loanwords adapted into AA, the researcher also accounted for the phonological adaptation of English consonants and vowels. He concluded that the phonological structure of the host language (AA) played a crucial role in accounting for the variable adaptation patterns.

Another phonological study was undertaken by Aloufi (2016) to analyse the adaptation of English consonants that are foreign in Urban Hijazi Arabic (UHA), in addition to English syllable structures that are illicit in UHA. The author contrasted two phonological approaches: the Theory of Constraints and Repairs Strategies Loanword Model (TCRS-LM) proposed by Paradis and LaCharité (1997), and the Optimality Theory (OT) (Prince and Smolensky 1993). The researcher discovered that OT is superior to TCRS-LM in accounting for the consonantal and syllabic adaptation of English loanwords into UHA. In particular, she proposed the following OT constraints that can account for the consonantal adaptations as well as importation in UHA:

(1) *p, v*, *ŋ, dʒ-onset, tʃ-non low >> IDENT-IO [±voice] except for /p/ and /v/, IDENT-IO [place] except for /ŋ/, IDENT-IO [±continuant]

1.2 Research Goals

Although previous studies of the segmental adaptation on loanword phonology, especially Arabic varieties, have analysed the adaptation patterns from a phonological perspective, they have some limitations that need to be addressed. First, even though Abu-Guba (2016) analysed the adaptation patterns of consonants and vowels appear in English loanwords adapted into AA, he did not analyse them within OT framework. Second, Aloufi (2016) analysed the phonological adaptation of English consonants into UHA; however, she did not discover how English vowels are adapted into UHA. Third, in his short paper, Jarrah (2013) provided only a very short description of the adaptation of English consonants and vowels into MHA without analysing them into a phonological framework. Fourth, despite some researchers demonstrating the effect of the contrastive features of the borrowing language on segmental adaptation (e.g. Clements 2001; Herd 2005), this impact has not been analysed within an OT framework.

Given these limitations in the literature on loanword phonology, this study investigates the segmental adaptation of English loanwords into Qassimi Arabic (QA) from an Optimality-Theoretic framework with a view to achieving several goals. First, this study aims to contribute to the field of loanword phonology through a novel way of applying Dresher's model (2009) of evaluating segmental adaptation patterns in an OT framework. This model should account for the adaptation patterns of English segments into QA, whether they are licit or illicit.

Second, this study aims to discover the factors influencing the selection of one QA segment over others to replace English non-native segments where such a choice might appear ambiguous.

Third, this study aims to investigate the extent to which the contrastive hierarchy of L1 features can be used to predict and account for the segmental adaptation of L2 loanwords.

Fourth, based on the nature of the adaptation patterns observed in the data, this study aims to determine whether the nature of the adaptation patterns is primarily phonetic or phonological.

1.3 Research Questions

According to recent research on loanword phonology that reveal the effect of borrowing language constraints in segmental adaptation, this study intends to answer four major questions.

1. Since the English segmental inventory does not overlap entirely with the QA segmental inventory, what factors determine how foreign consonants and vowels in English loanwords are adapted in QA?
2. What roles do the constraints of QA grammar play in the adaptation process? And how are these constraints motivated and ranked?
3. Do the phonological features of QA segments influence the segmental adaptation of English segments that are native and non-native in QA? And if so, in what way?
4. Based on the proposed analysis of this study, is it primarily the phonetic or phonological details of segments that are crucial to the adaptation process?

1.4 Approach of this Study

This study analyses all the segmental adaptation patterns of loanwords from English into QA by integrating the Contrastive Hierarchy Theory (CHT) proposed by Dresher, Piggott and Rice (1994); Zhang (1996); Dresher and van der Hulst (1998); Dresher (2002, 2003, 2008) and summarised in Dresher (2009) with the Optimality Theory (OT) framework (Prince and Smolensky 1993)[1]. I chose to integrate Dresher's model with the OT framework for several reasons. First, the CHT is a robust means of determining the contrastive specifications of QA segments by ordering features hierarchically. Second, Dresher's model could incorporate the contrastive features of QA in the form of constraint ranking within OT framework; thereby leading to the next reason. Third, the constraint rankings established in this study can be determined based on the features order within the contrastive hierarchy of QA segmental inventory. Fourth, OT can account for the adaptation processes by referring merely to the borrowing language's constraints without needing to add new rules or have separate grammar (Broselow 1999). Fifth, OT has the principle of *Richness of the Base*, which enables it to propose any input for evaluation. In our case, the input is assumed to be full-specified, which does not subsequently contradict the principle of *Richness of the Base*

[1] Since Dresher (2009) wrote a whole book called *The Contrastive Hierarchy in Phonology* to extensively explain the Contrastive Hierarchy Theory, for simplicity and consistency, I will only refer to this reference when applying the theory to the data in this study.

(McCarthy 2008). Sixth, OT can account for the new adaptation processes that are not found in the borrowing language's grammar (Kang 2011).

Although several researchers have applied the CHT to account for different phonological patterns in different languages (Zhang 1996; Dresher 2002, 2003, 2008; Dresher and Zhang 2005; Hall 2007, 2011; Mackenzie 2011, 2013, 2016; Spahr 2014, 2016; Oxford 2015; among others), to my knowledge, the integration of the CHT with the OT has not been utilised in the field of loanword phonology to account for the segmental adaptation patterns. Therefore, this integration provides a unified model that can account for the adaptation of all segments (whether existent or not in QA) of English loanwords adapted in QA.

1.5 Why choose QA?

I chose the dialect of QA for several reasons. First, some of the loanwords utilised in this study are adapted in QA but not Modern Standard Arabic (MSA). Furthermore, it is not necessary to adapt an English word into an Arabic dialect, as it is also adapted into QA. For instance, some of the English loanwords used in Abu-Guba's study are not adapted into QA. Second, Arabic dialects demonstrate variability in the adaptation of loanwords according to their specific phonotactic constraints. The variability is evident on the segmental, phonotactic, and morphological levels. For instance, although the consonant /v/ is not a separate phoneme in most of the Arabic dialects, Abu-Guba (2016: 75) revealed that the English /v/ is most of the time imported into AA, rather than adapted as [f] although /v/ is considered a foreign consonant in AA. However, QA grammar always replaces the English consonant /v/ with the QA consonant [f]. Furthermore, Aloufi (2016) reported that the English segment /v/ can be adapted in UHA as [w] and the English /dʒ/ can be adapted as [ʒ]. However, the English sounds /v/ and /ʒ/ cannot be preserved faithfully in QA as they are not part of the QA inventory. Another instance comes from the English word *check* which is adapted as [tʃeːk] in Kuwaiti Arabic but as [ʃeːk] in QA. This variability exists because Kuwaiti Arabic contains the allophonic sound [tʃ] in its inventory, which QA lacks.

At the phonotactic level, the first syllable in the English word *protein* is repaired in Egyptian Arabic by vowel epenthesis [b**<u>o</u>**.ro.tiːn], since some Arabic varieties do not allow complex onsets (Hafez 1996). However, the same word is adapted in the QA with the onset cluster being intact [bro.tiːn].

On the morphological level, MSA uses the Arabic verb *saddad* to give the meaning of 'shooting' in sports; however, QA uses the English loanword *shoot* and integrates the word in the

QA templatic morphology to derive other forms, such as *shaat-at* ‘she shot’, *shaat-u* ‘they.M shot’, *shaat-an* ‘they.F shot’.

Noting that the adaptation of English loanwords varies across Arabic dialects and in view of the need for a comprehensive theoretical analysis, this study aims to contribute to the field of loanword phonology, particularly in Arabic, by investigating how segments of English loanwords are adapted phonologically into the QA dialect.

1.6 History of English in Saudi Arabia

This section is devoted to providing a brief overview of the origins of English loanwords in Saudi Arabia. This is crucial to enhance our understanding of the role played by English loanwords in Saudi Arabia, and in particular in QA. This overview also works to demonstrate the reason for proposing that the nature of the input in this study is British English.

Saudi Arabia was formally established by King Abdul-Aziz AlSa’ud in 1932 after several conquests. King Abdul-Aziz successfully united the main regions of the Arab Peninsula into a single state: namely, Hijaz (western region), ‘Asir (southern), Hasa (eastern) and Najd (central). As a country comprising a huge desert, the economy of Saudi Arabia was based primarily on agriculture and pilgrimage (Al-Othaimeen 2018). Immediately prior to unifying the Arab Peninsula as one state called the Kingdom of Saudi Arabia, oil was discovered in 1930 in the Eastern Province of the country. Accordingly, there was a need for experts to extract oil. Therefore, a concession agreement was signed in 1933 between Saudi Arabia and the American company Standard Oil of California (SOCAL) to explore oil (Al-Othaimeen 2018). SOCAL acted as a basis for establishing a big company called ARAMCO (Arabian American Oil Company) in 1933 (Alshahrani 2016). The establishment of ARAMCO was the major influx of English workers in Saudi Arabia. Consequently, ARAMCO had an effect on spreading massive number of English loanwords among the population of Saudi Arabia, particularly those living in the Eastern Province (Zughoul 1978).

Given the historic background of the English-origin in Saudi Arabia, some researchers argue that the introduction of English loanwords began with the arrival of American workers in the Eastern Province of Saudi Arabia (e.g. Zughoul 1978; Al-Johani 2009; Mahboob and Elyas 2014). However, other researchers relate the date of the introduction of English in Saudi Arabia to the 1920s following the establishment of the Directorate of Education in 1923: in other words, before the arrival of American companies in 1930 (Al-Shabbi 1989; Niblock 2006; Baghdadi 1985; Al-Seghyer 2014). Accordingly, I agree with Alshahrani (2016) who assumes that English was first introduced in Saudi Arabia in the late 1920s via the Saudi educational system just before the exploration of oil in 1930. Indeed, teaching English in Saudi Arabia can be traced back to the late 1920s when the Saudi educational system decided to teach English in schools (Alshahrani 2016). Following this assumption, I assume that the input is the source form of British English. This is because the English curriculum taught in schools in Saudi Arabia is primarily British. Therefore, we do not deny that QA speakers might borrow some English loanwords from American or other English-speaking countries, as indicated by Abu-Guba (2016). However, to ensure consistency when evaluating the segmental adaptation in OT tableaux, I will assume one form of input (a British source form).

Despite the assumption proposed in this study that the input is British English, whereby /r/ is not pronounced in particular positions (e.g. word-finally), the English /r/ is always retained in QA. The faithful adaptation of the input /r/ in some words, although they are not pronounced in the source forms, could be attributed to the effect of orthography (as argued by Abu-Guba 2016: 85). For instance, I assume that the existence of the grapheme <r> in final position in the English loanword *projector* leads this word to be adapted in QA as [bru.ˈdʒik.tar] although final /r/ is not totally realised in British English.

1.7 Data

Borrowing loanwords can be achieved via different methods, each of which has bespoke characteristics. Borrowing can be through loan translations, code switches or established loanwords (Dohlus 2010).[2] Established loanwords refers to the cases whereby the meaning of the source language forms are imported but are subject to the borrowing language constraints (Haugen 1950). Paradis and LaCharite (1997: 391) provided the definition of established loanwords, as presented below:

> Definition of a loanword
> An individual L2 word, or compound functioning as a single word, which
> (a) is incorporated into the discourse of L1, the recipient language;
> (b) has a mental representation in L1…and thus
> (c) is made to conform with at least the outermost peripheral
> phonological constraints of L1, which represent absolute constraints in L1.

[2] Loan translations refers to the cases whereby the meanings of the source language words are translated literally into their equivalents in the borrowing language. For instance, the English word steam engine is translated into German as Dampfmaschine (Dohlus 2010: 31). Code switching refers to the cases when bilingual speakers alternate between two languages without changing the forms of the source language.

The established loanwords are used commonly in the borrowing language in a sense that established loanwords are 'used by monolinguals who may or may not be aware of their foreign origin... probably not even perceived as foreign by the majority of speakers' (Romaine 1989: 55). Accordingly, the English loanwords used in this study are established loanwords in QA. In other words, they are used by the monolingual QA speakers and typically do not have QA equivalents. Even if some are translated into Arabic by Arabic Language scholars, these translations are not used frequently by ordinary QA speakers. For instance, the English loanword *internet* is translated literally into Arabic as 'the net of spider'. However, this translation is used only in formal settings, such as religious speech.; in their everyday lives, QA speakers use the source form *internet.*

The data are drawn from three main sources: first, an etymological dictionary that includes a list of 800 loanwords adapted into colloquial Arabic (Al-Obodi 2006); second, two studies of English loans in Arabic conducted by Jarrah (2013) and Abu-Guba (2016); and third, the author's own collection of loanwords as a native speaker of QA. Consequently, this study identified 400 English loanwords, which are adapted into QA and used by monolingual QA speakers. Indeed, the main sources for the corpus were the loanwords included in Al-Obodi (2006), Abu-Guba (2016) and Jarrah (2013) constituting most of the data.

This study attempts to avoid English technical words and English proper names. The exclusion of proper names is attributed to the fact that their use is limited to particular people who are interested in specific areas, such as politics. Therefore, the corpus of this study comprises solely English words perceived as being common to monolingual QA speakers. If a technical word is included, it must be used and understood by most monolingual speakers. For instance, the English loanwords *cholesterol* and *modem* are used commonly in the QA community and understood by monolingual speakers. This also includes trademark names like *Ford, Hammer, Instagram*, which are used frequently among monolingual QA speakers and do not have equivalent translations in Arabic.

With the influence of globalisation and modernisation and the invention of new technologies, such as smartphones, a number of English loanwords have recently entered the QA lexicon. This includes loanwords such as *snap, modem, IPhone, IPad, google, plus, admin, wireless, plasma, YouTube, zoom etc*. These new additions to the QA lexicon are integrated and treated as native QA words in a sense that other forms (e.g. verb, noun, plural, etc…) are derived from the recently-adapted English loanwords. For instance, the English loanword *snap* entered the QA lexicon approximately five years ago and is now regarded as a native word. Moreover, it has the verb form [san.nab] ‘he snapped’ and the plural form [snaa.baat] ‘snaps’, the possessive form ‘snaa.bi’ ‘my snap’, etc.

For my own collection of loanwords, I depended largely on self-observation, which includes spoken and written language on social media, such as What’s App. However, if it is written, I must have heard the word before and know how it is pronounced in the QA. Therefore, even if the English loanword is extracted from What’s App, its written form reflects accurately its pronunciation by monolingual QA speakers.

The corpus of this study also includes contemporary loanwords that have been spread recently among monolingual QA speakers. Indeed, a current business-trend in Qassim is to open new restaurants and shops with English, rather than Arabic, names. The reason for doing so is that these English-named shops are generally considered by QA society -especially women- to be more prestigious than their Arabic-named counterparts. With the spread of this phenomenon, more English words have been used widely by monolingual QA speakers. What is crucial to me is that these English words are not translated into Arabic. That is, the only way to identify these shops is to use the English names. This way of not translating English words leads to the spread of the words among monolingual QA speakers. For instance, the English word *Splash* is used in QA to refer to a clothing shop with the same name.

In terms collecting loanwords, I spent two years gathering and revising the data. Being a native speaker of QA facilitated the task of choosing only English loanwords that are used by monolingual QA speakers. For instance, although words such as *georgette, spray, plaster and nougat* are included in Abu-Guba’s corpus, these words are excluded from the corpus of this study as they are not used in QA. Furthermore, several English loanwords collected in this study were excluded from the corpus either because they are seldom used in QA or they belong exclusively to scientific fields. For instance, the use of the English loanword *asthma* is limited to people who work in hospitals, while ordinary people in QA use the Arabic word *rabu* instead.

All adapted forms presented in this study are provided in IPA transcriptions. Note that the adapted forms are transcribed based on their pronunciations by monolingual QA speakers. I have relied on my pronunciation as a native speaker of QA to transcribe the English adapted forms. Furthermore, I have confirmed the pronunciation of loanwords by native speakers of QA. For instance, I made a daily video call to my mother-who is illiterate and a native speaker of QA- and confirmed the pronunciation of the loanwords by asking her to produce the words. Furthermore, I kept an observation on monolingual QA speakers as they were speaking the loanwords included in this study.

For the English transcription used in this study, I depend entirely on the *Cambridge English Dictionary*. Since I assume that the input is British English, 'a more broadly-based and accessible model accent for British English is represented [and transcribed in this study]… [t]he model used for British English is [not Received Pronunciation but] what is referred to as BBC English; this is the pronunciation of professional speakers employed by the BBC as newsreaders and announcers…'. (Jones 2006: V).

The *Cambridge English Dictionary* follows the 'Maximal Onsets Principle' as a specific strategy on dividing syllables of English words. This strategy works as follows:

> syllables should be divided in such a way that as many consonants as possible are assigned to the beginning of the syllable to the right (if one thinks in terms of how they are written in transcription), rather than to the end of the syllable to the left (Jones 2006: xiii)

This syllable strategy cannot be followed in cases where the resulting syllable division violates English phonotactics. For instance, consonants cannot be positioned at the beginning of the syllable to the right if this would lead having a syllable ending with a stressed /ɪ/, /e/, /ʊ/, /ɒ/, /ʌ/ or /æ/. In this case, the first or intervocalic consonant occupies the coda position of the preceding syllable. For example, the English word *better* is syllabified in this dictionary as /ˈbet.əʳ/, rather than */ˈbe.təʳ/. Conversely, the syllabification of the English word *beater* follows the syllabification strategy of this dictionary and is syllabified as /ˈbiː.təʳ/ because the first stressed syllable ends with the long vowel /iː/. Furthermore, the unstressed short vowels /e/, /ɒ/, /ʌ/ and /æ/ are not allowed to surface in syllable-final positions. However, the unstressed short vowels /ɪ/ and /ʊ/ can surface in syllable-final positions if they are followed by a consonant-initial syllable. This is evident in the syllabification of the English word *develop* /dɪˈvel.əp/.

The appendix of this study contains a list of all English loanwords included. The appendix is divided into three columns. The first includes the English words, whereas the second and the third columns respectively contain English and QA IPA transcriptions.

Following Abu-Guba (2016), who analyses the adaptation of English loanwords into AA, I assume that the source of the input form is British English. This assumption is made because the English curriculum taught in schools in Saudi Arabia is mainly British, alongside the historical relationship between Saudi Arabia and Britain. Given this, we do not deny that QA speakers might borrow some English loanwords from American or other English-speaking countries, as indicated by Abu-Guba (2016). However, to ensure consistency when evaluating the segmental adaptation in OT tableaux, I will assume one form of input (a British source form).

1.8 Influence of Orthography

Typically, phonetic and phonological factors are considered when analysing the adaptation patterns of loanwords. However, the influence of orthography can also be an influential factor in shaping these patterns (Vendelin and Peperkamp 2006). In an experimental study, Vendelin and Peperkamp (2006) asked their participants, who were late French–English bilinguals, to pronounce English non-words with the focus on the productions of the eight English vowels. The target words were presented first orally, then as oral-written forms. The results revealed that the participants pronounced the target English vowels in the first task (oral forms only) differently from the second task (oral+written). In particular, the productions of the second task resembled how French participants read English graphemes. These results demonstrate how the adaptation patterns can differ based on the influence of orthography. This argument is in line with other studies in the literature that reveal the influence of orthography on adaptation process (Blair and Ingram 1998; Kertész 2006; Dohlus 2010; Abu-Guba 2016; among others). Abu Guba (2016), who examined the adaptation patterns of English loanwords in Ammani Arabic, highlighted that several adaptation patterns can be accounted for by referring to English written forms. Subsequently, this is the result of English being taught in schools and universities. For instance, Abu-Guba argued that the faithful adaptation of the English rhotic consonant in postvocalic position was attributed to the influence of orthography, despite the input being assumed to be British forms.

Accordingly, I assume that orthography influence some of the adaptation patterns of English loanwords in QA. This is evidenced especially when considering adaptation patterns that deviate from the typical patterns. For instance, because the English /tʃ/ is replaced largely by the QA consonant [ʃ] (see section 5.1.6), I argue that this is the conventional adaptation. Furthermore, I argue that orthography affects QA speakers to adapt the English word *ketchup* /ˈketʃ.ʌp/ as [ˈkat.ʃab] with the preservation of the English /tʃ/. That is, the fact that the English forms contain the grapheme <t> causes QA speakers to preserve the English /tʃ/ and treat this consonant as two separate segments [t] and [ʃ] as it can be seen from the syllable positions (i.e. [t] occurs in coda and [ʃ] in onset of the next syllable).

The influence of orthography also impacts the realisations of final post-vocalic /r/ and the adaptations of some vowels like schwa. For instance, I assume that the existence of the grapheme <r> in final position in the English loanword *projector* leads this word to be adapted in QA as [bruˈdʒik.tar] although final /r/ is not totally realized in British English.

Furthermore, I argue in section 6.4.11 that the English schwa sound is adapted typically as [a$^{\text{-back}}$] in QA, and that any other adaptation patterns are attributed to the influence of orthography. This is evident in the massive words in the data that include the sound /ə/. The grapheme of the source forms plays a crucial role in adapting /ə/. In other words, the sound /ə/ in the source forms is represented in writing by the graphemes (o, u, i, e, …). If the schwa sound is not mapped to [a$^{\text{-back}}$], these different graphemes determine how the schwa sound /ə/ is adapted in QA. For instance, the English loanword *album* /ˈæl.bəm/ is adapted in QA as [ʔalˈbuːm]. The existence of the grapheme <u> in the source form affects the schwa to be adapted as [uː] instead of the typical mapping [a-back].

1.9 Dissertation Outline

This thesis is structured into seven chapters. The current chapter includes an introduction that provides a very brief review of the main approaches to loanword phonology. It also indicates the scope, core argument, contribution, goals, questions, data and approach of this study. Chapter Two provides an overview of the main approaches in the field of loanword phonology. Chapter Three provides a sketch of the segmental inventories of the Qassimi Arabic and English languages a long with a brief description of certain aspects of the QA grammar. Chapter Four presents the approach applied to this study: the Contrastive Hierarchy Theory. Chapters Five and Six provide the main analyses of this study. Chapter Five outlines the results of the segmental adaptations of English consonants into QA. It also presents an Optimality Theoretic analysis of the adaptation of English consonants in QA. Chapter Six is devoted to presenting the adaptation patterns of English vowels into QA as well as a complete OT analysis of the adaptation patterns. Chapter Seven concludes the thesis and suggests recommendations for further research.

Chapter 2: Approaches in Loanword Phonology

In the field of loanword phonology, there is a significant debate surrounding two issues. One is whether the adaptation process of loanwords occurs at the level of perception or production. The second is whether the nature of the adaptation process is grounded in the phonetic or phonological details of the source and borrowing language. Therefore, this chapter aims to provide an overview of the main approaches to loanword phonology in relation to the previous two issues. First, I present the perception-only approach which holds that nativisation of loanwords occurs at perception and that phonetic details are responsible for this. Second, I present the production-only approach which neglects the effect of perception and/or phonetic details and focuses only on phonological details. Third, I present the perception-production approach which includes two prominent views: the Multi-Scansion view, which argues that loanword adaptation occurs at two successive levels: perceptual and production levels and the P-Map hypothesis which argues that nativisation of loanwords is based on perceptual similarity. This approach converts perceptual factors into faithfulness constraints, which can be integrated into the constraints of production grammar.

While presenting these approaches, I have raised several questions based on the segmental adaptations of English loanwords in QA and I have concluded that the Contrastive Hierarchy Theory proposed by Dresher (2009) can answer these questions.

2.1 The perception-only approach

Dupoux *et al.* (1999) conducted an experimental study on Japanese and French participants to discover the extent of the effect of L1 constraints on perception of non-native structures. They provided the participants with stimuli of non-sense words. Since Japanese grammar does not allow consonant clusters, the stimuli for Japanese participants consist of VCCV (e.g. ebzo) and VCVCV (e.g. ebuzo). Interestingly, in both stimuli, Japanese participants reported that they heard a vowel between the consonants. Dupoux *et al*. concluded that the phonotactic constraints of Japanese trigger the participants to perceive an 'illusory' vowel between consonants in VCCV stimuli. The authors confirmed their findings by performing another experiment in which they found that Japanese participants found it difficult to distinguish between VCCV and VCuCV stimuli.

In contrast to Japanese, French participants had no difficulty in detecting the presence of the illusory vowel in the stimulus VCVCV versus its absence in VCCV. The ability to detect epenthetic vowels is derived from the fact that the grammar of French allows complex syllabic structures.

However, the effect of L1 phonotactic constraints on perception can be observed from the French participants when the contrast of vowel length is present. Since the vowel length is not contrastive in French, the French participants faced difficulties in discriminate between two non-sense words that differ in vowel length (ebuzo vs. ebuuzo). Similarly, and since the stress in French occurs finally, Dupoux *et al.* (1999) reported that French speakers experienced difficulty in discriminating words where their meanings differ according to the assignment of stress. Therefore, for the adaptation of loanwords, French speakers consistently assign stress finally to the adapted forms. Dupoux *et al*. deduced that the phonotactic constraints of a language influence speech perception.

The findings of these speech perception experiments are utilised to explain the nature of the adaptation processes observed in different languages. Accordingly, in several psycholinguistic studies, Peperkamp and Dupoux (2003); Peperkamp (2005); Peperkamp *et al.* (2008) argued that the nativisation of loanwords:

> are considered to be the formal reflex of perceptual assimilation, a process that applies during speech perception and that maps non-native sound structures onto the phonetically closest native ones. This process being computed by an acoustic distance metric, we depart from the idea that loanword adaptations are computed by the phonological grammar of the borrowing language. Rather, they are influenced by it, in that it is this grammar that determines which sounds and sound structures are available for non-native ones to be mapped onto.
> (Peperkamp *et al.* 2008: 131)

In particular, Peperkamp and Dupoux in all their works argued that the phonological grammar of the borrowing language has no relevance in loanword adaptations. Rather, the whole process can be defined as ‘phonetically minimal transformations.’ (Peperkamp 2005: 1). The primary reasons for this argument emerge from different observations in loanword phonology. First, loanword adaptations do not always mirror the constraints of the borrowing language. There are cases where native forms vs. foreign forms are treated differently although both forms exhibit the same phonological process. Second, sometimes foreign forms are modified, and native forms are not although the two forms are identical, cases where Peperkamp called them ‘unnecessary adaptations’. Each case is illustrated with examples from the adaptation patterns of different languages as presented by Peperkamp (2005).

For the first case, Korean does not allow the surface of /s/ in coda position. Thus, native forms that include /s/ in coda surface with /t/ instead of /s/. According to the phonological view in loanword phonology, Peperkamp (2005) argued that foreign forms that include /s/ in coda should be adapted in Korean with /t/. However, English loanwords ending in /s/ are adapted in Korean by inserting a vowel to avoid having /s/ in coda, as illustrated below (Kenstowicz and Sohn 2001).

(2)	Native forms	a.	/nas/	[nat]	‘sickle-NOM’
			/nas + ɨl/	[nasɨl]	‘sickle-ACC’
(3)	Foreign forms	b.	[posɨ]	<	‘boss’
			[kɨrasɨ]	<	‘glass’
			[mausɨ]	<	‘mouse’
			[kʰarisɨma]	<	‘charisma’

For the second case, native Japanese words can surface with final-moraic nasal consonants. However, French loanwords ending in /n/ are adapted in Japanese with gemination of the final /n/ + an epenthetic vowel, as shown in (4). This adaptation pattern does not occur when the adapted forms are English, as illustrated in (5) (Shinohara 1997, as cited in Peperkamp 2005).

(4)	a. [dua<u>nːɯ</u>]	<	Fr. douane	[dwan]	‘customs’
	b. [pisi<u>nːɯ</u>]	<	Fr. piscine	[pisin]	‘swimming pool’
	c. [pɯroçe<u>nːɯ</u>]	<	Fr. prochaine	[pro ʃɛn]	‘next-FEM’
(5)	a. [sɯkɯrii<u>N</u>]	<	‘screen’		
	b. [napɯki<u>N</u>]	<	‘napkin’		
	c. [koto<u>N</u>]	<	‘cotton’		

Peperkamp (2005) argued that these instances of loanword adaptations create problems for the phonological view as they are not motivated by the borrowing language constraints. However, such problems are resolved when the previous adaptation patterns presented in (2), (3), (4) and (5) are explained from a phonetic and/or a perceptual perspective. To account for the adaptation patterns presented in (2) and (3), Peperkamp (2005: 9) argued that the different treatment of native words versus English words ending in /s/ can be accounted for by referring to the notion of ‘perceptual minimal change’. In other words, Korean speakers perceive English /s/ to be perceptually closer to [sɨ] than to [t̚]. With regard the adaptation pattern provided in (4) and (5), Peperkamp (2005) contended that the realisations of phonetic details of the surface forms differ from language to language. This explains why foreign words are perceived differently by speakers of borrowing languages. In other words, the diverse treatments of the French and English forms presented in (4) and (5) are attributed to the fact that the two forms have different phonetic representations (Vendelin and Peperkamp 2004; Peperkamp *et al.* 2008). The nasal consonant /n/ in the French loanwords has more phonetic duration and intensity than the English /n/. Therefore, the phonetic differences of the final nasal /n/ in English and French influence Japanese speakers to perceive the French loanwords ending in /n/ with epenthetic vowels. Therefore, proponents of the purely phonetic approach argued that the first cases where native and foreign forms are treated differently and the second cases where we have 'unnecessary' adaptation patterns to French loanwords provide empirical evidence that loanword adaptations do not necessarily reflect the borrowing language constraints. Rather, 'all loanword adaptations directly reflect perceptual assimilations…' (Peperkamp 2005: 8).

In summary, based on the arguments proposed by proponents of the perception-only view, if borrowed words contain segments that are illicit in the borrowing language, they will not be perceived by the borrowers. Instead, at the perceptual level, they automatically will be changed to the closest segments available in the borrowing language. The term 'closest' is measured using the phonetic distance between the input vs. the output segments. This process is formally termed 'deafnesses'; thereby indicating that the borrowers are unable to perceive non-native segments or structures (Dupoux *et al.* 1997).

Based on this argument that all loanword adaptation processes are performed on speech perception, Peperkamp and Dupoux (2003: 368) explicitly refute the relevance of the phonological features in loanword phonology. I argue that this is not applicable to the adaptation of English segments into QA. This is evidenced by the fact that contrastive features of QA play a crucial role in the adaptation process (as will be demonstrated and discussed in depth in chapters five and six).

In discussing the nature of the adaptation process in loanword phonology, Peperkamp and Dupoux (2003) indicated that L2 forms that are illicit in L1 are typically analysed according to the phonological view, in a way that L2 illicit forms are modified in conformity with the L1 constraints. However, the authors argued that there is no specific repair strategy for every illicit form; in other words, modification of illicit forms can constitute several ways. For instance, at the segmental adaptation level, mapping non-native segments to native ones can be accomplished by several repair strategies (e.g. changing one or more features). Similarly, at the syllabic level, L2 syllable structures that are illicit in the borrowing language can be repaired by different strategies (e.g. deletion, vowel epenthesis, etc…). Peperkamp and Dupoux argued that the reason for having multiple repair strategies in modifying one illicit pattern is attributed to the fact that the grammar of the borrowing language lacks evidence as to which repair strategies are chosen. The authors argued that the puzzle of multiple repair strategies is resolved if the nature of the adaptation process is attributed to phonetic rather than phonological details. For instance, English loanwords containing final obstruent clusters are illicit in Cantonese. Thus, they are adapted by deleting a final consonant if it is a stop or with insertion of a vowel if the English cluster ends with a fricative (Silverman 1992; Yip 1993). It has been argued that the choice between deletion vs. epenthesis is attributed to the phonetic representations of the L2 consonant clusters. In other words, insertion of a vowel is motivated by the phonetic fact that English fricatives that occur word-finally have stronger phonetic cues than stops. Therefore, these stronger cues induce Cantonese speakers to insert a vowel after English word-final clusters ending in fricatives whereas English final stops in CC # are deleted because they phonetically resemble ø. However, I argue against this notion of having multiple repair strategies for repairing one illicit form. In particular, the repair strategy of adapting foreign English segments into QA is not arbitrary chosen. Nonetheless, the input features of English segments are mapped to the contrastive features of QA. For instance, the input features [-son, +lab, -cont, -voice] that denote the English /p/ are mapped to the contrastive features of QA to produce the following features [-son, +lab, -cont], which denotes the segment [b] in QA. Targeting the feature [voice] to be deleted instead of the other input features is motivated mainly by the contrastive hierarchy of QA consonant inventory. In other words, deleting the input feature [-voice] is governed by the co-occurrence constraint *[αvoice, +labial], which states literally that the feature [voice] is not contrastive within the labial segments in QA. This co-occurrence constraint is derived from the native phonology of QA, which subsequently states that the repair strategy of deleting the [voice] feature is the sole means of adapting the non-native segment /p/. This method of subjecting input features to contrastive features of a language resolves the issue raised by Peperkamp and Dupoux (2003) of having multiple repair strategies in the phonological process.

2.2 The production-only approach

The hypothesis that perception and phonetic details play the main role in the adaptation process has been criticised by the proponents of the phonological view (Paradis and LaCharité 1997, 2001, 2008; LaCharité and Paradis, 2002, 2005; Jacobs and Gussenhoven 2000). The primary criticism is that the phonetic view/misperception fails to predict the adaptation patterns of foreign segments and structures observed cross-linguistically (LaCharité and Paradis 2002). In other words, if the adaptation of foreign segments or structures is based largely on the phonetic approximation/misperception, it should account universally for the adaptation patterns observed across languages. The following section presents studies that demonstrate the effect of phonological representations within the *Theory of Constraints and Repair Strategies* (TCRS), in addition to the OT.

2.2.1 The Theory of Constraints and Repair Strategies (TCRS)

Based on the initial work undertaken by Paradis (1988a, 1988b, 1996), Paradis and LaCharité (1997) presents the *Theory of Constraints and Repair Strategies* (TCRS). This theory works as a universal model for analysing any process of loanwords adaptation from a phonological perspective. Therefore, the TCRS counters the purely phonetic view proposed by Peperkamp and Dupoux (2003). The authors define *Constraints* by arguing that the phonology of a language contains universal and non-universal constraints. When a segment or a structure violates these constraints, it is subject to modifications. These modifications are known formally as *Repair Strategies.*

The TCRS comprises several principles. First, the *Preservation Principle* which states that, in loanword phonology, the segmental information of the input of the L2 form is maximally preserved in the output. If the L2 form violates the constraints of L1, this violation is attributed to the fact that the phonology of L1 lacks a content or structure of the L2 borrowed form. Therefore, the priority of the repair strategies is to insert a content or structure. For instance, if a consonant cluster (CC) is borrowed to a language that forbids the occurrence of (CC), this cluster tends to be repaired universally by inserting a vowel between the cluster rather than deleting a member of the cluster. The tendency of insertion is preferable over deletion because insertion satisfies the L1 constraint against *(CC) and simultaneously preserves the input segments. However, the repair strategy of insertion should not exceed the steps of repairs; otherwise, the illicit L2 form is deleted. These steps are formalised within the *Threshold Principle* given in (6).

(6) Threshold Hypothesis/Principle:

(a) All languages have a tolerance threshold to the amount of repair needed to enforce segment preservation.
(b) This threshold is the same for all languages: two steps (or two repairs) within a given constraint domain. (Paradis and LaCharité 1997: 385)

The *Threshold Principle* determines when the illicit L2 form is subject to deletion as a repair strategy of satisfying the L1 constraints. In other words, if the repair process of an L2 illicit form requires more than two steps of repairs, this L2 form will be deleted. Accordingly, Paradis and

LaCharité (1997) argued that achieving the *Preservation Principle* is guided by the *Minimality Principle* provided in (7).

(7) Minimality Principle:
(a) A repair strategy must apply at the lowest phonological level to which the violated constraint refers.
(b) Repair must involve as few strategies (steps) as possible.
(Paradis and LaCharité 1997: 386)

By the term ‘the lowest phonological level’, Paradis and LaCharité (1997: 386) proposed the *Phonological Level Hierarchy* (PLH) given in (8)

(8) Phonological Level Hierarchy
Metrical level > syllabic level > skeletal level > root level > feature with a dependent > feature without a dependent

The PLH states that repairs should target first the lowest phonological level (feature without a dependent) then repairs increase gradually to apply at the level of a feature with a dependent and so on until repairs reach the top level (metrical level). For instance, if the repair strategies of losing a syllable or a segment are two options for satisfying an illicit form, priority is given to the loss of a segment because the syllabic level occurs higher than the segmental level in the PLH.

Paradis and LaCharité in all their works emphasise the effect of the phonological features of the source language on the adaptation of foreign segments. They argue that L1 speakers, who are assumed to be bilinguals and presumably have access to the L2 phonology, match L2 foreign segments to their closest phonological segments available in L1. In other words, it is the phonological representations of the L2 segments, not their source forms (phonetic representations), that play a crucial role in the adaptation process (LaCharité and Paradis 2002).

LaCharité and Paradis (2005) continue to argue that the adaptation process of foreign segments is based largely on the phonological representations of segments rather than the phonetic details. This was achieved by testing the effect of the phonological representations against the phonetic representations by analysing the adaptation of foreign segments in 12 large corpora of English and French loanwords, which are adapted in several different languages. In particular, the authors demonstrated that the majority of the adaptation processes of sound change is based primarily on the category, rather than perceptual, proximity. Furthermore, the L2 perception errors observed in L2 studies are not found on the adaptation processes of LaCharité and Paradis’ data.

LaCharité and Paradis (2005) propose that sounds are universally identical regarding their underlying phonological features. In other words, the segment /b/ for instance, in English and Spanish is phonologically assumed to be voiced labial stop. However, the English /b/ differs phonetically from the Spanish /b/. In adapting L2 phonemes, L1 borrowers neglect any phonetic differences and preserve the phonological features of L2 phonemes. This adaptation method is known formally as the *Category Preservation Principle* and is defined in (9):

(9) Category Preservation Principle:
If a given L2 phonological category (i.e. feature combination) exists in L1, this L2 category will be preserved in L1 despite phonetic differences.
(LaCharité and Paradis 2005: 226)

If the combinations of features of L2 phoneme are not available in L1, they will be mapped to their similar phonological features in L1. This process is called *Category Proximity Principle* and defined in (10).

(10) Category Proximity Principle:
If a given L2 phonological category (phoneme) does not exist in L1, this L2 category will be replaced by the closest phonological category in L1, even if the L1 inventory contains acoustically closer sounds. [Based on this principle], category proximity is determined by the number of changes (in terms of structure and features) that an L2 phoneme must undergo to become a permissible phoneme in L1
(LaCharité and Paradis 2005: 227)

Consider the following two examples where the first illustrates *the Category Preservation Principle* and the second demonstrates *the Category Proximity Principle*. First, from the perspective of Voice Onset Time (VOT), English voiced stops are phonetically close to the Spanish voiceless stops (LaCharité and Paradis 2005). Based on the difference between English and Spanish voiced and voiceless stops in VOT and according to the phonetic view which argues that the process of adapting foreign segments is based on mapping L2 phonetic cues to their closest ones in L1, it is expected that English voiced onset stops are adapted as their voiceless counterparts in Spanish. Indeed, LaCharité and Paradis (2005: 253) tested this prediction in 1, 1514 of English loanwords adapted in Mexican Spanish. They found that all the English voiced stops (/b/, /d/, /g/) in onset positions are adapted in Mexican Spanish intact (i.e. they are never adapted as their voiceless counterparts). This adaptation is illustrated in the English loanwords *body* [**b**ɑ**d**i] and *garbage* [**ɡ**ɑɹ**b**ɪdʒ] which are adapted in Mexican Spanish as [**b**ɔ**d**i] and [**ɡ**aɾ**b**itʃ]. LaCharité and

Paradis (2005) concluded that Mexican Spanish speakers adapt the English voiced stops according to their phonological representations not their phonetic details.

Second, based on acoustic measurements, English high vowels /ɪ/ and /ʊ/ are phonetically close to the mid vowels /e/ and /o/ in Mexican Spanish and Paris French. Therefore, it is expected that the vowels /ɪ/ and /ʊ/ in English loanwords are mapped respectively to the vowels /e/ and /o/ in Mexican Spanish and Paris French. However, the results of loanwords demonstrated that the English vowels /ɪ/ and /ʊ/ are adapted as [i] and [u], as exemplified in (11) (LaCharité and Paradis (2005: 234-235).

(11)	English	IPA	Mexican Spanish	Paris French
	building	[b**ɪ**ld**ɪ**ŋ]	[b**i**ldiŋ]	
	cook	[k**ʊ**k]	[k**u**k]	
	kid	[k**ɪ**d]		[k**i**d]
	look	[l**ʊ**k]		[l**u**k]

As can be seen from the adaptation patterns in (11) that the phonemic, rather than phonetic, proximity played a crucial role in adapting foreign segments. In particular, the borrowers preserved the input feature [+high] and changed only the value of the input feature [-ATR] into [+ATR]. The motivation for this adaptation is that the vowels /ɪ/ and /ʊ/ are phonologically closer to /i/ and /u/ than to /e/ and /o/.

Results support the phonological view are also presented in Paradis and Tremblay (2009) who investigated a total of 500 stops occur in 371 English loanwords adapted in Mandarin Chinese (MC). The purpose of this investigation was to discover the behaviour of the adaptation of English aspirated/unaspirated stops into MC. At the outset, the authors showed that the aspiration of English stops is characterised as a phonetic property because the occurrence of aspiration in English is predictable; thus, aspirated vs unaspirated stops in English are not contrastive (i.e. they belong to the same phoneme). On the contrary, aspiration in MC is characterized as a phonological property because aspirated and unaspirated stops in MC are two separate phonemes. Based on these facts and according to the opposing views in loanword phonology (the perceptual vs the phonological views), the following predictions are expected regarding the adaptation of the English voiceless stops in MC:

(12) The perceptual stance (phonetic view) predicts that MC speakers will map the English aspirated stops to MC aspirated stops and the English unaspirated stops to MC unaspirated stops. This adaptation pattern is motivated by the argument that phonetic details play a crucial role in the adaptation of non-native segments.

(13) The phonological stance predicts that the aspiration of English stops would not affect MC speakers during adaptation. In other words, there should not be a relationship between the English aspirated/unaspirated voiceless stops and MC aspirated/unaspirated stops. This is because this stance argues that only the phonological representations of L2 forms (not phonetic) are related to the adaptation process of non-native segments.

The results presented by Paradis and Tremblay revealed that English aspirated and unaspirated voiceless stops were adapted systematically in MC as aspirated stops (e.g. English pizza [ˈpʰitsə] > MC [pʰitsa] / [pʰisa], and English hippies [ˈhɪpiz] *[ˈhɪpʰiz] > MC [sipʰiʂ]). Whereas English voiced stops (which are illicit in MC) were mapped to unaspirated segments in MC (e.g. English Boeing [ˈboɪŋ] > MC [pəin]). Paradis and Tremblay used this evidence to argue against the perceptual stance and in support of the phonological stance.

As an evidence for supporting the TCRS, Paradis and LaCharite (1997) investigated the adaptation pattern of the French segment /v/ into Fula, a language spoken in West and Central Africa. Fula inventory lacks the segment /v/. Accordingly, the segment /v/ appears in French loanwords adapted into Fula is required to be adjusted to a Fula native segment. Indeed, Paradis and LaCharite (1997: 400-402) demonstrated that the French segment /v/ is typically adapted into Fula as [w]. Based on the TCRS, the authors argued that among the possible available repairs /v/ → [f] (delinking [+voice]), /v/ → [b] (delinking [+continuant]) or /v/ → [w] (inserting [+sonorant]), any adaptation would not contradict the TCRS as each repair involves only one step of changing input features; in other words, they are similar in terms of minimal repairs. However, the repair /v/ → [w] is selected over other repairs because it entails insertion of a feature (+sonorant), given the assumption that /v/ is not specified for the feature [sonorant] at the underlying level, whereas /v/ → [f] and /v/ → [b] entail deletion of the features [+voice] and [+continuant], respectively. Insertion is favoured over deletion because the former satisfies the Preservation Principle by preserving the input features (Paradis and LaCharite 1997: 404).

QA inventory resembles that of Fula in that they both lack the voiced fricative /v/. If we apply Paradis and LaCharite’s analysis to the adaptation of the English consonant /v/ into QA, we should achieve the following mapping: /v/ → [w]. However, the English /v/ is always adapted into QA as its voiceless counterpart [f]. With this actual mapping at hand (i.e. /v/ → [f]), how can the TCRS exclude the other possible repairs /v/ → [w] and /v/ → [b]? Based on the principles of TCRS, all possible repairs equally have an opportunity to adjust the illicit segment /v/ as they all involve one step of repair; thus, satisfying the *Minimality Principle*. However, the issue of multiple repairs is restricted within the Contrastive Hierarchy Theory proposed by Dresher (2009). In other words, the contrastive hierarchy of a language, which is eventually converted into OT constraints, determines the repair strategy of a specific illicit segment. For instance, consider a language inventory that includes only the following vowels: /i/, /u/, and /a/ and that the contrastive hierarchy of this language produces the feature order: [high] > [round] (Dresher 2009). This means that /i/ is contrastively specified as [+high, -round], /u/ as [+high, +round] and /a/ as [-high]. If the foreign segment /o/, which is presumably specified as [-high, +round], is adapted into this language, the prediction is that it will be mapped to [a] rather than [i] or [u]. This is because the contrastive hierarchy of this language states that the priority is to preserve the value of the input feature [high] as it is ranked higher than [round]. If the input feature [-high] is preserved at the expense of [+round], the result produces the contrastive specification [-high] that denotes the vowel [a]. As can be observed, the contrastive hierarchy of this language predicts choosing the repair /o/ → [a] over other possible repairs /o/ → [i] and /o/ → [u].

In summary, I agree with the argument put forward by Paradis and LaCharité whereby phonetic approximation and/or misperception of foreign segments do not have a significant effect on the adaptation process of the English segments into QA. Instead, the phonological representations of the QA play a crucial role in the adaptation process. However, the primary difference between the model proposed by Paradis and LaCharité and the model followed in this study is that whereas Paradis and LaCharité use constraints within the TCRS, I utilise the constraints within the OT framework. The model of OT leads to dispense with the notion of steps of repair strategies proposed by Paradis and LaCharité.

2.2.2 Analysing the effect of phonological details in OT

Using a different analysis to demonstrate the impact of the phonological details on loanword adaptation, Jacobs and Gussenhoven (2000) (J&G) analysed the adaptation of French front rounded vowels in Mauritian Creole, a language spoken in Mauritius, in an OT framework. In their analysis, they provided an argument that the segmental adaptation in loanword phonology can be sufficiently accounted for without referring to the Perceptual Level proposed by Silverman (1992) and Yip

(1993)[3]. This is achieved by solely applying the non-native segments of L2 to the constraint ranking of the borrowing language. For J&G, the input to loanword phonology is created by transforming the acoustic signals of L2 segments into abstract featural representations. The input of featural representations might include a combination of features that are illicit in the borrowing language. Therefore, these illicit features are repaired in the output by the native grammar of the borrowing language. Contrary to Silverman's argument that the input in loanword phonology is unanalysed acoustic signals, J&G (2000: 193) proposed that the input is 'a universally defined, fully specified phonological representation'. By the term universal, the authors indicated that speakers of any language can perceive any sound. Then, their native grammars determine if these perceived sounds can surface or not. For instance, since front-labial vowels are illicit in Mauritian Creole, it is predicted that front-labial vowels that appeared in French loanwords are adapted in Mauritian Creole as front vowels. In feature terms, a French input that contains the articulations *Coronal-Labial* surfaces in Mauritian Creole as *Coronal* because the Mauritian Creole inventory has the anti-association constraint *V-Place/Cor-Lab, which prevents the combination of features [coronal+labial] from surface. This adaptation is exemplified in the French words *plumeau* [pl**y**ˈmo] and *cheveux* [ʃəˈv**ø**] which are adapted in Mauritian Creole as *plimo* [pl**i**mo] and *seve* [sev**e**]. The evaluation of this adaptation pattern is illustrated in the following tableau.

Tableau 1

[V-Pl, Lab,Cor]	FILL (Place)	*V-Place/Dor-Cor, *V-Place/Cor-Lab, *V-Place/Lab	PARSE (F)	*V-Place/Lab-Dor	*V-Place/Cor	*V-Place/Dor
a. [Cor, Lab]		*!				
b. ⟨Cor⟩ [Lab]		*!	*			
c. [ ] ⟨Cor, Lab⟩	*!		**			
☞ d. [Cor] ⟨Lab⟩			*		*	

In conclusion, J&G highlighted that the native constraints of the borrowing language account sufficiently for the adaptation process in loanword phonology without the need to include the

[3] The Perceptual Level is explained in §2.3.1.

Perceptual Level proposed by Silverman (1992) and Yip (1993). Furthermore, the authors argued that the input in loanword phonology is the surface form of the L2. This means that the input may include segments or structures that are ill-formed in the borrowing language. Then, the input is filtered out by the native constraints of the borrowing language to produce the form that is compatible with the L1 phonotactic constraints.

The J&G model was criticised by Herd (2005), who attempted to apply the model to account for the adaptation pattern of the English /s/ into several languages: NZ Māori, Cook Islands and Hawaiian. These languages do not contain the coronal fricative /s/ in their inventories. Accordingly, the English segment /s/ is adapted in NZ Māori as [h], as [t] in Cook Islands and as [k] in Hawaiian. Herd (2005) proposed that the adaptation pattern in NZ Māori can be accounted for by proposing that the constraint IDENT(Cor) is outranked by the constraint IDENT(+continuant). Whereas in Cook Island, the adaptation of /s/ as [t] can be explained by having the opposite ranking: IDENT[+Cor] >> IDENT[+continuant]. However, as the features of the segment /s/ are more similar to the features of the segments /h/ and /t/ than to the features of /k/, it is difficult to find a means in which IDENT constraints can explain why the English /s/ is adapted as [k] in Hawaiian and not as *[h] or *[t] like NZ Māori and Cook Islands. Therefore, Herd (2005: 80) criticised J&G model because the constraints related to features of inventories are not motivated from 'the underlying shape of these inventories'. However, by referring to the notion of the contrastive specification, Herd argued, the adaptation of the English /s/ as [k] in Hawaiian is predictable as Hawaiian inventory does not have any coronal obstruents but has /k/ as the only non-labial obstruent segment.

If we apply Herd's criticism of the J&G model to the adaptation patterns of English segments into QA, we can conclude that the feature constraints of QA are not motivated by the lexical level of the QA inventory. However, applying Dresher's model enables us to contrastively specify the QA segments at the lexical level. Then, applying these contrastive features to any input, whether this input includes full specifications or underspecification.

2.3 The perception-production approach

2.3.1 Multi-scansion view

Silverman (1992) analysed the segmental, prosodic and tonal adaptation of English loanwords in Cantonese from a rule-based perspective. Silverman's (1992) first assumption is that two levels are involved in loanword phonology to account for the phonological adaptation of loanwords: the Perceptual Level and the Operative Level, as illustrated in Figure 1. The first level includes the perceived segments and works as an input to the second level. At the Operative Level, the perceived segments pass through some borrowing language' constraints. If these constraints are satisfied, the perceived segments are taken to the actual output (surface level). However, if the surface of these perceived segments violates the borrowing language constraints, they are modified. This means that the phonotactic constraints of the borrowing language is only active at the Operative level where the source forms undergo various phonological processes to ensure they conform with the borrowing language grammar.

Silverman (1992: 289) argues the input at the Perceptual level contains 'merely a superficial non-linguistic acoustic signal'. In other words, the input in the adaptation of loanwords is phonetic, rather than phonological. According to this view, borrowers are unable to perceive segments that are not part of their inventory. Furthermore, the phonological representation of the source language has no effect on the adaptation process.

The second assumption of Silverman's view is that the notion of phonetic salience accounts for the surface of some segments (e.g. the faithful adaptation of the English coda /s/ in Cantonese although fricatives are not allowed to surface in coda positions in Cantonese). The third assumption is that the rules observed in the analysis of the adaptation of English loanwords into Cantonese belong exclusively to the grammar of loanword phonology.

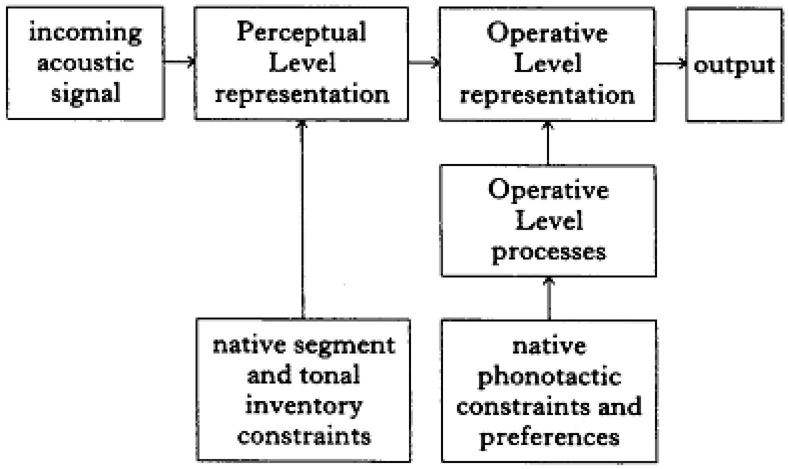

Figure 1. Silverman's multiple-scansion model (1992: 293)

Consider the following concrete example. Cantonese speakers match the input of an English non-native feature matrix to the closest native segment. This closeness is based on the articulatory and/or acoustic properties of segments. For instance, Cantonese does not contrast stop consonants in voicing; therefore, all Cantonese stops are voiceless. Accordingly, English voiced and unaspirated voiceless obstruents are adapted identically in Cantonese as voiceless obstruents. This identical adaptation is attributed to the fact that Cantonese does not contain 'the proper feature matrices' that distinguish voiced from voiceless stops (Silverman 1992: 297). Thus, when adapting the English voiced stops, Cantonese speakers attempt to produce the native segments which carry the feature bundles that articulatory and/or acoustically resemble the feature bundles of English voiced stops. This adaptation is demonstrated in the following examples (Silverman 1992: 297).

(14)		input		Perceptual Level
	a.	**b**all	→	[**p**ɔ]
		game	→	[**k**ɛm]
	b.	sala**d**	→	[sa lø**t**]
		sideboar**d**	→	[say pu**t**]
	c.	s**t**ick	→	[si **t**ik]

As presented in (14), the underlined English stops (whether voiceless or voiced) are mapped to Cantonese voiceless stops. The main difference between the Perceptual and Operative levels is that all English segments that are available in Cantonese are perceived at the Perceptual level, regardless of any phonotactic constraints that prohibit the surface of some segments in particular positions. Only at the Operative Level do the perceived segments at the Perceptual Level undergo phonological processes depending on the Cantonese phonotactic constraints. For instance, although Cantonese inventory includes fricatives and affricates, they are only allowed to surface in onset positions. Therefore, the adaptation of English fricatives in coda positions is subject to occlusivisation, as demonstrated by the following derivation (Silverman 1992: 300).

(15)	Input	shaft	lift
	Perceptual Level	[sɐf]	[lif]
	Operative Level	[sɐp]	[lip]

As can be seen in the previous derivation, the English fricatives are perceived faithfully by Cantonese speakers at the Perceptual level. However, the fricatives are changed to stops at the Operative Level due to the Cantonese constraint C > [-cont] /___]$_\sigma$.

Yip (1993) utilised the Optimality-Theoretic framework to reanalyse the phonological adaptation of English loanwords into Cantonese presented in Silverman's work. In particular, she dispensed with the notion of the phonological rules proposed by Silverman at the Operative Level; presenting instead a constraint-based approach. Furthermore, she argued that the native Cantonese constraints account sufficiently for the adaptation processes without the need for specific constraints related only to loanword phonology. This argument contradicts Silverman's (1992: 290) proposal that the rules involved in the adaptation process of English loanwords into Cantonese are 'peculiar to the loanword phonology'.

Although Yip (1993) disagreed with Silverman on the aforementioned points, she agreed that there are two levels in loanword phonology: the Perceptual level and the Operative level. In particular, she concurred with Silverman's view that Cantonese speakers would perceive only English segments that are available in Cantonese inventory. Segments which Cantonese inventory lacks would not be included in the input at the Perceptual level.

Focusing on the nature of the Operative level, Yip (1993: 271) argued that the phonological processes conducted at this level aim to produce outputs that are well-formed in the borrowing language in addition to 'mimic the perceived input as closely as possible'. Therefore, in her analysis, Yip presented five major constraints: OK- σ constraint that is related to satisfy the syllable structures of Cantonese, FAITHFULNESS which is related to the requirement of preserving the elements of the inputs, PARSE and FILL which respectively militate against deletion (underparsing) and epenthesis (overparsing), and the last constraint is MINWD$^{\sigma\sigma}$ which requires the prosodic words in Cantonese to be minimally bisyllabic. To illustrate Yip's argument, consider the following example. The English loanword *cut* /kʌt/ is adapted in Cantonese as [k^hat]. The evaluation of this adaptation is presented in the following tableaux.

Tableau 2

/kʌt/	OK-σ	FAITHFULNESS	MINWD	PARSE	FILL
☞ a. k^hat			*		
b. k^ha.t^hi		*!			*
c. k^ha.<t>		*!	*	*	

As illustrated in tableau (2), the optimal output wins against other outputs *[k^ha.t^hi] and *[k^ha.<t>]; thereby violating the FAITHFILNESS constraint by respectively inserting the vowel finally and deleting the segment /t/.

It appears unlikely that the phonetic view proposed by Silverman is capable of accounting for all the segmental adaptation patterns in English loanwords adapted in QA. For instance, Silverman (1992: 299) argued that the non-native segment /v/ is adapted in Cantonese as [w] because [w] is the acoustically closest segment to /v/. However, in QA, the English /v/ is always mapped to its phonologically-closest segment [f].

Although Peperkamp and Dupoux agree with Silverman that perception plays a role in the adaptation of loanwords, they differ in terms of the degree of the perception effect on the process of loanword adaptation. Whereas Silverman (1992) proposes that the adaptation processes are performed at the Perception and the Production levels, Peperkamp and Dupoux believe that all adaptation processes occur automatically at perception. The process of vowel epenthesis employed in some languages to break up the consonant clusters illustrates this point. According to Silverman, consonant clusters are perceived faithfully until they are modified by vowel insertion at the production level. However, Peperkamp and Dupoux propose that consonant clusters are immediately perceived with a vowel insertion.

2.3.2 P-map Hypothesis

Within the perceptual view, there are two opinions regarding the nature of the adaptation process. The first holds that the adaptation process of non-native segments and structures occurs completely during perception (Peperkamp and Dupoux 2003; Peperkamp 2005; Peperkamp *et al*. 2008). This adaptation process 'originate(s) in the process of phonetic decoding during speech perception' (Peperkamp 2005: 350). According to this perspective, borrowers are unable to perceive foreign inputs. The second opinion argues that perception plays a role in the adaptation process; but adjustments of non-native segments and structures are motivated by the notion of perceptual similarity which is incorporated into the L1 native grammar in production. In other words, illicit forms are mapped to their perceptually similar forms in the borrowing language. The perceptual similarity 'is determined by the relative ranking of (perceptual) faithfulness constraints with respect to native structural constraints.' (Kang 2011: 6). This view differs from the perception-only approach which holds that borrowers can not perceive non-native structures or sounds. Instead, according to the view of perceptual similarity, borrowers can perceive foreign inputs; however, their native phonotactic constraints adjust foreign inputs based on perceptual similarity (Kang 2011). The most prominent work in this regard is the Perceptual-map Hypothesis (P-map) proposed by Steriade (2001). Following the P-map, several studies were conducted to demonstrate that the adaptation process is based crucially on the perceptual similarity between inputs and outputs (Yip 2002, 2006; Kang 2003; Kang *et al.* 2008; Kenstowicz 2003, 2007; Miao 2005; Kawahara 2006; Shinohara 2006; among others).

Steriade (2001) observed that languages tend to follow a universal repair in adapting foreign sounds or syllables. In other words, among the possible repair strategies, languages tend to select one strategy for repairing foreign sounds or illicit syllable structures. Steriade argued that the reason for choosing this particular repair strategy is to make the input relatively similar to the output. That is, languages attempt to perceptually make the input similar to the output. Therefore, Steriade (2001) based her argument on the notion of perceptual similarity. When L1 speakers are confronted with a foreign sound or an illicit syllable structure, they attempt to modify the foreign sound or the illicit syllable so that the L1 forms resemble the L2 forms perceptually for the purpose of reducing confusion. Consequently, the L2 and L1 forms will have similarities from the perspective of perception. To illustrate Steriade's notion of perceptual similarity, consider the following two cases where the first one relates to a repair of a phonotactic constraint and the second case presents a repair of the segmental constraint.

The Korean language prohibits the occurrence of the cluster /tm/ and it has been found that this illicit cluster is repaired frequently by vowel epenthesis between the cluster (Steriade 2007). For instance, the English word *litmus* is adapted in Korean as [lit^{h}ɨmusɨ] by inserting the vowel /ɨ/ to break the illicit cluster /tm/. Steriade wondered why Korean follows the strategy of vowel insertion to break the illicit cluster (i.e. [tm]->[tɨm]) instead of changing the first consonant of the cluster /t/ to [m] (i.e. [tm]->[mm])? She argued that the reason for choosing the strategy of vowel epenthesis is to preserve most of the input details. Accordingly, the pair [tm]-> [tɨm] will be more similar than the pair [tm]-> [mm]. This observation of the notion of similarity leads Steriade (2007: 14) to universally propose that 'the faithfulness constraints prohibiting greater input-output disparities ranked higher than those prohibiting lesser disparities'. For instance, in the Korean case, the faithfulness constraint IDENT[PLACE] will be ranked higher than IDENT-IO because Korean speakers reported that changing the ill-formed cluster /tm/ into [mm] is less similar than inserting a vowel between the cluster [tɨm]. The primary effect of proposing the notion of relative similarity is to favour one repair of a phonotactic violation over several possible repairs. In Korean, the repair [tɨm] is selected over [mm] for repairing the ill-formed cluster /tm/.

The other example that illustrates the repairing of the segmental constraint is presented in Miao's (2005) study. The author applied Steriade's model to analyse the adaptation patterns of English, Italian and Germanic loanwords adapted into Mandarin. Miao reported that foreign obstruents are adapted into Mandarin with a change in voicing or aspiration feature but never in manner or place. For instance, the foreign segment /p/ is mapped to the Mandarin aspirated plosive [p^h] but never to *[k^h] or *[m]. Furthermore, the foreign-voiced plosive /b/ is mapped to the Mandarin voiceless plosive [p]. The adaptation patterns observed by Miao produced the following ranking of perceptual faithfulness constraints, which accords with the P-map hypothesis:

(16) IDENT(Manner) >> IDENT(Major Place) >> IDENT(Place) >> IDENT(Voice/Aspiration)

Observing that some repair strategies are universally preferable over others leads Steriade (2001) formulated universal perceptual constraints termed as Perceptual Map (P-Map). The P-map includes universal preferences for repairing phonotactic or segmental violations and these preferences become ranked faithfulness constraints. The formal definition of the P-Map is 'a conjecture about the link between similarity rankings and the structure of the faithfulness component in an Optimality Theoretic grammar'. (Steriade 2007: 13).

Following Steriade's approach, Kang (2003), Yip (2002, 2006) and Kenstowicz (2003) based their analysis on the specific production constraints derived from perceptual and/or phonetic factors. For instance, Yip (2002, 2006) investigated the adaptation patterns of English vowels into Cantonese and proposed a set of MIMIC constraints. These faithfulness constraints originated from acoustic similarity between English (input) and Cantonese (output) vowels and aimed to base the adaptation process on the notion of phonetic similarity. Consider a concrete example, Cantonese grammar prioritises matching the quality of English vowels to their acoustically closest Cantonese vowels at the expense of their length. Therefore, MIMIC-QUALITY outranks MIMIC-LENGTH. For instance, the English short vowel /æ/ is mapped to its acoustically closest match in Cantonese [ɛː] or [aː]. We can observe that the quality match takes precedence over the length match.

Kang (2003) found that a word-final postvocalic stop in English loanwords is adapted into Korean with a vowel insertion after it. This adaptation pattern is deemed peculiar as Korean phonology does not require a vowel insertion after a word-final postvocalic stop in native words. Therefore, Kang examined almost 5000 English words that are adapted recently into Korean to discover the factors that lead to vowel insertion after a word-final postvocalic stop. She identified phonological factors that are involved in the vowel insertion; namely, when the final stop is preceded by a tense vowel and when the final stop is voiced. In particular, she indicated the effect of two phonetic characteristics of the English input: stop release and voicing. In English, stops are released more frequently after tense vowels. This phonetic fact explains why Korean speakers frequently insert a vowel after a word-final stop preceded by a tense vowel in English loanwords. Given this, Kang (2003) related the phenomenon of a vowel insertion after a word-final stop in English loanwords to the idea of perceptual similarity between input and output. In particular, since final stops are more likely to be released after tense vowels, an insertion of a vowel after a word-final postvocalic stop occurs to produce an output that is perceptually close to the input (Kang 2003). The idea of perceptual similarity can also be utilized to account for the adaptation pattern of inserting a vowel more frequently after English voiced stops than after voiceless stops. Accordingly, Kang proposed the constraints BESIMILAR[release] and BESIMILAR[voice] which are ranked above DEP(V). These constraints and their rankings can account for the adaptation pattern of vowel insertion after prevocalic word-final stops in English loanwords adapted in Korean.

Kenstowicz (2007) analysed the adaptation of English loanwords into Fijian with the focus on four adaptation patterns: stress, consonant cluster resolution, variation in the form of the epenthetic vowel, and the adaptation of voiced stops. He analysed these adaptation patterns from the perspective of auditory saliency and similarity and argued that Fijian speakers ‘will tend to preserve features whose absence would be most noticeable’ and map foreign segments to the closest ones available in Fijian inventory (317). Although stress in Fijian is predictable and not presented on orthography, Kenstowicz (2007) found that Fijian speakers often preserved the source stress of English loanwords. If repair was needed, Fijian speakers attempted to bring the English loanword forms into conformity with the phonotactic constraints of the Fijian native grammar (e.g. vowel length for bimoraic restriction) while keeping intact the source language’s stress. For instance, Fijian language adapts the English word *colony* as [kòːlóni] with the input stress being preserved and the first vowel being lengthened to satisfy the bimoracity restriction. Kenstowicz (2007) concluded that the different adaptation patterns of loanwords from English into Fijian are motivated primarily by the notions of auditory saliency and similarity.

To illustrate Steriade’s model, we can apply Steriade’s perceptual scale to the adaptation of foreign English consonants into QA. According to Steriade’s hypothesis, languages tend to use the repair strategy of devoicing universally when confronted with illicit voiced consonants. Therefore, the [voicing] feature is cross-linguistically ranked as the lowest confusable feature. In other words, if voicing feature is changed, it would perceptually create a less difference between input and output than if we change other features. Based on this argument and since QA lacks the voicing contrast between labial consonants, the English voiceless stop /p/ is expected to be adapted as its voiced counterpart [b] and the English voiced fricative /v/ is expected to be mapped to its voiceless peer [f]. Indeed, this is demonstrated precisely in the results pertaining to the adaptation patterns of the English labial consonants into QA, as illustrated in the following examples.

(17) Pepsi > [bib.si]
video > [**f**id.ju]

However, what about the adaptation of the English sounds /tʃ/ and /ʒ/ which are considered as illicit sounds in QA? According to the P-map hypothesis, manner features are more resilient to change than place and that place are more resilient than voice. Therefore, /ʒ/ is predicted to be mapped to [ʃ] as this adaptation targets changing the value of the input feature [+voiced] to [-voiced]. However, the results reveal that /tʃ/ and /ʒ/ are mapped to the QA consonants [ʃ] and [dʒ] with a change in manner feature. Changing the manner feature of the input (i.e. continuant) instead of the place feature (i.e. coronal or anterior) or voicing does not correlate with the ranking constraints of the P-map, which proposes that IDENT[Manner] should outrank IDENT[Place] and IDENT[Voice].

Overall and as indicated by Herd (2005), a positive aspect of the P-Map is that it provides insights into universal preferences for choosing one repair strategy over others; consequently, having rankings of universal faithfulness constraints. These universal preferences could resolve the issue that the traditional framework of OT faces when generating ('Too-Many-Solutions') to one phonological process. However, the weak thing about the P-map, as noted by Herd (2005), is that this theory does not provide an explanation of why some universal repairs are preferred over others. For instance, what makes the [voicing] feature to be perceived as the less discriminable feature? Steriade (2001, 2007) does not provide an answer to this question as she (2007: 14) states explicitly that "the P-map does not claim that perceptibility determines when a phonotactic will be satisfied or violated, or whether it will trigger any input modification at all...". The primary function of the P-map is to predict that if a repair strategy of a specific violation makes the input be less similar than the output, this repair strategy will not be chosen. Conversely, if a repair strategy makes the input be more similar to the output, it will be selected.

In the same line of Herd's argument, we return to the adaptation patterns of the English consonants /p/, /v/, /tʃ/ and /ʒ/ as the QA consonants [b], [f], [ʃ] and [dʒ], respectively. What factors lead QA speakers to consider changing the values of the input features [voicing] and [continuant] be less discriminable than changing other features? The P-Map theory could not answer this question. However, by referring to the contrastive hierarchy of QA consonant inventory, we can find the answer to the above question. The motivation of adapting the English consonants /p/ and /v/ as the QA consonants [b] and [f] is that the [voicing] feature is not contrastive at the lexical level within the labial consonants in QA. Furthermore, adapting the English /tʃ/ and /ʒ/ as the QA consonants [ʃ] and [dʒ] is attributed to the fact that the feature [continuant] is not contrastive within the QA [-anterior] consonants. Therefore, the contrastive hierarchy of QA consonant inventory can provide us with rankings of faithfulness and markedness constraints that are motivated by the lexical level, which is beyond the scope of the P-Map.

2.4 Conclusion

This chapter provides an overview of the main approaches in the field of loanword phonology. It demonstrates that some researchers argue that all adaptation processes occur at perception and that the phonetic representations of the source and borrowing language shape the nativisation of loanwords. On the other hand, other researchers maintain that perception has no effect on the process of adaptation and that phonological representations undertake the primary role in nativisation. Finally, researchers consider both perception and production to affect the adaptation process. By reviewing these approaches, I have proposed that perception and/or phonetic details appears to have no crucial effect on the segmental adaptation of English loanwords in QA. Rather, the adaptation patterns of English consonants and vowels into QA is better accounted for by referring to the phonological features of the QA.

Chapter 3: Phonology of QA and English

Since the central topic of this study is to examine how segments of English words are mapped to QA, this chapter aims to provide a short overview of the phonology system of QA and English; focusing primarily on the segmental inventories of the two languages. In §3.1.1, a profile of QA is presented, followed by a description of the QA consonant and vowel inventories in §3.1.2 and §3.1.3, respectively. Chapter Six will highlight that some of the variable adaptation patterns are attributed to the influence of QA syllable structures in addition to its stress system. Therefore, §3.1.4 and §3.1.5 provide a short sketch regarding QA syllabic and stress patterns. Then, the consonant and vowel inventories of English are provided in §3.2. Finally, the conclusion of this chapter is provided in §3.3.

3.1 Qassimi Arabic

3.1.1 Where is Qassimi Arabic spoken?

Qassimi Arabic (QA) is a variety of Arabic spoken in the Qassim region located in the north central region of Saudi Arabia (see Figure 2). As illustrated on the map, Qassim shares borders with three regions: Ha'il in the north, Riyadh in the south and east, and Medina in the west. Qassim is located approximately 220 miles from the capital city of Riyadh and had an estimated one million inhabitants in 2004 (Al-Rojaie 2013). The largest city in the Qassim region is Buraydah, which constitutes half the population of Qassim region.

This dialect is considered a sub-dialect of Najdi Arabic (NA) and it is spoken by the sedentary people (Ingham 1994, Al-Rojaie 2013); in other words, people who live in the urban areas. Al-Rojaie proposed that the roots and origins of the QA can be traced back to the era between the 13th and 16th century when people first settled in Qassim.

Figure 2: A map showing the location of Qassim region in Saudi Arabia (adapted from Al-Rojaie 2013: 45).

NA is spoken widely in the middle of Saudi Arabia and its borders range from Yemen in the south to Jordan in the north and from Al-Ahsa in the east to Hijaz in the west (Al-Sweel 1990). The fact that the dialect is spoken within this huge area entails the development of linguistic variations across NA sub-dialects. Therefore, I chose QA instead of NA to limit my focus to one specific variety since I am a native speaker of QA. It is noteworthy that the QA dialect is distinct from both Modern Standard Arabic (MSA) and Classical Arabic (CA)[4].

Whereas Najdi Arabic has received significant attention in the literature, with several studies targeting different varieties (e.g. Lehn 1967; Abboud 1979; Prochazka 1988; Ingham 1994; Alqahtani 2014), few have described exclusively the phonology of QA (Johnstone 1967; Al-Sweel 1990; AlMotairi 2015; Alrashed 2018). Although QA has been influenced by the mother dialect NA in most of its linguistic features, QA remains distinguished by some linguistic features. One of

[4] '[T]he terms Classical Arabic and Modern Standard Arabic being used to describe its medieval and modern variants, respectively…Arabic came to have one standard variety and a large number of regional and social dialects'. (Watson 2002: 8).

the most distinctive and best-known features of QA is the morphological fact of having the item *buh* instead of the Najdi item *fiih* to give the literal meaning ‘there is/are’, as in ***<u>buh</u>*** *sajjarah* ‘there is a car’. Furthermore, QA is distinguished by not exhibiting a final vowel /a/ in the feminine possessive pronoun -*ha*, as in /ki.taː.ba.h**<u>a</u>**/ > [ktaː. bah] ‘her book’. Finally, QA omits the final vowel /i/, which is suffixed to the past-tense verbs and prepositions to denote first singular pronoun; for example, /ðˤa.ra.ba.n**<u>i</u>**/ > [ðˤra.ban] ‘he hit me’ and /min.n**<u>i</u>**/ > [min] ‘from me’.

The following section provides a detailed description of the QA consonants based on the place and manner of articulation.

3.1.2 Consonant inventory of QA

QA inventory comprise the 27 consonants presented in Table 1. The consonants are /b/, /f/, /t/, /tˤ/ /d/, /θ/, /ð/, /ðˤ/, /s/, /sˤ/, /z/, /ʃ/, /dʒ/, /k/, /g/, /χ/, /ʁ/, /ħ/, /ʕ/, /h/, /ʔ/, /n/, /m/, /w/, /j/, /l/, /r/.

	Bilabial	Labio-dental	Inter-dental	Alveolar	Post-alveolar	Palatal	Velar	Uvular	Pharyngeal	Glottal
Stop	b			t d			k g	*q		ʔ
Emphatic Stop				tˤ *dˤ[5]						
Fricative		f	θ ð	s z	ʃ			χ ʁ	ħ ʕ	h
Emphatic Fricative			ðˤ	sˤ						
Affricate				[t͡s] [d͡z]	dʒ					
Nasal	m			n						
Lateral				l						
Tap				r						
Glide	w					j				

Table 1: The Consonantal Inventory of Qassimi Arabic.

Comparing the CA consonant inventory with QA consonant inventory reveals the following differences, as noted by Ingham (1994: 13) when describing the consonant inventory of NA. First, as can be seen from Table 1, the CA pharyngealised voiced plosive /dˤ/ and pharyngealised voiced interdental fricative /ðˤ/ are a single phoneme in QA as /ðˤ/. Thus, the CA consonant /dˤ/ is lost in QA inventory. For instance, the first consonants of the CA verbs /**<u>dˤ</u>**arab/ 'to hit' and /**<u>ðˤ</u>**alaːl/ 'shadow' are pronounced in QA identically as /ðˤ/ (Ingham 1994). Second, the CA glottal stop /ʔ/ is replaced in QA by a long vowel when it occurs medially, with the exception of some words that are borrowed from CA. This is illustrated in the following two CA words /ra**<u>ʔ</u>**s/ 'head' and /ði**<u>ʔ</u>**b/

[5] Consonants with the asterisk * are mainly available in Classical Arabic inventory and lost in QA inventory or pronounced in limited situations, as will be demonstrated soon after this table. Furthermore, [t͡s] and [d͡z] are allophones of /k/ and /g/, respectively.

‘wolf’, which are pronounced in QA as /r**<u>aː</u>**s/ and /ð**<u>iː</u>**b/. However, the glottal stop in the CA word /sa**<u>ʔ</u>**al/ ‘to ask’ is persevered faithfully in QA. Third, the CA voiceless uvular plosive /q/ is fronted a bit in QA to be produced as the voiced velar plosive /g/, as in /qaːl/ > [gaːl] 'he said'. This substitution has its exception in some words borrowed from CA and/or MSA, as in /**<u>q</u>**ur.ʔaːn/ 'Muslim holy book' /**<u>q</u>**aːr.rah/ 'continent'. Fourth, the consonant /r/ in QA is realised as a tap. However, it is pronounced as a trill when it is geminated, as in *dʒarraah* ‘surgeon’. Fifth, the QA consonant inventory includes the process of affrication where ‘the velar stops /k/ and /g/ are realized as two dental and affricated variants [t͡s] and [d͡z], respectively (when these sounds /k/ and /g/ precede front vowels), as in [at͡sil] 'food' and [briːd͡z] 'teapot'.’ (Al-Rojaie 2013: 43).

3.1.3 Vowel inventory of QA

The QA vowel inventory consists of eight vowels /i/, /iː[6]/, /a/, /aː/, /u/, /uː/, /eː/ and /oː/, as illustrated in Figure 3.

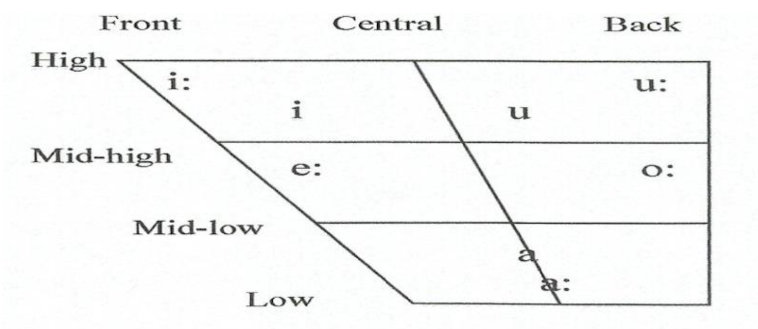

Figure 3: The vowel inventory of QA (adapted from AlMotairi 2015: 8).

As can be seen from the vowel chart, the QA vowel inventory contrasts phonemically back vowels /u(ː)/ and /oː/ with non-back vowels /i(ː)/, /eː/ and /a(ː)/. Furthermore, the inventory distinguishes three degrees of vowel height: high, mid, and low. The high vowels /i/ and /u/ and the low vowel /a/ contrast in length with their long counterparts /iː/, /uː/ and /aː/. However, the length contrast within the mid vowels /eː/ and /oː/ is missing and they surface only as long. This is because the mid vowels in QA are derived diachronically from the CA diphthongs. In particular, the vowel inventory of CA comprises two diphthongs, /aj/ and /aw/. However, the surface of diphthongs in

[6] Throughout this study, the IPA sign ː is used to represent long vowels.

QA is prohibited, as it is in numerous Arabic dialects (Ingham 1994; Watson 2002). According to this restriction, the diphthongs /aj/ and /aw/ in CA surface as the long vowels [eː] and [oː] in QA. This is illustrated in the following words:

(18)	CA	QA	Gloss
	/bajt/	[beːt]	‘house’
	/lawn/	[loːn]	‘colour’

The lax-tense distinction is not available within the QA inventory. In other words, QA has the tense vowel /i/ but not /ɪ/. Finally, the low vowel /a/ in QA is changed to the low back vowel /ɑ/ if /a/ occurs adjacent to emphatic consonants. That is, the low back vowel /ɑ/ in QA co-occurs with emphatic consonants, as in [ð**<u>aː</u>**ʕ] 'he spread' vs. [ðˤ**<u>ɑː</u>**ʕ] 'he got lost'.

Before contrastively specifying the QA vowels with the phonological features in §6.2, it is crucial to explain here that the low vowel /a/ in QA is divided phonologically into two allophones [a^{+back}] and [a^{-back}]. This is because in §6.1.3 and §6.1.6, we show that the English low back vowel /ɑ/ is adapted as the QA low vowel [a]. Simultaneously, the English low front vowel /æ/ is mapped to the QA low vowel [a]. Based on this adaptation pattern, we assume that, phonetically, QA has only one low vowel /a/ but phonologically there are two vowels [a^{+back}] and [a^{-back}] and each vowel has its long counterpart [$aː^{+back}$, $aː^{-back}$]. The consequence of this division leads to different feature specifications for each vowel. Therefore, [a^{+back}] is contrastively specified as [-consonant, +back, -labial, -long], [$aː^{+back}$] as [-consonant, +back, -labial, +long], [a^{-back}] as [-consonant, -back, +low, -long] and [$aː^{-back}$] as [-consonant, -back, +low, +long].

The QA writing system has roughly a direct correspondence between grapheme and phoneme. In other words, all the QA produced consonants should contain correspondent graphemes. This case of direct grapheme-to-phoneme correspondence is not always attainable in terms of vowels. Unlike short vowles, long vowels in QA are always reflected in the writing system.

Chapters five and six outline that the syllable structures and the distribution of stress in QA play a role in having variations on segmental adaptations. For instance, English long vowels that occur word-finally are not mapped faithfully. That is, they are adapted as short vowels in QA because long vowels in QA are prohibited from surface if they occur word-finally. Therefore, sections 3.1.4 and 3.1.5 provide a brief sketch of the syllable patterns of QA alongside the distribution of stress.

3.1.4 Syllable patterns in QA

QA has ten different syllable patterns, as presented in (19).

(19) Examples of syllable patterns in QA:

a.	CV	/**<u>ki</u>**.tab/	'he wrote'
b.	CVC	/ki.**<u>tab</u>**/	'he wrote'
c.	CVV	/**<u>ka</u>**ː.tib/	'writer'
d.	CVVC	/**ra**ː**ħ**/	'he went'
e.	CVCC	/**bint**/	'daughter'
f.	CCV	/**<u>kta</u>**.bat/	'she wrote'
g.	CCVVC	/**kta**ː**b**/	'book'
h.	CCVC	/**<u>gtˤaʕ</u>**/	'pieces'[7]
i.	CCVCC	/**<u>ħrimt</u>**/	'I was deprived'
j.	CCVV	/**<u>jsaa</u>**.fir/	'he travels'

According to the syllable patterns in (19), the syllables in QA should contain onsets, and initial-vowel syllables are not permitted. Moreover, complex onset clusters are not preferable; however, they do occur in specific environments, for instance, as a result of deleting short vowel /i/ when it occurs in open unstressed syllable position, as in (19f) /kitaːb/ > [ktaːb] 'book' (Ingham 1994). Furthermore, complex codas are allowed within the constraint of Sonority Sequencing Principle, which poses restrictions on the sonority profile in both onset and coda clusters, as in (19e). Finally, two syllables could occur anywhere in a word: CV and CVC, while CVV does not occur finally.

QA strictly prohibits the occurrence of vowel-initial syllables, i.e. it always requires onsets. Given this syllable constraint, English loanwords that have vowel-initial syllables are repaired by inserting glottal stops initially. This repair strategy is illustrated in the adaptation of the following English loanwords.

(20)	acid	/ˈæs.ɪd/	>	[ʔaˈsiːd]
	aerial	/ˈeə.ri.əl/	>	[ˈʔir.jal]
	album	/ˈæl.bəm/	>	[ʔalˈbuːm]
	Aspirin	/ˈæs.prɪn/	>	[ʔas.biˈriːn]

The following section discusses the stress system in QA.

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[7] Syllable patterns h, i, and j are taken from AlMotairi (2015: 59-60).

3.1.5 Stress and Syllable weight in QA

3.1.5.1 Theoretical background

The mora has been proposed as a weight unit to determine syllable weight (Hyman 1985, McCarthy and Prince 1986, Hayes 1989, Broselow 1995). Following the moraic weight representation, only nucleus and codas are projecting moras; onsets are not. Onsets are projected by the syllable nodes whilst nucleus and codas are projected by mora levels, as shown in (21). Moreover, short vowels project one mora and long vowels project two moras, as in (22) and (23). Davis and Ragheb (2014) propose that geminate consonants in Arabic contribute weight to the syllables and project one mora. That is, the syllables CVGG constitutes two moras, whether the geminate consonants occur in final or non-final positions, as shown in (24).

(21) Only nucleus and coda are associated to moras

μ μ

C V C

(22) Short vowel is associated to one mora

μ

C V

(23) Long vowel is associated to two moras

μ μ

C V V

(24) Geminates are associated to one mora

μ μ

C V G G

Given this basic notion about moraic representation, syllables are classified into three different kinds based on their weights: light, heavy and superheavy syllables. Light syllables constitute one mora (CV), heavy syllables constitute two moras (CVV or CVC) and superheavy syllables constitute three moras (CVVC or CVCC) (Hyman 1985). However, we will see in the next section that QA exhibits only two levels of weights: light syllables project one mora and heavy syllables two moras. Before discussing the syllable weight of QA, it is important to shed the light on the stress system in QA as its distributions are essential in determining the syllables weight.

3.1.5.2 Stress in QA

QA is a quantity-sensitive dialect that relies on the heaviness of the syllables to determine stress assignment and therefore position (like CA, McCarthy 1979). Since stress depends on the weight of the syllables, I argue that stress position in QA plays a major role in determining the number of moras available in the syllable patterns. Therefore, we will introduce the distribution of stress in QA followed by the weight of the syllables.

Stress falls finally in QA if the word ends with CVVC or CVCC, as shown in pattern (25a, b, h). Otherwise, the rightmost heaviest syllables always attract stress, as exemplified in pattern (25a, b, e, f, h, j, l). In the absence of heavy syllables, stress falls on the penultimate syllables in disyllabic words as in (25d); otherwise, the antepenultimates are stressed, as illustrated in (25i):

(25) Stress patterns in QA:

Stress in disyllabic words

a.	(H)(ˈH)	[(kaːt)(ˈbiːn)]	‘they.MAS wrote’
b.	L(ˈH)	[ka(ˈtabt)]	‘I wrote’
c.	(ˈH)L	[(ˈraː)si]	‘my head’
d.	(ˈLL)	[(ˈka.tab)]	‘he wrote’

Stress in trisyllabic words

e.	(H)(ˈH)L	[(tˤaːb)(ˈʕaː)tah]	‘her printers’
f.	L(ˈH)L	[ka(ˈtab)tu]	‘you.MAS.PL wrote’
g.	(ˈH)(L)L	[(ˈman)(za)li]	‘my home’
h.	(LL)(ˈH)	[(tˤa.la)(ˈbaːt)]	‘orders’
i.	(ˈLL)L	[(ˈku.tu)bi]	‘my books’

Stress in quadrisyllabic words

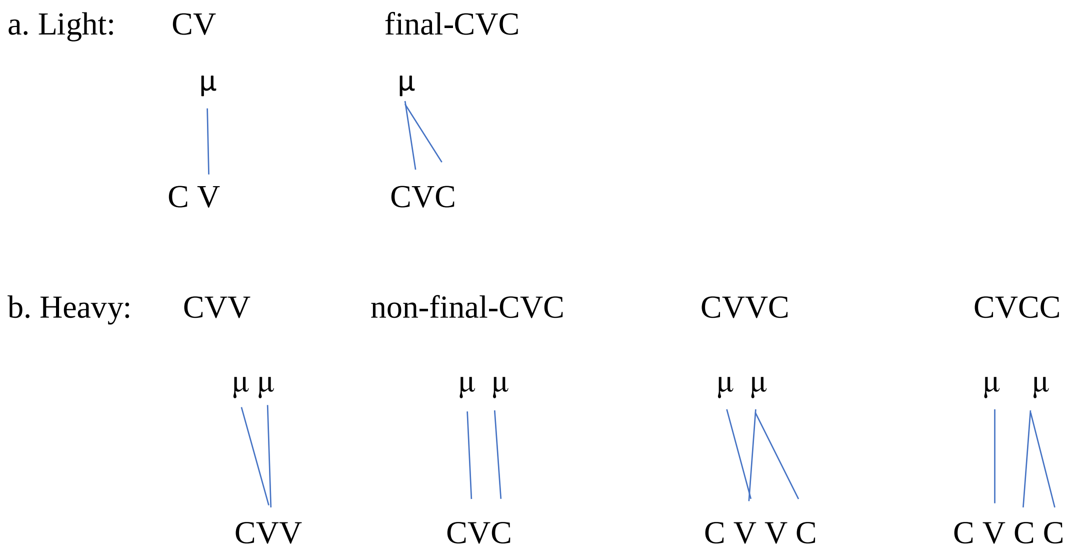
j.	L(H)(ˈH)L	[si(jaː)(ˈraː)tuh]	‘his cars’
k.	L(ˈH)(L)L	[si(ˈjaː)(ra)tuh]	‘his car’
l.	(LL)(ˈH)L	[(ma.ra)(dʒiː)ħah]	‘her swings'
m.	(H)(ˈLL)L	[(mir)(ˈwa.ħa)tuh]	‘his fan’

By virtue of the moraic structure proposed by Hyman (1985) and Hayes (1989) and based on the fact that QA is a quantity-sensitive language that relies primarily on syllable weight to identify stress positions, several major aspects of stress and foot in QA could be noticed from the examples in (25): (i) feet are parsed from left to right and the foot is strictly binary; (ii) QA is trochaic and stress falls on the right foot of the prosodic word; (iii) stress never falls finally unless the final syllables are CVVC or CVCC; (iv) in the absence of final-CVVC or CVCC syllables, non-final rightmost heavy syllables attract stress; (v) stress falls on non-final (but not final) CVC syllables; (vi) non-final-CVVC or CVCC syllables do not attract stress if followed by non-final heavy syllables (CVV or CVC); and (vii) the foot inventory consists of (H) and (LL).

3.1.5.3 Syllable weight in QA

Based on the previous observations about stress distributions in QA, it is obvious that final consonants do not count as adding a mora for the purposes of stress assignment. Grossly speaking, there are several ways to tackle this: first, the last Cs in final CVC are treated as extrasyllabics (adjoined to prosodic words, Kenstowicz 1994; Kiparsky 2003); second, as extrametricals (adjoined to syllable nodes, McCarthy and Prince 1990); third, as mora-sharing (Broselow et al. 1997). That is, segments in codas are dominated by mora levels before they are affiliated by syllable nodes. Broselow et al. (1997) reported a phonetic fact that CV is shorter in duration than final-CVC in Arabic, indicating that coda consonants should be linked to a mora rather than to a syllable node. This phonetic pattern is supported by the fact that heavy syllables (CVV or non-final-CVC) in Arabic "…are about twice the length of [CV] […] and that [final-CVC] […] has about one and a half times the duration of [CV]" (Broselow et al. 1997: 63). Therefore, Broselow et al (1997) hold the view that mora-sharing solution applies to last Cs in final CVC. Following this argument that all codas in almost all Arabic dialects are linked to a mora (Broselow et al. 1995 and 1997), I argue that the last Cs in final CVC in QA are adjoined to the preceding mora, not to the syllable node nor the prosodic word. Furthermore, due to the fact that non-final superheavy syllables in QA do not attract stress when followed by non-final heavy syllables, it is possible to suggest that CVVC and CVCC are similar to heavy syllables in that they are bimoraic, i.e. the last consonant of CVVC and CVCC does not bear its own mora; rather, it is adjoined to the preceding mora (following the proposal first introduced by Broselow (1992) who called it Adjunction-to-Mora, and then mora-sharing in Broselow et al. 1995; 1997; and Watson 2007). The following structures show the syllables weight in QA in terms of mora count:

(26): QA syllable weights



According to the mora patterns in (26), I argue that QA permits only CVVC and CVCC to surface as monosyllabic words; for example, *baab* 'door', *naar* 'fire', *kalb* 'dog', *dʒarħ* 'wound', etc. This is because the prosodic words in QA are minimally bimoraic, as is the case in most Arabic dialects (McCarthy and Prince 1990). By meeting the condition of bimoracity, monosyllabic CVVC and CVCC are allowed to surface in QA. However, CVCs are prohibited from surfacing as monosyllabic words in QA as they form only one mora (only the short vowel is projecting a mora). Moreover, monosyllabic words of CVV are not permitted in QA because CVVs do not occur word-finally and surface medially with other syllables

With the background of the sketch of the QA phonology, the following section provides a brief review of the segmental inventories of English.

3.2 English Phonology

As the consonant and vowel inventories of QA are presented, this section is devoted to providing consonant and vowel inventories of English, which are adapted from Hyman (1975)[8]. Table 2 and 3 below include the consonants and vowels of English.

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[8] Table 2 and 3 are based substantially on Hyman (1975: 240 & 241) with some modifications. For instance, since Hyman includes segments from other languages other than English, I have omitted those segments. Furthermore, as the input in this study is assumed to be British English, I have included the low back rounded vowel /ɒ/. In terms of the IPA symobles, I have substituted the consonants symbols /č/, /ǰ/, /š/, /ž/ with /tʃ/, /dʒ/, /ʃ/ and /ʒ/, respectively and the mid vowels /e/ and /o/ with /eɪ/ and /oʊ/.

	Bilabial	Labio-dental	Inter-dental	Alveolar	alveopalatal	Palatal	Velar	Glottal
Voiceless stop Voiced stop	p b			t d			k g	
Voiceless affricate Voiced affricate					tʃ dʒ			
Voiceless fricative Voiced fricative		f v	θ ð	s z	ʃ ʒ			h
Nasal	m			n			ŋ	
Liquid				l ɹ				
Glide	w					j		

Table 2: The consonants of English

	Front	Central	Back unrounded	Back rounded
High (tense)	iː			uː
(lax)	ɪ			ʊ
Mid (high)	eɪ			oʊ
(central)		ə		
(low)	ɛ		ʌ	ɔ
Low	æ		ɑ	ɒ

Table 3: The vowels of English

Against the background of the QA and English inventories, several differences can be observed between the two. First, whereas English maintain the voicing contrast among labial consonants, this contrast is absent in QA (QA has /b/ and /f/ but not */p/ and */v/). Second, as opposed to English, QA lacks the distinction between the fricative /ʃ/ and its counterpart */tʃ/ and between the affricate /dʒ/ and its fricative counterpart */ʒ/. This indicates that the phonological feature [continuant] is not contrastive among the QA postalveolar consonants. Third, while the feature [dorsal] is active among the nasal consonants in English to denote the velar nasal /ŋ/, the feature [dorsal] in QA is prohibited among nasal consonants (i.e */ŋ/ is an illicit consonant in QA). Fourth, the English post-alveolar approximant /r/ has its phonologically tap counterpart /r/ in QA inventory. Fifth, with respect to the differences between English and QA vowels, since the lax-tense distinction is missing within the QA vowel inventory, the English lax vowels /ɪ/, /æ/ and /ʊ/ are not present in QA inventory. Furthermore, QA inventory lacks the English mid short vowels /ɛ/, /ɔ/, /ʌ/ and /ə/ as the mid vowels in QA should always be long. Sixth, the vowel inventory of QA has the mid vowels /eː/ and /oː/. While these differ acoustically from the English mid vowels /eɪ/ and /oʊ/, they could phonologically resemble the English vowels /eɪ/ and /oʊ/. Finally, the low vowels in QA are non-back. Hence, the English low back vowels /ɒ/ and /ɑ/ are considered foreign in QA.

3.3 Conclusion

This chapter highlights that QA and English inventories overlap in some aspects and differ in others. In particular, whereas QA consonant inventory includes the English consonants /b/, /f/, /t/, /d/, /θ/, /ð, /s/, /z/, /ʃ/, /dʒ/, /k/, /ɡ/, /h/, /n/, /m/, /w/, /j/, /l/, /r/, it lacks the English consonants: /p/, /v/, /tʃ/, /ʒ/, /ŋ/. On the other hand, English inventory lacks the following QA consonants: /tˤ/, /ðˤ/, /sˤ/, /q/, /ʔ/, /χ/, /ʁ/, /ħ/ and /ʕ/. Furthermore, we have seen that the vowel inventory of QA is smaller than that of English, containing only eight vowels /i/, /iː/, /a/, /aː/, /u/, /uː/, /eː/ and /oː/.

Chapter 4: Theoretical Framework

This chapter presents the Contrastive Hierarchy Theory (CHT) proposed by Dresher, Piggott and Rice (1994); Zhang (1996); Dresher and van der Hulst (1998); Dresher (2002, 2003, 2008) and summarised in Dresher (2009)[9]. This theory describes how contrastive features of an inventory are better determined by ordering features hierarchically.[10]

This chapter is structured as follows: section 4.1 introduces the Contrastive Hierarchy Theory (CHT) along with its main tenets. It also contains the *Successive Division Algorithm* (SDA), which demonstrates the process of determining contrastive specifications hierarchically. This is followed by section 4.2, which includes the factors for determining contrastive features. Then, section 4.3 presents how any contrastive hierarchy can be converted into a ranking of OT constraints. Finally, section 4.4 concludes the chapter.

4.1 Contrastive Hierarchy Theory (CHT)

Dresher (2009) proposes the Contrastive Hierarchy Theory, which acts as a method for obtaining contrastive feature specifications of any inventory. He suggests that the contrastive specifications of any phonological inventory can be determined by ordering features hierarchically. The main principles of this theory are: first, contrastive features of an inventory are determined by ordering features hierarchically (Dresher 2018); second, segments in any inventory are specified only for contrastive features (Hall 2011); third, features are binary (±) in a sense that if a feature is considered to be contrastive within an inventory, it should have two representations (+F and –F) (Dresher 2018); fourth, the phonology of a language works only on contrastive features (thus, contrastive features are considered active) (Dresher 2018). In other words, contrastive, rather than redundant, features can account for phonological patterns. Fifth, Dresher (2009) proposes that the feature hierarchy is language-specific. Therefore, even if two languages have identical inventories, they may differ regarding contrastive features of their inventories.

Dresher (2009) provided the *Successive Division Algorithm*, which demonstrates the process of determining contrastive specifications hierarchically.

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[9] For simplicity and consistency, I will often refer to Dresher (2009) when talking about the Contrastive Hierarchy Theory since this theory is summarized in a whole book written by Dresher (2009).

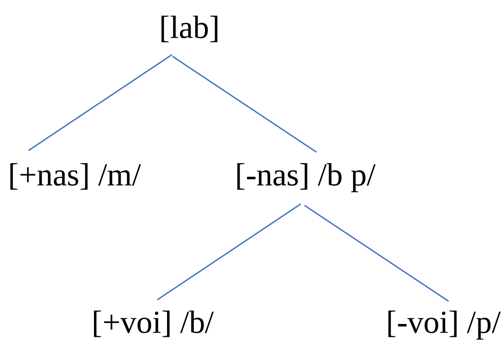
[10] See Dresher (2009) for a detailed argument that obtaining contrastive features through ordering features hierarchically is superior than obtaining contrastive features by following the pairwise approach.

(27) The Successive Division Algorithm (SDA) Dresher (2009: 16)

a. Begin with no feature specifications: assume all sounds are allophones of a single undifferentiated phoneme.
b. If the set is found to consist of more than one contrasting member, select a feature and divide the set into as many subsets as the feature allows for.
c. Repeat step (b) in each subset: keep dividing up the inventory into sets, applying successive features in turn, until every set has only one member.

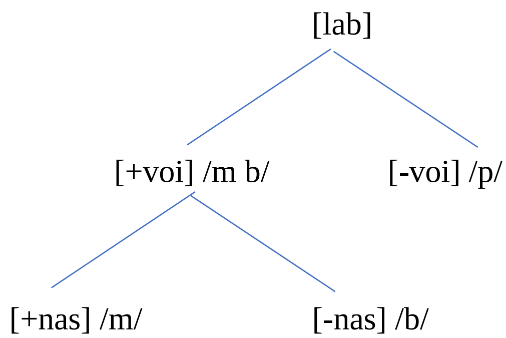
Dresher (2009) illustrates this algorithm by revising the contrastive specifications for the French bilabial stops /m/, /b/ and /p/, which were proposed by Jakobson and Lotz (1949). Since all these sounds share an identical place of articulation, they cannot be distinguished by the [labial] feature. Therefore, the [nasal] feature is required. The sounds are distinguished by dividing them into [+nasal] and [-nasal]. In this case, the sound /m/ is specified contrastively as [+nasal], and there is no need to add further features. Moving to the [-nasal] set, /b/ and /p/ need to be distinguished. This can be accomplished by the laryngeal feature [voicing]. The segment /b/ is specified as [+voiced] and the segment /p/ as [-voiced]. By employing these means to assign contrastive specifications to segments, the ordering features are as follows: [nasal] > [voiced], as depicted in the hierarchical diagram (28a).

(28) a. [nasal] > [voice]



A different order is created if the feature order is altered to begin with the laryngeal feature [voicing]. In this instance, the [voicing] feature will dominate the [nasal] feature: [voicing] > [nasal], as illustrated in the hierarchical diagram (28b). Furthermore, the contrastive representations will differ. The segment /p/ is specified contrastively as [-voiced], and this feature is sufficient to distinguish /p/ from the other segments. Conversely, segments /m/ and /b/ are specified as [+voiced]. To distinguish /m/ from /b/, /m/ is specified as [+nasal] and /b/ as [-nasal].

b. [voice] > [nasal]



4.2 Principles for determining order of features

It is important to establish the mechanism of determining the order of the contrastive features. That is, what factors lead to determine that specific features of an inventory are contrastive? Dresher (2015) reported three principles that motivate feature ordering. These principles are provided below.

(29) The main principles that determine the ordering of features in a hierarchy are:

a. Activity: to identify the contrastive features that are relevant to the phonological computation.
b. Minimality: to minimise redundancy in phonological representations and to maximise the amount of information conveyed by each feature.
c. Universality: to express universal tendencies in the nature of phonological inventoires and the order of acquisition of feature contrasts. Dresher (2015: 1)

Regarding the first principle, Dresher (2009) and Mackenzie (2013) propose that grouping two segments into one set indicates their involvement in phonological activity. For instance, Dresher (2009) provides an example from ATR harmony in Nez Perce, spoken in Northwestern United States, to illustrate how a phonological process can empirically provide motivation in determining the contrastive features of an inventory. This language has dominant-recessive ATR harmony where any vowel in the word, except /i/, specified as [-ATR] causes other [+ATR] vowels to turn into [-ATR]. Based on this phonological process of ATR harmony, Dresher (2009) proposes that the feature [ATR] is active in Nez Perce and should be considered a contrastive feature. In other words, the phonological fact of ATR harmony in Nez Perce motives Dresher to classify the feature [ATR] as a contrastive feature. This is in accordance with Mackenzie and Dresher (2004).

Furthermore, Mackenzie (2013) argues that some phonological processes can be accounted for by referring to the contrastive hierarchy of features; for example, the laryngeal co-occurrence restrictions in Aymara, a native American language spoken in the Andes. In particular, Mackenzie applies the notion of the correlation between features ordering and phonological activity to the laryngeal co-occurrence restrictions in Aymara. She proposes that if the inventory of language X includes only three segments /t d ɗ/, two methods can be applied to specify them hierarchically. The first is to add the [constricted glottis] feature, after which it specifies /ɗ/ as [+constricted glottis] and leaves the segments /t/ and /d/ as [-constricted glottis]. Thus far, /ɗ/ does not need to be specified further, as it is specified distinctively as [+constricted glottis]. However, the segments /t, d/ within the [-constricted glottis] set require additional features to be differentiated. Therefore, the feature [voicing] is assigned and specified /t/ as [-voiced] and /d/ as [+voiced]. In this ordering of assigning features, the feature [constricted glottis] dominates the feature [voicing], as illustrated in (30a). Furthermore, based on this type of division, it is anticipated that /t/ and /d/ will be involved in a phonological activity because they are grouped together within the [-constricted glottis] set. In other words, the phonological activity in this language is predicted to determine the division illustrated in (30a).

(30) a. [constricted glottis] > [voicing]

/ɗ, d, t/

[+constricted glottis] /ɗ/ [-constricted glottis] /t d/

[+voi] /d/ [-voi] /t/

b. [voicing] > [constricted glottis]

/ɗ, d, t/

[+voi] /ɗ d/ [-voi] /t/

[+constricted glottis] /ɗ/ [-constricted glottis] /d/

However, if the feature ordering is reversed and the [voicing] feature dominates the [constricted glottis], as illustrated in (30b), different representations of specifications are obtained. In this case, the [voicing] feature is assigned first, and it will divide the inventory into [+voiced] set: /ɗ/ and /d/, and [-voiced] set: /t/. This leaves /t/ as the only segment specified as [-voiced]. Next, the feature [constricted glottis] is assigned to contrast /ɗ/ and /d/, after which /ɗ/ is specified as [+constricted glottis] and /d/ as [-constricted glottis]. Moreover, this outcome predicts the involvement of /ɗ/ and /d/ in phonological processes (e.g. constricted glottis harmony). Again, in line with Dresher (2009), Mackenzie (2013) argues that although the phonetic realisations of the three segments /t/, /d/, and /ɗ/ in ((30a) and (30b) are identical, there is an assumption that feature ordering plays a role at the phonological level. Indeed, these predictions are supported by empirical evidence. Mackenzie (2013) provides evidence from Ngizim, a Chadic language spoken in Nigeria, whereby the following feature ordering should be applied: [constricted glottis] > [voicing], as presented in (30a). Crucially, such ordering is based on the existence of [voicing] harmony in Ngizim between /t/ and /d/. The presence of the [voicing] harmony between the alveolar stops /t/ and /d/ necessitates grouping these two segments into one set. Conversely, Hausa, a language spoken also in Nigeria, exhibits the phonological process of [constricted glottis] harmony between the alveolar stop /d/ and the alveolar implosive /ɗ/. In this case, the contrastive feature hierarchy would resemble that illustrated in (30b), in which the [voicing] feature has a wider scope than the [constricted glottis].

Concerning the *Universality* principle, Clements (2001) proposes a phonological approach to specifying features contrastively. In the application of his approach, features are specified at different levels, beginning with the lexical level (abstract level) and progressing to the phonological and phonetic levels. In this regard, Clements (2001) proposes that a feature is specified if it meets one of the following essential conditions.

(31) Conditions for feature specification

a. Lexical level: distinctiveness
A feature or feature value is present in the lexicon if and only if it is distinctive (in a sense to be defined).

b. Phonological level: feature activity
A feature or feature value is present at a given phonological level if it is required for the statement of phonological patterns (phonotactic patterns, alternations) at that level.

c. Phonetic level: pronounceability
Feature values are present in the phonetics if required to account for relevant aspects of phonetic realisation. Clements (2001: 77-78)

Furthermore, Clements (2001) proposes that if a feature or feature value is present at the lexical level (abstract level), it is subsequently present at the following level (phonological level). Likewise, if a feature is present at the phonological level, it is present at the phonetic level. Therefore, if a segment is phonetically specified for a feature, it is not necessary for it to be phonologically specified. For instance, the phoneme /k/ is realised phonetically as a voiceless dorsal stop. However, this segment cannot be phonologically specified for the feature [dorsal] in a given language unless the feature [dorsal] is active at the phonological level. In other words, a feature must be distinctive at the lexical level or active at the phonological level to be assigned phonologically. Clements (2001: 78) clarifies the term *distinctiveness* by stating that “a feature is distinctive in a given segment if it is required to distinguish that segment from another segment”. By *activity*, Clements (2001) refers to a feature being active if it is required to introduce a phonological pattern.

To identify distinctive features at the lexical level, Clements (2001, 2009) suggests ordering features in a universal hierarchy scale. In particular, he creates the model of the *accessibility hierarchy* (2001) presented in (32) followed by an edited scale called the *Robustness Scale* (2009) presented in (33). The proposed scales demonstrate that phonological features are ranked universally according to their frequency and acquisition by children. In other words, features that are used frequently cross-linguistically in forming inventories are ranked higher than those used less often. For example, almost all languages differentiate between sonorant vs. non-sonorant segments. However, fewer languages feature a contrast between distributed vs. non-distributed segments. Therefore, the feature [sonorant] is ranked higher than the feature [distributed], because [sonorant] is a highly accessible feature cross-linguistically than [distributed] (Clements 2001). Furthermore, children demonstrate that they acquire the contrast of [+sonorant] vs. [-sonorant] consonants early; thereby entailing the feature’s importance [sonorant] (Clements 2001). For the factors of frequency and acquisition, the feature [sonorant] is ranked high in the hierarchy to show that it is a highly accessible feature. These factors are also applied to the other features from the top down. The main purpose of these scales is to determine among a subset of available features, which are contrastive at the lexical level and redundant in a given inventory.

The scale presented in (32) has two columns. The left column includes the consonant features which are ordered hierarchically. The second column indicates that some features are usually constrained to appear within other features. For instance, the feature [dorsal] presented in (32d) is highly accessible cross-linguistically within the [–sonorant] consonants. This notion is based on the observation that dorsal obstruents (e.g. /k/ and /g/) are used cross-linguistically more frequently than dorsal sonorants (e.g. /ŋ/).

(32) Partial ranked scale of feature accessibility for consonants: Clements (2001: 80)

Feature:	In:
[coronal]	
[sonorant]	
[labial]	
[dorsal]	[-sonorant]
[strident]	
[nasal]	
[posterior]	[+sonorant, -nasal]
[lateral]	[+sonorant]
[voice]	[-sonorant]

In (2009), Clements developed the *Robustness Scale* presented in (33), which is a modified version of the *Accessibility Hierarchy*. This scale comprises five groups of features that are ordered from the top according to their universal robustness and importance. Clements ranks the feature [±sonorant] and the major place features (labial, coronal and dorsal) demonstrated in group (a) above the manner features (±continuant and ±posterior) in group (b). Group (c), which includes the laryngeal feature [±voice] and the manner feature [±nasal], is ranked before the laryngeal feature [glottal] shown in group (d). Finally, other features come in group (e).

(33) Robustness Scale for consonant features: (Clements 2009: 46-47)

Feature:
[±sonorant]
[labial]
[coronal]
[dorsal]
[±continuant]
[±posterior]
[±voiced]
[±nasal]
[glottal]
others

While ordering the consonants of QA hierarchically and when referring to the principle of *Universality*, I will attempt to combine the two scales *Accessibility* and *Robustness*. However, since the *Robustness Scale* is the latest modified scale, I hypothesise that it is the default ranking of phonological features in QA consonant inventory. However, this scale is constrained not to contradict the *Activity* principle if it is available; in other words, the principles of *Activity* and *Universality* will be integrated. However, if these principles are in conflict, priority is given to the *Activity* principle, given that the universal feature hierarchy may encounter some variability across languages, as reported by Dresher (2009, 2015) and Herd (2005), and conceded by Clements (2001: 84-85; 2009: 49).

Note that when appealing to the *Activity* principle, phonological processes are derived from the native grammar of QA. I will refer to the *Feature Accessibility Hierarchy* when I need it to account for features order not included in the *Robustness Scale* or to support the selection of some features. For instance, we refer to the *Feature Accessibility Hierarchy* to exclude the feature [dorsal] from specifying the [+sonorant] segments.

I will refer to the third motivation, *Minimality*, to support the choice of specific features. In other words, in some stages of selecting a feature to specify QA consonants, I will attempt to integrate the principles of *Minimality* with *Universality*. For instance, within the [–dorsal] set /ħ, ʕ, h, ʔ/, the feature [continuant] is selected to distinguish members of this set. This selection is motivated by *Universality*, which characterises [continuant] as a universal accessible feature. However, this selection is also supported by *Minimality* as most of the segments in this set /ħ, ʕ, h/ share the manner feature [continuant].

4.3 Converting the SDA into OT constraints

Mackenzie and Dresher (2004) and Dresher (2009) propose that in order to convert any contrastive hierarchy into a ranking of constraints, only three types of constraints are required: MAX[F], *[F, ф] and *[F]. The first represents the faithfulness constraints, which penalise any output that deletes input features or changes the value of input features. Thus, this type of constraint requires preserving the values of the input features whether + or -. The second constraint denotes co-occurrence constraints, which require prevention of specifying *F* if it co-occurs with ϕ. The last constraint assigns a number of violation marks equal to the number of feature specifications (i.e. an output with three feature specifications will be penalised by three violation marks). The definitions of these constraints are provided below in Mackenzie's (2013: 304) wording.

(34)

a. Max[F]: Assign a violation mark for any instance of [+F] or [—F] in the input that does not have an output correspondent.
b. *[αF, ϕ]$_{seg}$: Exclude αF in the context ϕ, where α ranges over + and —, and ϕ is the set of feature values (with a wider scope than F) forming the context of F. The exclusion holds within the domain of the segment.
c. *[F]: No features may be specified.

The previous constraints are used by applying a series of steps proposed by Mackenzie and Dresher (2004) and Dresher (2009) to convert any contrastive hierarchy into a constraint hierarchy.

(35) Converting a contrastive hierarchy to a constraint hierarchy (Dresher 2009:148)

a. Go to the next contrastive feature in the list, F_i. If there are no more contrastive features, go to (e).
b. In the next stratum of constraints, place any co-occurrence constraints of the form *[F_i, ϕ], where ϕ consists of feature values of features ordered higher than F_i.
c. In the next stratum, place the constraint MAX[F_i].
d. Go to (a).
e. In the next constraint stratum, place the constraint *[F], and end.

The mechanism provided in (35) can be illustrated using the order of features presented in (28a), which can be converted into OT constraints. Since only two features are suggested in (28a), there will be two featural faithfulness constraints MAX[NASAL] and MAX[VOICE]. Since the feature [nasal] is ranked at the top of the hierarchy and divides the inventory into [+nasal] and [-nasal] sets, the featural faithfulness constraint MAX[NASAL] is undominated and ranked above MAX[VOICE]. Step (b), which requires listing all co-occurrence constraints, cannot be applied at this stage as the feature [nasal] is ordered at the top of the hierarchy and there is no feature ordered before [nasal]. As the feature [voice] is not used within the domain of [+nasal], the co-occurrence constraint *[αVOICE, +NASAL] is created, which militates against having the combination of features [voice, +nasal]. Based on the algorithm presented in (35), this co-occurrence constraint should be ranked above the faithfulness constraint MAX[VOICE]. Now, we should move on to step (d) and create the constraint *[F], which will be ranked below MAX[VOICE]. The resulting constraints along with their rankings are provided in (36).

(36) MAX[NASAL] >> *[αVOICE, +NASAL] >> MAX[VOICE] >> *[F]

4.4 Conclusion

The chapter provides a means of identifying contrastive features in an inventory. This can be achieved by ordering features hierarchically to contrastively specify an inventory's segments. The benefit of ranking features hierarchically is to ensure each segment will be distinguished entirely from other segments. Furthermore, the chapter demonstrates how the contrastive hierarchy of features can be converted into a ranking of constraints. By applying this conversion, one can analyse any input of feature specifications within the OT framework. This can be attained by mapping any input of feature specifications to an output that carries only the contrastive specifications.

After introducing the CHT and the means for contrastive specifications hierarchically, Chapter Five will likewise determine the contrastive specifications of QA consonant inventory. Accordingly, it will analyse the segmental adaptation patterns of English loanwords adapted in QA through several OT tableaux.

Chapter 5: Adaptation of English consonants into Qassimi Arabic

In this chapter, I present an Optimality Theoretic (Prince and Smolensky 1993) analysis of the adaptation of English consonants in QA. Remember that the central argument of this thesis assumes that the inputs to QA are fully-specified English outputs which serve as inputs to QA. Note that the assumption of full-specification does not contradict the principle of *Richness of the Base,* as put it by McCarthy (2008: 94): '[y]ou are free to assume *universal* restrictions on inputs, such as full specification, without running afoul of richness of the base'.[11] Then, the native grammar of QA allows only the phonological features of inputs to surface that are contrastive in QA. Thus, phonological features that are redundant or non-contrastive in QA are eliminated from outputs. For instance, based on the contrastive hierarchy of QA, /b/ is contrastively specified as [-sonorant, +labial, -continuant]. In the adaptation of English consonants, the English input segment /p/ is mapped consistently to /b/ in the QA. In this case, the QA grammar filters out the input features, if the input is fully-specified [-sonorant, +labial, -coronal, -continuant, -voiced, …], and permits only the contrastive features [-sonorant, +labial, -continuant] to surface. The core argument is that the adaptation process concentrates on maintaining the input features that are contrastive in QA at the expense of redundant or non-contrastive features in the input. To identify the contrastive features of QA consonant inventory, I rely on the Contrastive Hierarchy Theory (CHT) proposed by Dresher (2009). This theory suggests that phonological features should be ordered hierarchically to obtain only the contrastive features of any phonological inventory. This is achieved by dividing any inventory into subsets of features until each segment is distinguished contrastively from other segments. After creating the contrastive hierarchy of QA consonant inventory, I will frame the features of the contrastive hierarchy as OT constraints to analyse the data in OT tableaux.

Since the inputs are assumed to be fully-specified, the inputs include combinations of features that are licit and illicit in QA. Then, the phonology of QA will allow to surface only the combinations of features that are licit and contrastive in QA.

This chapter is structured as follows. §5.1 presents the results of the adaptation patterns of the English consonants into QA. §5.2 consists of the contrastive hierarchy of the QA consonant inventory. In §5.3, I reveal how the contrastive hierarchy of QA can be converted into OT

[11] Richness of the Base refers to the notion that 'no constraints hold at the level of underlying forms' (Kager 1999: 19).

constraints. Finally, based on the constraint rankings proposed in §5.3, §5.4 features several tableaux that account for the adaptation of all English consonants to QA.

5.1 Results of the adaptation of English consonants into QA

This section provides the results of the adaptation patterns of English consonants into QA. The results show that English consonants which are existent in QA (i.e. /b/, /f/, /t/, /d/, /θ/, /s/, /z/, /ʃ/, /dʒ/, /k/, /g/, /h/, /n/, /m/, /w/, /j/, /l/, /r/) are adapted faithfully. QA differs from English in that voicing is not contrastive among labial consonants, continuancy is not contrastive within postalveolar consonants and, lastly, the dorsal feature is not contrastive among nasal consonants. Based on this, it is predicted that English consonants /p/ and /v/ which are foreign in QA are adapted as [b] and [f] with the disappearance of voicing contrast. Furthermore, the continuancy contrast found among English postalveaolar consonants is expected to be lost after adaptation in QA. Thus, the English /tʃ/ and /ʒ/ will be replaced by [ʃ] and [dʒ] in QA. Lastly, the English velar nasal consonant /ŋ/ is expected to lose the feature dorsal and mapped to the nasal consonant [n] in QA. These predictions are attested and the results of the adaptation patterns of English consonants into QA are provided in the following sub-sections.

5.1.1 Adaptation of English labial stops /b/ and /p/

QA inventory, as English, has the bilabial voiced stop /b/ but it lacks its voiceless counterpart /p/. Therefore, based on the argument proposed in this study that contrastive features of QA play a role in the adaptation process, English /b/ and /p/ are predicted to be mapped to the QA consonant [b]. Consider Table 4 below where it displays the results of the adaptation of the English consonants /b/ and /p/. Note that every table in section 5.1 includes four columns: the first one consists of the inputs of the English consonants, the second includes the QA outputs, the third presents the number of occurrences of the target consonants as well as the percentages of their faithful adaptations and the final column provides the total occurrences of English consonants.

English phonemes	QA outputs	Number of occurrences and percentages	Total
*/p/[12]	[b]	89 (100%)	89
/b/	[b]	55 (100%)	55

Table 4: Adaptation of English bilabial stops /b/ and /p/ in QA

Indeed, the results provided in the table confirms our prediction and shows that all English bilabial stops /b/ and /p/ are adapted into QA as [b]. This adaptation pattern is demonstrated in the following examples.

(37)	English word	English transcription	QA transcription
	album	/ˈæl.**b**əm/	[ʔalˈ**b**uːm]
	captain	/ˈkæ**p**.tɪn/	[ˈka**b**.tin]

5.1.2 Adaptation of English labial fricatives /f/ and /v/

Whereas the consonant inventory of English has distinctive contrast among labial fricatives /f/ vs. /v/, QA inventory lacks this contrast. The absence of the voicing contrast within the QA labial fricatives predicts its influence on adapting the English consonants /f/ and /v/ as the QA voiceless consonant [f]. As can be seen from table 5, the English /f/ is always adapted faithfully (38 occurrences, 100%) and the English /v/ is mapped predominately to [f] (30 occurrences, 96.8%).

English phonemes	QA outputs	Number of occurrences and percentages	Total
/f/	[f]	38 (100%)	38
*/v/	[f] [b]	30 (96.8%) 1 (3.2%)	31

Table 5: Adaptation of English labial fricatives /f/ and /v/ in QA

The adaptation patterns of the English labial fricatives /f/ and /v/ into QA are illustrated in the following examples.

(38)	English word	English transcription	QA transcription
	caffeine	/ˈkæ**f**.iːn/	[kaˈ**f**iːn]
	caravan	/ˈkær.ə.**v**æn/	[ka.raˈ**f**aːn]

[12] The asterisk denotes English consonants that are foreign in QA.

The only exception to this adaptation pattern is mapping the English /v/ in the word *valve* /**v**ælv/ as [b] [**b**alf] instead of the typical mapping [f]. I propose that this case is a dissimilation of place as the loanword *valve* contains the segment /v/ in the first and final syllables. To prevent the occurrence of two homorganic consonants (i.e. the occurrence of two /f/ after adaptation in the same syllable), the first foreign segment /v/ is adapted as /b/ and the final foreign segment /v/ is adapted as the typical segment /f/.

5.1.3 Adaptation of English alveolar stops /t/ and /d/

The data of this study includes 143 occurrences of the English /t/ and 61 of /d/ and the analysis of the data shows that QA speakers have no difficulty in faithfully adapting the English alveolar stops /t/ and /d/ as these two consonants are available in the QA inventory. The results of the adaptation patterns of the English consonants /t/ and /d/ are summarized in table 6 and demonstrated in examples (39).

English phonemes	QA outputs	Number of occurrences and percentages	Total
/t/	[t] [tˤ]	140 (97.9%) 3 (2.1%)	143
/d/	[d] [t]	60 (98.4%) 1 (1.6%)	61

Table 6: Adaptation of English alveolar stops /t/ and /d/ in QA

(39)	English word	English transcription	QA transcription
	boot	/buː**t**/	[buː**t**]
	comedy	/ˈkɒm.ə.**d**i/	[kuˈmiː.**d**i]

However, the table also shows variant adaptation patterns. These patterns include mapping the plain alveolar consonant /t/ to its emphatic counterpart /tˤ/ (3/143 occurrences, 2.1%), as in the English loanword /bɒ**t**.əl/ > [ˈbɑ.**tˤ**il]. In this case, the input feature [-emphatic] undergoes a change to [+emphatic]. This change in the status of emphasis is attributed to the phonological fact that the source forms (i.e. English words) include a low back vowel. The existing of the low back vowel affects the plain consonant /t/ to be produced as [tˤ] (see §5.4.16 for a detailed analysis of the adaptation of the English consonants /t/ and /s/ as their QA emphatic counterparts [tˤ] and [sˤ]). Furthermore, table 6 shows that the English /d/ is adapted as the QA [t] in only one word (i.e. the English word *card* /kɑːr**d**/ is adapted as [kar**t**]).

5.1.4 *Adaptation of English alveolar fricatives /s/ and /z/*

QA inventory includes the alveolar fricatives /s/ and /z/. Therefore, it is expected that the English consonants /s/ and /z/ are adapted faithfully. The results of the data presented in table 7 confirm this expectation and reveal that the English /s/ is regularly mapped to [s] in QA (119/135, 88.1%) as in (40a), sometimes to [sˤ] (11/135, 8.1%) as in (40b) and [z] (5/135, 3.7%) as in (40c). The table also shows that the English /z/ is always realized as [z] in QA.

English phonemes	QA outputs	Number of occurrences and percentages	Total
/s/	[s] [sˤ] [z]	119 (88.1%) 11 (8.1%) 5 (3.7%)	135
/z/	[z]	28 (100%)	28

Table 7: Adaptation of English alveolar fricatives /s/ and /z/ in QA

(40)		English word	English transcription	QA transcription
	(a)	cassette	/kə.ˈ**s**et/	[ˈka.**s**it]
		charisma	/kəˈrɪ**z**.mə/	[kaˈri**z**.ma]
	(b)	offside	/ɒfˈ**s**aɪd/	[ʔuf.ˈ**sˤ**ɑː.jad]
	(c)	glucose	/ˈɡluː.kəʊ**s**/	[ˈdʒluː.koː**z**]
		casino	/kə.ˈ**s**iː.nəʊ/	[ˈka.**z**i.nu]
		gas	/gæ**s**/	[gaː**z**]
		eczema	/ˈek.**s**ɪ.mə/	[ʔikˈ**z**iː.ma]
		Vaseline	/ˈvæ**s**.ə.liːn/	[faː**z**ˈliːn]

5.1.5 *Adaptation of English interdental fricative /θ/*

The English interdental fricative /θ/ appears only in four words. It is preserved faithfully in two words and mapped to [t] in the others, as shown in table 8 and exmplified in (41).

English phonemes	QA outputs	Number of occurrences and percentages	Total
/θ/	[θ] [t]	2 (50%) 2 (50%)	4

Table 8: Adaptation of English interdental fricative /θ/ in QA

(41)		English word	English transcription	QA transcription
	(a)	theme	/**θ**iːm/	[**θ**iːm]
		marathon	/mer.ə.**θ**ɑːn/	[ma.ra.**θ**oːn]
	(b)	thermos	/**θ**ɜː.məs/	[**t**ir.mis]
		thermometer	/**θ**əˈmɒm.ɪ.tər/	[**t**ir.mu.mi.tir]

Since the examples provided in (41b) reveal that the English interdental fricative /θ/ changes to /t/ when it occurs before the central vowels /ɜː/ or /ə/, I assume that the QA speakers have a restriction that bans the occurrence of /θ/ before *[-back, -front, -low] vowels. However, this restriction is not active when the segment /θ/ occurs before other vowels; thus, /θ/ is preserved faithfully in the output as in (41a).

5.1.6 Adaptation of English fricative /ʃ/ and affricate /tʃ/

The QA inventory has the alveopalatal fricative /ʃ/ but it lacks the affricate /tʃ/. Therefore, it is expected that the English /ʃ/ and /tʃ/ are mapped in QA to [ʃ]. Indeed, table 9 shows that the English /ʃ/ is always retained faithfully in QA, as in (42a), and that /tʃ/ is regularly adapted as [ʃ] as in (42b) and, in particular cases, it is retained as in (42c).

English phonemes	QA outputs	Number of occurrences and percentages	Total
/ʃ/	[ʃ]	22 (100%)	22
*/tʃ/	[ʃ] [tʃ]	8 (61.5%) 5 (38.5%)	13

Table 9: Adaptation of English alveopalatal consonants /ʃ/ and /tʃ/ in QA

(42) English word	English transcription	QA transcription
(a) cash	/kæ**ʃ**/	[kaː**ʃ**]
(b) inch	/ɪn**tʃ**/	[ʔin**ʃ**]
(c) clutch	/klʌ**tʃ**/	[kaˈla**tʃ**]
ketchup	/ˈke**tʃ**.ʌp/	[ˈka**t.ʃ**ab]
switch	/swɪ**tʃ**/	[swi**tʃ**]
capture	/ˈkæp.**tʃ**ər/	[ˈkab**t.ʃ**ar]
cappuccino	/kæp. əˈ**tʃ**iː.nəʊ/	[ka.bu**tˈʃ**iː.nu]

Because the English /tʃ/ is replaced largely by the QA consonant [ʃ], I argue that this is the conventional adaptation. Furthermore, I argue that the reason behind preserving the English /tʃ/ in (42c) is attributed to the orthography effect. That is, the fact that the English forms contain the grapheme <t> causes QA speakers to preserve the English /tʃ/ and treat this consonant as two separate segments [t] and [ʃ] as it can be seen from the syllable positions (i.e. [t] occurs in coda and [ʃ] in onset of the next syllable). The only exception to the orthography effect is the English word *cappuccino* /kæp.uˈ**tʃ**iː.nəʊ/ which is adapted in QA as [ka.bu**tˈʃ**iː.nu]. I follow Abu-Guba (2016) who assumes that the retention of /tʃ/ in *cappuccino* could be attributed to the adaptation status that this word is adapted orally from media as it is a recent word.

5.1.7 Adaptation of English fricative /ʒ/ and affricate /dʒ/

The QA inventory has the affricate consonant /dʒ/ but it does not have the fricative counterpart /ʒ/. Thus, it is predicted that English consonants /dʒ/ and /ʒ/ are mapped to the QA consonant [dʒ]. This prediction is attested in the data and the results shown in table 10 and illustrated in (43) reveal that the English affricate /dʒ/ and fricative /ʒ/ are always mapped to the QA affricate [dʒ].

English phonemes	QA outputs	Number of occurrences and percentages	Total
/dʒ/	[dʒ]	30 (100%)	30
*/ʒ/	[dʒ]	7 (100%)	7

Table 10: Adaptation of English alveopalatal consonants /dʒ/ and /ʒ/ in QA

(43)	English word	English transcription	QA transcription
	gentle	/ˈ**<u>dʒ</u>**en.təl/	[ˈ**<u>dʒ</u>**in.til]
	beige	/beɪ**<u>ʒ</u>**/	[beː**<u>dʒ</u>**]

5.1.8 Adaptation of English velar consonants /k/ and /g/

QA inventory includes the velar consonants /k/ and /g/; therefore, it is expected that these two consonants are adapted faithfully in QA. Table 11 reveals that the English velar stops /k/ and /g/ are regularly mapped to the QA consonants [k] and [g] (154/157, 98.2% and 22/26, 84.6%, respectively). This faithful adaptation is demonstrated in examples (44a and b).

English phonemes	QA outputs	Number of occurrences and percentages	Total
/k/	[k] [q] [ʃ] Ø	154 (98.2%) 1 (0.6%) 1 (0.6%) 1 (0.6%)	157
/g/	[g] [dʒ]	22 (84.6%) 4 (15.4%)	26

Table 11: Adaptation of English velar stops /k/ and /g/ in QA

However, several variable adaptation patterns are attested for the English consonants /k/ and /ɡ/ as displayed in (44). First, (44c) shows that the English /k/ is adapted as [ʃ] in QA. I assume that this adaptation pattern is influenced by orthography as the source form is spelled with the grapheme <ch>. Second, (44d) includes the English loanword *consul* which its first consonant /k/ is adapted in QA as [q] instead of the typical adaptation [k]. The place of articulation of /q/ (i.e. uvular) is further back than the place of articulation of /k/ (i.e. velar). This entails that /q/ is more assimilated to low back vowels than /k/. For this reason, I assume that the existence of the low back vowel /ɒ/ in the source form /ˈk**ɒ**n.səl/ affects the velar consonant /k/ to be adapted as the QA uvular consonant [q]. Third, (44e) presents an example where the English /k/ is deleted in the adapted form. Note that the source form includes a complex cluster /ŋk/ followed by a complex consonant /tʃ/. Therefore, if all these consonants are preserved faithfully in QA after adaptation, this leads to constitute a sequence of three consonants /ŋ/ > [n], /k/ > [k], /tʃ/ > [ʃ]. The sequence of these consonants requires a modification by deletion or vowel epenthesis. QA grammar maps the English /ŋ/ to [n] and the English /tʃ/ to [ʃ] and deletes the English /k/. This deletion is necessary because QA grammar does not allow a medial coda cluster of /nk/ nor a complex onset cluster of */kʃ/. If /k/ in this word can not appear in coda or onset position, it needs to be omitted. Fourth, (44f) consists of four English loanwords that have a mapping of the English velar consonant /ɡ/ to the QA affricate consonant [dʒ].

(44)	English word	English transcription	QA transcription
(a)	cable	/ˈ**k**eɪ.bəl/	[ˈ**k**eː.bal]
(b)	air bag	/ˈeər.bæ**ɡ**/	[ʔirˈbaː**ɡ**]
(c)	archive	/ˈɑːr.**k**aɪv/	[ʔar.**ʃ**iːf]
(d)	consul	/ˈ**k**ɒn.səl/	[ˈ**q**ɑn.sˤɑl]
(e)	puncture	/ˈpʌŋ**k**.tʃər/	[ˈban.ʃar]
(f)	catalogue	/kæt.əl.ɒ**ɡ**/	[ka.taˈloː**dʒ**]
	gallon	/ˈ**ɡ**æl.ən/	[**dʒ**aːˈluːn]
	glucose	/ˈ**ɡ**luː.kəʊs/	[ˈ**dʒ**luː.koːz]
	guava	/ˈ**ɡ**wɑː.və/	[**dʒ**aˈwaː.fah]

5.1.9 Adaptation of English nasal consonants /n/ and /m/

The results provided in table 12 and illustrated in (45) display that a total of 92 occurrences of the English /m/ and 145 of /n/ in the English loanwords are preserved faithfully in QA.

English phonemes	QA outputs	Number of occurrences and percentages	Total
/m/	[m]	92 (100%)	92
/n/	[n]	145 (100%)	145

Table 12: Adaptation of English nasal consonants /m/ and /n/ in QA

(45)	English word	English transcription	QA transcription
	(a) ceramics	/sə.ˈræ**m**.ɪks/	[sa.raˈ**m**iːk]
	(b) doughnut	/ˈdəʊ.**n**ʌt/	[doːˈ**n**aːt]

5.1.10 Adaptation of English velar nasal /ŋ/

Whereas the consonant inventory of English distinguishes three different nasal consonants /ŋ/, /n/ and /m/, QA inventory distinguishes only two nasals /n/ and /m/. According to the contrastive specification hierarchy of the QA consonant inventory shown in section 5.2, I showed that the feature [nasal] was employed to contrast /m/ with /w/, and /n/ with /j, l, r/. I also hold the view that it was crucial to use the feature [nasal] instead of [dorsal] to distinguish /m/ from /w/ because, following Clements's accessibility hierarchy (2001: 84), I assume that the feature [dorsal] should not be used within the [+sonorant] set in the contrastive hierarchy of QA consonant inventory. This view is in line with Watson (2002: 36) who stated that '[t]here are no [nasal] dorsal phonemes in either Cairene or San'ani, therefore [nasal] is not an active feature in the specification of [dorsal]s'. The QA segment /n/ assimilates in place to the following velar stops /k, g/ and surfaces as a velar nasal [ŋ], as exemplified in the following words.

(46)				
	[mi**n**.gaːr]	>	[mi**ŋ**.gaːr]	'a bird bill'
	[ʔa**n**.gað]	>	[ʔa**ŋ**.gað]	'he rescued'
	[ʔa**n**.kar]	>	[ʔa**ŋ**.kar]	'he denied'
	[ya**n**.kis]	>	[ya**ŋ**.kis]	'he returned'

Although the alveolar nasal /n/ assimilates the place of the following velars, the velar nasal [ŋ] is not a separate phoneme in QA as it does not contrast with another consonant in QA. Therefore, it is an allophone of /n/. Given this, it is predicted that the English velar nasal /ŋ/ is adapted in QA as the alveolar nasal [n]. Indeed, the results given on table 13 show that the English velar nasal /ŋ/ is always adapted as [n] in QA if /ŋ/ is followed by /k/ and as the sequence of the two sounds [ng] in English words that contain -ng as exemplified in the following words.

(47)	**English word**	**English transcription**	**QA transcription**
	pancreas	/ˈpæŋ.kri.əs/	[ban.kirˈjaːs]
	tank	/tæŋk/	[ˈtaːn.ki]
	boarding	/ˈbɔː.dɪŋ/	[boːrˈding]
	bowling	/ˈbəʊ.lɪŋ/	[boːˈling]
	hanger	/ˈhæ**ŋ**.ə^r/	[ˈhan.gar]

It is obvious from the adaptations of velar nasals in the English words *boarding*, *bowling* and *hanger* that English /ŋ/ is adapted as a sequence of an alveolar nasal /n/ and a velar stop /g/ in QA. This adaptation pattern is illustrated by the stress distributions of the adapted forms [boːrˈding] and [boːˈling] and by the syllabification of the adapted form [ˈhan.gar]. In other words, stress in QA does not occur finally unless the last syllable is superheavy (CVVC or CVCC). If the adapted forms [boːrˈding] and [boːˈling] constituted only final CVC, stress can not be assigned finally. Furthermore, the syllabification of the adapted form [ˈhan.gar] shows that /n/ occupies the coda position of the first syllable whereas /g/ surfaces as the onset of the second syllable. In this adaptation pattern, the feature combination [nasal] and [dorsal] of the English velar nasal /ŋ/ is preserved in a sequence of two phonemes /ng/ whereby /n/ preserves the [nasal] feature and /g/ the [dorsal] feature. This strategy is linguistically known as unpacking (cf. Paradis and Prunet 2000; Dohlus 2010 for other languages).

English phonemes	QA outputs	Number of occurrences and percentages	Total
*/ŋ/	[n]	5 (41%)	12
*/ŋ/	[ng]	7 (59%)	

Table 13: Adaptation of English velar nasal consonant /ŋ/ in QA

5.1.11 Adaptation of English glides /w/ and /j/

As the inventory of QA has the glides /w/ and /j/, it is expected that the English glides are adapted faithfully. Indeed, the data analysis reveals that the English glide /w/ is always preserved faithfully (15/15, 100%) as presented in table 14 and demonstrated in example (48a). Furthermore, table 14 and examples (48b) and (48c) display that the English glide /j/ is regularly retained after adaptation (8/15, 53.3%) and sometimes deleted (7/15, 46.7%).

English phonemes	QA outputs	Number of occurrences and percentages	Total
/w/	[w]	15 (100%)	15
/j/	[j] Ø	8 (53.3) 7 (46.7)	15

Table 14: Adaptation of English glides /w/ and /j/ in QA

(48)	English word	English transcription	QA transcription
(a)	Twitter	/ˈt**w**ɪt.ər/	[ˈt**w**i.tar]
(b)	menu	/ˈmen.**j**uː/	[ˈmin.**j**u]
(c)	bermuda	/bəˈm**j**uː.də/	[barˈmuː.da]
	insulin	/ˈɪn.s**j**ə.lɪn/	[ʔin.suˈliːn]
	manicure	/ˈmæn.ɪ.k**j**ʊər/	[ma.naˈkiːr]

Looking carefully at the examples provided in (48c) where the English glide /j/ is deleted, I propose that the reason for deletion is attributed to the occurrence of /j/ in complex onset clusters /mj/, /sj/ and /kj/ which are not allowed to surface in QA.

5.1.12 Adaptation of English liquids /l/ and /r/

Whereas the rhotic in English is realised as the post-alveolar approximant, /r/ is typically realised in QA as a tap. However, it is pronounced as a trill when geminated, as in *dʒarraah* ‘surgeon’. Given this, varieties of English can be classified as rhotic or non-rhotic (Sharbawi and Deterding 2010). Rhotic varieties include American, Scottish and Irish Englishes, whereas non-rhotic includes Australia, New Zealand, South Africa and Received Pronunciation British Englishes (Wells 1982). The effect of this division is that /r/ in rhotic varieties is pronounced whenever it is found as a grapheme in writing. Conversely, /r/ in non-rhotic varieties is pronounced when it occurs before a vowel (Crystal 2003). In other words, if an accent of English is classified as a non-rhotic variety, /r/ is not pronounced post-vocalically (*e.g. cart*) except if /r/ is followed by a vowel (*e.g. very*, *colour*) (Watt and Allen 2003).

With this basic background about the rhotic vs non-rhotic varieties of English, I assume that the inputs of English loanwords in this study are non-rhotic British English. This assumption is based on the treatment of /r/ in the transcriptions of *Cambridge English Dictionary*. In particular, the author of the dictionary states that ‘[t]he accent used for British English [in this dictionary] is classed as *non-rhotic* – the phoneme /r/ is not usually pronounced except when a vowel follows it’ (Jones 2006: xiv). Although the dictionary follows the assumption that /r/ is not realised in British

English when /r/ occurs in word-final position (*e.g. car /ka:/*), this /r/ can be pronounced if it is followed by a vowel (*e.g. car owner*). Therefore, the dictionary uses the superscript /ʳ/ to demonstrate the potential for pronunciation of /r/ and the word *car* is transcribed as */ka:ʳ/* instead of */ka:/*.

Despite the assumption proposed in this study that the input is British English, which means that /r/ is not pronounced in particular positions (e.g. word-final positions), the results of this study reveal that the English /r/ is always adapted faithfully in QA (186 occurrences of /r/). The faithful adaptation of the input /r/ in some words, although they are not pronounced in the source forms, could be attributed to the effect of orthography (as argued by Abu-Guba 2016: 85). For instance, I assume that the existence of the grapheme <r> in final position in the English loanword *projector* leads this word to be adapted in QA as [bru.ˈdʒik.tar], although final /r/ is not totally realised in British English.

Table 15 presents that the English liquids /l/ and /r/ are always adapted faithfully in QA (123 occurrences of /l/ and 186 of /r/, as illustrated in (49)). In spite of the assumption proposed in this study that the input is British English which means that /r/ is not pronounced in particular positions (e.g. word-final positions), the results of this study show that the English /r/ is always adapted faithfully in QA (186 occurrences of /r/). The faithful adaptation of the input /r/ in some words although they are not pronounced in the source forms could be attributed to the effect of orthography (as argued by Abu-Guba 2016: 85). For instance, I assume that the existence of the grapheme <r> in final position in the English loanword projector leads this word to be adapted in QA as [bru.ˈdʒik.tar] although final /r/ is not totally realized in British English.

English phonemes	QA outputs	Number of occurrences and percentages	Total
/l/	[l]	123 (100%)	123
/r/	[r]	186 (100%)	186

Table 15: Adaptation of English liquids /l/ and /r/ in QA

(49) English word	English transcription	QA transcription
(a) cable	/ˈkeɪ.bə**l**/	[ˈke:.ba**l**]
(b) group	/g**r**u:p/	[g**r**u:b]

5.1.13 Adaptation of English glottal fricative /h/

The English glottal fricative /h/ is preserved faithfully in all its 12 occurrences as shown in table 16 and demonstrated in (50).

English phonemes	QA outputs	Number of occurrences and percentages	Total
/h/	[h]	12 (100%)	12

Table 16: Adaptation of English glottal fricative /h/ in QA

(50)	English word	English transcription	QA transcription
	hormone	/ˈ**h**ɔː.məʊn/	[**h**urˈmoːn]

As the adaptation patterns of the English consonants into QA are presented, we now turn to evaluate this segmental adaptation in OT tableaux. However, before this analysis and given the core assumption of this study that a full-specified English input is mapped to an output that carries only the contrastive features of QA segments, it is necessary to establish first the contrastive features of QA consonants. Thus, the following section aims to establish the contrastive hierarchy of the QA consonant inventory.

5.2 The Contrastive Hierarchy of QA Consonants

As this study argues that the phonological features of inputs that are contrastive in the QA are preserved, it is essential to establish the contrastive hierarchy of QA consonant inventory. Therefore, according to the CHT proposed by Dresher (2009) and following the algorithm of the *Sucessive Division Algorithm*, the consonants of QA are contrastively specificed in a hierarchial manner. In the next section §5.3, these contrastive specifications are converted into OT constraints, using markedness and faithfulness constraints.

Now, we specify the phonological features contrastively in QA. According to the universal hierarchy of features proposed by Clements (2009), the feature *sonorant* is ranked at the top of the scale. Therefore, I assume that the first contrastive feature is [sonorant], which divides the QA segments into the [+sonorant] set /m w n l r j/ and the [-sonorant] set /b f t d tˤ θ ð ðˤ s z sˤ ʃ dʒ k g q χ ʁ ħ ʕ h ʔ/, as depicted in (51). This division ensures the feature [sonorant] has a higher-ranking status as it dominates all segments. Therefore, it is assumed that the input feature [±sonorant] will always be preserved in the output.

(51) QA consonant feature hierarchy

/m w n l r j b f t d tˤ θ ð ðˤ s z sˤ
ʃ dʒ k g q χ ʁ ħ ʕ h ʔ/

[+son]
/m w n l r j/

[–son]
/b f t d tˤ θ ð ðˤ s z sˤ ʃ dʒ k g q χ ʁ ħ ʕ h ʔ/

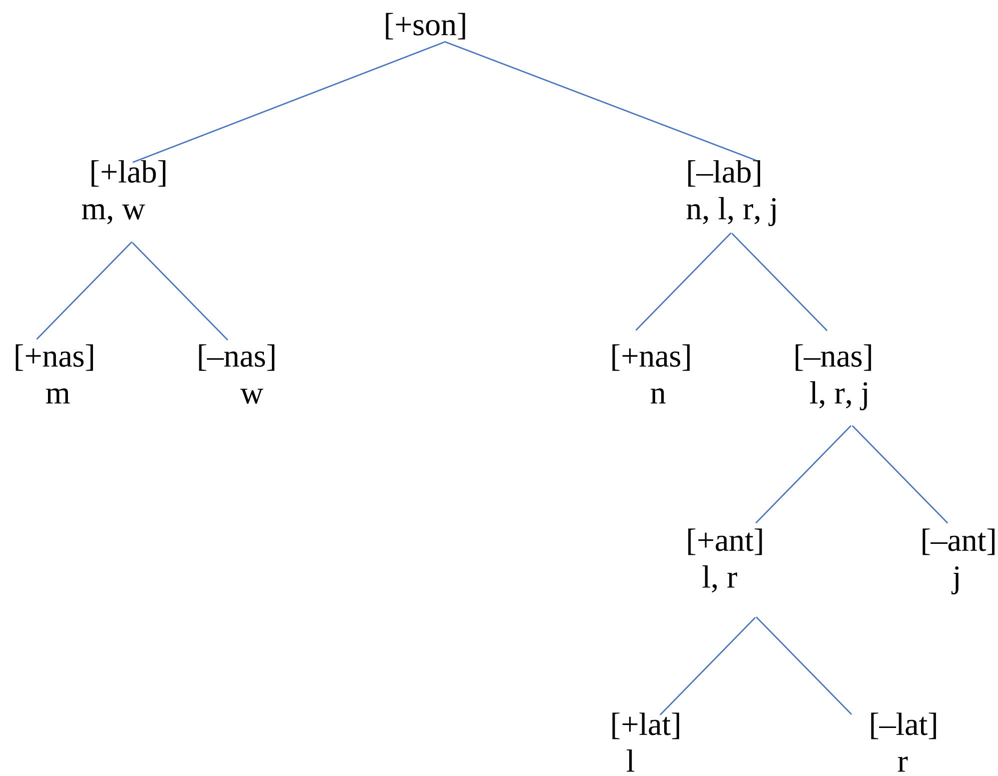
In Clements's scale (2001, 2009), the feature [labial] is ranked below the feature [sonorant]; thereby leading us to assume that the feature [labial] is subsequent to the contrastive hierarchy of QA and dominates all the consonants. Consequently, all output segments should be specified contrastively as [±sonorant] and [±labial].

Continuing with the contrastive specification hierarchy in the QA consonant inventory, we will consider first the [+sonorant] set and the hierarchical organisation of its features. The [+sonorant] set is divided into a [+labial] set, which includes only two segments /m, w/, and a [-labial] set, which includes four segments /n, j, l, r/. Next, the feature [nasal] is employed and it contrasts /m/ with /w/, and /n/ with /j, l, r/. It is crucial to use the feature [nasal] instead of [dorsal] to distinguish /m/ from /w/ because, following Clements's accessibility hierarchy (2001: 84), I assume that the feature [dorsal] should not be used within the [+sonorant] set in the contrastive hierarchy of QA consonant inventory. Specifying /m/ and /n/ as [+nasal] denotes that the English input feature [+nasal] is expected to be maintained faithfully in the QA output.

The feature [anterior] is introduced to specify /j/ as [-anterior] and contrast it with the [+anterior] segments /l/ and /r/. Using the feature [anterior] instead of [lateral] is attributed to the former being ranked higher than the latter on the Clements's scale (2001)[13]. Finally, the segment /l/ is specified as [+lateral]; thereby distinguishing it from the [-lateral] segment /r/. The contrastive specifications of the [+sonorant] set in the QA consonant inventory are illustrated in the following contrastive hierarchy.

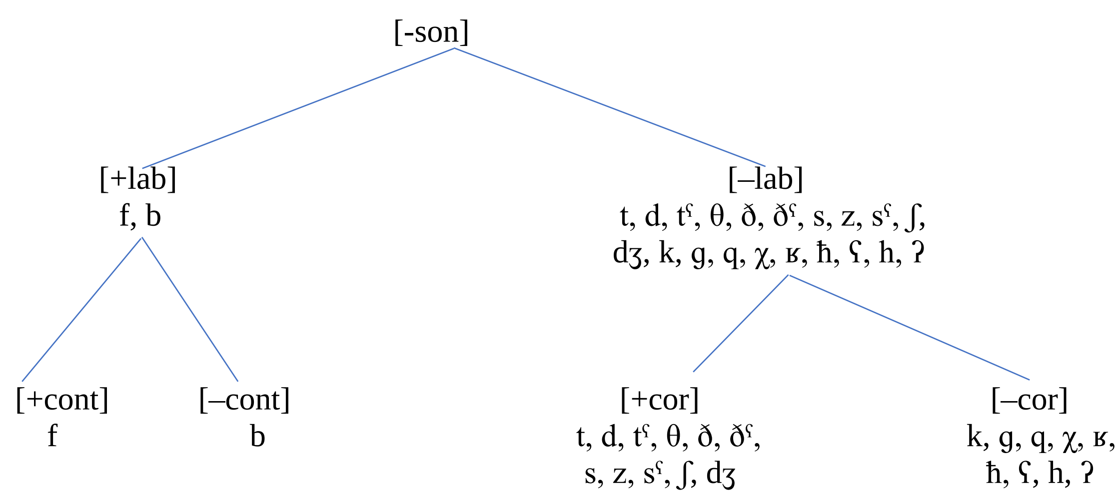
[13] Note that Clements (2001, 2009) uses the feature [posterior] and I use the feature [anterior] instead. This is because when analysing the loanwords data in OT tableaux in section 5.4, I depend on the feature chart proposed by Hyman (1975: 240) to determine the input features of English loanwords. In his feature chart, Hyman use the feature [anterior] not [posterior].

(52) QA consonant feature hierarchy: the [+sonorant] set



The [-sonorant] set is considered next, as the segments in the [+sonorant] set are contrastively specified. The [-sonorant] set includes more segments than its counterpart [+sonorant] set, as illustrated in (53); therefore, it requires more contrastive features.

(53) QA consonant feature hierarchy: the [-sonorant] set



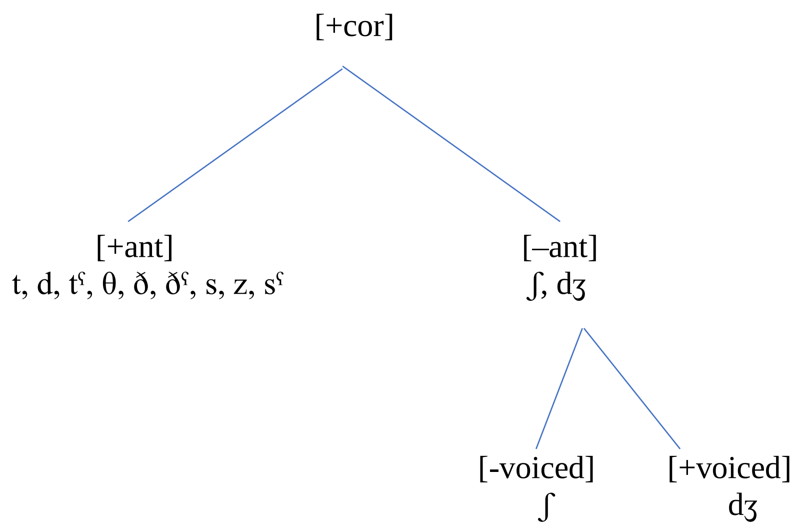
As established in the previous set [+sonorant], the feature [labial] is universally placed at the top of the feature hierarchy just after the feature [sonorant]. The status of ranking the feature [labial] below the feature [sonorant] culminates in dividing the [-sonorant] set into [+labial] set and [-labial] set. The [+labial] set includes the segments /b, f/, and the [-labial] set contains the rest of the segments /t, d, tˤ, θ, ð, ðˤ, s, z, sˤ, ʃ, dʒ, k, g, q, χ, ʁ, ħ, ʕ, h, ʔ/.

Since QA does not contain a laryngeal contrast between labial segments and because the two segments /b/ and /f/ share the same place of articulation, the manner feature [continuant] is required to differentiate /b/ from /f/. Consequently, /b/ is specified as [-sonorant, +labial, -continuant] and /f/ as [-sonorant, +labial, +continuant].

The next set, [-labial], includes the following segments: /t, d, tˤ, θ, ð, ðˤ, s, z, sˤ, ʃ, dʒ, k, g, q, χ, ʁ, ħ, ʕ, h, ʔ/. This set comprises segments produced at different places of articulations, with varying manners and laryngeal features. By appealing to the universal scale of feature ordering proposed by Clements (2009) and since most of the segments in the [-labial] set share the place feature [coronal], I argue that the feature [coronal] should enter the hierarchy at this level. Once the feature [coronal] is assigned after the feature [labial], it divides the [-labial] set into a [+coronal] set and a [-coronal] set. The former includes the following segments: /t, d, tˤ, θ, ð, ðˤ, s, z, sˤ, ʃ, dʒ/ whereas the latter set consists of the following segments: /k, g, q, χ, ʁ, ħ, ʕ, h, ʔ/.

For simplicity, I will discuss first the [+coronal] set, followed by the [-coronal] set. The segments in the [+coronal] set share the place of articulation [coronal] but differ in terms of other features, such as [continuant], [anterior], [strident], [voicing], etc. According to the *Robustness Scale,* the features [continuant] and [anterior] come after [coronal]. Note that we skip the feature [dorsal] as it is not relevant within the [+coronal] set. Because the features [continuant] and [anterior] are ranked similarly in one group in the *Robustness Scale*, the two features can differentiate segments of the [+coronal] set. However, it is necessary to select only one feature at this level. Therefore, two scenarios emerge: one where the feature [continuant] is accessed before [anterior], and one where the [anterior] is accessed before [continuant]. In the first scenario, the feature [continuant] is assigned initially and distinguishes stop segments /t, d, tˤ, dʒ/ from fricative segments /θ, ð, ðˤ, s, z, sˤ, ʃ/. In the second scenario, the feature [anterior] is assigned first and differentiates [+anterior] segments /t, d, tˤ, θ, ð, ðˤ, s, z, sˤ/ from [-anterior] segments /ʃ, dʒ/. By referring to the *Accessibility Hierarchy* proposed by Clements (2001), the feature [anterior] is ranked above the feature [continuant]. With this order of features, the [+coronal] set is divided into [+anterior] set, which includes /t, d, tˤ, θ, ð, ðˤ, s, z, sˤ/, and [-anterior] set, which comprises two segments: /ʃ/ and /dʒ/. Then, within the [-anterior] set, the segment /ʃ/ is specified as [-voiced] and /dʒ/ as [+voiced]. The specifications of the [+coronal] set so far are presented in (54).

(54) QA consonant feature hierarchy: the [+coronal] set

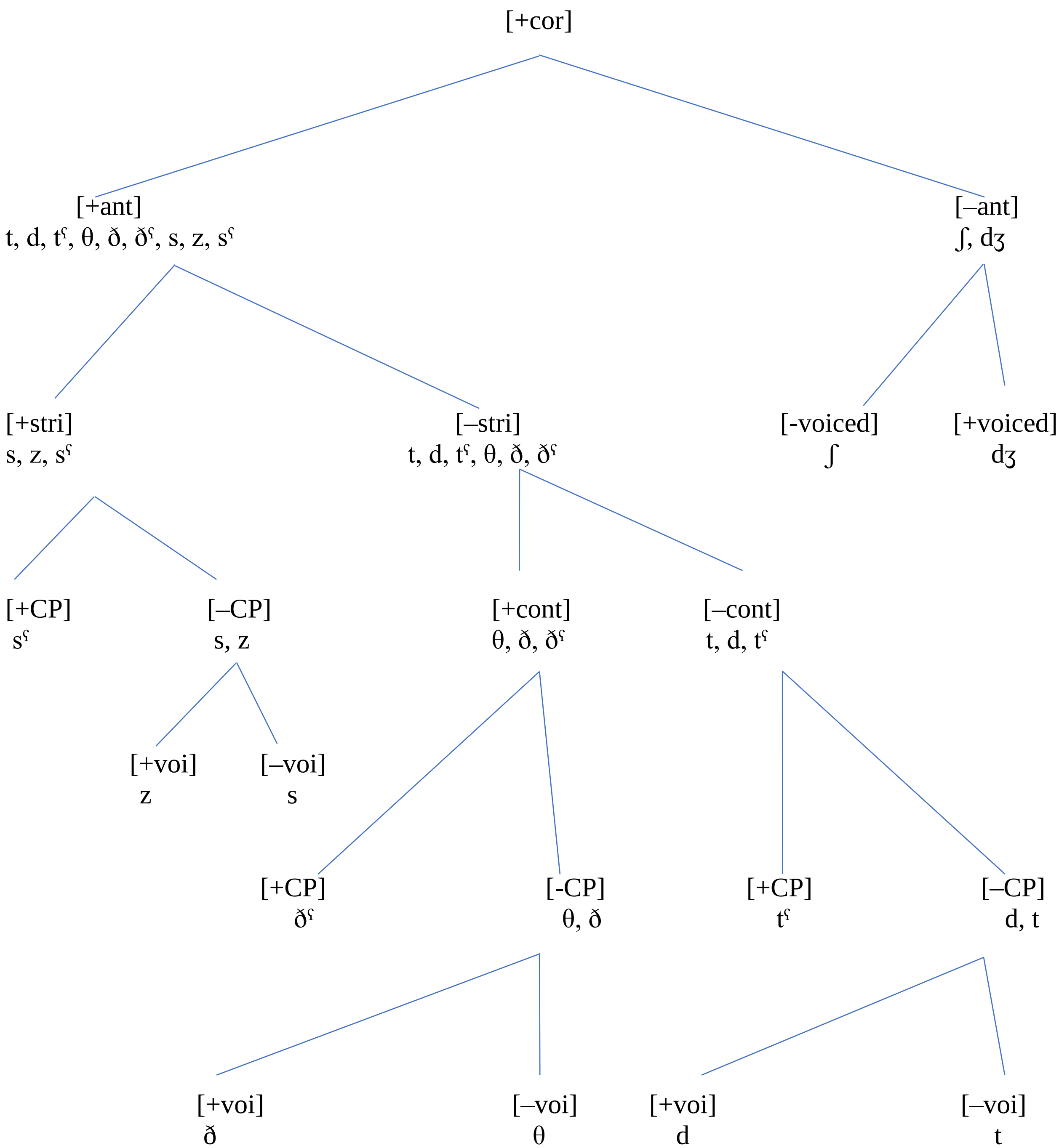


Next, we consider the specifications of the contrastive features presented in the [+anterior] set. The members of this set share some phonological features, such as [coronal] and [anterior], but differ in other features, namely, [continuant] and [strident]. Since Clements (2009) did not include the feature [strident] in the *Robustness Scale,* I will refer to the *Feature Accessibility Hierarchy* (Clements 2001) which shows that [strident] is ranked higher than [continuant]. With the feature [strident] ordered after [anterior] in the hierarchy, the segments /t, d, tˤ, θ, ð, ðˤ/ are specified contrastively as [-strident], while the segments /s, z, sˤ/ are specified as [+strident].

For the next set, [+strident], all segments share the same place of articulations, in addition to their manners. However, the segments in this set differ in their laryngeal and emphatic status. Thus, I assume that the crucial features that can differentiate segments of the [+strident] set are either [constricted pharynx] or [voicing]. I argue that the feature [constricted pharynx] should be accessed first. Consequently, the feature [constricted pharynx] should dominate the [voicing] feature. Crucially, this suggestion of ordering has its basis in emphatic consonants in QA not contrasting with other segments in [voicing]. In other words, the QA inventory has the voiceless emphatic stop /tˤ/ but is lacking its counterpart, the voiced emphatic stop */dˤ/. Furthermore, the lack of contrast in [voicing] is illustrated when considering the voiceless emphatic fricative /sˤ/, which does not contrast with another emphatic segment in [voicing], */zˤ/. Additional evidence emerges from the voiced emphatic segment /ðˤ/, which lacks an emphatic segment that differs in [voicing], */θˤ/. With access to the feature [constricted pharynx], the [+strident] set will be divided into [+constricted pharynx] set, which includes only one segment /sˤ/ and [-constricted pharynx] set, which consists of two segments /s, z/. Now, the segment /sˤ/ is specified contrastively as [+constricted pharynx] without the need to add the [voicing] feature. Conversely, the [voicing] feature is required in [-constricted pharynx] set to specify /s/ as [-voiced] and /z/ as [+voiced]. Within the [-strident] set, members of this set share the place of articulation [coronal] but differ in their manners. Therefore, the feature [continuant] is assigned to specify the segments /t, d, tˤ/ as [-continuant] and the segments /θ, ð, ðˤ/ as [+continuant].

The contrastive feature hierarchy, in which the [constricted pharynx] feature has a wider scope than the [voicing] feature, assigns the [constricted pharynx] feature to distinguish members of the [+continuant] set in addition to the [-continuant] set. Once [constricted pharynx] is assigned, it groups /t, d/ in one set with the specification [-constricted pharynx] and /tˤ/ in another set with the contrastive specification [+constricted pharynx]. At the next level of the hierarchy, the [voicing] feature accomplishes its task in specifying the segment [d] as [+voiced] and /t/ as [-voiced]. The feature specifications of the [+continuant] set will presumably experience the similar specifications of the [-continuant] set. This has been accomplished by assigning the feature [constricted pharynx] that, subsequently, distinguishes /ðˤ/ from /θ, ð/. Then, the feature [voicing] specifies /θ/ as [-voiced] and /ð/ as [+voiced]. The contrastive hierarchy shown in (55) illustrates the specifications of the [+coronal] set.

(55) QA consonant feature hierarchy: the [+coronal] set



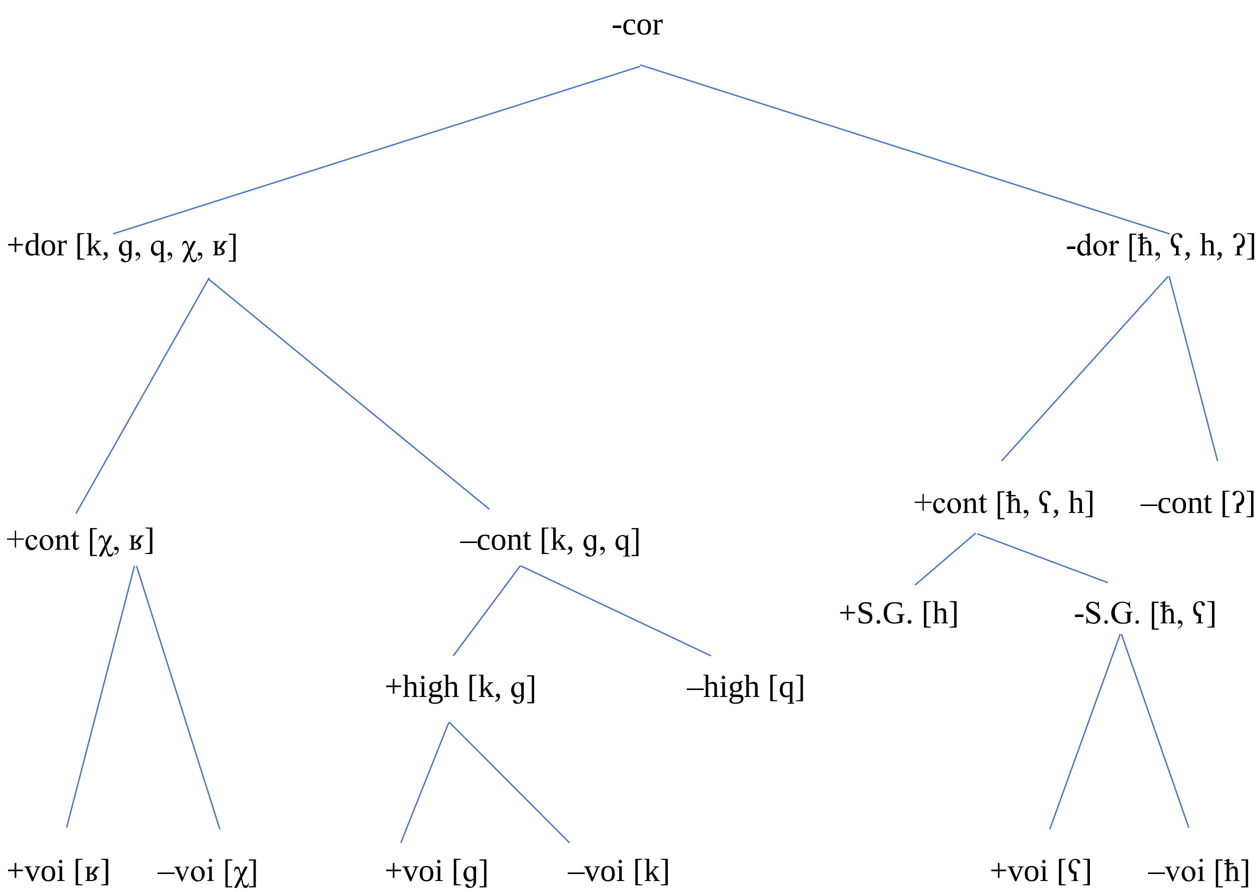
Having observed that the [voicing] feature is ranked lower in the contrastive hierarchy below the other features, it is predicted that the [voicing] feature will be the most vulnerable feature to undergo a change in the adaptation process. In other words, when QA speakers are confronted with English segments that are illicit in their inventory, it is expected that the [voicing] feature will be changed in order to preserve high-ranking features, such as: [sonorant, labial, coronal, nasal, anterior, strident] etc.

We turn now to the hierarchy of the contrastive features provided in the [-coronal] set, which includes the following segments: /k, g, q, χ, ʁ, ħ, ʕ, h, ʔ/. Two different features are assumed to be able to distinguish members of the [-coronal] set; namely, the manner feature [continuant] or the place feature [dorsal]. However, based on the universal hierarchy of features proposed by Clements (2001, 2009), the feature [dorsal] is ranked higher than [continuant]. Consequently, the feature [dorsal] should be assigned first before adding the feature [continuant]. Moreover, grouping the segments /k, g, q, χ, ʁ/ in one set is attributed to the fact that these segments share the major place of articulation *dorsal*. With this ordering of features, [dorsal] will split the [-coronal] set into [+dorsal] and [-dorsal] sets. The [+dorsal] set includes the segments: /k, g, q, χ, ʁ/, and the [-dorsal] set includes the segments: /ħ, ʕ, h, ʔ/.

Within the [+dorsal] set, members of the set can be distinguished by the feature [high] or the feature [continuant]. If we allow the first choice [high] to enter the hierarchy first, it will specify /k, g/ as [+high] and /q, χ, ʁ/ as [-high]. However, the *Robustness Scale* ranks the feature [continuant] higher than [high]. Furthermore, the native grammar of QA shows that QA speakers substitute most of the Classical Arabic words which contain the segment /q/ with the segment /g/, as in /**q**aːl/ > [**g**aːl] 'he said'. This substitution suggests that /g/ and /q/ are required to be in one group. In order to achieve this, we need to dispense with the feature [high] at this level and allow the feature [continuant] to enter the hierarchy. Once the feature [continuant] is assigned, it contrasts /k, g, q/ with /χ, ʁ/, specifying the former as [-continuant] and the latter as [+continuant]. As members of the [-continuant] set share the same place feature [dorsal] as well as the manner feature [-continuant], another feature of place is required. Therefore, the feature [high] is added and specifies /q/ as [-high] and /k, g/ as [+high]. At this point, the segment /q/ is fully distinct, and does not require any further specifications. It remains to distinguish /k/ from /g/ and /χ/ from /ʁ/. Therefore, the laryngeal feature [voicing] is assigned and differentiates /k/ from /g/ and /χ/ from /ʁ/.

In terms of the feature specifications of [-dorsal] set, three features can distinguish memebrs of this set; namely, [continuant], [glottal] and [pharyngeal]. I will begin with the last feature [pharyngeal] and exclude it at this level from specifying the segments of this set. This is because this feature is not included within the *Robustness Scale.* Then, I will dispense with the feature [glottal] as it is ranked below [continuant] in the *Robustness Scale.* Therefore, given the fact that most of the segments within the [-dorsal] set, in particular /ħ, ʕ, h/, share the manner feature [continuant] and that the feature [continuant] is ranked higher than [glottal] and [pharyngeal] in Clements' scale (2009), the feature [continuant] should be assigned at this level to distinguish members of the set. After assigning the feature [continuant], the segment /ʔ/ is distinct from all other segments as it is the only one in the set specified as [-continuant]. Now, we need a feature that contrasts the segments /h, ħ, ʕ/. Two features can be used to make the contrast: either [spread glottis] or [pharyngeal]. However, Clements (2009) includes the feature [glottal] within the *Robustness Scale* and excludes [pharyngeal]. Thus, the feature [spread glottis] is introduced and it contrasts /h/ with /ħ, ʕ/. Now, /h/ is contrastively specified as [+spread glottis] and /ħ, ʕ/ as [-spread glottis]. Finally, the feature [voicing] is assigned, specifying /ħ/ as [-voiced] and /ʕ/ as [+voiced]. The resulting specifications of the [-coronal] set are provided in (56).

(56) QA consonant feature hierarchy: the [-coronal] set



As the QA consonants have been contrastively specified, the resulting feature specifications of all QA consonants are listed in (57).

(57) Output Specifications of QA consonants

$$/b/ \begin{bmatrix} \text{-SON} \\ \text{+LAB} \\ \text{-CONT} \end{bmatrix} \qquad /f/ \begin{bmatrix} \text{-SON} \\ \text{+LAB} \\ \text{+CONT} \end{bmatrix}$$

$$/t/ \begin{bmatrix} \text{-SON} \\ \text{-LAB} \\ \text{+COR} \\ \text{+ANT} \\ \text{-STRI} \\ \text{-CONT} \\ \text{-CP} \\ \text{-VOI} \end{bmatrix} \qquad /d/ \begin{bmatrix} \text{-SON} \\ \text{-LAB} \\ \text{+COR} \\ \text{+ANT} \\ \text{-STRI} \\ \text{-CONT} \\ \text{-CP} \\ \text{+VOI} \end{bmatrix}$$

$$/t^{ʕ}/ \begin{bmatrix} \text{-SON} \\ \text{-LAB} \\ \text{+COR} \\ \text{+ANT} \\ \text{-STRI} \\ \text{-CONT} \\ \text{+CP} \\ \text{-VOI} \end{bmatrix} \qquad /\theta/ \begin{bmatrix} \text{-SON} \\ \text{–LAB} \\ \text{+COR} \\ \text{+ANT} \\ \text{–STRI} \\ \text{+CONT} \\ \text{–CP} \end{bmatrix}$$

$$/ð^{ʕ}/ \begin{bmatrix} \text{-SON} \\ \text{-LAB} \\ \text{+COR} \\ \text{+ANT} \\ \text{-STRI} \\ \text{+CONT} \\ \text{+CP} \\ \text{+VOI} \end{bmatrix} \qquad /ð/ \begin{bmatrix} \text{-SON} \\ \text{–LAB} \\ \text{+COR} \\ \text{+ANT} \\ \text{–STRI} \\ \text{+CONT} \\ \text{-CP} \end{bmatrix}$$

/s/
-SON
-LAB
+COR
+ANT
+STRI
-CP
-VOI

/z/
-SON
-LAB
+COR
+ANT
+STRI
-CP
+VOI

/sˤ/
-SON
-LAB
+COR
+ANT
+STRI
+CP

/ʃ/
-SON
–LAB
+COR
-ANT
-VOI

/dʒ/
-SON
-LAB
+COR
-ANT
+VOI

/k/
-SON
–LAB
-COR
+DOR
–CONT
+HIGH
–VOI

/g/
-SON
-LAB
-COR
+DOR
-CONT
+HIGH
+VOI

/q/
-SON
-LAB
-COR
+DOR
-CONT
-HIGH

/χ/
-SON
-LAB
-COR
+DOR
+CONT
-VOI

/ʁ/
-SON
–LAB
-COR
+DOR
+CONT
+VOI

/ħ/ $\begin{bmatrix} \text{-SON} \\ \text{-LAB} \\ \text{-COR} \\ \text{-DOR} \\ \text{+CONT} \\ \text{-SG} \\ \text{-VOI} \end{bmatrix}$

/ʕ/ $\begin{bmatrix} \text{-SON} \\ \text{–LAB} \\ \text{-COR} \\ \text{-DOR} \\ \text{+CONT} \\ \text{-SG} \\ \text{+VOI} \end{bmatrix}$

/h/ $\begin{bmatrix} \text{-SON} \\ \text{-LAB} \\ \text{-COR} \\ \text{-DOR} \\ \text{+CONT} \\ \text{+SG} \end{bmatrix}$

/ʔ/ $\begin{bmatrix} \text{-SON} \\ \text{-LAB} \\ \text{-COR} \\ \text{-DOR} \\ \text{-CONT} \end{bmatrix}$

/m/ $\begin{bmatrix} \text{+SON} \\ \text{+LAB} \\ \text{+NAS} \end{bmatrix}$

/w/ $\begin{bmatrix} \text{+SON} \\ \text{+LAB} \\ \text{-NAS} \end{bmatrix}$

/n/ $\begin{bmatrix} \text{+SON} \\ \text{-LAB} \\ \text{+NAS} \end{bmatrix}$

/j/ $\begin{bmatrix} \text{+SON} \\ \text{–LAB} \\ \text{-NAS} \\ \text{-ANT} \end{bmatrix}$

/l/ $\begin{bmatrix} \text{+SON} \\ \text{-LAB} \\ \text{-NAS} \\ \text{+ANT} \\ \text{+LAT} \end{bmatrix}$

/r/ $\begin{bmatrix} \text{+SON} \\ \text{-LAB} \\ \text{-NAS} \\ \text{+ANT} \\ \text{-LAT} \end{bmatrix}$

5.3 Converting Successive Division Algorithm into OT Constraints

Based on the contrastive hierarchy of QA consonant inventory provided in §5.2, this section analyses the adaptation of English consonants in QA through the OT framework. However, before the analysis, it is necessary to present the relevant constraints and their rankings. In accordance with Mackenzie and Dresher (2004) and Dresher (2009), the contrastive hierarchy of QA consonant inventory will be converted into a ranking of OT constraints using the procedure given in (35) in §4.3. The ranking of the constraints is determined according to the hierarchy of the contrastive features of QA. These contrastive features represent the faithfulness constraints. Between these faithfulness constraints, there exist some co-occurrence constraints that represent the markedness constraints. It will be revealed that the analysis of the adaptation of English consonants in QA is a result of an interaction between the faithfulness constraints and the co-occurrence constraints, and that this interaction produces the outputs that are contrastive in the QA consonant inventory. Based on the main argument of this study, the inputs are assumed to be fully-specified. Then, according to the contrastive hierarchy of QA consonant inventory, the QA grammar will block any redundant or non-contrastive features in inputs from appearing in the surface and preserve only the contrastive features.

According to the algorithm proposed in (35), all the steps will be followed until the contrastive hierarchy of QA consonant inventory is converted into an OT constraint hierarchy. We will start with the highest feature in the hierarchy and then move downwards, feature-by-feature.

Since the feature [sonorant] is ranked at the top of the hierarchy and it divides the inventory into [+sonorant] and [-sonorant] set, all the segments in the QA consonant inventory must be specified for the feature [±sonorant]. This specification entails that the feature [sonorant] must be preserved in the outputs. Recall that the inputs are assumed to be fully-specified inputs. The feature [sonorant] is one of the high-ranked features that always needs to be maintained faithfully. Therefore, in OT terms, preserving the feature [sonorant] can be converted into the faithfulness constraint: MAX[SONORONAT]. We propose that the constraint MAX[SONORANT] is undominated and must not be violated. Step (b) which requires listing all co-occurrence constraints cannot be applied at this stage as the feature [sonorant] is ordered at the top of the hierarchy and there is no feature ordered before [sonorant].

The next feature in the hierarchy is [labial]. This feature is used within the two sets [+sonorant] and [-sonorant] and it specifies all the segments as [+labial] or [-labial]. As discussed in the feature [sonorant], the feature [labial] is ranked high and its input value [+ or -] must be preserved. This means that all the outputs must be specified as [±labial] and any candidate breaks this rule will be precluded immediately from the competition. The status of preserving the feature [labial] can be formulated into the faithfulness constraint: MAX[LABIAL]. Again, step (b) cannot be applied here as the feature [labial] is specified contrastively for all segments.

I propose that the next feature in the hierarchy is [coronal]; hence, MAX[CORONAL] will be the next constraint. In addition to ranking [coronal] above [nasal] universally (Clements 2001, 2009), this ordering is derived from the fact that although the nasal segment /n/ in QA is articulated with the front of the tongue, it is not specified phonologically as [coronal]. Therefore, the feature [coronal] should dominate the feature [nasal] to prevent the occurrence of feature combinations [αnasal, +coronal]. Since the feature [coronal] is not used within the sets [+sonorant] and [+labial], the co-occurrence constraints *[αCORONAL, +SONORANT] and *[αCORONAL, +LABIAL] are created and ranked above the faithfulness constraint MAX[CORONAL].

Moving to the next feature in the hierarchy [nasal] and MAX[NASAL] will be the next constraint. This feature is specified contrastively for all the segments in the [+sonorant] set. Therefore, any output specified as [+sonorant] must also be specified as [+ or - nasal]. In contrast, any output specified as [-sonorant] must not be specified as [+ or – nasal]. This is because the feature [nasal] is not used within the [-sonorant] set. Thus, we propose the co-occurrence constraint *[αNASAL, -SONORANT], which militates against having a feature combination of [nasal, -sonorant]. Based on the algorithm presented in (35), this co-occurrence constraint should be ranked above the faithfulness constraint MAX[NASAL]. For the reason that the feature [nasal] is used within the [+labial] set as well as the [-labial] set, step (b) cannot be applied at the [labial] level. Conversely, the feature [nasal] is not used in the domain of either [+coronal] or [-coronal]. Therefore, the co-occurrence constraints *[αNASAL, +CORONAL] and [αNASAL, -CORONAL] are proposed to prevent the occurrence of these combinations of features.

The next features in the hierarchy of QA consonant inventory are [dorsal] and [anterior]. Indeed, it makes no difference if we rank one over another. However, based on the universal ranking of features proposed by Clements (2001; 2009), the feature [dorsal] is ordered before [anterior]. According to this universal ranking, MAX[DORSAL] will be the next constraint. As the feature [dorsal] is not included within the [+sonorant] set, the feature [dorsal] cannot co-occur with the feature [+sonorant]. Thus, a restriction is required to avoid this combination of features. This restriction is formulated in the co-occurrence constraint *[αDORSAL, +SONORANT] and ranked above the faithfulness constraint MAX[DORSAL]. Furthermore, the feature [dorsal] is not included within the [+labial] and [+coronal] sets. Hence, the co-occurrence constraints *[αDORSAL, +LABIAL] and *[αDORSAL, +CORONAL] are required in dictating that the feature [dorsal] cannot occur with the features [+labial] and [+coronal]. Again, these co-occurrence constraints (marked constraints) should be ranked just above the faithfulness constraint MAX[DORSAL] but below MAX[NASAL].

The next contrastive feature in the hierarchy is [anterior] and its preservation status is formulated in the following faithfulness constraint: MAX[ANTERIOR]. However, since this feature is dominated by other features [sonorant, labial, coronal, nasal, dorsal] and excluded from some sets, some co-occurrence constraints are required to prevent the occurrence of the feature [anterior] in some environments. These environments or sets from which the feature [anterior] is excluded are based on their orders in the hierarchy, [+labial], [+nasal], [-coronal], [-dorsal], and [+dorsal]. The exclusion from these sets is converted into the co-occurrence constraints given in (58) which, in turn, are ranked higher than the faithfulness constraint MAX[ANTERIOR]:

(58) *[αANTERIOR, +LABIAL] >> *[αANTERIOR, +NASAL] >> *[αANTERIOR, -CORONAL] >> *[αANTERIOR, -DORSAL], *[αANTERIOR, +DORSAL]

Up to this point, the ranking of the previous co-occurrence and faithfulness constraints are summarised in (59).

(59) MAX[SON] >> MAX[LABIAL] >> *[αCORONAL, +SONORANT] >> MAX[CORONAL] >> *[αNASAL, -SONORANT] >> *[αNASAL, +CORONAL], *[αNASAL, -CORONAL] >> MAX[NASAL] >> *[αDORSAL, +LABIAL] >> *[αDORSAL, +CORONAL] >> MAX[DORSAL] >> *[αANTERIOR, +LABIAL] >> *[αANTERIOR, +NASAL] >> *[αANTERIOR, -CORONAL] >> *[αANTERIOR, -DORSAL], *[αANTERIOR, +DORSAL] >> MAX[ANTERIOR]

We now focus on the next feature in the hierarchy [strident], which is specified contrastively for the segments specified already as [-sonorant, +anterior]. In other words, members of segments in the [-sonorant] set, which are specified as [+anterior], are also specified for [strident]. This feature is another contrastive feature in the consonant inventory of QA and its preservation is required in the outputs. In accordance with the OT model, this preservation is formed as the faithfulness constraint MAX[STRIDENT]. As the feature [strident] is not used within the domains of [+sonorant], [+labial], [-coronal] [-nasal], [+nasal], [+dorsal], [-dorsal], and [-anterior], the co-occurrence constraints in (60) are proposed and ranked above MAX[STRIDENT]. These dictate simply that if a segment is specified as [+sonorant], [+labial], [-coronal] [-nasal], [+nasal], [+dorsal], [-dorsal] or [-anterior], it cannot be specified for any value of [strident].

(60) *[αSTRIDENT, +SONORANT] >> *[αSTRIDENT, +LABIAL] >> *[αSTRIDENT, -CORONAL] >> *[αSTRIDENT, -NASAL], *[αSTRIDENT, +NASAL] >> *[αSTRIDENT, +DORSAL], *[αSTRIDENT, -DORSAL] >> *[αSTRIDENT, -ANTERIOR]

The feature [continuant] is the next feature in the hierarchy. Thus, we propose the faithfulness constraint MAX[CONTINUANT], which requires preserving the feature value of [+ or –continuant]. As this feature is not included in the domain of [+sonorant], any output specified as [+sonorant] must not be specified as [+ or – continuant]. This condition is translated into the co-occurrence constraint: *[αCONTINUANT, +SONORANT]. As the feature [continuant] is excluded from the [+sonorant] set, it supposedly will be exempt from the sets of [+nasal] and [-nasal] because the feature [nasal] is included solely within the [+sonorant] set. Hence, the following co-occurrence constraints are proposed: [αCONTINUANT, +NASAL] and [αCONTINUANT, -NASAL]. On the other side of the hierarchy, the feature [continuant] is included in the sets of [+ and – labial], [+ and – coronal], [+ and – dorsal], [+ anterior] and [-strident]; however, it is not used within the [-anterior] and [+strident] sets. Thus, we propose the co-occurrence constraints [αCONTINUANT, -ANTERIOR] and [αCONTINUANT, +STRIDENT], which militate against having the feature combinations of [continuant, -anterior] and [continuant, +strident]. All these co-occurrence constraints are provided in (61) and should be ranked above the faithfulness constraint MAX[CONTINUANT].

(61) *[αCONTINUANT, +SONORANT] >> *[αCONTINUANT, +NASAL], *[αCONTINUANT, -NASAL] >> *[αCONTINUANT, -ANTERIOR] >> *[αCONTINUANT, +STRIDENT]

The remaining features in the hierarchy of QA consonant inventory are [lateral], [spread glottis], [high], [constricted pharynx] and [voicing]. Since it has been established in the contrastive hierarchy of QA consonant inventory that the [voicing] feature is dominated by all the remaining features [lateral], [spread glottis], [high] and [constricted pharynx], the [voicing] feature should be ranked low. As the feature [constricted pharynx] is a secondary articulation feature, I propose that it should be ranked below the other major features: [lateral], [spread glottis] and [high]. Moreover, I assume that the feature [high] should be dominated by the other features [lateral] and [spread glottis] given the fact that the feature [high] is a sub-feature within the class of the major feature [dorsal]. The order of the remaining features [lateral] and [spread glottis] does not influence the analysis. However, according to the *Robustness Scale* proposed by Clements (2009), the feature [spread glottis] is universally used more frequently than [lateral]. Therefore, I assume that the feature [spread glottis] is ranked higher than the feature [lateral]. The next feature in the hierarchy is [spread glottis], which specifies the segments already specified contrastively as [-dorsal, +continuant]. In other words, members of segments in the [-dorsal] set specified as [+continuant] are also specified for [spread glottis]. The input feature value [+ or – spread glottis] has to be preserved faithfully in the outputs. Following the OT model, this preservation is formed as the faithfulness constraint MAX[SPREAD GLOTTIS]. However, as the feature [spread glottis] is not used within the domains of [+sonorant], [+labial], [+coronal], [+nasal], [-nasal], [+dorsal], [+anterior], [-anterior], [+strident], [-strident] and [-continuant], the co-occurrence constraints in (62) are proposed and ranked above MAX[SPREAD GLOTTIS].

(62) *[αSPREAD GLOTTIS, +SONORANT] >> *[αSPREAD GLOTTIS, +LABIAL] >> *[αSPREAD GLOTTIS, +CORONAL] >> *[αSPREAD GLOTTIS, +NASAL], *[αSPREAD GLOTTIS, -NASAL] >> *[αSPREAD GLOTTIS, +DORSAL] >> *[αSPREAD GLOTTIS, +ANTERIOR], *[αSPREAD GLOTTIS, -ANTERIOR] >> *[αSPREAD GLOTTIS, +STRIDENT], *[αSPREAD GLOTTIS, -STRIDENT] >> *[αSPREAD GLOTTIS, -CONTINUANT] >> MAX[SPREAD GLOTTIS]

The feature [lateral] comes next in the hierarchy after [spread glottis]. Thus, the faithfulness constraint MAX[LATERAL] will ensure the input feature value of (+ or – lateral) is maintained faithfully in the outputs. Although the feature [lateral] is excluded from several sets in the contrastive hierarchy of QA: [-sonorant], [+labial], [+coronal], [-coronal], [+nasal], [+dorsal], [-dorsal], [-anterior], [+strident], [-strident], [+continuant], [-continuant], [+spread glottis] and [-spread glottis]; yet, it is included within the following sets: [+sonorant], [-nasal], [+anterior]. Those exclusions are converted into the markedness constraints provided in (63). Having observed that the feature [lateral] is excluded from several domains, the faithfulness constraint MAX[LATERAL] will not be met until the co-occurrence constraints in (63) are satisfied.

(63) *[αLATERAL, -SONORANT] >> *[αLATERAL, +LABIAL] >> *[αLATERAL, +CORONAL], *[αLATERAL, -CORONAL] >> *[αLATERAL, +NASAL] >> *[αLATERAL, +DORSAL], *[αLATERAL, -DORSAL] >> *[αLATERAL, -ANTERIOR] >> *[αLATERAL, +STRIDENT], *[αLATERAL, -STRIDENT] >> *[αLATERAL, +CONTINUANT], *[αLATERAL, -CONTINUANT] >> *[αLATERAL, +SPREAD GLOTTIS], *[αLATERAL, -SPREAD GLOTTIS] >> MAX[LATERAL]

The next feature in the contrastive hierarchy is [high], which is used to distinguish /k, g/ from /q/. Therefore, the faithfulness constraint MAX[HIGH] is created to ensure the input feature value (+ or

– high) should be preserved in the outputs. Based on the process of converting any contrastive hierarchy into an OT constraint hierarchy, we must seek for any co-occurrence constraints. Following this requirement, it has been found that the feature [high] is excluded from the following sets: [+sonorant], [+labial], [+coronal], [+nasal], [-nasal], [-dorsal], [+anterior], [-anterior], [+strident], [-strident], [+continuant], [+lateral], [-lateral], [+spread glottis], [-spread glottis]. Therefore, the markedness constraints presented in (64) are formulated to prevent the occurrence of the feature [+ or - high] with the excluded sets. Again, these markedness constraints are ranked higher than the faithfulness constraint MAX[HIGH].

(64) *[αHIGH, +SONORANT] >> *[αHIGH, +LABIAL] >> *[αHIGH, +CORONAL] >> *[αHIGH, +NASAL], *[αHIGH, -NASAL] >> *[αHIGH, -DORSAL] >> *[αHIGH, +ANTERIOR], *[αHIGH, -ANTERIOR] >> *[αHIGH, +STRIDENT], *[αHIGH, -STRIDENT] >> *[αHIGH, +CONTINUANT] >> *[αHIGH, +LATERAL], *[αHIGH, -LATERAL] >> *[αHIGH, +SPREAD GLOTTIS], *[αHIGH, -SPREAD GLOTTIS] >> MAX[HIGH]

I have argued that the next feature in the hierarchy is [constricted pharynx]; hence, the faithfulness constraint MAX[CONSTRICTED PHARYNX] is created. As established previously, ranking the feature [constricted pharynx] above the feature [voicing] is derived from the fact that emphatic consonants in QA do not contrast in voicing (/tˤ/ but not */dˤ/, /ðˤ/ but not */θˤ/, /sˤ/ but not */zˤ/). Conversely, non-emphatic consonants contrast in voicing (/t/ vs. /d/, /s/ vs. /z/, and /θ/ vs. /ð/). However, the faithfulness constraint MAX[CONSTRICTED PHARYNX] can be violated in order to satisfy some higher-ranked co-occurrence constraints. These are resulted from the contrastive hierarchy proposed for the QA consonant inventory, which assumes that the feature [constricted pharynx] is included only in particular sets: [-sonorant], [-labial], [+coronal], [+anterior], [+strident], [-strident], [+continuant] and [-continuant]. Being excluded from the remaining sets resulted in the formulation of the following co-occurrence constraints:

(65) *[αCONSTRICTED PHARYNX, +SONORANT] >> *[αCONSTRICTED PHARYNX, +LABIAL] >> *[αCONSTRICTED PHARYNX, -CORONAL] >> *[αCONSTRICTED PHARYNX, -NASAL], *[αCONSTRICTED PHARYNX, +NASAL] >> *[αCONSTRICTED PHARYNX, +DORSAL], *[αCONSTRICTED PHARYNX, -DORSAL] >> *[αCONSTRICTED PHARYNX, -ANTERIOR] >> *[αCONSTRICTED PHARYNX, +LATERAL], *[αCONSTRICTED PHARYNX, -LATERAL] >> *[αCONSTRICTED PHARYNX, +SPREAD GLOTTIS], *[αCONSTRICTED PHARYNX, -SPREAD GLOTTIS] >> *[αCONSTRICTED PHARYNX, +HIGH], *[αCONSTRICTED PHARYNX, -HIGH] >> MAX[CONSTRICTED PHARYNX]

The final feature in the contrastive hierarchy is [voicing]. The preservation of the value of this feature is formulated into the faithfulness constraint MAX[VOICE]. The feature [voicing] is included within most of the sets in the hierarchy. However, it is excluded from some sets either for the reason of redundancy or not being contrastive. The former is illustrated in the case that any segment defined as [+sonorant], [+nasal], or [+lateral] is specified directly as [+voice]; thus, including the feature [voicing] within these specifications is redundant. Since the features [nasal] and [lateral] are included only within the [+sonorant] set, the feature [voicing] is excluded from the [-nasal] and [-lateral] sets. With regard to the latter, the feature [voicing] is not contrastive within the [+labial] segments /b/ and /f/. Therefore, [voicing] is excluded from [+labial] set. Furthermore, the feature [voicing] is excluded from the [+spread glottis], [-high] and [+constricted pharynx] sets as it is not contrastive within these sets. These exclusions are converted into the following co-occurrence constraints.

(66) *[αVOICE, +SONORANT] >> *[αVOICE, +LABIAL] >> *[αVOICE, +NASAL], *[αVOICE, -NASAL] >> *[αVOICE, +LATERAL], *[αVOICE, -LATERAL] >> *[αVOICE, +SPREAD GLOTTIS] >> *[αVOICE, -HIGH] >> *[αVOICE, +CONSTRICTED PHARYNX] >>MAX[VOICE]

In (67), the algorithm of SDA produces the order of the contrastive features of QA consonant inventory.

(67) Sonorant >> Labial >> Coronal >> Nasal >> Dorsal >> Anterior >> Strident >> Continuant >> Spread Glottis >> Lateral >> High >> Constricted Pharynx >> Voice

In this section, I have converted the feature hierarchy of QA consonant inventory into OT constraint rankings. The procedure begins with the top feature [sonorant] and culminates in the lower-ranked feature [voicing]. These features represent the faithfulness constraints and their rankings are based on their orders in the hierarchy. Between these faithfulness constraints, there exist some co-occurrence constraints (markedness constraints) that aim to prevent the occurrence of some feature combinations. All the constraint rankings are summarised in (68). These constraints are responsible for establishing the contrastive specifications of the consonant inventory of QA. Then these constraints can account for the consonants adaptation of English loanwords in QA.

(68) **MAX[SON]** >> **MAX[LABIAL]** >> *[αCORONAL, +SONORANT] >> *[αCORONAL, +LABIAL] >> **MAX[CORONAL]** >> *[αNASAL, -SONORANT] >> *[αNASAL, +CORONAL], *[αNASAL, -CORONAL] >> **MAX[NASAL]** >> *[αDORSAL, +LABIAL] >> *[αDORSAL, +CORONAL] >> **MAX[DORSAL]** >> *[αANTERIOR, +LABIAL] >> *[αANTERIOR, +NASAL] >> *[αANTERIOR, -CORONAL] >> *[αANTERIOR, -DORSAL], *[αANTERIOR, +DORSAL] >> **MAX[ANTERIOR]** >> *[αSTRIDENT, +SONORANT] >> *[αSTRIDENT, +LABIAL] >> *[αSTRIDENT, -CORONAL] >> *[αSTRIDENT, -NASAL], *[αSTRIDENT, +NASAL] >> *[αSTRIDENT, +DORSAL], *[αSTRIDENT, -DORSAL] >> *[αSTRIDENT, -ANTERIOR] >> **MAX[STRIDENT]** >> *[αCONTINUANT, +SONORANT] >> *[αCONTINUANT, +NASAL], *[αCONTINUANT, +NASAL] >> *[αCONTINUANT, +STRIDENT] >> **MAX[CONTINUANT]** >> *[αSPREAD GLOTTIS, +SONORANT] >> *[αSPREAD GLOTTIS, +LABIAL] >> *[αSPREAD GLOTTIS, +CORONAL] >> *[αSPREAD GLOTTIS, +NASAL], *[αSPREAD GLOTTIS, -NASAL] >> *[αSPREAD GLOTTIS, +DORSAL] >> *[αSPREAD GLOTTIS, +ANTERIOR], *[αSPREAD GLOTTIS, -ANTERIOR] >> *[αSPREAD GLOTTIS, +STRIDENT], *[αSPREAD GLOTTIS, -STRIDENT] >> *[αSPREAD GLOTTIS, -CONTINUANT] >> **MAX[SPREAD GLOTTIS]** >> *[αLATERAL, -SONORANT] >> *[αLATERAL, +LABIAL] >> *[αLATERAL, +CORONAL], *[αLATERAL, -CORONAL] >> *[αLATERAL, +NASAL] >> *[αLATERAL, +DORSAL], *[αLATERAL, -DORSAL] >> *[αLATERAL, -ANTERIOR] >> *[αLATERAL, +STRIDENT], *[αLATERAL, -STRIDENT] >> *[αLATERAL, +CONTINUANT], *[αLATERAL, -CONTINUANT] >> *[αLATERAL, +SPREAD GLOTTIS], *[αLATERAL, -SPREAD GLOTTIS] >> **MAX[LATERAL]** >> *[αHIGH, +SONORANT] >> *[αHIGH, +LABIAL] >> *[αHIGH, +CORONAL] >> *[αHIGH, +NASAL], *[αHIGH, -NASAL] >> *[αHIGH, -DORSAL] >> *[αHIGH, +ANTERIOR], *[αHIGH, -ANTERIOR] >> *[αHIGH, +STRIDENT], *[αHIGH, -STRIDENT] >> *[αHIGH, +CONTINUANT] >> *[αHIGH, +LATERAL], *[αHIGH, -LATERAL] >> *[αHIGH, +SPREAD GLOTTIS], *[αHIGH, -SPREAD GLOTTIS] >> **MAX[HIGH]** >> *[αCONSTRICTED PHARYNX, +SONORANT] >> *[αCONSTRICTED PHARYNX, +LABIAL] >> *[αCONSTRICTED PHARYNX, -CORONAL] >> *[αCONSTRICTED PHARYNX, -NASAL], *[αCONSTRICTED PHARYNX, +NASAL] >> *[αCONSTRICTED PHARYNX, +DORSAL], *[αCONSTRICTED PHARYNX, -DORSAL] >> *[αCONSTRICTED PHARYNX, -ANTERIOR] >> *[αCONSTRICTED PHARYNX, +LATERAL], *[αCONSTRICTED PHARYNX, -LATERAL] >> *[αCONSTRICTED PHARYNX, +SPREAD GLOTTIS], *[αCONSTRICTED PHARYNX, -SPREAD GLOTTIS] >> *[αCONSTRICTED PHARYNX, +HIGH], *[αCONSTRICTED PHARYNX, -HIGH] >> **MAX[CONSTRICTED PHARYNX]** >> *[αVOICE, +SONORANT] >> *[αVOICE, +LABIAL] >> *[αVOICE, +NASAL], *[αVOICE, -NASAL] >> *[αVOICE, +LATERAL], *[αVOICE, -LATERAL] >> *[αVOICE, +SPREAD GLOTTIS] >> *[αVOICE, -HIGH] >> *[αVOICE, +CONSTRICTED PHARYNX] >> **MAX[VOICE]**

5.4 Analysis and Tableaux

Based on the constraint rankings given in (68), this section includes several tableaux which devoted to account for the consonants adaptation of English loanwords in QA. Within the framework of OT and following Mackenzie and Dresher (2004), Dresher (2009), and Mackenzie (2013), I posit that the inputs are fully-specified segments and that the outputs should only contain the contrastive specifications. “Thus, the constraint system acts as a *filter*, sifting fully-specified representations and allowing only the contrastive specifications to pass through” (Dresher 2009: 145). Based on this assumption, it is expected to have inputs which include combinations of features that are illicit in the consonant inventory of QA. These illicit combinations of features are going to be ruled out by the co-occurrence constraints given in (68), whereas the contrastive specifications are projected by the faithfulness constraints. With respect to English consonants that are foreign to QA, I postulate that QA speakers would change the lowered-ranked features like [voicing] and [continuant] at the expense of preserving the high-ranked features like [sonorant], [labial], [coronal], [nasal], etc. The input features of English segments are drawn mainly from Hyman's feature chart (1975: 240). It should be noted that features such as [low] which are not part of the contrastive specifications of QA consonant inventory will not be included in inputs. The omission of these additional features is due to the reason that these kinds of features do not affect the analysis as they are ranked below *[F]. As discussed in §4.3, the constraint *[F] denotes the end of the contrastive specifications of any inventory and any additional feature will be ranked lower than this constraint *[F]. In contrast, given that the inputs are supposed to be fully-specified segments, the contrastive features of QA consonant inventory which are not mentioned in Hyman’s feature chart will be added to the inputs. For instance, the feature [constricted pharynx] or [spread glottis] are not included within Hyman’s feature chart. However, I include these features as part of the fully-specified inputs.

As the hierarchy of constraints have been established and the nature of the input has been determined, let’s consider the evaluation of adapting English consonants into QA. It should be noted that only English consonants that are illicit in QA are going to be evaluated in OT tableaux. This is because it has been shown in §5.1 that English consonants which are licit in QA are always adapted faithfully.

5.4.1 Adaptation of English /p/

As has been mentioned in §5.1, QA consonant inventory has the voiced bilabial stop /b/. However, this segment does not contrast with another segment in voicing which means that the voiceless bilabial stop /p/ is not part of the QA inventory. Accordingly, in the case of the adaptation of the segment /p/ which is illicit in QA, it is expected to change the [voicing] feature and replace /p/ with its voiced counterpart /b/ (e.g. /b/ > /p/, as in *A**s**pirin* /æs.**p**rɪn/ > [ʔas.**b**i.riːn])[14], rather than changing the place feature [labial] or the manner feature [plosive]. Changing the value of the [voicing] feature is predictable as this feature occupies lowered-position in the contrastive hierarchy of QA consonant inventory. Ranking the [voicing] feature low in the contrastive hierarchy is in line with the perceptual observation that [voicing] is the least perceptible feature (Steriade 2001; Miao 2005). Steriade's argument is based on the notion of 'similarity' which postulates that /d/ and /t/ are more similar than /d/ and /z/ or /d/ and /n/. This is because the difference between /d/ and /t/ is the [voicing] feature whereas /d/ and /z/ or /d/ and /n/ are distinguished by other features; namely, [continuant] and [nasal]. As a result, borrowers, when confronted with the non-native segment, tend to change the [voicing] feature rather than place or manner because this feature will make the output more similar to the input.

Now let's consider the tableau in (3) which illustrates how the English fully-specified segment /p/ is mapped to the QA contrastive specified segment [b]. It should be noted that all the candidates in the coming tableaux are going to violate the constraints, even the winning candidates. However, what makes these candidates winners is that they violate only some faithfulness constraints but respect all the co-occurrence constraints. The input cannot surface with full specifications because some combinations of features are not allowed in the contrastive hierarchy of QA consonant inventory. Therefore, the winning candidate should bear only the contrastive features.

In tableau (3), candidate (a) is excluded immediately because it fatally incurs a violation of the co-occurrence constraint *[αCORONAL, +LABIAL] as well as all other co-occurrence constraints. Candidate (b) satisfies all the co-occurrence constraints by having the feature specifications [-sonorant, +labial, +continuant] which represent [f] in QA. However, this mapping leads to a fatal violation of the faithfulness constraint MAX[CONTINUANT]. Since QA lacks a voicing contrast among bilabial stops, candidate (c) omits the specification for the feature [voicing] and, therefore, it is selected as optimal. It is evident from the tableau that all candidates violate more than one constraint, even the winning candidate. However, alongside violating some of the faithfulness constraints, the losing candidates cause fatal violations of some of the co-occurrence constraints. In contrast, the optimal candidate satisfies all co-occurrence constraints and violates

[14] The focus currently is on the adaptation of English consonants. However, I will consider the other adaptations (e.g. vowels) in chapter six.

only some of the faithfulness constraints. Thus, the winning candidate is required to meet all co-occurrence constraints.

Tableau 3

[-son, +lab, -cor, +ant, -stri, -cont, -voi] = **/p/**	Max [son]	Max [lab]	*[αCor, +lab]	Max [cor]	*[αAnt, +lab]	Max [ant]	*[αStri, +lab]	Max [stri]	Max [cont]	*[αVoi, +lab	Max [voi]	*[F]
a. [-son, +lab, -cor, +ant, -stri, -cont, -voi] = **[p]**			*!		*		*			*		*******
b.[-son, +lab, +cont] = **[f]**				*		*		*	*!		*	***
☞c.[-son, +lab, -cont] **=[b]**				*		*		*			*	***

5.4.2 Adaptation of English /v/

In the list of candidates in tableau (4), the output with the contrastive specifications [-sonorant, +labial, +continuant] is selected as an optimal output. This is because in QA, the labio-fricative segment /f/ does not contrast in voicing with another segment. This lack of voicing contrast results in the adaptation of the English labio-fricative consonant /v/ in QA as [f] (e.g. ***v***ideo /**v**ɪd.i.əʊ/ > [**f**id.ju]). Tableau (4) below presents those outputs that violate the markedness constraints and, thus, fail to win the competition.

The first candidate in (4) which maintains all the input specifications to produce [v] is ruled out because it makes several violations of the co-occurrence constraints. Candidate (b) changes the input specification [-sonorant] to [+sonorant] to produce the segment [w]. Although this change leads to avoid the violation of all the co-occurrence constraints, it incurs a fatal violation of the undominated constraint MAX[SONORANT]. The decision between the remaining two candidates (c) and (d) relies on the faithfulness constraint MAX[CONTINUANT] as they both violate the same constraints. Since the feature [continuant] is essential in the contrastive hierarchy of QA to distinguish between labial consonants /b/ vs. /f/, candidate (c) loses to (d) as the former does not satisfy the faithfulness constraint MAX[CONTINUANT] by changing the input specification [+continuant] into [-continuant].

Tableau 4

[-son, +lab, -cor, +ant, +stri, +cont, +voi] = **/v/**	Max [son]	Max [lab]	*[αCor, +lab]	Max [cor]	*[αAnt, +lab]	Max [ant]	*[αStri, +lab]	Max [stri]	Max [cont]	*[αVoi, +lab	Max [voi]	*[F]
a.[-son, +lab, -cor, +ant, +stri, +cont, +voi] **=[v]**			*!		*		*			*		*******
b. [+son, +lab, +cont] **= [w]**	*!			*		*		*			*	***
c.[-son, +lab, -cont] =**[b]**				*		*		*	*!		*	****
☞d.[-son, +lab, +cont] =**[f]**				*		*		*			*	***

5.4.3 Adaptation of English /tʃ/

The English segment /tʃ/ is adapted as [ʃ] in QA because the QA consonant inventory includes only the postalveolar fricative [ʃ] (e.g. /tʃ/ > [ʃ], as in *chips* /**tʃ**ɪps/ > [**ʃ**ibs]). It is worth mentioning that the postalveolar segment [ʃ] is contrastively specified in the QA as [-sonorant, -labial, +coronal, -anterior, -voiced]. Therefore, any other specifications should be removed from the optimal output by particular co-occurrence constraints ranked higher than the faithfulness constraints.

The input in tableau (5) includes the feature specifications that characterise the segment /tʃ/. However, the constraint system of QA eliminates the feature specifications [+strident] and [-continuant] and preserve the rest of specifications that contrastively specify the segment [ʃ] in QA. As can be seen in tableau (5), candidate (a) preserves all the input features and avoids violating any faithfulness constraint. However, this preservation leads to serious violations of the co-occurrence constraints *[αSTRIDENT, -ANTERIOR] and *[αCONTINUANT, -ANTERIOR]; thus, this candidate is excluded. Candidate (b) avoids the violation of the markedness constraints *[αSTRIDENT, -ANTERIOR] and *[αCONTINUANT, -ANTERIOR] by removing the specifications [+strident] and [-continuant] to produce the segment [dʒ]. Nonetheless, this candidate changes the input feature [-voiced] into [+voiced]; making a fatal violation of the faithfulness constraint MAX[VOICED]. Candidate (c) maps the input segment /tʃ/ to [s] which entails changing the input specification [-anterior] into [+anterior]. Although this mapping avoids the violations of the co-occurrence constraints *[αSTRIDENT, -ANTERIOR] and *[αCONTINUANT, -ANTERIOR], it fatally violates the faithfulness constraint MAX[ANTERIOR]. The result is that candidate (d) wins the competition because it respects all the co-occurrence constraints and maps the input consonant /tʃ/ to [ʃ].

Tableau 5

[-son, -lab, +cor, -ant, +stri, -cont, -voi] = **/tʃ/**	Max [son]	Max [lab]	Max [cor]	Max [ant]	*[αStri, -ant]	Max [stri]	*[αCont, -ant]	Max [cont]	Max [voi]	*[F]
a. [-son, -lab, +cor, -ant, +stri, -cont, +del rel, -voi] = **/tʃ/**					*!		*			********
b. [-son, -lab, +cor, -ant, +voi] = **[dʒ]**						*		*	*!	*****
c. [-son, -lab, +cor, +ant, +stri, -voi] = **[s]**				*!				*		******
☞d. [-son, -lab, +cor, -ant, -voi] = **[ʃ]**						*		*		*****

5.4.4 Adaptation of English /ʒ/

As observed in the adaptations of the segments /tʃ/ and /ʃ/, QA speakers map the English segment /ʒ/ as [dʒ] (e.g. /ʒ/ > [dʒ], as in beige /beɪ**ʒ**/ > [beː**dʒ**]). This can be attributed to the lack of segment /ʒ/ in the QA consonant inventory. Tableau (6) illustrates how the English fully-specified segment /ʒ/ is mapped to the QA contrastive specified segment [dʒ]. According to the contrastive hierarchy of QA consonant inventory, the optimised output should be contrastively specified as [-sonorant, -labial, +coronal, -anterior, +voiced]. Any other specifications should be crossed out from the output. In other words, the specifications appear in the input [+strident] and [+continuant] should be eliminated from the output as they are not contrastive for the segment [dʒ] in QA.

This tableau hypothesises that the foreign segment /ʒ/ is mapped to different segments in QA: (as [ʒ] in candidate (a), as [ʃ] in candidate (b), as [z] in candidate (c), and finally as the actual output [dʒ] in candidate (d)). Based on the contrastive specification of the segment [dʒ], candidate (a) is eliminated for including the specifications [+strident], [+continuant] within the domain [-anterior]; thereby incurring violations of the co-occurrence constraints *[αSTRIDENT, -ANTERIOR] and *[αCONTINUANT, -ANTERIOR]. Candidate (b) correctly omits the specifications [+strident] and [+continuant] to satisfy *[αSTRIDENT, -ANTERIOR] and *[αCONTINUANT, -ANTERIOR]. However, this candidate is also removed from the competition for changing the value of the input specification [+voiced] into [-voiced] to produce the segment [ʃ]; thus, violating the faithfulness constraint MAX[VOICED]. The feature specifications of candidate (c) are assumed to represent the segment [z] in QA. Therefore, the input specification [-anterior] changes to [+anterior]. This change of specification culminates in satisfying the co-occurrence constraints correctly *[αSTRIDENT, -ANTERIOR] and *[αCONTINUANT, -ANTERIOR], as the specification [-anterior] no longer appears in the output. However, candidate (c) loses because it incurs a fatal violation of the faithfulness constraint MAX[ANTERIOR] by changing the value of the input specification from [-anterior] to [+anterior]. Finally, candidate (d) avoids violating the co-occurrence constraints by omitting the specifications [+strident] and [+continuant]; therefore, it wins.

Tableau 6

[-son, -lab, +cor, -ant, +stri, +cont, +voi] = **/ʒ/**	Max [son]	Max [lab]	Max [cor]	Max [ant]	*[αStri, -ant]	Max [stri]	*[αCont, -ant]	Max [cont]	Max [voi]	*[F]
a. [-son, -lab, +cor, -ant, +stri, +cont, +voi] = **[ʒ]**					*!		*			*** ****
b. [-son, -lab, +cor, -ant, -voi] = **[ʃ]**						*		*	*!	*** **
c. [-son, -lab, +cor, +ant, +stri, +cont, +voi] = **[z]**				*!						*** ****
☞d. [-son, -lab, +cor, -ant, +voi] = **[dʒ]**						*		*		*** **

5.4.5 Adaptation of English /ŋ/

Tableau (7) demonstrates how to account for the mapping of an input that contains combinations of features that are illicit in the borrowing language. This is exemplified in the English nasal segment /ŋ/, which carries the combination of features [nasal and dorsal] that are illicit in the QA (e.g. /ŋ/ > [n], as in *pancreas* /ˈpæ**ŋ**.kri.əs/ > [ba**n**.kirˈjaːs]). The two features [nasal] and [dorsal] are used in the contrastive hierarchy of QA; however, QA system prevents the occurrence of the two features in one segment. Therefore, one of the features needs to be excluded to satisfy the native grammar of QA. According to the contrastive hierarchy of QA, the feature [dorsal] is ranked lower than the feature [nasal]. As a result, MAX[DORSAL] is dominated by the faithfulness constraint MAX[NASAL] and the co-occurrence constraint *[αDORSAL, +NASAL] which prevents the combinations of features [nasal and dorsal]. If deletion of the specification [+nasal], as what candidate (b) and (c) do, were the optimal way of avoiding the violation of the constraint *[αDORSAL, +NASAL], the English velar nasal /ŋ/ would be mapped to the QA velar stops [k] or [g]. However, the data shows that it is better for QA speakers to delete the specification [+dorsal], violating the faithfulness constraint MAX[DORSAL], than it is to delete the specification [+nasal]. Therefore, MAX[NASAL] should outrank MAX[DORSAL] and the optimal output should omit the specification [+dorsal] and leave the specification [+nasal] intact. As a result, the English velar nasal /ŋ/ is mapped to the QA alveolar nasal [n]. It is worth mentioning that in Clements' scale (2009), the feature [dorsal] is ranked higher than [nasal]. However, the adaptation of the English segment /ŋ/ in QA shows that the feature [nasal] is ranked higher than [dorsal] and this ranking provides an empirical evidence that the universal order of features proposed by Clements (2001, 2009) is not fixed and it may encounter variation across languages.

For [n] to win out over the other candidates *[ŋ], [k] and [g], the optimal candidate should carry the contrastive specifications of the segment /n/: [+sonorant, -labial, +nasal]. As established previously, any candidate containing redundant specifications of features as well as non-contrastive specifications will be ruled out immediately. Indeed, candidate (a) is removed for including the specifications [+dorsal, +high, +voiced], and violating the co-occurrence constraints *[αDORSAL, +NASAL], *[αHIGH, +SONORANT] and *[αVOICED, +SONORANT]. Candidates (b) and (c), respectively, attempt to map the illicit input to the velar stops [k] and [g] by deleting the specification [+nasal] to satisfy the co-occurrence constraint *[αDORSAL, +NASAL]. However, mapping the velar nasal /ŋ/ to the velar stops [k] or [g] entails a change to the feature specification [+sonorant] to [-sonorant]. This change leads to a fatal violation of the undominated constraint MAX[SONORANT]. Since candidate (d) dispenses with the non-contrastive specifications [+dorsal], [+high] and [+voiced], it wins.

Tableau 7

[+son, -lab, +nas, +dor, +high, +voi] = **/ŋ/**	Max [son]	Max [lab]	Max [nas]	*[αDor, +nas]	Max [dor]	*[αHigh, +son]	Max [high]	*[αVoi, +son]	Max [voi]	*[F]
a.[+son, -lab,+nas, +dor, +high, +voi] = **[ŋ]**				*!		*		*		******
b. [-son, -lab, +dor, +high, -voi] = **[k]**	*!		*						*	*****
c. [-son, -lab, +dor, +high, +voi] = **[g]**	*!		*							*****
☞d.[+son, -lab, +nas] = **[n]**					*		*		*	***

5.4.6 Adaptation of English consonants /s/ and /t/ as emphatics /sˤ/ and /tˤ/ in QA

This section presents the phonological analysis of mapping the English plain consonants /s/ and /t/ to emphatics [sˤ] and [tˤ] in QA. It demonstrates that the main motivation for such adaptation is the occurrence of the non-high back vowels in the source words (English loanwords). This effect is due to the phonological fact that the low front vowel /a/ in QA is changed to the low back vowel [ɑ] if /a/ occurs adjacent to emphatic consonants. That is, the low back vowel [ɑ] in QA co-occurs with emphatic consonants. Therefore, I propose that the co-occurrence of the plain consonants /t/ and /s/ with the low back vowel /ɑ/ in the English loanwords motivates QA speakers to produce these plain consonants as emphatics. Although in QA system the effect of emphasis on vowels comes from emphatic consonants, it seems that in loanwords we have a counter effect of emphasis on plain consonants from back vowels. Before analysing this phenomenon in OT tableaux, it is worth outlining the emphasis in Arabic.

Several researches have shown that Arabic has the so-called phonological phenomenon: emphasis (Lehn 1963; Al-Ani 1970; Davis 1995; Zawaydah 1999; Watson 1999, 2002; among others). The process of emphasis in Arabic is formed by articulating a set of sounds /t/, /d/, /s/, and /ð/ in the alveolar and dental regions (as primary features) along with the back region of the tongue root (as secondary features). Classical and Modern Standard Arabic exhibit the emphatic consonants /tˤ/, /dˤ/, /sˤ/ and /ðˤ/ (Ingham 1994). However, QA is characterised by having /tˤ/ to contrast with /t/, /sˤ/ to contrast with /s/ and /ð/ to contrast with /ðˤ/. The alveolar emphatic stop /dˤ/

is lost in QA and merged with /ðˤ/. Examples about the plain consonants /t, s, ð/, along with their emphatic counterparts /tˤ, sˤ, ðˤ/, are provided in (69)[15].

(69) Examples about emphatics consonants in QA

(a)	[ðaːʕ]	'he spread'	[ðˤɑːʕ]	'he got lost'
(b)	[ðam]	'he dispraised'	[ðˤɑm]	'he joined'
(c)	[saːħ]	'it's melt'	[sˤɑːħ]	'he cried'
(d)	[sad]	'he plugged'	[sˤɑd]	'he repelled'
(e)	[tal]	'hill'	[tˤɑl]	'he overlooked'
(f)	[taːb]	'he repented'	[tˤɑːb]	'he cured'[16]

In addition to the fact that some plain consonants become emphatics as a result of emphasis, it has been highlighted that the process of emphasis also affects neighbouring vowels (Al-Ani 1970; Ghazeli 1977). It has also been demonstrated that whereas in some Arabic dialects, the emphasis effect is confined within the adjacent vowels (e.g. Younes 1993), this effect spreads to include the entire phonological word in other Arabic dialects (e.g. Lehn 1963; Schulte 1985). Watson (2002), for instance, showed that in Cairene Arabic the influence of emphatic consonants affects a CV syllable minimally and it can spread to include the phonological word (Watson 2002). Furthermore, Al-Ammar (2017) reported that the emphasis in Zilfawi Arabic spreads across the word boundary to include suffixes.

There is no consensus on the nature of the secondary articulation and several researchers have reported different analyses for different dialects of Arabic. For instance, it has been claimed that the process of emphasis in Arabic is characterised as uvularisation by which the production of emphatic consonants involves constricting the back of the tongue in the upper pharynx (Ali and Daniloff 1974; Ghazeli 1977; McCarthy 1994; Shahin 1997; Zawaydah 1999). Other researchers have characterised the process of emphasis as pharyngealisation since the root of the tongue is moved back and constricted in the lower pharynx (Al-Ani 1970; Giannini and Pettorino 1982; Younes 1982; Laufer and Baer 1988; Davis 1995; Khattab *et al.* 2006). A few researchers claim that emphasis is velarisation (e.g. Catford 1977; Herzallah 1990).

Based on acoustic analysis, Al-Ammar (2017) argues that emphasis in Zilfawi Arabic, a sub-dialect of Najdi Arabic spoken in central Saudi Arabia, is characterised as a pharyngealisation process. This is attributed to acoustic measurements which show that there is an increase in F1 and

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[15] The IPA symbol (ˤ) refers to emphatic consonants.
[16] Example (f) is taken from Al-Ammar (2017)

a decrease in F2 formants of vowels within emphatic environments (see Al-Ani 1970; Davis 1995; Watson 1999 for similar arguments). Furthermore, he found that the effect of emphasis in Zilfawi Arabic extends to include all vowels in the word. Al-Ammar (2017) has investigated a sub-dialect of Najdi Arabic, which has a phonological inventory similar to that found in QA. Therefore, I will follow his lead by assuming that emphasis in QA occurs by lowering the back of the tongue (pharyngealisation process); moreover, this process changes the low front vowel /a/ to the low back vowel [ɑ].

Although the literature reveals that vowels are affected when emphasis takes place, the primary concern of this study is on the low vowels and their impact on the process of emphasis in English loanwords adapted in QA. Crucially, this concern is derived from the findings reported by several acoustic studies. These studies reveal that the the low vowels in Arabic /a, aː/ are the most affected vowels to undergo a decreasing of F2 in emphatic environments (Al-Ani 1970; Habis 1998; Khattab *et al.* 2006; Al-Masri 2009; Al-Ammar 2017).

Al-Masri (2009) investigated the phonetic and perceptual correlates of emphasis in Urban Jordanian Arabic. The main purpose of his study was to test the participants' perception of detecting the distinction between plain and emphatic consonants. Indeed, his perception experiment is especially pertinent to our discussion. The researcher asked the participants to hear non-sense words and decide whether they heard plain or emphatic consonants. He concluded that the participants do not depend on the quality of the consonants in perceiving the target consonants. Rather, the vowel quality affects the participants' perceptions of the target consonants as plains or emphatics. Thus, the participants use vowel quality as a strong perceptual cue to detect plain versus emphatic consonants. As Al-Masri (2009: 140) put it in his words 'when the vowel from the plain word is spliced into the emphatic word, subjects detected the plain stop /t/ with a very high percentage. When the vowel from the emphatic word was spliced into the plain word, subjects detected the emphatic stop /tˤ/.'

In studies of Arabic loanword phonology, Abu-Guba (2016: 92) found that emphasis was also attested in his data where he got 12 loanwords denoting /s/ and four words denoting /t/. He argued that emphasis in loanwords is motivated mainly by the back vowels of the source forms. That is, based on the acoustic facts that back vowels and emphatic consonants have a lowering of F2, the occurrence of the back vowels /ɑː, ɒ, ʌ, ɔː, aʊ, ʊ, uː/ in the source forms (i.e. English loanwords) affects Ammani Arabic speakers to produce plain consonants /t/ and /s/ as emphatic counterparts to achieve what Abu-Guba called 'coarticulation effect'. However, this coarticulation effect is highly observed when the source forms include low back vowels and reduced when the vowels go higher and fronter. Thus, Abu-Guba (2016: 93) came up with the following hierarchy (ɒ, ʌ, ɑː, ɔː >> ʌɪ, aʊ >> ʊ, uː >> oɪ >> ə) to show that emphasis in loanwords would more likely occur if the adapted forms include a vowel from the first set (i.e. ɒ, ʌ, ɑː, ɔː) than other set of vowels.

Since it has been argued in several studies that quality of vowels (i.e lowering of F2) play a role in affecting adjacent consonants to become emphatics (e.g. Al-Masri 2009; Abu-Guba 2016), we predict that the plain consonants /t/ and /s/ in English loanwords are adapted as their emphatic counterparts [tˤ] and [sˤ] if these consonants co-occur with back vowels in the source forms. Indeed, our results reveal that the coronal consonants /t/ and /s/ in English loanwords are adapted as [tˤ] and [sˤ] when these coronal consonants /t/ and /s/ occur together with the non-high back vowels /ʌ, ɔː, ɔɪ, əʊ/ in the same word. Examples are given in table 17.

English Word	English IPA transcription	QA IPA transcription
offside	/ɒfˈsaɪd/	[ʔuf.ˈ**sˤ**ɑː.jad]
stop	/stɒp/	[ʔi**sˤ**.**tˤ**ɑb.bɑh] ‘car rear light’
bottle	/ˈbɒt.əl/	[ˈbɑ.**tˤ**il]
watt	/wɒt/	[wɑː**tˤ**]
consul	/ˈkɒn.səl/	[ˈqun.**sˤ**ɑl]
bus	/bʌs/	[bɑː**sˤ**]
Subway	/ˈsʌb.weɪ/	[**sˤ**ɑbˈweː]
ton	/tʌn/	[**tˤ**ɑn]
plus	/plʌs/	[blɑ**sˤ**]
soya	/ˈsɔɪ.ə/	[ˈ**sˤ**oː.ja]
dinosaur	/ˈdaɪ.nə.sɔːʳ/	[di.naˈ**sˤ**oːr]
sauce	/sɔːs/	[**sˤ**oː**sˤ**]
sodium	/ˈsəʊ.di.əm/	[ˈ**sˤ**oːd.jum]

Table 17: Emphasis in English loanwords adapted in QA

The data of this study show that emphasis is attested in 13 words which are provided in table 17. It can be observed from the table that the source forms in the first five words include the low back vowel /ɒ/ whereas the rest of the words include the mid back vowels /ʌ, ɔː, ɔɪ, əʊ/. Therefore, in line with Abu-Guba’s (2016) argument, I propose that the presence of the non-high back vowels in the source forms entails the introduction of the phonological feature [constricted pharynx] to the plain consonants /t/ and /s/ to become [tˤ] and [sˤ]. Phonetically speaking, this entailment takes place to have the articulations of emphatic consonants that resemble non-high back vowels.

Now, the phonological process of emphasis in English loanwords adapted in QA are analysed in OT tableaux. The evaluation and constraints that have been used previously to account for the adaptation of /t/ and /s/ will be used here to account for the adaptation of emphatic consonants. However, the significant differences between the evaluations of the adaptation of emphatic vs. non-emphatic consonants in QA are that the optimal outputs in emphatics tableaux should carry the contrastive specification [+constricted pharynx], in addition to removing the feature specification [±voiced].

It is necessary to add two essential constrains before analysing the emphasis of English loanwords in OT tableaux. First, we must create the markedness constraint *[+back, -high] [-CP] provided in (70) to prevent the surface of any consonant specified as [-CP] if it co-occurs with a non-high back vowel within one phonological word. Second, it is necessary to reformulate the faithfulness constraint MAX[F] and divide it into two faithfulness constraints with two different definitions[17]. This division aims to prevent any candidate attempts to avoid the markedness constraint *[+back, -high] [-CP] by deleting the whole input feature specification [-CP]. The additional constraints along with their definitions are given in (70).

(70)

a. *[+BACK, -HIGH] [-CP]: a segment specified as [-CP] should not follow or precede a segment specified as [+back, -high].
b. MAX[F]: 'Assign a violation mark for any instance of [+F] or [-F] in the input that does not have an output correspondent.'
c. IDENT[F]: 'Assign a violation mark for any output segment specified as [αF] with an input correspondent specified as [-αF]'.
Mackenzie (2013: 304 and 320)

If we do not amend the constraint MAX[F], this constraint will assign a violation mark to any candidate deletes or changes the value of the input feature specification. In this case, the plain consonant /s/ with the input feature specification [-CP] cannot surface as its emphatic counterpart /sˤ/ since this kind of change in feature specifications entails a violation of the faithfulness constraint MAX[F]. Therefore, the reformulation of the constraint MAX[F] is indispensable to allow the optimal output with a different value of input feature specification to surface. This means that the optimal output will violate the faithfulness constraint IDENT[F] by changing the value of

[17] This method of creating markedness constraints is taken from Mackenzie (2013). Moreover, the faithfulness constraints are borrowed from Mackenzie (2013: 304 and 320).

the input feature specification; however, this constraint will be ranked lower than the other faithfulness constraint MAX[F].

Tableau (8) outlines how a fully-specified input that represents the alveolar stop /s/ is realised as its emphatic counterpart [sˤ] in the adaptation of English loanwords in QA. According to the CHT, any fully-specified input is filtered out by the co-occurrence constraints that militate against some combinations of features; thereby facilitating the appearance of contrastive features in the surface level. Given the input /s/, which is fully-specified as [-sonorant, -labial, +coronal, +anterior, +continuant, +strident, -CP, -voiced] and occurs together with the back non-high vowel within one phonological word, the optimal output should carry only the following contrastive features which characterise the emphatic consonant [sˤ] in QA [-sonorant, -labial, +coronal, +anterior, +strident, +CP]. Moreover, this optimal output should avoid violating the contextual constraint *[+BACK, -HIGH] [-CP] by shifting the feature value [-CP] to its positive counterpart [+CP].

Tableau 8 /s/ preceded or followed by a non-high back vowel

[-son, -lab, +cor, +ant, +cont, +stri, -CP, -voi] = **/s/**	Max [son]	Max [lab]	Max [cor]	Max [ant]	Max [stri]	*[αCont, +stri]	Max [cont]	*[+bk, -high] [-CP]	Max [CP]	Ident [CP]	*[αVoi, +CP]	Max [voi]	*[F]
a. [-son, -lab, +cor, +ant, +cont, +stri, -CP, -voi] = **/s/**						*!		*					********
b. [-son, -lab, +cor, +ant, +stri, -CP, -voi] = **/s/**							*	*!					*******
c. [-son, -lab, +cor, +ant, +stri, -voi] = **/s/**							*		*!				******
d. [-son, -lab, +cor, +ant, +stri, +CP, -voi] = **/sˤ/**							*			*	*!		*******
☞e. [-son, -lab, +cor, +ant, +stri, +CP] = **[sˤ]**							*			*		*	******

Tableau 9 /t/ preceded or followed by a non-high back vowel

[-son, -lab, +cor, +ant, -cont, -stri, -CP, -voi] = /t/	Max [son]	Max [lab]	Max [cor]	Max [ant]	Max [stri]	*[αCont, +stri]	Max [cont]	*[+bk, -high] [-CP]	Max [CP]	Ident [CP]	*[αVoi, +CP]	Max [voi]	*[F]
a. [-son, -lab, +cor, +ant, -cont, -stri, -CP, -voi] **= /t/**						*!		*					********
b. [-son, -lab, +cor, +ant, -stri, -CP, -voi] **= /t/**							*	*!					*******
c. [-son, -lab, +cor, +ant, -stri, -voi] **= /t/**							*		*!				******
d. [-son, -lab, +cor, +ant, -stri, +CP, -voi] **= /tˤ/**							*			*	*!		*******
☞e. [-son, -lab, +cor, +ant, -stri, +CP] = **[tˤ]**							*			*		*	******

The two tableaux are nearly identical regarding their competing candidates and how they are evaluated; they will be subjected to simultaneous analysis. Candidates (a) in both tableaux are completely faithful to the input. However, this preservation of input feature specifications leads to allow the specification [+continuant] to surface although in QA phonological inventory this feature is not contrastive within the scope of alveolar fricatives /s, z, sˤ/. Therefore, candidates (a) cause fatal violations of the co-occurrence constraint *[αCONTINUANT, +STRIDENT].

According to the mechanism proposed by Dresher (2009), it is more important to satisfy the markedness constraints at the expense of violating the faithfulness constraints. Thus, candidates (b) are removed from the competition for fatally violating the markedness constraint *[+BACK, -HIGH] [-CP] by having the specification [-CP]. Candidates (c) in the two tableaux have the opportunity to win as they avoid the markedness constraint *[+BACK, -HIGH] [-CP] by omitting the feature specification [-CP]. However, this type of deletion culminates in the violation of the faithfulness constraint MAX[CP], which is ranked higher than IDENT[CP]. Unlike the optimal candidates, candidates (d) in the two tableaux violate the constraint *[αVOICED, +CP], which is ranked higher than the faithfulness constraint MAX[VOICED], by allowing the input feature [-voiced] to surface. This is how the optimal outputs (e) win. First, these candidates omit the specification [+continuant] as the emphatic consonants /sˤ/ and /tˤ/ in QA are not contrastively specified for this feature; thus, these candidates incur a violation of the faithfulness constraint MAX[CONTINUANT]. Second, these candidates change the value of the input feature [-CP] into [+CP], incurring a violation of IDENT[CP] but respecting MAX[CP]. This change of value is necessary to avoid the violation of the markedness constraint *[+BACK, -HIGH] [-CP] which penalises a segment specified as [-CP] if preceded or followed by a non-high back vowel. It should be noted that the optimal outputs can not omit the feature [CP] to satisfy the constraint *[+BACK, -HIGH] [-CP] since the emphatic and non-emphatic consonants in QA /sˤ, tˤ, s, t/ are contrastively specified as [+CP] and [-CP], respectively. Third, the winning candidates eliminate the specification [-voiced] as the feature [voicing] is not contrastive within the domain of emphatic consonants in QA.

This section concludes with the observation that the occurrence of emphasis in English loanwords adapted in QA is typically triggered by the occurrence of low back vowels in the source forms (English word). This tendency is attributed to the observation reported by several researchers, which states that the front vowel /a/ is the most affected vowel (among other Arabic vowels) that underwent F2 lowering and becomes /ɑ/ in emphatic contexts (e.g. Card 1983; Yeou 1997; Al-Masri 2009; Al-ammar 2017). Based on this observation and according to the phonological fact that the low back vowel /ɑ/ appears exclusively in emphatic environments in QA native grammar, I propose that the main factor that triggers emphasis in English loanwords adapted in QA is the occurrence of the low back vowel /ɑ/ in the source forms. This suggestion is supported by the perceptual study conducted by Al-Masri (2009). In his study, the Arabic subjects are asked to determine whether the target consonants they heard were plains or emphatics. The researcher found that the quality of vowels adjacent to target consonants affects the subjects to identify the quality of target consonants (whether plains or emphatics).

Analysing the adaptation of loanwords sometimes provides a researcher with answers to some phonological questions that would not be answered from looking merely at the native grammar (Jacobs and Gussenhoven 2000). Thus, the observation pertaining to the emphasis of English loanwords in QA supports the findings that vowel quality is more effective than consonant quality in determining the existence of emphasis in Arabic. In other words, in QA native grammar, the emphatic consonant triggers the occurrence of the low back vowel /ɑ/. However, in loanword adaptation, and because English has a low back vowel /ɑ/ but lacks emphatic consonants, I propose that the low back vowel /ɑ/ in the input is the main motivation for affecting plain consonants /t/ and /s/ to be produced as emphatics [$t^ʕ$] and [$s^ʕ$] after adaptation.

Furthermore, the observation that QA speakers sometimes do not remain faithful to the quality of the consonants (i.e. changing plain consonants to emphatics although plains are available in QA inventory) supports the argument followed in this study; whereby markedness constraints outrank faithfulness constraints.

5.5 Conclusion

The proposal offered in this chapter argues that the analysis of consonants adaptation of English loanwords adapted in QA can be accounted for by proposing that the inputs are fully-specified. Moreover, the outputs should only bear features that are underlyingly contrastive in the QA phonological inventory. As a theory of phonological contrast, I have followed the CHT (Dresher 2009) to create the contrastive hierarchy of QA consonant inventory. This contrastive hierarchy determines how English consonants should surface in QA after adaptation. In particular, the contrastive hierarchy of QA is converted to a constraint hierarchy. Then, this constraint hierarchy evaluates inputs with full feature specifications to rule out redundant and non-contrastive features and preserve only features that are contrastive in QA.

The English sounds (consonants and vowels) are adapted similarly in QA. In other words, the fact that an English sound surfaces with different phonetic representations depending on its position does not lead to different adaptation patterns. For instance, the English unaspirated and aspirated stop /p/ and /p^h/ are adapted in QA as [b]. This adaptation is in line with the phonological view which argues that the adaptation of foreign sounds is symmetrical. On the contrary, this adaptation contradicts the phonetic view which argues that the nature of the adaptation of foreign segments in L1 is based on the phonetic realizations of L2.

Chapter 6: Adaptation of English Vowels into QA

This chapter presents the adaptation patterns of English vowels into QA. The analysis will demonstrate that full-specified English vowels are mapped to the contrastive vowels in QA. This is achieved by allowing to surface only the phonological features of inputs that are contrastive in the QA vowel inventory. For instance, based on the contrastive hierarchy of QA vowel inventory, the high front vowel /i/ is specified contrastively as [-back, -low, -long, +vocalic]. Since /i/ in QA does not contrast with another vowel in [ATR], the phonological feature [ATR] is not a contrastive feature in QA. Therefore, the English vowels /i/ and /ɪ/ are adapted in QA as [i] with the contrastive specifications [-back, -low, -long, +vocalic].

The chapter is structured as follows: §6.1 presents the results of the adaptation patterns of the English vowels into QA. §6.2 comprises the contrastive hierarchy of QA non-consonant inventory.[18] Then, the contrastive hierarchy established in §6.2 is converted into OT constraints in §6.3. The data analysis is evaluated in several tableaux in §6.4. Finally, a conclusion is presented in §6.5.

6.1 Results of the adaptation of English vowels into QA

This section presents the results of the adaptation patterns of English vowels in QA. The findings reveal that English vowels that are unmarked in QA /i(ː), uː/ are adapted faithfully. However, English vowels that are marked in QA /ɪ, ʊ, a, eɪ, ɛ, æ, ɑ, ɒ, o, ɔ, ʌ, ə/ are mapped to their phonological closest vowels in QA. First, we consider the results of the adaptation of English vowels that are unmarked in QA, before presenting the adaptation patterns of English vowels that are marked in QA.

6.1.1 Adaptation of English high front vowel /i(ː)/[19]

QA has a small vowel inventory compared with English. Therefore, only two English vowels /i(ː)/ and /uː/ are considered unmarked in QA and are adapted faithfully. The table below presents the

[18] Note that the terms non-consonant inventory and vowel inventory are used interchangeably throughout this chapter.
[19] In English, the long vowel /iː/ and the short one /ɪ/ are distinctive. However, there are some cases where a phonemic distinction between /iː/ and /ɪ/ is neutralized. i.e. the phonemic distinction disappears. For instance, the final vowel in the English words *city* and *happy* cannot be transcribed as /iː/ nor /ɪ/. Therefore, the Cambridge English Dictionary

numbers of occurrences and percentages of adaptation patterns of English high front tense vowel /i(ː)/ in QA. The first column denotes the numbers of occurrences and percentages whereby the English high front vowel /i(ː)/ is replaced by [i] in QA. The second column includes the numbers of occurrences and percentages whereby the English high front vowel /i(ː)/ is adapted as [iː] in QA. The third column reveals the frequency with which the English high front vowel /i/ is adapted as the mid vowel [eː] in QA. The final column includes the total number of English loanwords featuring /i/.

	Adapted as /i/ in QA	Adapted as /iː/ in QA	Adapted as /eː/ in QA	Total
English /i/	24 (100%)	-	-	24
English /iː/	5 (14.7%)	27 (79.4%)	2 (5.8%)	34

Table 18: Adaptation of English high front tense vowel /i(ː)/ in QA

Variant adaptation patterns are illustrated in examples (71) and (72). These patterns range from faithful mappings, as in (71, (72a), to less faithful mappings, as in (72b) by shortening long vowels, to unfaithful mapping, as in (72c) by adapting English /iː/ as [eː] in QA. In the faithful adaptation of (71 and (72a), the English high front tense vowels /i/ and /iː/ are mapped respectively to the QA front high vowels [i] and [iː]. However, in the less faithful adaptation of (72b), the English high front tense vowel /iː/ is replaced with the QA front high vowel [i]. This change in the length feature is attributed to the phonological fact that long vowels in the native system of QA are prohibited from occurring word-finally. The last examples in (72c) demonstrate that the English high front tense vowel /iː/ is mapped to the QA mid-front vowel [eː]. In these examples, the input feature (+high) is changed to (-high). Although this type of mapping alters only one feature, I would consider it unfaithful mapping as it changes the position of the tongue from high to mid. In examples (72c), the nucleus sound /iː/ in the two words *cream* and *Jeep* is adapted as [eː]. I assume that this adaptation is attributed to orthography effect; that is, the two words include the English graphemes *ea* and *ee*. I argue that these English graphemes affect QA speakers to pronounce the two words with [eː] rather than [iː]. With the effect of orthography, I assume that the input would

transcribes this vowel as /i/ to denote the final unstressed vowel. Accordingly, in this study, I use the English vowel /iː/ to refer to the long one, /ɪ/ to refer to the short and /i/ to denote the final unstressed vowel.

no longer be /iː/; rather, it would be /eɪ/. If this assumption is true, we have a faithful adaptation in which the English mid vowel /eɪ/ is mapped to the QA mid vowel [eː].

(71) English /i/ → QA [i]

candy	/ˈkæn.d**i**/	→	[ˈkaːn.d**i**]
comedy	/ˈkɒm.ə.d**i**/	→	[kuˈmiː.d**i**]

(72) English /i(ː)/ → QA [iː], [i], [eː]

(a) /iː/ → [iː]

caffeine	/ˈkæf.**iː**n/	→	[kaˈf**iː**n]
kiwi	/ˈk**iː**.wiː/	→	[ˈk**iː**.wi]

(b) /iː/ → [i]

litre	/ˈl**iː**.tər/	→	[ˈl**i**.tir]
metre	/ˈm**iː**.tər/	→	[ˈm**i**.tir]
free	/fr**iː**/	→	[fr**i**]
Chimpanzee	/tʃɪm.pænˈz**iː**/	→	[ʃim.baːnˈz**i**]
kiwi	/ˈkiː.w**iː**/	→	[ˈkiː.w**i**]

(c) /iː/ → [eː]

Jeep	/dʒ**iː**p/	→	[dʒ**eː**b]
cream	/kr**iː**m/	→	[kr**eː**m]

6.1.2 Adaptation of English high back vowel /uː/

QA, as English, has the high back vowel /uː/. The sole difference is the contrastive nature of /u/ and /uː/ in QA. Therefore, English /uː/ is predicted to be mapped to QA [uː]. Moreover, any divergent mapping observed will be attributed either to QA phonological constraints or the orthography effect.

The data reveal that the English high back long vowel /uː/ is mapped frequently to [uː] in QA but can also be mapped to [u] or [oː]. For instance, the English loanword *tubeless* /ˈt**uː**b.les/ is adapted in QA as [ˈt**uː**b.lis]. However, the English loanwords *shampoo* /ʃæm.ˈp**uː**/ and *scooter* /ˈsk**uː**.təʳ/ are adapted respectively in QA as [ˈʃam.b**u**] and [ˈsk**oː**.tar] with the input vowels /uː/ surfacing as [u] and [oː].

Based on table 19, English /uː/ is adapted regularly as [uː] in QA (28/32 occurrences, 88%). It can be seen from the table that only four occurrences are not adapted as [uː] (two occurrences are mapped to [u] (6%) and two occurrences are mapped to [oː] (6%)). To account for these divergent mappings, we must refer to the QA phonological constraints as well as the orthographic effect. In example (73b), the English vowel /uː/ occurs word-finally. If this vowel is adapted faithfully, this adaptation will lead to violation of the QA prosodic constraint which prohibits long vowels from surfacing word-finally. To solve this problem, QA speakers shorten the long vowel

/uː/. In terms of example (73c), we note that the English words are written with <ou> and <oo>. I assume that these English graphemes affect QA speakers in their pronunciation of the English loanwords *rouge* /r**u**ːʒ/ and *scooter* /ˈsk**u**ː.təʳ/ as [r**o**ːdʒ] and [ˈsk**o**ː.tar], rather than */r**u**ːdʒ/ and */ˈsk**u**ː.tar/.

(73) English /uː/ → QA [uː], [u], [oː]

(a) /uː/ → [uː]

Jacuzzi	/dʒəˈk**u**ː.zi/	→	[dʒaˈk**u**ː.zi]
Tubeless	/ˈt**u**ːb.les/	→	[ˈt**u**ːb.lis]

(b) /uː/ → [u]

Menu	/ˈmen.j**u**ː/	→	[ˈmin.j**u**]
Shampoo	/ʃæm.ˈp**u**ː/	→	[ˈʃam.b**u**]

(c) /uː/ → [oː]

rouge	/r**u**ːʒ/	→	[r**o**ːdʒ]
scooter	/ˈsk**u**ː.təʳ/	→	[ˈsk**o**ː.tar]

	Adapted as [u] in QA	Adapted as [uː] in QA	Adapted as [oː] in QA	Total
English /uː/	2 (6%)	28 (88%)	2 (6%)	32

Table 19 : Adaptation of English high back tense vowel /u(ː)/ in QA

6.1.3 Adaptation of English lax vowels /ʊ/, /ɪ/, /æ/

Whereas the vowel inventory of English has distinctive contrast among tense versus lax vowels (Hyman 1975), QA inventory lacks this contrast. The absence of the lax-tense contrast within vowels in the QA vowel inventory causes the English lax vowels /ʊ/, /ɪ/, /æ/ to be adapted respectively as the QA tense vowels [u(ː)], [i(ː)] and [a(ː)]. As observed in table 20, /ʊ/ is mapped predominantly to /u/ (3/4 occurrences, 75%) and [uː] in only one case (1/4 occurrences, 25%). The adaptation patterns of the English vowel /ʊ/ into QA are illustrated in example (74) and table 20.

(74) English /ʊ/ → QA [uː] and [u]

(a) /ʊ/ → [uː]

hook /h**ʊ**k/ → [h**u**ːk]

(b) /ʊ/ → [u]

Facebook	/ˈfeɪs.b**ʊ**k/	→	[ˈfeːs.b**u**k]
buffet	/b**ʊ**f.eɪ/	→	[b**u**ˈfeːh]
full	/f**ʊ**l/	→	[f**u**ll]

	Adapted as [u] in QA	Adapted as [uː] in QA	Total
English /ʊ/	3 (75%)	1 (25%)	4

Table 20: Adaptation of English high back lax vowel /ʊ/ in QA

The examples given in (75a and (75b) demonstrate that the English high front lax vowel /ɪ/ is adapted regularly in QA as [i] or, in some cases, as the long one [iː]. However, examples ((75c, d, e and f) highlight that the English vowel /ɪ/ can be adapted divergently as [eː], [a] or [aː] in QA.

(75) English /ɪ/ → QA [iː], [i], [eː], [aː], [a], [oː]

(a) /ɪ/ → [i]

chips /tʃ**ɪ**ps/ → [ʃ**i**bs]

captain /ˈkæp.t**ɪ**n/ → [ˈkab.t**i**n]

(b) /ɪ/ → [iː]

tactic /ˈtæk.t**ɪ**k/ → [takˈt**iː**k]

acid /ˈæs.**ɪ**d/ → [ʔaˈs**iː**d]

(c) /ɪ/ → [eː]

gear /g**ɪ**r/ → [g**eː**r]

jacket /ˈdʒæk.**ɪ**t/ → [dʒaˈk**eː**t]

drill /dr**ɪ**l/ → [dr**eː**l]

transit /ˈtræn.z**ɪ**t/ → [tranˈz**eː**t]

(d) /ɪ/ → [a]

pocket /ˈpɑk.**ɪ**t/ → [ˈba.k**a**t]

manicure /ˈmæn.**ɪ**.kjʊr/ → [ma.n**a**ˈkiːr]

(e) /ɪ/ → [aː]

porcelain /ˈpɔːr.səl.**ɪ**n/ → [boːr.saˈl**aː**n]

The results of the adaptation patterns of the English vowel /ɪ/ in QA is summarized in table 21 below.

	Adapted as /i/ in QA	Adapted as /iː/ in QA	Adapted as /eː/ in QA	Adapted as /aː/ in QA	Adapted as /a/ in QA	Total
English /ɪ/	88 (82%)	11 (10.65%)	4 (3.5%)	1 (1%)	2 (1.85%)	108

Table 21: Adaptation of the English high front lax vowel /ɪ/ in QA

The English high front lax vowel /ɪ/ is expected to be mapped in QA to its closest sound phonologically /i/. This expectation arises from the contrast in ATR of high front vowels in English (/i/ vs. /ɪ/); whereas, this contrast is missing in QA. In fact, table 21 illustrates that /ɪ/ is adapted predominantly in QA as [i] (88/107, 82%) and occasionally as the long vowel [iː] (11/107, 10.65%). Adapting the English vowel /ɪ/ as [iː] appertains to stressed syllables in QA. In other words, mapping /ɪ/ as [iː] not [i] is attributed to the prosodic fact that [iː] occurs in stressed syllables. This is noticeable from all the 11 words in the data that have been adapted with [iː] where stress co-occurs with the long vowel [iː].

Furthermore, table 21 highlights that /ɪ/ is adapted exceptionally as [eː] (4/107, 3.5%), [aː] (1/107, 1%), [a] (2/107, 1.85%). I presume that the phonological process of vowel harmony provokes the English vowel /ɪ/ to be adapted as [a(ː)] in QA. Consider all the three words in (75d and e), you will find that the target vowel (/ɪ/, which becomes [a] after adaptation) shares identical features with its preceded vowel [a]. For instance, the low vowel /ɑ/ in the English word *pocket* /ˈpɑk.**ɪ**t/ is mapped to the low vowel [a] in QA, and this vowel [a] spreads its features to the following vowel and causes the second vowel /ɪ/ to be adapted as [a] instead of [i].

Now, we move to consider the adaptation of the English low front lax vowel /æ/. This vowel is adapted as [a] or [aː] in QA. The examples provided in (76) illustrate this adaptation.

(76) English /æ/ → QA /a/ and /aː/
(a) /æ/ → /a/
caffeine /ˈk**æ**f.iːn/ → [k**a**ˈfiːn]
Amazon /ˈ**æ**m.ə.zən/ → [ʔ**a**.maˈzoːn]
album /ˈ**æ**l.bəm/ → [ʔ**a**lˈbuːm]
(b) /æ/ → /aː/
gram /gr**æ**m/ → [gr**aː**m]
candy /ˈk**æ**n.di/ → [ˈk**aː**n.di]
plasma /ˈpl**æ**z.mə/ → [ˈbl**aː**z.ma]

The data analysis reveals that the English /æ/ is mapped solely to the QA low vowel [a] (60/91, 66%) or its long counterpart [aː] (31/91, 34%), as detailed in table 22. As the QA vowel inventory includes only one low vowel, i.e. /a/, the input feature [+low] of the vowel /æ/ is expected to be maintained faithfully in the output following adaptation; thus, /æ/ is mapped to its closest phonological match [a].

	Adapted as [a] in QA	Adapted as [aː] in QA	Total
English /æ/	60 (66%)	31 (34%)	91

Table 22 : Adaptation of the English low front lax vowel /æ/ in QA

Because the English vowel /æ/ is replaced largely by the QA vowel [a], I argue that this is the conventional adaptation. However, /æ/ can be mapped to the long vowel [aː] for the purpose of stress assignment in QA. Indeed, the analysis of the stress distribution of all the English loanwords in QA that include a mapping of /æ/ to [a] reveals that stress occurs most frequently on the rightmost heavy syllables (whether CVVC, CVCC, CVV or CVC). The tendency of assigning stress to heavy syllables in QA, rather than light syllables, accounts for cases in which the English vowel /æ/ is lengthened to be adapted as [aː] instead of [a] in QA because [aː] occurs in stressed syllables. This explanation is supported by the fact that most English loanwords in QA that include a mapping of /æ/ to [aː] (28/31 words) assign stress to the syllables that contain the vowel [aː].

Furthermore, another trigger for the adaptation of the English vowel /æ/ as [aː] instead of [a] in QA is the prosodic restrictions of QA. In the native system, QA permits only CVVC and CVCC to surface as monosyllabic words; for example, *baab* ‘door’, *naar* ‘fire’, *kalb* ‘dog’, *dʒarħ* ‘wound’, etc. This is because the prosodic words in QA are minimally bimoraic, as is the case in most Arabic dialects (McCarthy and Prince 1990). Furthermore, final consonants in QA do not bear moras; that is, CVVC and CVCC constitute two moras and surface as heavy syllables. By meeting the condition of bimoracity, monosyllabic CVVC and CVCC are allowed to surface in QA. However, CVCs are prohibited from surfacing as monosyllabic words in QA as they form only one mora (only the short vowel is projecting a mora). Moreover, monosyllabic words of CVV are not permitted in QA because CVVs do not occur word-finally and surface medially with other syllables. According to this prosodic restriction of QA, the English loanwords *van* /væn/, *cash* /kæʃ/, *gas* /gæs/ and *gram* /græm/ cannot be adapted in QA by mapping the English vowel /æ/ to the QA short vowel [a]. Such mapping would lead to the production of prosodic words that are illicit in QA, as these words will constitute only one mora following adaptation, given that final consonants are extrametricals in QA. Therefore, the English vowel /æ/ must be mapped to the long vowel [aː] in order to carry two moras. Consequently, the data reveals that the English loanwords *van* /væn/, *cash* /kæʃ/, *gas* /gæs/ and *gram* /græm/ are adapted respectively in QA as [faːn], [kaːʃ], [gaːz] and [graːm].

However, the English loanwords *bank* /b**<u>æ</u>**ŋk/ and *valve* /v**<u>æ</u>**lv/ are adapted in QA as [b**<u>a</u>**nk] and [b**<u>a</u>**lf], replacing the source vowel /æ/ with the short vowel [a]. These loanwords are licit words in QA and can surface with the short vowel [a] because these loanwords include a bimoraic foot after adaptation. In other words, the short vowel [a] projects the first mora, while the first consonant of the coda cluster projects the second mora.

6.1.4 Adaptation of English mid front vowel /e/

QA lacks the mid vowel /e/, but contains the mid vowel /eː/ in its inventory. Therefore, there is an expectation that the English mid vowel /e/ is mapped to /eː/ in QA. However, the data analysis reveals that the English mid vowel /e/ is adapted regularly as [i] in QA (53/59, 88%), as presented in table 23 and illustrated in example (77a). Furthermore, several QA vowels are attested for the English vowel /e/. In particular, table 23 illustrates that the English /e/ is mapped to [a] in five words, to [iː] in one word, and to [eː] in one word. This is outlined in examples (77b, c, d).

(77) English /e/ → QA [i], [a], [iː], [eː]
(a) /e/ → [i]
metro /ˈm**e**t.rəʊ/ → [ˈm**i**t.ru]
slender /ˈsl**e**n.dəʳ/ → [ˈsl**i**n.dar]
(b) /e/ → [a]
ketchup /ˈk**e**tʃ.ʌp/ → [ˈk**a**t.ʃab]
Messenger /ˈm**e**s.ɪn.dʒəʳ/ → [m**a**ˈsin.dʒar]
(c) /ɪ/ → [eː]
check /tʃ**e**k/ → [ʃ**eː**k]
(d) /e/ → [iː]
chef /ʃ**e**f/ → [ʃ**iː**f]

	Adapted as [i] in QA	Adapted as [a] in QA	Adapted as [iː] in QA	Adapted as [eː] in QA	Total
English /e/	52 (88%)	5 (8.6%)	1 (1.7%)	1 (1.7%)	59

Table 23: Adaptation of the English mid front vowel /e/ in QA

As demonstrated in the previous section, changing the feature value [±long] in QA is associated typically with the stress status of QA. In examples (77c and d), the English loanwords *check* /tʃ**e**k/ and *chef* /ʃ**e**f/ are adapted in QA as [ʃ**eː**k] and [ʃ**iː**f]. Changing the value of the input feature [-long] to its counterpart [+long] is necessary in these two words to follow the bimoracity condition of QA. If the vowels of these words are mapped to QA short vowels, they will violate the bimoracity restriction.

6.1.5 Adaptation of English mid front vowel /eɪ/

Table 24 presents that the English mid vowel /eɪ/ is adapted mostly as its phonologically-equivalent vowel [eː] in QA (22/28, 79%). However, the table also reveals that six occurrences of /eɪ/ deviate from this adaptation pattern and are mapped to [aː$^{-back}$] (2/28 7%,) [a^{-back}] (3/28 10.5%) and [i] (1/28 3.5%).

	Adapted as [eː] in QA	Adapted as [aː$^{-back}$] in QA	Adapted as [a^{-back}] in QA	Adapted as [i] in QA	Total
English /eɪ/	22 (79%)	2 (7%)	3 (10.5%)	1 (3.5%)	28

Table 24: Adaptation of the English mid front vowel /eɪ/ in QA

QA contains in its inventory the mid vowel /eː/, which diachronically replaces the Modern Standard Arabic diphthong /ey/. Therefore, the expectation is that the English mid vowel /eɪ/ will be replaced by the QA mid vowel [eː], as illustrated in example (78a). However, exceptions are detailed in examples (78b, c and d) where the English vowel /eɪ/ is adapted as [aː$^{-back}$], [a^{-back}] and [i] rather than the anticipated vowel [eː].

(78) English /eɪ/ → QA [eː], [aː$^{-back}$], [a^{-back}]

(a) /eɪ/ → [eː]

cable	/ˈk**<u>eɪ</u>**.bəl/	→	[ˈk**<u>eː</u>**.bal]
lazer	/ˈl**<u>eɪ</u>**.zə^{r}/	→	[ˈl**<u>eː</u>**.zar]

(b) /eɪ/ → [aː$^{-back}$]

prostate	/ˈprɒs.t**<u>eɪ</u>**t/	→	[brusˈt**<u>aː</u>**t]
radio	/ˈr**<u>eɪ</u>**.di.əʊ/	→	[ˈr**<u>aː</u>**.du]

(c) /eɪ/ → [a^{-back}]

April	/ˈ**<u>eɪ</u>**.prəl/	→	[ʔ**<u>a</u>**bˈriːl]
radar	/ˈr**<u>eɪ</u>**.dɑː^{r}/	→	[r**<u>a</u>**ˈdaːr]
radiator	/ˈr**<u>eɪ</u>**.di.eɪ.tə^{r}/	→	[r**<u>a</u>**ˈdeː.tar]

(d) /eɪ/ → [i]

regime	/r**<u>eɪ</u>**ˈʒiːm/	→	[r**<u>i</u>**ˈdʒiːm]

In example (78a), the input segment [-high, -low, -back, +long, +tense] (i.e. /eɪ/) surfaces as [eː]. In terms of features representations, it can be observed that all the values of the input features are preserved in the output. However, the input features [-high, -low, -back, +long, +tense] of the English vowel /eɪ/ may sometimes undergo a change, as shown in examples (78b, c and d) where the English vowel /eɪ/ is mapped to [aː$^{-back}$], [a^{-back}] and [i]. In (78b), the value of the input feature [-low] is changed to [+low]. In (78c), the value of the input features [-low, +long] are changed to [+low, -long]. In (78d), the value of the input features [-high, +long] are changed to [+high, -long]. The adaptation of /eɪ/ as the low vowels [aː$^{-back}$] and [a^{-back}] can be accounted for by referring to the QA phonotactic constraints as well as the effect of orthography. In terms of the first case, since the QA adapted forms of the English loanwords do not provide any instance where the QA mid vowel /eː/ occurs between two identical consonants, I assume that this restriction is the cause of adapting the English loanword *prostate* /ˈprɒs.teɪt/ as [brusˈtaːt] instead of *[brusˈteːt]. Furthermore, since QA grammar does not have a native word that begins with /r/ and followed by /eː/, the English loanwords *radio* /ˈr**eɪ**.di.əʊ/, *radar* /ˈr**eɪ**.dɑːr/, *radiator* /ˈr**eɪ**.di.eɪ.tər/ and *regime* /r**eɪ**ˈʒiːm/ are respectively adapted in QA as [ˈraː.du], [raˈdaːr], [raˈdeː.tar] and [riˈdʒiːm] with the first vowels of the source forms being changed to [aː$^{-back}$], [a^{-back}] and [i]. Regarding the adaptation of /eɪ/ as [a^{-back}] in the English loanword *April*, I argue that orthography plays a role because the source form is written with the grapheme <A>.

6.1.6 Adaptation of English low back vowel /a:/

A total of 24 occurrences of the low back vowel /ɑː/ in the English loanwords adapted in QA is observed. Table 25 details that the English vowel /ɑː/ is always replaced with the QA low back vowel [a(ː) $^{+back}$]. However, this table also reveals that /ɑː/ is adapted more frequently in QA as the long vowel [aː$^{+back}$] (19/24, 79%) than the short vowel [a^{+back}] (5/24, 21%).

	Adapted as [aː^{back}] in QA	Adapted as [a^{back}] in QA	Total
English /ɑː/	19 (79%)	5 (21%)	24

Table 25: Adaptation of the English low back unrounded vowel /ɑː/ in QA

The examples given in (79) illustrate the mapping of the English vowel /ɑː/ onto the QA vowels [a(ː) $^{+back}$]. In (79a), the English low back long vowel /ɑː/ is replaced faithfully by the QA low back long vowel [aː$^{+back}$]. In this adaptation, the values of the input features [+low, +back, +long, -labial] are preserved faithfully in the output. However, in a less faithful mapping, the English low back long vowel /ɑː/ is replaced by the QA low back short vowel [a^{+back}], as presented in examples (79b). In other words, the input features [+low, +back, -labial] are maintained in the output and the [+long] feature has shifted to its counterpart [-long]. By analysing the distribution of stress in the adapted forms (i.e. the 24 loanwords that include a mapping of /ɑː/ to [a(ː) $^{+back}$]), stress has been found to occur frequently on the right-most syllables that include long vowels, whether CVVC or CVV (23/24 vs. only one word that assigns stress to non-final CVC). Furthermore, it has been observed that whenever the English vowel /ɑː/ is mapped faithfully to the QA [aː$^{+back}$], stress occurs on the syllables that contain the adapted vowel [aː$^{+back}$]. Nevertheless, if the adapted vowel [a(ː) $^{+back}$] is not stressed, it is shortened, and it surfaces as [a^{+back}]. This is noticeable in all the five loanwords mentioned in (79b) where stress does not occur in the syllables that include the adapted short vowel [a^{+back}]. Therefore, I argue that the preference for stressing long vowels motivates the faithful adaptation of the English long vowel /ɑː/ as the QA long vowel [aː$^{+back}$]. Conversely, the adaptation of the English long vowel /ɑː/ as the QA short vowel [a^{+back}] is attributed to the prosodic condition that the adapted vowel [a^{+back}] does not occur in a stressed syllable; thus, it cannot surface as a long vowel.

(79) English /ɑː/ → QA [aː$^{+back}$], [a^{+back}]
(a) /ɑː/ → [aː$^{+back}$]

massage	/ˈmæs.**ɑː**ʒ/	→	[maˈs**aː**dʒ]
guitar	/gɪˈt**ɑ**ːr/	→	[giˈt**a**ːr]

(b) /ɑː/ → [a^{+back}]

carbon	/ˈk**ɑː**r.bən/	→	[k**a**rˈboːn]
carnival	/ˈk**ɑː**.nɪ.vəl/	→	[k**a**r.naˈfaːl]
cartoon	/k**ɑː**r.ˈtuːn/	→	[k**a**rˈtuːn]
mascara	/mæsˈk**ɑː**.rə/	→	[ˈmas.k**a**.rah]
card	/k**ɑː**rd/	→	[k**a**rt]

6.1.7 Adaptation of English low back rounded vowel /ɒ/

The English low back rounded vowel /ɒ/ appears in 39 words and has six possible corresponding vowels in QA, as illustrated in table 26. The most frequently corresponding vowel is the high back rounded vowel [u(ː)] (forming 22 occurrences out of 39: 19 occurrences for [u] (50%) and 2 occurrences for [uː] (5%)). The next correspondent vowel is the mid back rounded vowel [oː] (forming 13/39, 35%). Then, the low back unrounded vowels [ɑ] followed by [a(ː)^{back}] (forming 2/39, 5% and 1/39, 2.5%, respectively).

	Adapted as [u] in QA	Adapted as [uː] in QA	Adapted as [oː] in QA	Adapted as [ɑ] in QA	Adapted as [aː^{back}] in QA	Adapted as [a^{back}] in QA	Total
English /ɒ/	19 (50%)	2 (5%)	13 (35%)	2 (5%)	1 (2.5%)	1 (2.5%)	39

Table 26: Adaptation of the English low back rounded vowel /ɒ/ in QA

The English loanwords in (80a, b) illustrate the mapping of the English vowel /ɒ/ to the QA vowel [u(ː)]; whereas the English loanwords presented in (80c) illustrate the adaptation of the English vowel /ɒ/ as the QA vowel [oː] when the vowel /ɒ/ occurs in final syllables.

Not all the English loanwords including the vowel /ɒ/ appear to follow the previous adaptation patterns in preserving the input feature [+labial]. In some cases, the input feature [+low] resists the change and surfaces as [+low]. This is shown in examples (80d, e) where the English low rounded vowel /ɒ/ is mapped to the QA low unrounded vowel [ɑ] and [a^{+back}]. Although [ɑ] is not a separate phoneme in QA but an allophone of /a/ when /a/ occurs adjacent to emphatic consonants, it surfaces in these limited loanwords presented in examples (80d).

(80) English /ɒ/ → QA [u(ː)], [oː], [ɑ], [a(ː)]

(a) /ɒ/ → [u]

cocktail	/ˈk**ɒ**k.teɪl/	→	[k**u**kˈteːl]
comedy	/ˈk**ɒ**m.ə.di/	→	[k**u**ˈmiː.di]
nylon	/ˈnaɪ.l**ɒ**n/	→	[ˈnaːj.l**u**n]
laptop	/ˈlæp.t**ɒ**p/	→	[ˈlaːb.t**u**b]

(b) /ɒ/ → [uː]

lobby	/ˈl**ɒ**b.i/	→	[ˈl**uː**.bi]
toffee	/ˈt**ɒ**f.i/	→	[ˈt**uː**.fi]

(c) /ɒ/ → [oː]

cholesterol	/kəˈles.tər.**ɒ**l/	→	[ku.listˈr**oː**l]
coupon	/ˈkuː.p**ɒ**n/	→	[kuːˈb**oː**n]
protocol	/ˈprəʊ.tə.k**ɒ**l/	→	[broː.tuˈk**oː**l]

(d) /ɒ/ → [ɒ]

coffee	/ˈk**ɒ**f.i/	→	[ˈk**ɑ**.fi]
body	/b**ɒ**d.i/	→	[ˈb**ɑ**.di]

(e) /ɒ/ → [a(ː)$^{+back}$]

pocket	/ˈp**ɒ**k.ɪt/	→	[ˈb**a**.kat]
waffle	/ˈw**ɒ**f.əl/	→	[ˈw**aː**.fil]

It can be observed from the loanwords in (80a, b, and c) that stress distribution plays a crucial role in creating different adaptation patterns. That is, the English vowel /ɒ/ is adapted typically as the QA short vowel [u] as shown in (80a). However, if the adapted form ends in an open syllable, this open syllable cannot receive stress in QA as stress in QA does not occur finally unless the last syllable is heavy. Therefore, stress moves to the penultimate syllable. Since the tendency of stress in the adapted forms of the English loanwords in QA occurs on heavy syllables, the nucleus of the penultimate syllable is lengthened in order to constitute a bimoraic syllable. Accordingly, the English short vowel /ɒ/ is mapped to the QA long vowel [uː]. This is illustrated in the English loanwords presented in (80b).

The adapted vowel [u] surfaces as [oː] when it occurs in a stressed ultimate syllable. This is illustrated in the English loanwords given in (80c), where stress occurs finally and the English vowel /ɒ/ is mapped to the QA vowel [oː].

6.1.8 Adaptation of English mid back rounded vowels /əʊ/ and /ɔː/[20]

The QA inventory lacks the mid back rounded vowels /əʊ/ or /ɔː/. However, similar to many other Arabic dialects (Watson 2002), the QA inventory contains the mid back rounded vowel /oː/, which derives diachronically from the Classical Arabic diphthong */aw/.* Therefore, it is expected that the English vowels /əʊ/ or /ɔː/ are mapped in QA to their phonologically-closest sound [oː]. Indeed, table 27 highlights that the English vowels /əʊ/ or /ɔː/ are adapted regularly as [oː] in QA (44/64, 69%). This adaptation pattern is illustrated in the English loanwords given in (81a). Furthermore, the table reveals that the English vowels /əʊ/ or /ɔː/ could be mapped to the high back rounded vowel [u] (20/64, 31%).

	Adapted as [oː] in QA	Adapted as [u] in QA	Total
English /əʊ/ or /ɔː/	44 (69%)	20 (31%)	64

Table 27: Adaptation of the English mid back rounded vowel /əʊ/ or /ɔː/ in QA

(81) English /əʊ/ or /ɔː/→ QA [oː], [u]

(a) /əʊ/ → [oː]

cobra	/ˈk**<u>əʊ</u>**.brə/	→	[ˈk**<u>oː</u>**b.ra]
glucose	/ˈgluː.k**<u>əʊ</u>**s/	→	[ˈdʒluː.k**<u>oː</u>**z]
telescope	/ˈtel.ɪ.sk**<u>əʊ</u>**p/	→	[ti.lis.ˈk**<u>oː</u>**b]
goal	/g**<u>əʊ</u>**l/	→	[g**<u>oː</u>**l]
coat	/k**<u>əʊ</u>**t/	→	[k**<u>oː</u>**t]
fluoride	/ˈfl**<u>ɔː</u>**.raɪd/	→	[fl**<u>oː</u>**ˈraː.jad/

The examples provided in (81b) demonstrate that the English vowels /əʊ/ and /ɔː/ are adapted as [u] in QA instead of the normal adaptation pattern (i.e. /əʊ/ and /ɔː/ → [oː]).

[20] I have merged the results of the adaptation patterns of the English vowels /əʊ/ and /ɔː/ in one section because these two vowels are adapted typically as [oː] in QA.

(b) /əʊ/ → [u]

(1)	disco	/ˈdɪs.k**əʊ**/	→	[ˈdis.k**u**]
	turbo	/ˈtɜːr.b**əʊ**/	→	[ˈteːr.b**u**]
	metro	/ˈmet.r**əʊ**/	→	[ˈmit.r**u**]
(2)	toast	/t**əʊ**st/	→	[t**u**st]
	short	/ʃ**ɔː**rt/	→	[ʃ**u**rt]
	volt	/v**əʊ**lt/	→	[f**u**lt]
(3)	hormone	/ˈh**ɔː**.məʊn/	→	[h**u**rˈmoːn]
	ozone	/ˈ**əʊ**.zəʊn/	→	[ʔ**u**ˈzoːn]
	folklore	/ˈf**əʊ**k.lɔːr/	→	[f**u**lˈkloːr]

Dividing the examples in (81b) into three parts (1, 2 & 3) is necessary if we are to account for this variable adaptation pattern. The first part includes the English loanwords *disco* /ˈdɪs.k**əʊ**/, *turbo* /ˈtɜːr.b**əʊ**/, *metro* /ˈmet.r**əʊ**/ which are adapted in QA as [ˈdis.k**u**], [ˈteːr.b**u**] and [ˈmit.r**u**], respectively. This adaptation pattern can be explained by referring to the native grammar of QA. As with other Arabic dialects, such as Cairene Arabic (Watson 2002; McCarthy 2005), QA does not allow long vowels to surface word-finally. Due to this constraint and because the vowel /əʊ/ in the source forms of all the three English loanwords under consideration appears word-finally, the long vowel /əʊ/ is mapped to the short vowel [u].

The second part of the examples includes the English loanwords *toast* /t**əʊ**st/, *short* /ʃ**ɔː**rt/ and *volt* /v**əʊ**lt/, which are adapted respectively as [t**u**st], [ʃ**u**rt] and [f**u**lt]. This type of adaptation is attributed to the moraic status of QA. As demonstrated earlier in this chapter, the minimal word in QA should be bimoraic. Furthermore, trimoraic syallbles are not allowed in QA. Therefore, if these English loanwords are adapted with the long vowel /oː/, the adapted forms will constitute three moras (i.e. given that final consonants in QA are extrametricals, the long vowel /oː/ will project two moras and the first consonant of the coda cluster will project one mora). Consequently, since the vowel inventory of QA does not have a short mid vowel */o/, it is necessary to adapt these three loanwords, *toast*, *short* and *volt*, with the short vowel [u] instead of /oː/ so as to have bimoraic syllables.

The third part of the examples in (81b) includes the English loanwords *hormone* /ˈh**ɔː**.məʊn/, *ozone* /ˈ**əʊ**.zəʊn/ and *folklore* /ˈf**əʊ**k.lɔːr/ which are adapted respectively in QA as [h**u**rˈmoːn], [ʔ**u**ˈzoːn] and [f**u**lˈkloːr]. In these cases, the target vowel /əʊ/ neither appears finally nor in a trimoraic syllable; nonetheless, /əʊ/ is mapped to [u] instead of [oː]. I propose that QA contains a constraint that dictates the prohibition of the occurrence of two consecutive mid vowels. If two consecutive mid vowels surface within a word, the first is shortened while the second maintains its length. It is noteworthy that all mid vowels in QA (i.e. /eː/ and /oː/) are long. Thus, by adapting the

English loanwords *hormone, ozone* and *folklore,* the first vowel in these loanwords must be raised to surface as [u].

6.1.9 Adaptation of English mid central vowel /ə/

QA inventory lacks the schwa sound /ə/; therefore, this sound is not expected to be adapted faithfully and must be mapped to another vowel. Indeed, the data analysis reveals that the English vowel /ə/ is adapted regularly as [a(ː)$^{\text{-back}}$] in QA (131/197, 66.5%), as presented in table 28 and examples (82a, b). Furthermore, several QA vowels are attested for the English vowel /ə/. In particular, table 28 highlights that the English vowel /ə/ is mapped to [oː] in 10 words, to [u] in 24 words, to [uː] in four words, to [i] in 21 words and to [iː] in seven words. These variant adaptation patterns are illustrated in examples (82c, d, e, f, and g).

	Adapted as [a$^{\text{-back}}$] in QA	Adapted as [aː$^{\text{-back}}$] in QA	Adapted as [oː] in QA	Adapted as [u] in QA	Adapted as [uː] in QA	Adapted as [i] in QA	Adapted as [iː] in QA	Total
English /ə/	120 (61%)	11 (5.7%)	10 (5%)	24 (12%)	4 (2%)	21 (10.8%)	7 (3.5%)	197

Table 28: Adaptation of the English vowel /ə/

(82) English /ə/ → QA [a$^{\text{-back}}$], [aː$^{\text{-back}}$], [oː], [u], [uː], [i], [iː]

(a) /ə/ → [a$^{\text{-back}}$]
cable /ˈkeɪ.b**ə**l/ → [ˈkeː.b**a**l]
cacao /k**ə**ˈkaʊ/ → [k**a**ˈkaːw]
cancel /ˈkæn.s**ə**l/ → [ˈkan.s**a**l]
cassette /k**ə**.ˈset/ → [ˈk**a**.sit]
cover /ˈkʌv.**ə**r/ → [ˈka.f**a**r]
(b) /ə/ → [aː$^{\text{-back}}$]
Vatican /ˈvæt.ɪ.k**ə**n/ → [fa.tiˈk**aː**n]
crystal /ˈkrɪs.t**ə**l/ → [krisˈt**aː**l]
madam /ˈmæd.**ə**m/ → [maˈd**aː**m]
dollar /ˈdɒl.**ə**r/ → [duˈl**aː**r]
(c) /ə/ → [oː]
Amazon /ˈæm.ə.z**ə**n/ → [ʔa.maˈz**oː**n]
petrol /ˈpet.r**ə**l/ → [bit.ˈr**oː**l]
carbon /ˈkɑːr.b**ə**n/ → [karˈb**oː**n]
(d) /ə/ → [u]
nicotine /ˈnɪk.**ə**.tiːn/ → [ni.k**u**ˈtiːn]
panorama /pæn.**ə**rˈɑː.mə/ → [ba.n**u**ˈraː.ma]
protocol /ˈprəʊ.t**ə**.kɒl/ → [broː.t**u**ˈkoːl]

(e) /ə/ → [uː]				
	album	/ˈæl.b**ə**m/	→	[ʔalˈb**uː**m]
	virus	/ˈvaɪ.r**ə**s/	→	[faːj.ˈr**uː**s]
(f) /ə/ → [i]				
	pixel	/ˈpɪk.s**ə**l/	→	[ˈbik.s**i**l]
	system	/ˈsɪs.t**ə**m/	→	[ˈsis.t**i**m]
(g) /ə/ → [iː]				
	nicotine	/ˈnɪk.**ə**.tiːn/	→	[ni.k**u**ˈtiːn]
	April	/ˈeɪ.pr**ə**l/	→	[ʔabˈr**iː**l]
	oxygen	/ˈɒk.sɪ.dʒ**ə**n/	→	[ʔuk.siˈdʒ**iː**n]

I argue that the English schwa sound is adapted typically as [a$^{\text{-back}}$] in QA, and that any other adaptation patterns are attributed to the influence of orthography. This is evident in the massive words in the data that include the sound /ə/. The grapheme of the source forms plays a crucial role in adapting /ə/. In other words, the sound /ə/ in the source forms is represented in writing by the graphemes (o, u, i, e, …). If the schwa sound is not mapped to [a$^{\text{-back}}$], these different graphemes determine how the schwa sound /ə/ is adapted in QA. For instance, the English loanword *album* /ˈæl.b**ə**m/ is adapted in QA as [ʔalˈb**uː**m]. The existence of the grapheme <u> in the source form affects the schwa to be adapted as [uː] instead of the typical mapping [a$^{\text{-back}}$]. As discussed previously, the occurrence of [u] in a stressed syllable after adaptation triggers the lengthening of [u] in accordance with the QA stress system, which requires final stressed syllables to be heavy. In line with this prosodic requirement, it is worth noting from the examples in (82c and d) that if the source form contains the grapheme <o> that represents the schwa sound, this schwa is adapted as [u] in QA if it occurs in unstressed syllables, and as [oː] if it occurs in stressed syllables. For instance, the English loanword *nicotine* /ˈnɪk.**ə**.tiːn/ is adapted in QA as [ni.k**u**ˈtiːn] with mapping the English schwa to [u] as it occurs within an unstressed syllable. However, the English loanword *Amazon* /ˈæm.ə.z**ə**n/ is adapted as [ʔa.maˈz**oː**n] with the English schwa being mapped to [oː] as it occurs within a stressed syllable. One last notice about the examples (82f and g) which includes a mapping of the schwa to [i(ː)]. In this adaptation pattern, the source form may contain the grapheme <i> or <e> and both graphemes affect the adaptation of the schwa as the QA vowel [i(ː)].

6.1.10 Adaptation of English mid back unrounded vowel /ʌ/

QA does not contain the lower mid back unrounded vowel /ʌ/. Therefore, faithful adaptation of the English input vowel /ʌ/ is not anticipated. In other words, this vowel must be mapped to its QA phonologically-closest vowel. Indeed, the data analysis reveals that the English /ʌ/ is mapped regularly to the QA vowel [a^{+back}] (11/16, 69%) or its long counterpart [aː$^{+back}$] (2/16, 13%), as detailed in table 29. The table also reveals that the English vowel /ʌ/ is adapted as [uː], [u], and [ɑː] in only one word each. All these adaptation patterns are illustrated in the examples provided in (83).

	Adapted as [a^{+back}] in QA	Adapted as [aː$^{+back}$] in QA	Adapted as [uː] in QA	Adapted as [u] in QA	Adapted as [ɑː] in QA	Total
English /ʌ/	11 (69%)	2 (13%)	1 (6%)	1 (6%)	1 (6%)	16

Table 29: Adaptation of the English vowel /ʌ/

(83) English /ʌ/ → QA [a^{+back}], [aː$^{+back}$], [uː], [u], [ɑː]

(a) /ʌ/ → [a^{+back}]

jumbo	/ˈdʒ**ʌ**m.bəʊ/	→	[ˈdʒ**a**m.bu]
cover	/ˈk**ʌ**v.ər/	→	[ˈk**a**.far]
ketchup	/ˈketʃ.**ʌ**p/	→	[ˈkat.ʃ**a**b]

(b) /ʌ/ → [aː$^{+back}$]

drum	/dr**ʌ**m/	→	[dr**aː**m]
doughnut	/ˈdəʊ.n**ʌ**t/	→	[doːˈn**aː**t]

(c) /ʌ/ → [uː]

cup	/k**ʌ**p/	→	[k**uː**b]

(d) /ʌ/ → [u]

deluxe	/dɪˈl**ʌ**ks/	→	[diˈl**u**ks]

(e) /ʌ/ → [ɑː]

bus	/b**ʌ**s/	→	[b**ɑː**sˤ]

It can be inferred from the adaptation patterns shown in table 29 and the examples (83a and b) that the English vowel /ʌ/ is mapped directly to the QA vowel [a^{+back}]. When divergent mapping occurs, it can be attributed to orthography (83c and d) or phonological reasons (83e). As seen in the examples (83c and d), the English /ʌ/ is divergently mapped to the QA high back vowel [u(ː)]. Since the input feature [-labial] is changed to [+labial], I argue that this is an influence of orthography. The reason for this argument is that the two English loanwords *cup* and *deluxe* includes the grapheme <u>. This grapheme influences QA speakers to produce the input vowel /ʌ/ as [u(ː)] instead of the typical adaptation (/ʌ/ > [a^{+back}]). As discussed previously, the vowel [u] in the English loanword *cup* is lengthened after adaptation to satisfy the bimoracity restriction. The last word, *bus*, demonstrates that the English vowel /ʌ/ is mapped to the QA [ɑː] which is originally an allophone of /a^{+back}/. This mapping is triggered by the occurrence of the low vowel [a^{+back}] adjacent to the emphatic consonant [sˁ].

6.1.11 Adaptation of English mid central vowel /ɜː/

QA lacks the mid vowel /ɜː/ but has the mid vowel /eː/ in its vowel inventory. Therefore, the English /ɜː/ is expected to be mapped to the QA vowel [eː]. Indeed, the data analysis reveals that the English vowel /ɜː/ is adapted frequently as [eː] in QA (2/5, 40%), as detailed in table 30 and example (84). Furthermore, the table highlights that the QA vowels [i] and [u] are also attested for the English vowel /ɜː/. In particular, /ɜː/ is mapped to [i] in two words and to [u] in one word.

	Adapted as [eː] in QA	Adapted as [i] in QA	Adapted as [u] in QA	Total
English /ɜː/	2 (40%)	2 (40%)	1 (20%)	5

Table 30: Adaptation of the English vowel /ɜː/

(84) English /ɜː/ → QA [eː]

a. /ɜː/ → [eː]
 derby /ˈd**ɜː**.bi/ → [ˈd**eː**r.bi][21]
 turbo /ˈt**ɜː**.bəʊ/ → [ˈt**eː**r.bu]
b. /ɜː/ → [i]
 term /t**ɜː**m/ → [t**i**rm]
 thermos /ˈθ**ɜː**.məs/ → [ˈt**i**r.mis]
c. /ɜː/ → [u]
 hamburger /ˈhæm.b**ɜː**r.gər/ → [hamˈb**u**r.gir]

Although table 30 demonstrates that the English mid vowel /ɜː/ is adapted as the QA mid vowel [eː] as well as the front high vowel [i], I argue that the typical mapping of /ɜː/ is to [eː] not [i]. This argument emerges from mapping the input features to the contrastive output features as will be shown in §6.4.10. With respect to adaptation /ɜː/ as [i], I assume that /ɜː/ is regularly adapted as [eː] unless /ɜː/ occurs in a monosyllabic word such as *term* or it is followed by a closed syllable as in *thermos.* In this case, the English vowel /ɜː/ is mapped to [i] instead of [eː]. Finally, I assume

[21] I assume that this word is adapted from American English.

that orthography plays a role in adapting /ɜː/ as [u] since the English word, *hamburger,* includes the grapheme <u>.

6.1.12 Adaptation of English diphthongs /aɪ/, /aʊ/

The vowel inventories of Classical Arabic (CA) and Modern Standard Arabic (MSA) comprise two diphthongs, /aj/ and /aw/. However, the surfacing of diphthongs in QA is prohibited, as it is in numerous Arabic dialects (Ingham 1994; Watson 2002). According to this restriction, the diphthongs /aj/ and /aw/ in MSA surface as the long vowels [eː] and [oː] in QA. This is illustrated in the following words:

(85)	MSA	QA	Gloss
	/bajt/	[beːt]	‘house’
	/ʔajn/	[ʔeːn]	‘eye’
	/lawn/	[loːn]	‘colour’
	/ʔawn/	[ʔoːn]	‘help’

Cross-linguistically, there are two types of diphthongs: one that includes a sequence of a low vowel /a/ and a high vowel, e.g. /i/, /u/ or /ʊ/, and one that includes a sequence of a low vowel /a/ and a glide /j/ or /w/ (Clark *et al.* 2007). The former type surfaces when the two elements of the diphthongs (i.e. a low vowel + a high vowel) form the nucleus position of the syllable, as in the English word *cow* /k**aʊ**/. The two adjacent vowels in this word /aʊ/ occupy the nucleus position. The latter type surfaces when ‘the second element of the diphthong has some consonantal value, as in Arabic…’ (Youssef 2013: 185). In other words, when the second element of the diphthong (i.e. a glide) occupies the edge of the syllable, either onset or coda positions. Therefore, Benhallam (1980) (as cited in Youssef 2013: 185) claimed that these glides in Arabic are derived from their corresponding high vowels. That is, /j/ is derived from /i/ and /w/ is derived from /u/. For the reason that the second element of the surface diphthongs (i.e. a glide) in some Arabic dialects (e.g. Cairene and Baghdadi Arabic) functions as other consonants in Arabic in a sense that it appears in a syllable margin, Youssef (2013) transcribed the surface diphthong in Cairene and Baghdadi Arabic as a sequence of /a/ plus a glide instead of two adjacent vowels.

Although the native grammar of QA follows the strategy of coalescence in realising MSA diphthongs, sometimes these diphthongs surface in QA as a sequence of the low vowel /a/ plus a glide. Following Youssef (2013), who thoroughly described the environments where the diphthongs of Classical Arabic are maintained in the surface in Cairene Arabic instead of coalescence, I have observed that MSA diphthongs are sometimes preserved in the surface level in Qassimi Arabic when a diphthong is derived from a root that includes a glide as the initial element of the radical consonants (i.e. GCC). This is illustrated in the following examples.

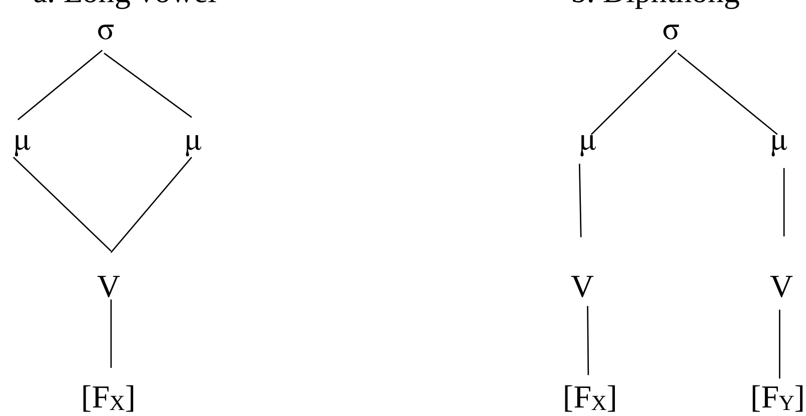
(86) /ʔ**aw**. dʒab/ ‘more necessary’ is derived from a root that has the glide /w/ as the initial element of the radical consonants **w**dʒb (i.e. GCC).

/ʔ**aw**.saʕ/ ‘wider’ is derived from a root that has the glide /w/ as the initial element of the radical consonants **w**sʕ (i.e. GCC).

/ʔ**aj**.sar/ ‘easier’ is derived from a root that has the glide /j/ as the initial element of the radical consonants **j**sr (i.e. GCC).

According to the moraic theory proposed by (Hyman 1985; Hayes 1989), long vowels and diphthongs are represented differently in Arabic. Both long vowels and diphthongs are associated with two moras. However, whereas the long vowels are associated with one single vocalic root (as shown in 87a), the diphthongs are linked to two separate vocalic roots (87b) (Watson 2002: 55). In the representations (87a) and (87b), a feature configuration has been added under the vowels in order to capture the different representations of long vowels vs. diphthongs in Arabic (Youssef 2013: 202). That is, while the long vowels in (87a) have a specific feature, the first element of the diphthong in (87b) has a different feature than the second element.

(87) a. Long vowel b. Diphthong



Based on the moraic representations provided in (87a) and (87b), QA grammar has a restriction on banning two adjacent moras that have been associated with two different vocalic root nodes. Therefore, MSA diphthongs surface as long vowels in QA because the two moras of the long vowels are associated with one vocalic root node. In OT terms, this restriction can be translated into the following markedness constraint:

(88) *[NODIPHTHONG] 'two tautosyllabic moras linked to two distinct vowels (are prohibited)' (Rosenthall 1997: 141)

The process of changing underlying diphthongs into long vowels is classified as coalescence (Youssef 2013). Although the native grammar of QA follows the strategy of coalescence in realizing MSA diphthongs, English loanwords containing diphthongs are adapted in QA with glide-formation strategy. In other words, the second elements of the English diphthongs /ɪ/ and /ʊ/ are replaced in QA with the corresponding coronal and labial glides /j/ and /w/, respectively. It has been observed that this process is applied to most of the English diphthongs, as outlined in tables (31) and (32) and illustrated in the examples in (89) and (90).

	Adapted as [aː] + [j] in QA	Adapted as [i] in QA	Adapted as [iː] in QA	Total
English /aɪ/	14 (68%)	5 (23%)	2 (9%)	21

Table 31: Adaptation of the English diphthong /aɪ/

(89) English /aɪ/ → QA [aː] + [j], [i], [iː]
(a) /aɪ/ → [aː] + [j]
fluoride /ˈflɔː.r**aɪ**d/ → [floːˈr**aː.j**ad]
overtime /ˈəʊ.vər.t**aɪ**m/ → [ʔoː.farˈt**aː.j**am]
diet /ˈd**aɪ**.ət/ → [ˈd**aː.j**at]
style /st**aɪ**l/ → [ˈst**aː.j**al]
(b) /aɪ/ → [i]
hydrogen /ˈh**aɪ**.drə.dʒən/ → [h**i**d.ruˈdʒiːn]
dinosaur /ˈd**aɪ**.nə.sɔːr/ → [d**i**.naˈsoːr]
nitrogen /ˈn**aɪ**.trə.dʒən/ → [n**i**t.ruˈdʒiːn]
microphone /ˈm**aɪ**.krə.fəʊn/ → [m**i**k.ruˈfoːn]
microwave /ˈm**aɪ**.krə.weɪv/ → [m**i**k.ruˈweːf]
(c) /aɪ/ → [iː]
mile /m**aɪ**l/ → [m**iː**l]
enzyme /ˈen.z**aɪ**m/ → [ʔinˈz**iː**m]

	Adapted as [aː] + [w] in QA	Total
English /aʊ/	6 (100%)	6

Table 32: Adaptation of the English dipthong /aʊ/

(90) English /aʊ/ → QA [aː] + [w]

cacao	/kəˈk**aʊ**/	→	[kaˈk**aːw**]
foul	/f**aʊ**l/	→	[ˈf**aː.w**il]
pound	/p**aʊ**nd/	→	[b**aː**ˈ**w**ind]
discount	/ˈdɪs.k**aʊ**nt/	→	[dis.k**aː**ˈ**w**int]

As demonstrated in the examples in (89) and (90), the underlying English diphthongs /aɪ/ and /aʊ/ are mapped typically in QA to the long vowel [aː] + the glides [j] or [w]. In this case, the grammar of QA divides the underlying two adjacent vowels into a long vowel + a glide. Based on this type of adaptation, QA speakers preserve most of the input features while simultaneously satisfying the grammar of their native language. In particular, the underlying low vowel /a/ (the first element of the diphthong) is mapped to the low vowel [aː], and the underlying high vowels /ɪ/ and /ʊ/ (the second elements of the diphthongs) are mapped to their correspondent glides [j] and [w].

However, some of the English diphthongs are reduced to a single vowel, as exemplified in (89b and c). During this process, the first element of the English diphthong /aɪ/ is lost and the diphthong surfaces as the QA high vowel [i(ː)]. It is noteworthy that all the English loanwords given in (89b) contain three syllables and the diphthong /aɪ/ occurs in the first. After adaptation, stress occurs finally as the final syllable includes a long vowel. Based on the number of the syllables and the distribution of stress after adaptation, I assume that QA has a constraint that forces the English diphthong /aɪ/ to surface as [i] if the diphthong occurs initially in a three-syllable word and stress ocuurs on final syllable.

Regarding the English loanwords *mile* /m**aɪ**l/ and *enzyme* /ˈen.z**aɪ**m/ which are adapted respectively in QA as [m**iː**l] and [ʔinˈz**iː**m]. The lengthening of the short vowel [i] is attributed to the prosodic constraints of QA. In other words, the nucleus segment in the adapted form [m**iː**l] is lengthened to satisfy the bimoracity condition, and since the final vowel [iː] in the adapted form [ʔinˈz**iː**m] occurs in a stressed syllable, it is lengthened. However, I do not know precisely why the English diphthong /aɪ/ in these two words *mile* and *enzyme* surfaces as the long vowel [iː] and not the normal adaptation [aː] + [j].

Based on the syllable structure of QA and the restriction of QA on prohibiting the surface of two adjacent vowels, I argue that the segments [a] and [j] or [w] provided in the adapted forms in (89a) and (90) are two separate phonemes, rather than diphthongs. This argument arises from syllabification. That is, glides appear in syllable margins (onset or coda positions), whereas low vowels always occupy nucleus positions. For instance, the English loanword *foul* /f**aʊ**l/ is adapted in QA as [ˈf**aː.w**il]. It is noteworthy that the source form has one syllable whereas the adapted form has two syllables. The first syllable of the adapted form is an open syllable which bears the first vowel of the diphthong [aː] as nucleus. Then, the second vowel of the diphthong /ʊ/ has been changed to the glide [w] and this glide occupies the onset position of the second syllable. This argument of making the two segments /a/ and /w/ as two separate segments rather than as a diphthong is in line with what Watson (2002) says about the difference between vowels and glides in Arabic. She argues that although high vowels and glides share similar features in terms of place and manner of articulation (/i/ and /j/ are high coronals, /u/ and /w/ are high labials), 'syllable position' distinguishes between high vowels and glides. In Arabic, high vowels occupy nucleus positions, whereas glides occur only in onset or coda positions.

Before theoretically analysing the adaptation of English diphthongs into QA in OT tableaux, it is worth establishing how previous studies have theoretically analysed the surface of glides in different languages. This is essential to recognise the types of glides in QA. The surface of glides have received significant attention from generative phonologists and are analysed differently (Clements and Keyser 1983; Steriade 1984; Levin 1985; Guerssel 1986; Rosenthall 1994; Levi 2004, 2008, 2011; Nevins and Chitoran 2008; Padgett 2008; Hall 2017; among others). The primary reason for analysing glides differently lies in the fact that glides sometimes are involved not only in phonological patterns with consonants, but also involved phonologically with vowels. Therefore, some researchers propose that the glides /w, j/ and the high vowels /u, i/ are similar in terms of their feature representations (they are both specified as [-consonant, +sonorant]) (Clements and Keyser 1983; Guerssel 1986); however, the syllable position determines which segments (glides or vowels) should surface. In other words, nucleus position entails the surface of vowels whereas margin positions (onset or coda) entails the surface of glides. In line with this assumption, it has been argued that surface glides are derived from underlying vowels because the occurrence of vowels vs. glides is predictable from the syllable positions (Steriade 1984; Levin 1985; Durand 1987; Rosenthall 1994). Nevertheless, this proposal has been criticised by some researchers (e.g. Levi 2008; Nevins and Chitoran 2008). In particular, it is observed that, in some languages, glides behave differently at the surface level. This variation in behaviour provides evidence that, in some languages, glides derive from diverse underlying segments. In particular, they can be characterised as phonemic (lexical) glides (derived from underlying glides) and derived glides (resulting from underlying vowels) (Nevins and Chitoran 2008). This division involves the derived glides and the high vowels having identical features. However, Nevins and Chitoran (2008) propose the feature [±vocalic] to distinguish between derived glides and high vowels. Whereas high vowels are assigned the [+vocalic] feature, derived glides are assigned the [-vocalic] feature. This is due to the prosodic reason that glides occupy the margins of syllables (Nevins and Chitoran 2008: 4).

Returning to phonemic and derived glides, it has been proposed that phonemic and derived glides can be distinguished by the feature [±consonantal] (Hyman 1985; Hayes 1989; Nevins and Chitoran 2008). In accordance with this proposal, I argue that glides in QA must be divided into two types: phonemic (lexical) and derived glides. Phonemic glides are derived from underlying glides, as depicted in (91a). The underlying and surface glides in (91a) are assumed to carry the feature [+consonant]. Therefore, the surface glides here carry consonantal features as other QA consonants do. Second, derived glides arise from underlying vowels and carry non-consonantal features, as illustrated in (91b). In other words, these glides are grouped together with the vowels of QA under the node [-consonant], according to the contrastive hierarchy of QA non-consonant inventory.

(91)	(a)	underlying glides /G/ → [G]	(b)	underlying vowels /V/ → [G]

Examples illustrating the two kinds of glides are given in (92):

(92)
(a) underlying glides: English loanword yoga /ˈ**j̠**əʊ.gə/ → QA adapted form [ˈ**j̠**oː.ga]
(b) underlying vowel: English loanword *flouriade* /ˈflɔː.ra**ɪ̠**d/ → QA adapted form [floːˈraː.**j̠**ad]

In (92a), the underlying glide /j/ is adapted faithfully; hence, the surface glide [j] carries the features [+consonant, +sonorant, -labial, -nasal, +anterior] that are used to contrastively specify the phonemic glide /j/ in the contrastive hierarchy of QA consonant inventory. In (92b), however, the surface glide [j] is derived from the high vowel /ɪ/. This is due to the prohibition of the surface of diphthongs in QA. Since the glide alternates with the high vowel /ɪ/, it carries the features [-consonant, -back, -low, -long, -vocalic] used to contrastively specify non-consonantal glide /j/

within the contrastive hierarchy of QA non-consonantal inventory. In terms of feature representations, the only difference between the high vowel /ɪ/ and the derived glide /j/ is that the former is contrastively specified as [+vocalic] and the latter as [-vocalic]. According to the contrastive hierarchy of QA non-consonant inventory, the presence of the feature [±vocalic] is sufficient to distinguish high vowels from derived glides. It should be noted that the two types of glides are phonetically identical; however, they differ phonologically. This division is crucial in accounting for the adaptation of the English glides /j , w/ alongside the alternation between high vowels and glides within the adaptation of the English diphthongs. Without creating such a division and based on our argument that full specified segments are mapped to features that are contrastive in QA, it is difficult to explain the surface of glides as outputs of underlying vowels versus the surface of glides as outputs of underlying glides.

The inclusion of glides under the [-consonant] node is supported by the phonology system of Arabic. An alternation has been identified between the high vowels /u, i/ and the glides /w, j/ in the native grammar of some Arabic dialects (Kenstowicz 1994: 37). For instance, the high vowels /u/ and /i/ in the words *dal**u*** 'pail' and *jad**i*** 'kid' surface as their corresponding glides /w/ and /j/ when the 2sg. suffix *-ak* is added finally *dal**w**-ak* 'your pail' and *jad**y**-ak* 'your kid'. This phonological process of alternating high vowels with their corresponding glides is also attested in the native grammar of QA. For instance, the high vowels /u/ and /i/ in the words *ʕa.d**u*** 'running' and *sa.ʕ**i*** 'endeavour' are changed to the glides /w/ and /j/ when these words are suffixed with *-ak*, *ʕad.**w**ak* 'your running' and *saʕ.**j**ak* 'your endeavour'. According to this evidence of vowel-to-glide alternation, I propose dividing glides in QA into two types: first, lexical glides included under the [+consonant] node; and second, glides derived from high vowels and called derived glides.

Since the high vowels and derived glides in QA are classified as non-consonantal segments, I will borrow Nevins & Chitoran's feature [vocalic] to distinguish between derived glides and high vowels in QA. Therefore, derived glides in QA would resemble the features of high vowels /i/ and /u/, but they differ in the status of the prosodic feature [±vocalic]. High short vowels are contrastively specified as [+vocalic] whereas derived glides as [-vocalic]. It is worth mentioning that the analysis of this study proposes that the phonemic glides in QA are specified as [+consonant] in the underlying and surface levels whereas the derived glides are specified as [-consonant] in the underlying and surface levels.

6.1.13 Adaptation of English vowel hiatus /i.ə/ , /i. əʊ/, /i.a:/

Vowel hiatus refers to the occurrence of two consecutive vowels in two separate syllables. This occurrence is prohibited in several languages and different resolutions have been attested cross-linguistically to avoid vowel hiatus. Among these resolutions are: diphthong formation, coalescence, vowel elision and Glide-formation (Clements 1986; Casali 1995, 1996, 1997, 2011; Rosenthall 1997; Bakovic 2007; Sabao 2013; Mutonga 2017; among others). Although deletion of the first vowel is the most common strategy for avoiding vowel hiatus (Casali 2011), changing the first vowel into a glide is also attested in several languages (Clements 1986; Casali 1995; Rosenthall 1997; Bakovic 2007; Mutonga 2017).

Vowel hiatus is not permitted in QA because having a sequence of two vowels in two different syllables entails having a vowel-initial syllable. According to the syllable structure of QA, vowel-initial syllables are always forbidden in QA. Therefore, vowel hiatus in the English loanwords adapted in QA should undergo a resolution to conform to the QA phonotactic constraint. The examples in (93) show that QA grammar follows the glide-formation strategy in resolving the English loanwords which contain vowel hiatus. In particular, the first vowel (whether /əʊ/ or /i/) is changed to its glide counterpart [w] or [j], respectively.

(93)	heroin	/ˈher.<u>əʊ</u>.ɪn/	→	[hirˈ<u>w</u>iːn]
	mafia	/ˈmæf.<u>i.ə</u>/	→	[ˈmaːf.<u>ja</u>]
	phobia	/ˈfəʊ.b<u>i.ə</u>/	→	[ˈfoːb.<u>ja</u>]
	video	/ˈvɪd.<u>i.əʊ</u>/	→	[ˈfid.<u>ju</u>]
	piano	/p<u>iˈæ</u>n.əʊ/	→	[ˈb<u>jaː</u>.nu]
	caviar	/ˈkæv.<u>i.ɑː</u>r/	→	[kafˈ<u>jaː</u>r]
	aerial	/ˈer.<u>i.ə</u>l/	→	[ˈʔir.<u>ja</u>l]

The previous adaptation patterns given in examples (93) show a tendency of preserving as much of the input features while at the same time meeting the requirements of the native grammar of QA. That is, the prohibition against vowel hiatus leads to adapt the English rounded vowel /əʊ/ as the QA glide [w] in the English loanword *heroin* /ˈher.**<u>əʊ</u>**.ɪn/ → [hirˈ**<u>w</u>**iːn]. In adapting the English vowel /əʊ/ as [w], it is ensured that the input feature [labial] is preserved in the output and, at the same time, the QA constraint against vowel hiatus is satisfied. Likewise, choosing the glide [j] in a replace of the front vowel /i/ in the English loanword *video* /ˈvɪd.**<u>i.əʊ</u>**/ → [ˈfid.**<u>ju</u>**] is triggered by the need to preserve the input feature as well as to satisfy the QA grammar by resolving vowel hiatus.

Having presented the adaptation patterns of the English vowels into QA and accounted for the variable adaptation patterns, the following section establishes the contrastive hierarchy of the QA vowel inventory.

6.2 The Contrastive Hierarchy of QA Vowels

Since the primary argument of this study is that the phonological features of inputs that are contrastive in QA are preserved in the outputs, it is necessary to establish the contrastive hierarchy of the QA vowel inventory. By following the *Successive Division Algorithm* (SDA) proposed by (Dresher 2009: 16), I will demonstrate that the vowels in QA are contrastively specified through dividing the QA vowel inventory hierarchy into groups. Each group contains a set of vowels that share identical phonological features. Then, these vowels are kept distinguished until each group has only one vowel. Consequently, each vowel will carry phonological features that are contrastive. In the previous chapter addressing consonants, we have seen that the principles of *Activity*, *Minimality* and *Universality* are proposed as a mechanism of determining the order of the contrastive features of any consonant inventory (Dresher 2015). However, since vowel features are not ranked universally, I assume that determining the phonological features of the contrastive hierarchy of the QA vowel inventory is based on two principles. First, choosing features may be triggered by phonological processes; hence, the principle of *Activity*. For instance, we use the feature [labial] because there is a phonological evidence in the native system of QA that the low vowel /a/ surfaces as [u] if it occurs before labial consonants. This phonological process of spreading the consonant feature [labial] to the preceding vowels yields evidence that the feature [labial] is active within the QA vowel inventory and the labial vowels in QA must be contrastively specified for the feature [labial]. Second, the selection of features may be motivated by the need to distinguish a segment from other segments. For instance, the feature [long] is used to distinguish short vowels from long vowels.

Before contrastively specifying the QA vowels with the phonological features, it should be noted that all the QA vowels are specified with the feature [-consonant]. This specification is involved because the feature [consonant] is used in the consonant chapter to distinguish QA consonants with the specification [+consonant] from QA vowels with the specification [-consonant]. Under the set [-consonant], the following segments exist: [uː, u, w, oː, $aː^{+back}$, a^{+back}, aː$^{-back}$, a^{-back}, iː, i, j, eː]. At this juncture, it is crucial to explain why the low vowel /a/ is divided phonologically into two vowels [a^{+back}] and [a^{-back}]. In §6.1.3 and §6.1.6, we have observed that the English low back vowel /ɑ/ is adapted as the QA low vowel [a]. Simultaneously, the English low front vowel /æ/ is mapped to the QA low vowel [a]. Based on this adaptation pattern, we assume that, phonetically, QA has only one low vowel /a/ but phonologically there are two vowels [a^{+back}] and [a^{-back}] and each vowel has its long counterpart [aː$^{+back}$, aː$^{-back}$].

I assume that the first contrastive feature is [back]. This feature divides the QA vowels into [+back] set [uː, u, w, oː, aː$^{+back}$, a^{+back}] and the [-back] set [aː$^{-back}$, a^{-back}, iː, i, j, eː], as illustrated in (94). Ranking the feature [back] high in the hierarchy to dominate all the segments involves all the segments in the contrastive hierarchy of QA non-consonant inventory being specified with a value of the feature [±back].

(94) QA non-consonant feature hierarchy

[-cons]

uː, u, w, oː, aː$^{+back}$, a^{+back}, aː$^{-back}$, a^{-back}, iː, i, j, eː

[+back]
uː, u, w, oː, aː$^{+back}$, a^{+back}

[–back]
aː$^{-back}$, a^{-back}, iː, i, j, eː

First, we consider the [+back] set and the hierarchical structure of its features. This set includes segments that share the feature [+back] but differ in terms of height, roundness and length. Four features can distinguish the segments in this set: [high], [low], [long] or [labial]. First, if we choose the [low] feature, it will separate the low segments [aː$^{+back}$, a^{+back}] from the non-low segments [uː, u, w, oː]. Second, if we choose the [high] feature, it will separate the high segments [uː, u, w] from the non-high segments [oː, aː$^{+back}$, a^{+back}]. If the [long] feature is assigned at this level, it will distinguish the long segments [uː, oː, aː$^{+back}$] from the short ones [u, w, a^{+back}]. Finally, if we assign the feature [labial], it will group the labial segments [uː, u, w, oː] in one set with the specification [+labial] and leave the non-labial segments [aː$^{+back}$, a^{+back}] with the specification [-labial]. To determine which feature should be assigned at this level, we need to look at the native grammar of QA and discover whether there is a phonological process that triggers the selection of one of the four features [high], [low], [long] or [labial].

In QA, the low vowel /aː/ appears in the past forms in (95a) and (96a). However, when these past forms are changed to feminine imperative forms, the same low vowel /aː/ surfaces as the high labial vowel [uː] and the high front vowel [iː] in (95b) and (96b), respectively. What is relevant to our discussion is that the low vowel /aː/ is changed to [uː] if it is followed by a labial consonant, and to [iː] if followed by a non-labial consonant.

(95a)	sˤ**a**ːm	'he fasted'	(95b)	sˤ**u**ː.mi	'fast.IMPER.FEM'
	tˤ**a**ːf	'he went around'		tˤ**u**ː.fi	'go around.IMPER.FEM'
	t**a**ːb	'he repented'		t**u**ː.bi	'repent.IMPER.FEM'
(96a)	tˤ**a**ːr	'he/it flew'	(96b)	tˤ**i**ː.ri	'fly.IMPER.FEM'
	tˤ**a**ːħ	'he fell'		tˤ**i**ː.ħi	'fall.IMPER.FEM'
	b**a**ːʕ	'he sold'		b**i**ː.ʕi	'sell.IMPER.FEM'

This phonological process of labializing the prevocalic labial consonants /m, f, b/ provides evidence that the feature [labial] is active in QA and that the back labial vowels in QA must be specified for the feature [labial]. I selected the feature [labial] instead of [rounding] as the trigger consonants /m, f, b/ are labial but not rounding consonants.

It is crucial to use the feature [labial] instead of any other features because, according to the phonological process of labial harmony presented in (95b), I propose that the feature [labial] is an active feature and it is considered as a salient feature in QA. Being a salient feature in QA grammar means that English input vowels containing the feature [labial] are expected to be preserved in the outputs.

It is worth noting that if we assign the features [low] or [high] at this level, the QA labial segments would no longer be specified with the feature [labial]. This is because if the feature [low] is assigned, the non-low segments [uː, u, w, oː] will all be labials and it is impossible to distinguish the segments in this set with the feature they all share, i.e [labial]. Furthermore, if the feature [high] is chosen to distinguish the [+back] segments, the high segments [uː, u, w] can no longer be specified with the feature [labial] as they are all labials. Finally, assigning the feature [long] at this level will not present an obstacle to the labial segments in QA to be specified as [labial] since the feature [labial] can be assigned under [long]. However, if we allow the feature [long] to enter the hierarchy before [labial], it will group the long segments [uː, oː, aː$^{+back}$] in one side and leave the short segments on the other side [u, w, a^{+back}]. Nevertheless, the native grammar of QA demonstrates that the final stem-vowels should always be short; but, these short vowels are lengthened when followed by a suffix. This is also true of other Arabic dialects (Watson 2002; McCarthy 2005) and is illustrated in the following words:

(97)	ʔa.χ**<u>u</u>** 'brother'		ʔa.χ**<u>u</u>**ːk	'your brother'
	ʕa.ʃ**<u>a</u>** 'dinner'		ʕa.ʃ**<u>a</u>**ːk	'your dinner

This alternation between the short and the long vowels suggests that they need to be in one group at this level. To achieve this, it is necessary to dispense with the feature [long] at this level and assign the feature [labial], as illustrated in (98).

(98) QA non-consonant feature hierarchy: the [+back] set

[+back]
uː, u, w, oː, aː$^{+back}$, a^{+back}

[+labial]
uː, u, w, oː

[–labial]
aː$^{+back}$, a^{+back}

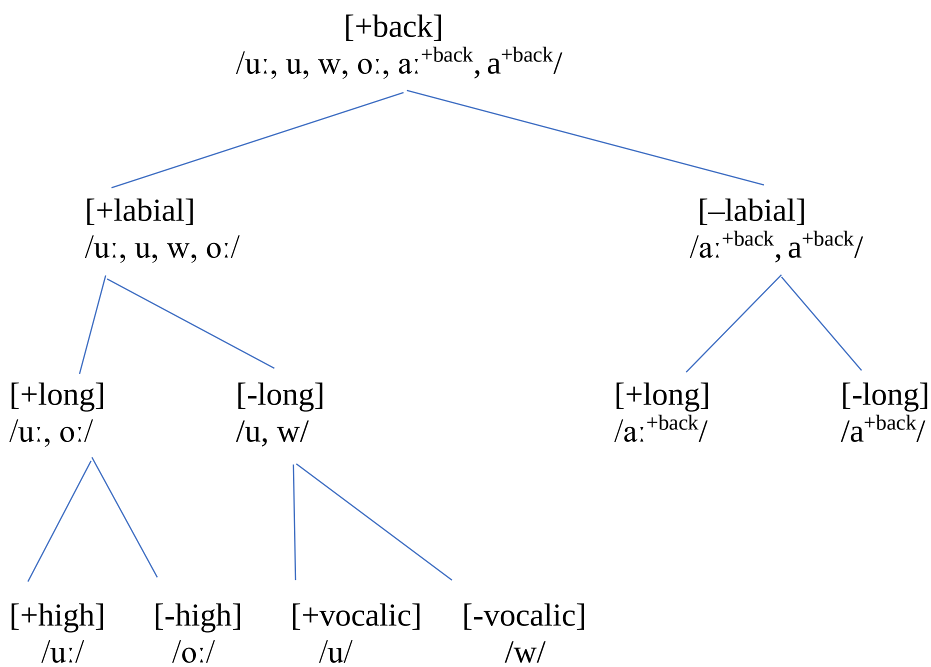
As members of the [-labial] set differ only in terms of their length status, the feature [long] is added and specifies [aː$^{+back}$] as [+long] and [a^{+back}] as [-long]. At this point, these two segments are fully distinct and require no further specification. It remains to distinguish the members of the [+labial] set. Two features can differentiate the segments of this set; namely, [high] and [long]. If we allow the feature [high] to enter the hierarchy, it will specify [uː, u, w] as [+high] and [oː] as [-high]. This means that the segment [oː] is fully distinct and would not require specification as [+long]. However, Watson (2002: 48) argues that the mid vowels in Cairene Arabic should be long. Moreover, she creates the constraint in (99) that prevents linking the mid vowels in Cairene Arabic to one mora.

(99) *μ

eː/oː

In accordance with Watson, I argue that the mid vowels in QA are required to be long. To ensure this, they must be specified with the feature [+long]. Therefore, it is essential to dispense with the feature [high] at this level and assign the feature [long] instead. After assigning the feature [long], the segments [uː, oː] are specified as [+long] and the segments [u, w] as [-long]. At this point, we can add the feature [high] to distinguish members of the [+long] set. Once the [high] feature is assigned, it specifies [uː] as [+high] and [oː] as [-high]. Now, it remains to distinguish [u] from [w]. These two segments are identical regarding the phonological features they share. Therefore, we refer to the feature [vocalic] (Nevins and Chitoran 2008) to distinguish the two segments. Accordingly, the segment [u] is specified as [+vocalic] and the segment [w] as [-vocalic]. The resulting specifications of the [+back] set are provided in (100).

(100) QA non-consonant feature hierarchy: the resulting specifications of the [+back] set



Next, we will address the hierarchy of the contrastive features provided in the [-back] set, including the following segments [aː$^{\text{-back}}$, a$^{\text{-back}}$, iː, i, j, eː]. Three different features can distinguish members of this set: [high], [long] and [low]. If we allow the feature [high] to enter the hierarchy first, it will specify [iː, i, j] as [+high] and [aː$^{\text{-back}}$, a$^{\text{-back}}$, eː] as [-high]. With this division at hand, the [high] feature will be ordered above the [long] feature in the contrastive hierarchy of QA. However, the feature [long] has a wider scope than the [high] feature within the [+back] set; therefore, the feature [high] should not dominate the feature [long]. Consequently, the feature [high] is excluded at this level. The other choice is assigning the feature [long] to distinguish the long segments [iː, eː,

aː$^{\text{-back}}$] from the short ones [i, j, a$^{\text{-back}}$]. However, since we have seen in (97) that there is an alternation between the short vs. long vowels in QA when the stem-vowels surface in open syllables versus closed syllables word-finally, the long and short vowels in QA need to be grouped together within one set. Therefore, the feature [long] should not be assigned at this level as it would not do the task of grouping the long vowels [iː, aː$^{\text{-back}}$] with their short counterparts [i, a$^{\text{-back}}$] within one set. Now, we are left with the feature [low]. Once the feature [low] is assigned, it divides the [-back] set into [+low] set, including the segments [aː$^{\text{-back}}$, a$^{\text{-back}}$], and [-low] set containing the segments [iː, i, j, eː]. The specifications of the [-back] set so far are presented in (101).

(101) QA non-consonant feature hierarchy: the [-back] set

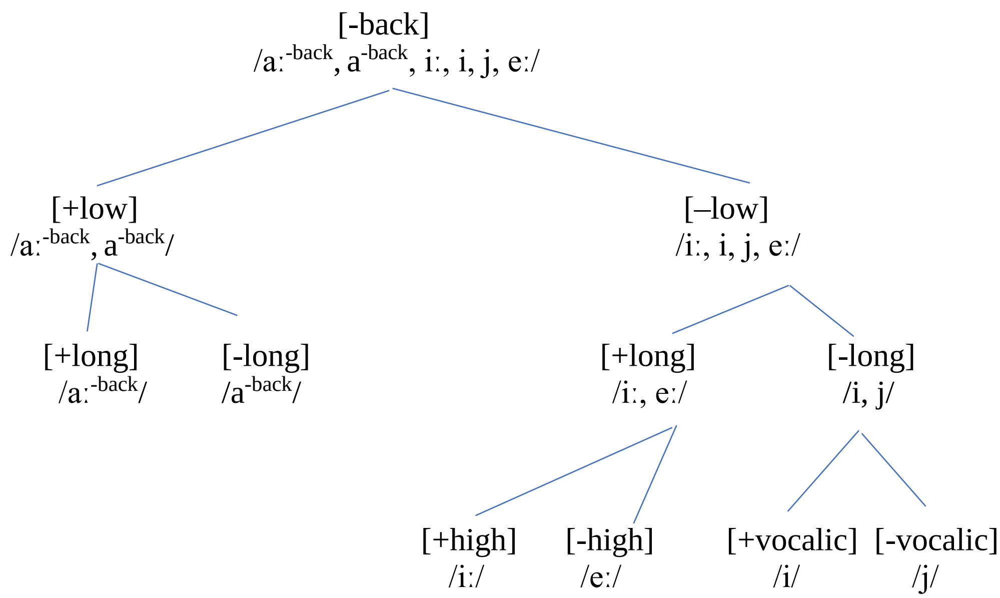
[-back]
aː$^{\text{-back}}$, a$^{\text{-back}}$, iː, i, j, eː

[+low]
/aː$^{\text{-back}}$, a$^{\text{-back}}$/

[–low]
/iː, i, j, eː/

Then, the contrastive feature hierarchy of QA assigns the [long] feature at this level. Once [long] is assigned, it groups [iː, eː] in one set with the specification [+long] and [i, j] in another set with the contrastive specification [-long]. At the next level of the hierarchy, the feature [high] is assigned within the [+long] set to distinguish [iː] from [eː], and the feature [vocalic] is assigned to specify [i] as [+vocalic] and [j] as [-vocalic]. The contrastive hierarchy presented in (102) illustrates the specifications of the [-back] set.

(102) QA non-consonant feature hierarchy: the resulting specifications of the [-back] set



The resulting feature specifications of all QA non-consonant segments are provided in (103).

(103) Output Specifications of QA non-consonant segments

/i/ $\begin{bmatrix} \text{-consonant} \\ \text{-back} \\ \text{-low} \\ \text{-long} \\ \text{+vocalic} \end{bmatrix}$

/iː/ $\begin{bmatrix} \text{-consonant} \\ \text{-back} \\ \text{-low} \\ \text{+long} \\ \text{+high} \end{bmatrix}$

/eː/ $\begin{bmatrix} \text{-consonant} \\ \text{-back} \\ \text{-low} \\ \text{+long} \\ \text{-high} \end{bmatrix}$

/aː$^{-back}$/ $\begin{bmatrix} \text{-consonant} \\ \text{-back} \\ \text{+low} \\ \text{+long} \end{bmatrix}$

/a^{-back}/ $\begin{bmatrix} \text{-consonant} \\ \text{-back} \\ \text{+low} \\ \text{-long} \end{bmatrix}$

$$/a{:}^{+\text{back}}/ \quad \begin{bmatrix} -\text{consonant} \\ +\text{back} \\ -\text{labial} \\ +\text{long} \end{bmatrix}$$

$$/a^{+\text{back}}/ \quad \begin{bmatrix} -\text{consonant} \\ +\text{back} \\ -\text{labial} \\ -\text{long} \end{bmatrix}$$

$$/u{:}/ \quad \begin{bmatrix} -\text{consonant} \\ +\text{back} \\ +\text{labial} \\ +\text{long} \\ +\text{high} \end{bmatrix}$$

$$/u/ \quad \begin{bmatrix} -\text{consonant} \\ +\text{back} \\ +\text{labial} \\ -\text{long} \\ +\text{vocalic} \end{bmatrix}$$

$$/o{:}/ \quad \begin{bmatrix} -\text{consonant} \\ +\text{back} \\ +\text{labial} \\ +\text{long} \\ -\text{high} \end{bmatrix}$$

6.3 Converting Successive Division Algorithm into OT constraints

Since all the segments within the [-consonant] set are specified as [-consonant], we will move to the next feature [back]. This feature is ranked at the top of the hierarchy provided in (94) and specifies all the segments as [+back] or [-back]. Being ranked high in the hierarchy involves preserving its input value [+ or -] in the outputs. This means that all the optimal outputs should be specified as [±back] and any output breaks this rule will be precluded. In OT terms, preserving the value of the input feature [±back] can be formulated into the faithfulness constraint: MAX[BACK]. Since the feature [back] dominate all the features, step (b) of the SDA, which requires listing all co-occurrence constraints cannot be applied here.

The next features in the hierarchy are [labial] and [low]. There is no difference in ranking the feature [low] over [labial] or vice versa as both are used exclusively within two different sets; that is, the former feature [low] is used only within the [-back] set, while the latter feature [labial] is used only within the [+back] set. However, since the vowel inventory of QA includes the low vowel /a/ but does not have a low-labial vowel, I assume that the feature [low] is ordered before [labial]. According to this feature ordering, the feature [low] appears next in the hierarchy after the feature [back] and the faithfulness constraint MAX[LOW] will be the next constraint after MAX[BACK]. As the feature [low] is not used within the [+back] set, the co-occurrence constraint *[αLOW, +BACK] is created and ranked above the faithfulness constraint MAX[LOW]. This co-occurrence constraint militates against having any value of the feature specification [low] if the feature specification [+back] is present.

The next contrastive feature in the hierarchy is [labial] and its preservation is formulated in the following faithfulness constraint MAX[LABIAL]. This feature is very crucial to any segment specified as [+back] since all the [+back] segments in QA are specified contrastively as [+labial] or [-labial]. Conversely, the feature [labial] is trivial among the [-back] segments as the feature [labial] is not used within the domain of [-back]. Accordingly, the co-occurrence constraint *[αLABIAL, -BACK] is proposed and ranked above MAX[LABIAL]. This constraint dictates that if a segment is specified as [-back], it cannot be specified for any value of the feature [labial]. Furthermore, the [labial] feature is not used within the [+low] or [-low] sets. Thus, the co-occurrence constraints *[αLABIAL, +LOW] and *[αLABIAL, -LOW] are required in preventing the feature [labial] from occurring with any value of the feature [low]. Again, these co-occurrence constraints must be ranked above the faithfulness constraint MAX[LABIAL].

Next in the hierarchy is the feature [long]. Thus, we propose the faithfulness constraint MAX[LONG], which requires preserving the value of the input feature [long]. Although the order of this feature is the fourth after [back], [low] and [labial], it dominates all the segments; that is, all the segments in the contrastive hierarchy of QA non-consonant inventory must receive a feature specification of [+ or – long]. In the situation of dominating all the segments, step (b) of the SDA, which requires listing all co-occurrence constraints cannot be applied. This means that there are no co-occurrence constraints relating to the feature [long].

The outcome of dominating all the segments entails that the feature [long] is essential in QA and plays a crucial role whether at the prosodic level (i.e. rightmost long vowels in QA attract stress) or at the phonological level (i.e. short and long vowels in QA are separate phonemes). Accordingly, we would anticipate that the English short vowels are mapped to the QA short vowels, and English long vowels are adapted typically as the long vowels in QA. Furthermore, we expect to identify a phonological reason for changing the input short vowel into long or vice versa if the input length is not maintained faithfully in the outputs. The phonological reason might be attributed to the syllabic or prosodic constraints of QA. For instance, the English word-final long vowels are expected to be adapted as their short counterparts in QA since long vowels are not allowed to surface word-finally in QA. Conversely, the English short vowels are expected to be lengthened in QA if they occur in prominent syllables. The following section analyses the adaptation of the English vowels in OT tableaux to reveal further details pertaining to the issue of shortening or lengthening input vowels.

The remaining features in the hierarchy of QA non-consonant inventory are [high] and [vocalic]. The order of these two features does not influence the analysis. However, since the [high] feature is a major element within any vowel inventory, I postulate that the [vocalic] feature is ranked below the [high] feature. This is unlike the [vocalic] feature, which relies on the existence of the alternation between high vowels and glides. Therefore, the feature [high] comes next in the hierarchy after the feature [long], and specifies the vowels already specified contrastively as [-low, +long] or [+labial, +long]. In other words, members of segments in the [-low] or [+labial] sets that are specified as [+long] must also receive a feature specification of [±high]. Accordingly, the input feature value [+ or – high] should be preserved faithfully in the outputs. Following the OT model, this preservation is formed as the faithfulness constraint MAX[HIGH]. However, since the feature [high] is not included within the domains of [+low], [-labial] and [-long], the co-occurrence constraints in (104) are proposed and ranked above MAX[HIGH].

(104) *[αHIGH, +LOW] >> *[αHIGH, -LABIAL] >> *[αHIGH, -LONG]

The last feature in the contrastive hierarchy of QA non-consonant inventory is [vocalic], which is used to distinguish /u/ from /w/ and /i/ from /j/. Therefore, the faithfulness constraint MAX[VOCALIC] is created to ensure the preservation of the input feature value [+vocalic]. However, the specification of [+vocalic] can be violated in two situations. First, if the vowel in QA is not contrastively specified for the feature [vocalic]. This means that there should be co-occurrence constraints preventing the surface of the input feature [+vocalic]. Given the fact that the feature [vocalic] is not used within the [+low], [-labial], [+long] [+high] [-high] sets, the following co-occurrence constraints are created to prevent the surface of [+vocalic] if it co-occurs with the aforementioned sets.

(105) *[αVOCALIC, +LOW] >> *[αVOCALIC, -LABIAL] >> *[αVOCALIC, +LONG]>> *[αVOCALIC, +HIGH], *[αVOCALIC, -HIGH]

The second situation in which the input feature [+vocalic] is not preserved in the output is found in cases where the high vowels /i/ and /u/ are changed to the glides [j] and [w]. In this situation, the input feature [+vocalic] will be changed to [-vocalic]. In (106), the algorithm of SDA produces the order of the contrastive features of QA non-consonant inventory.

(106) Back >> Low >> Labial >> Long >> High >> Vocalic

All the constraint rankings established in this section are summarised in (107). These constraints should be able to account for the vowels adaptation of English loanwords in QA.

(107) **MAX[BACK]** >> *[αLOW, +BACK] >> **MAX[LOW]** >> *[αLABIAL, -BACK] >> *[αLABIAL, +LOW] >> *[αLABIAL, -LOW] >> **MAX[LABIAL]** >> **MAX[LONG]** >> *[αHIGH, +LOW] >> *[αHIGH, -LABIAL] >> *[αHIGH, -LONG] >> **MAX[HIGH]** >> *[αVOCALIC, +LOW] >> *[αVOCALIC, -LABIAL] >> *[αVOCALIC, +LONG] >> *[αVOCALIC, +HIGH] >> *[αVOCALIC, -HIGH] >> **MAX[VOCALIC]**

6.4 Analysis and Tableaux

This section analyses the adaptation patterns of the English vowels into QA presented in § 6.1 through several OT tableaux. Since the focus is on features, I posit that the inputs are fully specified and the outputs should contain only the contrastive features within the contrastive hierarchy of QA vowel inventory. It is worth noting that some input features will be removed from the surface; not because they are not contrastive in QA, but because there are some co-occurrence constraints preventing these features from surfacing. For instance, although the feature [high] is contrastive in QA, it might not be retained in the output if [high] co-occurs with the specification [-long]. Conversely, the value of the input feature [±back] should always be preserved in the outputs because there are no co-occurrence constraints ranked above the faithfulness constraint MAX[BACK].

The input features of English vowels are drawn primarily from Hyman's feature vowel chart (1975: 240). Given that the inputs are postulated to be fully specified, the contrastive features of QA vowel inventory that are not mentioned in Hyman's feature chart will be added to the inputs. This is because any feature in the outputs needs to have a correspondent in the inputs. For instance, the feature [vocalic] is not mentioned in Hyman's feature chart. However, this feature is included as part of the fully-specified inputs. Next, we will consider the evaluation of the adaptation patterns of English vowels in QA.

6.4.1 Adaptation of English /uː/ and /ʊ/

Since the vowel inventory of QA includes the high back rounded vowel [u(ː)], it is predicted that the English vowel /uː/ is adapted faithfully in the QA. Since the feature [ATR] is not contrastive in QA vowel inventory, the high back lax vowel /ʊ/ is not part of the QA inventory. Therefore, it is predicted that the English high back lax vowel /ʊ/ is mapped in QA to its tense counterpart [u] (e.g. *full* /f**ʊ**l/ > [f**u**ll]). Changing the feature value [+ATR] into [-ATR] is expected as the feature [ATR] is ranked lower than the constraint *[F]. The constraint *[F] indicates the end of the contrastive features of any inventory. This entails that non-contrastive features should be ranked lower than *[F]. If a feature is ranked lower than *[F], a deletion will be made in the surface as it is not contrastive.

Tableau 10) reveals how the English vowel /ʊ/ is mapped in QA to its phonologically-closest vowel [u]. In the list of candidates in (10), (c) and (d) are ruled out as they incur violations of the faithfulness constraints MAX[LONG] and MAX[LABIAL]. Candidate (a) adapts the input vowel

/ʊ/ intact by preserving all the input features to satisfy all the faithfulness constraints. However, this mapping culminates in the violation of all the co-occurrence constraints *[αLOW, +BACK] and *[αHIGH, -LONG]. Now, the competition is between candidates (b) and (e) as they both dispense with the feature specifications [-low] and [+high] to avoid the violation of any co-occurrence constraint. However, the difference between the two candidates is that candidate (b) includes the feature specification [-ATR] to denote the vowel /ʊ/ whereas candidate (e) deletes this specification to produce the vowel [u]. As shown previously when discussing the adaptation of English consonants, for every feature specification, there will be a violation mark to the constraint *[F]. Therefore, candidate (b) incurs five violation marks to *[F] as it has five feature specifications whereas candidate (e) incurs only four violation marks to *[F] because it contains four feature specifications. Accordingly, candidate (b) loses to (e) as the former includes more feature specifications than the latter. Although the optimal candidate violates the constraint MAX[ATR], it is not prevented from winning the competition as the constraint *[F] outranks MAX[ATR].

Tableau 10

[+back, -low, +labial, -long, +high, -ATR, +vocalic] = **/ʊ/**	MAX [BACK]	*[αLOW, +BACK]	MAX [LOW]	MAX [LABIAL]	MAX [LONG]	*[αHIGH, -LONG]	MAX [HIGH]	MAX [VOCALIC]	*[F]	MAX [ATR]
a. [+back, -low, +labial, -long, +high, -ATR, +vocalic] = **[ʊ]**		*!				*			*******	
b. [+back, +labial, -long, -ATR, +vocalic] = **[ʊ]**			*				*		*****!	
c. [+back, +labial, +long, -high] = **[o:]**			*		*!		*	*	****	
d. [+back, -labial, -long] = **[a^{+back}]**			*	*!			*	*	***	
☞ e. [+back, +labial, -long, +vocalic] = **[u]**			*				*		****	*

Tableau 11) demonstrates the evaluation of the adaptation of the English high back long vowel /u:/, which is fully specified as [+back, -low, +labial, +long, +high +vocalic]. This vowel is adapted faithfully. Tableau 11) is created for the evaluation of the adaptation of /u:/ because the two vowels (/u/ and /u:/) have different contrastive specifications in the QA. As achieved in the previous tableaux, we must refine the feature specifications of the input presented in Tableau 11) to allow only the feature specifications that contrastively denote the high back long vowel [u:] in QA. Thus,

based on the contrastive specifications of the QA non-consonant inventory given in (100), the optimised output should only carry the following specifications [+back, +labial, +long, +high]. This means that the specifications [-low] and [+vocalic] are required to be eliminated and the co-occurrence constraints *[αLOW, +BACK] and *[αVOCALIC, +HIGH] are responsible for ruling these specifications out. The *[αLOW, +BACK] constraint states that if the segment is specified as [+back], it must not be specified for any value of the feature [low] and the *[αVOCALIC, +HIGH] constraint penalises any specification of the feature [vocalic] if the segment is already specified as [+high]. Accordingly, although the first candidate (a) maps the input vowel /uː/ to [uː], it is removed because it includes the specifications [-low] and [+vocalic], violating *[αLOW, +BACK] and *[αVOCALIC, +HIGH]. Candidate (b) maps the input vowel /uː/ to the mid vowel [oː]. This mapping entails changing the feature specification [+high] to [-high]; however, this change leads to the fatal violation of the faithfulness constraint MAX[HIGH]. Candidate (c) changes the input specification [+labial] into [-labial] to map the input vowel /uː/ to the low vowel [aː^{back}]. The feature [labial] is one of the high-ranked features in the contrastive hierarchy of QA non-consonant inventory. Therefore, candidate (c) is eliminated because any change to the input specification [+labial] results in the fatal violation of the faithfulness constraint MAX[LABIAL]. This leaves the final candidate (d) to win the competition as it correctly satisfies the co-occurrence constraints *[αLOW, +BACK] and *[αVOCALIC, +HIGH] by dispensing with the specifications [-low] and [+vocalic].

Tableau 11

[+back, -low, +labial, +long, +high +vocalic] = **/u:/**	MAX [BACK]	*[αLOW, +BACK]	MAX [LOW]	MAX [LABIAL]	MAX [LONG]	MAX [HIGH]	*[αVOCALIC, +HIGH]	MAX [VOCALIC]	*[F]
a. [+back, -low, +labial, +long, +high, +vocalic] =**[u:]**		*!					*		******
b. [+back, +labial, +long, -high] = **[o:]**			*			*!		*	****
c. [+back, -labial, +long] =**[a:$^{+back}$]**			*	*!		*		*	***
☞ d. [+back, +labial, +long, +high] = **[u:]**			*					*	****

6.4.2 *Adaptation of English /i/, /ɪ/ and /iː/*

Tableaux (12) and (13) include evaluations of the adaptation of the English high front vowels /i/ and /ɪ/. Since the QA vowel inventory has the high front vowel [i] but lacks its lax counterpart /ɪ/, tableaux (12) and (13) reveal that the English vowels /i/ and /ɪ/ are adapted as [i] in QA (e.g. /i/ > [i], as in *candy* /ˈkæn.d**i̲**/ > [ˈkaːn.d**i̲**] and /ɪ/ > [i], as in *chips* /tʃ**ɪ̲**ps/> [ʃ**i̲**bs]. According to the contrastive specifications of the QA non-consonant inventory given in (103), the high front vowel [i] in QA is contrastively specified as [-back, -low, -long, +vocalic]. Therefore, any other specifications should be removed from the optimal output. Since the two tableaux have the same optimal output [i], the evaluations will be identical.

In tableaux (12) and (13), the inputs contain the feature specifications required to identify the vowels /i/ and /ɪ/ in English. However, the contrastive hierarchy of QA inventory does not need all these feature specifications to specify the vowel [i]. Thus, the specifications [+high] and [-ATR] are redundant for specifying contrastively the vowel [i] in QA. Accordingly, candidates (a) in the two tableaux are ruled out for incurring fatal violations of the co-occurrence constraint *[αHIGH, -LONG] by having the specification [+high] within the domain of [-long]. Candidates (b) in the two tableaux are also excluded as they map the input vowels /i/ and /ɪ/ to the low vowel [a^{-back}], making a fatal violation of the faithfulness constraint MAX[LOW]. Candidates (c) preserve the value of the [-low] feature by mapping the input vowels /i/ and /ɪ/ to the high front long vowel [iː]. However, changing the input value [-long] to [+long] entails violation of the faithfulness constraint MAX[LONG]. Thus, these candidates are removed from the competition. The optimal candidates (d) in the two tableaux satisfy all the co-occurrence constraints and carry only the feature specifications that contrastively specify the high front vowel /i/ in QA.

Tableau 12

[-back, -low, -long, +high, +vocalic] = **/i/**	MAX [BACK]	MAX [LOW]	MAX [LONG]	*[αHIGH, -LONG]	MAX [HIGH]	MAX [VOCALIC]	*[F]
a. [-back, -low, -long, +high, +vocalic] = **[i]**				*!			*****
b. [-back, +low, -long] = **[a^{-back}]**		*!			*	*	***
c. [-back, -low, +long, +high] = **[iː]**			*!			*	****
☞ d. [-back, -low, -long, +vocalic] = **[i]**					*		****

Tableau 13

[-back, -low, -long, +high, +vocalic, -ATR] = **/ɪ/**	MAX [BACK]	MAX [LOW]	MAX [LONG]	*[αHIGH, -LONG]	MAX [HIGH]	MAX [VOCALIC]	*[F]	MAX [ATR]
a. [-back, -low, -long, +high, +vocalic, -ATR] = **[ɪ]**				*!			******	
b. [-back, +low, -long] = **[a^-back]**		*!			*	*	***	*
c. [-back, -low, +long, +high] = **[iː]**			*!			*	****	*
☞ d. [-back, -low, -long, +vocalic] = **[i]**					*		****	*

As in English, the QA inventory has the high front long vowel [iː]. Therefore, it is predicted that the English vowel /iː/ is adapted faithfully in QA. Indeed, the results provided in table 18 show that this vowel is adapted faithfully most of the time (e.g. /iː/ > [iː], as in *caffeine* /ˈkæf.**iː**n/ > [kaˈf**iː**n]. Consider the evaluation of the adaptation of the English vowel /iː/ in the next tableau (14). The evaluation in the following tableau is almost similar to that presented in tableaux (12) and (13). However, since we have argued that the high front long vowel [iː] in the contrastive hierarchy of QA non-consonant inventory does not require specification for the feature [vocalic], the optimal output in tableau (14) is necessary to dispense with the feature specification [+vocalic] and preserve the specification [+high]. This is achieved to avoid the violation of the co-occurrence constraint *[αVOCALIC, +LONG]; thereby militating against having any value of the feature [vocalic] with the feature specification [+long]. Therefore, the faithful candidate (a) is excluded as it preserves all the input feature specifications including [+vocalic]; leading subsequently to a fatal violation of the co-occurrence constraint *[αVOCALIC, +LONG]. Moreover, candidate (b) is eliminated as it changes the value of the input specification [+high] to produce the mid vowel [eː], incurring a violation of MAX[HIGH]. Candidate (c) avoids the violation of the faithfulness constraint MAX[HIGH] by mapping the input vowel /iː/ to [i]; nonetheless, this mapping results in a fatal violation of the faithfulness constraint MAX[LONG]. Candidate (d) is favoured as the optimal output as it violates the low-ranked constraint MAX[VOCALIC] by omitting the specification [+vocalic] but respects all the co-occurrence constraints and the high-ranked faithfulness constraints.

Tableau 14

[-back, -low, +long, +high, +vocalic] = **/iː/**	MAX [BACK]	MAX [LOW]	MAX [LONG]	*[αHIGH, -LONG]	MAX [HIGH]	*[αVOCALIC, +LONG]	MAX [VOCALIC]	*[F]
a. [-back, -low, +long, +high, +vocalic] = **[iː]**						*!		*****
b. [-back, -low, +long, -high] = **[eː]**					*!		*	****
c. [-back, -low, -long, +high] = **[i]**			*!				*	****
☞ d. [-back, -low, +long, +high] = **[iː]**							*	****

6.4.3 Adaptation of English /e/

The vowel inventory of QA contains the mid long vowel [eː] but not the mid short vowel */e/. Therefore, it is anticipated that the English mid vowel /e/ will be mapped to one of the front vowels available in QA [i], [eː], or [a^{-back}]. The results of the adaptation patterns provided in table 23 reveal that the English mid vowel /e/ is mapped regularly to the high vowel [i] in QA (as in the English loanword *metro* /ˈm**e̲**t.rəʊ/ which is adapted in QA as [ˈm**i̲**t.ru]). Tableau (15) illustrates how the English fully-specified vowel /e/ is mapped to the QA contrastive specified vowel [i]. The tableau also evaluates why the other choices, like mapping /e/ to [eː] or [a^{-back}], are not acceptable. This is crucial because it indicates that the mid vowels in QA are required to be long.

This tableau hypothesises first in candidate (a) that the English mid vowel /e/ is adapted faithfully as [e] in QA. However, this mapping entails that the output will include the specification [-high] as well as [-long] to denote the mid vowel [e]. However, the occurrence of the feature specification [-high] within the domain of [-long] is prohibited in the contrastive hierarchy of QA non-consonant inventory. Therefore, candidate (a) is ruled out because it incurs a fatal violation of the co-occurrence constraint *[αHIGH, -LONG]. Candidate (b) correctly omits the specification [-high] to satisfy *[αHIGH, -LONG]. However, this candidate is also removed from the competition for changing the value of the input specification [-low] to [+low] to denote the low vowel [a^{-back}]; thus, violating the faithfulness constraint MAX[LOW]. Candidate (c) satisfies the co-occurrence constraint *[αHIGH, -LONG] by preserving the specification [-high] but changing the input specification [-long] to [+long] to produce the vowel [eː]. This change leads to a fatal violation of the faithfulness constraint MAX[LONG]. Finally, candidate (d) wins by avoiding the violation of the co-occurrence constraint *[αHIGH, -LONG] by omitting the specification [-high] and preserving [-long]; thereby yielding the following contrastive specifications [-back, -low, -long, +vocalic]. These specifications denote contrastively the high front vowel [i] in QA.

Tableau 15

[-back, -low, -long, -high, +vocalic] = **/e/**	MAX [BACK]	MAX [LOW]	MAX [LONG]	*[αHIGH, -LONG]	MAX [HIGH]	MAX [VOCALIC]	*[F]
a. [-back, -low, -long, -high,+vocalic] = **[e]**				*!			*****
b. [-back, +low, -long] = **[a^{-back}]**		*!			*	*	***
c. [-back, -low, +long, -high] = **[eː]**			*!			*	****
☞ d. [-back, -low, -long, +vocalic] = **[i]**					*		****

6.4.4 Adaptation of English /eɪ/

The results presented in table 24 reveal that the English mid vowel /eɪ/ is mapped frequently to the QA mid vowel [eː] (e.g. the English loanword *cable* /ˈk**eɪ**.bəl/ is adapted in QA as [ˈk**eː**.bal]). Tableau (16) illustrates the importance of contrastively specifying the mid vowels in QA as [+long]. The status of preserving the value of the input feature [long] in the outputs of the adapted forms supports the argument proposed in this study that the feature [long] is ordered above the feature [high]. If the feature [high] was prioritised above [long] within the contrastive hierarchy of QA non-consonant inventory, we would predict the adaptation of the English mid vowels /e/ and /eɪ/ which are specified as [-high] in QA to the mid vowel [eː]. The primary motivation for such mapping is the preservation of the input specification [-high]. However, mapping the English mid vowel /e/ to the QA high vowel [i] and the English mid vowel /eɪ/ to the QA mid vowel [eː] indicates the importance of preserving the value of the input feature [long] at the expense of changing the value of the input feature [high].

Based on the contrastive specifications of QA non-consonant inventory given in (103), the mid vowel [eː] is specified contrastively as [-back, -low, +long, -high]. These four feature specifications are all necessary to distinguish [eː] from other vowels in QA. Accordingly, the input provided in tableau (16) which is fully-specified as [-back, -low, +long, -high] should surface with all these specifications. That is, no feature specification needs to be omitted or changed. Therefore, the requirement of preserving the input specification [-low] rules out candidate (a) as it changes the input specification [-low] to [+low], leading to a fatal violation of the faithfulness constraint MAX[LOW]. Likewise, changing the input specification [-high] to [+high] to produce the high front vowel [iː] in candidate (b) entails a fatal violation of the faithfulness constraint MAX[HIGH]. The optimal candidate (c) respects all the constraints by preserving faithfully all the input specifications in the output.

Tableau 16

[-back, -low, +long, -high] = **/eɪ/**	MAX [BACK]	MAX [LOW]	MAX [LONG]	*[αHIGH, -LONG]	MAX [HIGH]	*[F]
a. [-back, +low, -long] = **[aː$^{\text{-back}}$]**		*!			*	***
b. [-back, -low, +long, +high] = **[iː]**					*!	****
☞ c. [-back, -low, +long, -high] = **[eː]**						****

6.4.5 Adaptation of English /æ/

Since QA inventory does not have the low front lax vowel /æ/, it is predicted that the English vowel /æ/ would be adapted as the QA low tense vowel [a$^{\text{-back}}$]. The prediction of changing the value of the input feature [ATR] rather than the other features like [-back], [+low] or [-long] is based on the fact that [ATR] is not a contrastive feature within the contrastive hierarchy of QA non-consonant inventory. If a feature is not contrastive or it holds a low ranking in the hierarchy, it would be subject to a change more frequently than other features that are ranked high. Indeed, the results presented in table 22 show that the English low vowel /æ/ is always adapted as the QA low vowel [a$^{\text{-back}}$] and its long counterpart [aː$^{\text{-back}}$] (e.g. the English loanword *caffeine* /ˈk**æ**f.iːn/ is adapted in QA as [k**a**ˈfiːn] and the English loanword *gram* /gr**æ**m/ is adapted as [gr**aː**m]).

Tableau (17) illustrates how the English vowel /æ/, which is fully specified as [-back, +low, -long, -high, -ATR], is mapped to the QA contrastive specified vowel [a$^{\text{-back}}$]. As established in the contrastive specifications of QA vowel inventory provided in (103), the vowel [a$^{\text{-back}}$] requires merely the feature specifications [-back, +low, -long] to be distinguished from other vowels in the QA vowel inventory. This means that the input specifications [-high] and [-ATR] should be omitted from the optimal output. Therefore, candidate (a) which maintains all the input specifications faithfully to produce the vowel [æ] is eliminated for fatally violating the co-occurrence constraint *[αHIGH, -LONG]. Candidate (b) avoids violating *[αHIGH, -LONG] by omitting the specification [-high] to map the English vowel /æ/ to the QA vowel [i]. However, this candidate incurs a fatal violation of the faithfulness constraint MAX[LOW] by changing the input specification [+low] into [-low]. Candidate (c) is also ruled out from the competition as it violates the faithfulness constraints MAX[LOW] and MAX[LONG]. Candidate (d) wins as it preserves faithfully the specifications [-back, +low, -long] to satisfy the faithfulness constraints MAX[BACK], MAX[LOW] and MAX[LONG]. Simultaneously, this candidate avoids violating the co-occurrence constraint *[αHIGH, -LONG] by deleting the specification [-high]; thereby resulting in the output specifications [-back, +low, -long] that contrastively denote the vowel [a^{-back}] in QA.

Tableau 17

[-back, +low, -long, -high, -ATR] = **/æ/**	MAX [BACK]	MAX [LOW]	MAX [LONG]	*[αHIGH, -LONG]	MAX [HIGH]	*[F]	MAX [ATR]
a. [-back, +low, -long, -high,-ATR] = **[æ]**				*!		***** *	
b. [-back, -low, -long] = **[i]**		*!			*	***	*
c. [-back, -low, +long, -high] = **[eː]**		*!	*			****	*
☞ d. [-back, +low, -long] = **[a^{-back}]**					*	***	*

6.4.6 Adaptation of English /ɒ/

Tableau (18) demonstrates how to account for the mapping of an input that contains combinations of feature specifications that are illicit in the QA. This is demonstrated in the English low back labial vowel /ɒ/. This foreign vowel /ɒ/ carries the combination of feature specifications [+back, +labial, +low] that are illicit in the QA. Therefore, one of these specifications should undergo a modification to satisfy the contrastive hierarchy of QA. Since the feature [back] dominate all the vowels of QA and hence it is ranked at the top of other features in the contrastive hierarchy of QA non-consonant inventory, the specification [+back] should be preserved faithfully. Now, we are left with the specifications [+labial] and [+low]. Changing the [+labial] specification would culminate in mapping the English labial vowel /ɒ/ to one of the QA non-labial vowels. Furthermore, amending the [+low] specification and preserving the [+labial] would lead us to map the English labial vowel /ɒ/ to one of the QA labial vowels [u] or [oː]. According to the contrastive hierarchy of QA non-consonant inventory, the feature [low] is not used within the domain [+back]. Conversely, the feature [labial] is used only within the [+back] set. This involves dispensing with the specification [+low] and leave the [+labial] intact to map the English labial vowel /ɒ/ to one of the QA labial vowels. In OT terms, the purpose of deleting the [+low] is to avoid the violation of the co-occurrence constraint *[αLOW, +BACK]; thereby militating against achieving any value of the feature [low] with the [+back] set. As the specification [+low] has been deleted, the [+back, +labial] is a licit combination of feature specifications in the native grammar of QA. We will now consider the evaluation of the adaptation of /ɒ/ in the following tableau.

The input includes the specifications [+back, +low, +labial, -long, -high, +vocalic]. If preserving all the input specifications intact in the output, as what candidate (a) does, were the optimal way, the English vowel /ɒ/ would be mapped to the non-existent vowel in QA *[ɒ]. However, this mapping results in incurring fatal violations of the co-occurrence constraints *[αLOW, +BACK] and *[αLABIAL, +LOW]. Candidate (b) attempts to map the illicit input /ɒ/ to the QA low back vowel [a^{+back}] by deleting the specification [+low] and changing [+labial] into [-labial]. Although this mapping satisfies the co-occurrence constraint *[αLOW, +BACK] and *[αLABIAL, +LOW]; however, mapping /ɒ/ to [a^{+back}] entails a change to the feature specification [+labial] to [-labial]. This change leads to a fatal violation of the faithfulness constraint MAX[LABIAL]. To respect this constraint MAX[LABIAL], the input vowel /ɒ/ needs to be mapped to [oː] or [u] as what candidates (c) and (d) do. However, candidate (c) is eliminated from the competition for changing the input value [-long] to [+long] to produce the long vowel [oː]; thereby incurring a violation of the faithfulness constraint MAX[LONG]. Since candidate (d) respects this constraint MAX[LONG] by leaving the input specification [-long] intact, it wins.

Tableau 18

[+back, +low, +labial, -long, -high, +vocalic] = **/ɒ/**	MAX [BACK]	*[αLOW, +BACK]	*[αLABIAL, +LOW]	MAX [LOW]	MAX [LABIAL]	MAX [LONG]	*[αHIGH, -LONG]	MAX [HIGH]	MAX [VOCALIC]	*[F]
a. [+back, +low, +labial, -long, -high, +vocalic] = **[ɒ]**		*	*!				*			******
b. [+back, -labial, -long] = **[a^{back}]**				*	*!			*	*	***
c. [+back, +labial, +long, -high] =**[oː]**				*		*!			*	*****
☞ d. [+back, +labial, -long, +vocalic] = **[u]**				*				*		****

The results provided in table 26 reveal that the English /ɒ/ is adapted regularly to the QA mid labial vowel [oː] if /ɒ/ occurs in a stressed-final syllable after adaptation. For instance, although the vowel /ɒ/ in the English loanword *nylon* /ˈnaɪ.l**<u>ɒ</u>**n/ occurs finally, it is adapted as [u] in QA [ˈnaːj.l**<u>u</u>**n] because it occurs in an unstressed-final syllable after adaptation. On the contrary, the vowel /ɒ/ in the English loanword *cholesterol* /kəˈles.tər.**<u>ɒ</u>**l/ is mapped to the QA vowel [oː] [ku.listˈr**<u>oː</u>**l] because it occurs in a stressed-final syllable.

Tableau (19) below demonstrates how the English vowel /ɒ/ is mapped to the QA vowel [oː] and why the other QA labial vowels [u] and [uː] are not selected as optimal outputs. As can be seen from the tableau, candidate (a) is rejected because it fatally violates the markedness constraint *ɒ > -long]$\sigma_{prominent}$ which states that /ɒ/ cannot be mapped to a short vowel if it occurs in a stressed-final syllable. Candidate (b) attempts to avoid this constraint by mapping the vowel /ɒ/ to the long labial vowel [uː]; however, this mapping leads to a violation of the faithfulness constraint MAX[HIGH]. Candidate (c) wins against (a) by satisfying the markedness constraint *ɒ > -long]$\sigma_{prominent}$ by mapping /ɒ/ to the long labial vowel [oː]. Simultaneously, candidate (c) beats (b) by respecting the faithfulness constraint MAX[HIGH].

Tableau 19

[+back, +low, +labial, -long, -high, +vocalic] = **/ɒ/**	MAX [BACK]	*[αLOW, +BACK]	MAX [LOW]	MAX [LABIAL]	*ɒ > -LONG]$\sigma_{prominent}$	MAX [LONG]	*[αHIGH, -LONG]	MAX [HIGH]	MAX [VOCALIC]	*[F]
a. [+back, +labial, -long, +vocalic] = **[u]**			*		*!			*		****
b. [+back, +labial, +long, +high] = **[uː]**			*			*		*!	*	****
☞ c. [+back, +labial, +long, -high] =**[oː]**			*			*				****

6.4.7 Adaptation of English /ɑ/

Tableau (20) details the evaluation of the adaptation process of the English low non-labial vowel /ɑ/. This vowel is not available in the QA inventory as a separate phoneme, but rather as an allophone of the low vowel [a^{+back}]. Thus, there is no expectation for the English vowel /ɑ/ to be mapped faithfully in QA.

In tableau (20), the English input vowel /ɑ/ is assumed to be fully-specified as [+back, +low, -labial, -long, -high]. This is contrary to the previous adaptation pattern given in §6.4.6, which includes the illicit combinations of specifications [+back, +labial, +low]. This is because the combinations of feature specifications [+back, -labial, +low] is a licit specification in QA. Accordingly, we would expect that the optimal output will retain the input specifications [+back, -labial, +low] faithfully.

This section analyses how tableau (20) evaluates every possible candidate; ultimately, producing the actual output. Since the phoneme /ɑ/ does not exist in QA vowel inventory, preserving all the input feature specifications, as what candidate (a) does, to produce the vowel *[ɑ] fails to be the optimal way of adapting the English vowel /ɑ/ because this mapping incurs violations of the co-occurrence constraints *[αLOW, +BACK] and *[αHIGH, -LONG]. Candidate (b) did well in respecting the co-occurrence constraints *[αLOW, +BACK] and *[αHIGH, -LONG] by removing the specifications [+low] and [-high] from the output; however, mapping the input vowel /ɑ/ to [u] leads to fatally violate the faithfulness constraint MAX[LABIAL] by changing the input vowel [-labial] into [+labial]. Based on the contrastive hierarchy of the QA vowel inventory, the feature [low] is not used within the domain of [+back]. Moreover, the feature [high] is not used within the [-long] set. This means it is necessary to omit from the output the two feature specifications [+low] and [-high] included in the input to satisfy the co-occurrence constraints *[αLOW, +BACK] and *[αHIGH, -LONG], as performed by the optimal candidate (c). Then, we are left with the specifications [+back, -labial, -long]. These specifications denote contrastively the low back vowel [a^{+back}] in QA.

Tableau 20

[+back, +low, -labial, -long, -high] **= /ɑ/**	MAX [BACK]	*[αLOW, +BACK]	MAX [LOW]	MAX [LABIAL]	MAX [LONG]	*[αHIGH, -LONG]	MAX [HIGH]	*[F]
a. [+back, +low, -labial, -long, -high] = **[ɑ]**		*!				*		*****
b. [+back, +labial, -long] = **[u]**			*	*!			*	***
☞ c. [+back, -labial, -long] = **[a^{+back}]**			*				*	***

6.4.8 Adaptation of English /əʊ/

The results presented in table 27 reveal that the English mid back vowel /əʊ/ is mapped regularly to the QA mid vowel [oː] (e.g. the vowel /əʊ/ in the English loanword *glucose* /ˈɡluː.k**əʊ**s/ is adapted in QA as [oː] [ˈdʒluː.k**o**ːz]). This adaptation pattern reveals the importance in QA of preserving the values of the input features [back], [labial] and [high]. It is critical to note that the input feature specifications are always preserved in the output unless there are intervening co-occurrence constraints ranked above the faithfulness constraints. In this case, removing some of the input specifications from the output becomes necessary to satisfy those co-occurrence constraints.

Tableau (21) contains a fully-specified segment /əʊ/ and the optimised output should correspond to the contrastive specified [oː] in QA. The feature specifications of the input contain all the contrastive features that identify the mid vowel /oː/ in QA. However, the specification [-low] is considered a non-contrastive feature within the domain of [+back]. Furthermore, the feature [vocalic] is only used in QA to distinguish high short vowels from glides. Therefore, the optimised output should bear all the feature specifications of the input except [-low] and [+vocalic].

Accordingly, candidate (a) is removed immediately from the competition as it incurs a fatal violation of the co-occurrence constraint *[αLOW, +BACK]. Although candidates (b) and (c) correctly dispense with the specification [-low], they are removed from the competition as the former violates the faithfulness constraint MAX[HIGH] by changing the input specification [-high] into [+high] and the latter violates the faithfulness constraint MAX[LABIAL] by producing a non-labial vowel [aː^{back}]. Consequently, candidate (d) wins by respecting all the co-occurrence constraints by deleting the non-contrastive specifications [-low] and [+vocalic].

Tableau 21

[+back, -low, +labial, +long, -high, +vocalic] = **/əʊ/**	MAX [BACK]	*[αLOW, +BACK]	MAX [LOW]	MAX [LABIAL]	MAX [LONG]	*[αHIGH, -LONG]	MAX [HIGH]	*[αVOC, +LONG]	MAX [VOCALIC]	*[F]
a. [+back, -low, +labial, +long, -high, +vocalic] = **[oː]**		*!								******
b. [+back, +labial, +long, +high] = **[uː]**			*				*!			*****
c. [+back, -labial, +long] = **[aː^{back}]**			*	*!			*		*	***
☞ d. [+back, +labial, +long, -high] = **[oː]**			*						*	****

From the examples provided in (81b) repeated in (108) below, we can observe that the English mid vowel /əʊ/ is occasionally adapted as [u] in QA instead of the normal adaptation pattern (i.e. /əʊ/ > [oː]). For instance, the following English loanwords are adapted with the vowel /əʊ/ being mapped to [u].

(108)	disco	/ˈdɪs.k<u>əʊ</u>/	→	[ˈdis.k<u>u</u>]
	turbo	/ˈtɜːr.b<u>əʊ</u>/	→	[ˈteːr.b<u>u</u>]
	metro	/ˈmet.r<u>**əʊ**</u>/	→	[ˈmit.r<u>**u**</u>]

In §6.1.8, I argue that this adaptation pattern can be attributed to the phonology system of QA, which prevents long vowels from surfacing word-finally; in other words, all word-final vowels are required to be short. In OT terms, this constraint can be translated into the following constraint.

(109) *[+LONG/___]WD: word-final long vowels are prohibited.

Tableau (22) evaluates mapping the English /əʊ/ to the QA vowel [u] when /əʊ/ occurs word-finally. As can be seen, the faithful candidate (a) is eliminated because it fatally violates the markedness constraint *[+LONG/___]WD by having the specification [+long] in the surface level. Since markedness constraints in this study are ranked above faithfulness constraints, candidate (b) violates the faithfulness constraint MAX[-LONG] by changing the value of the input feature [+long] to [-long] to satisfy the markedness constraint *[+LONG/___]WD.

Tableau 22

[+back, -low, +labial, +long, -high, +vocalic] = **/əʊ/**	MAX [BACK]	*[αLOW, +BACK]	MAX [LOW]	MAX [LABIAL]	*[+LONG/___]WD	MAX [LONG]	*[αHIGH, -LONG]	MAX [HIGH]	*[αVOC, +LONG]	MAX [VOCALIC]	*[F]
a. [+back, +labial, +long, -high] = **[oː]**			*		*!					*	****
☞ b. [+back, +labial, -long, +vocalic] = **[u]**			*			*		*			****

6.4.9 Adaptation of English /ʌ/

Table 29 demonstrates that the English vowel /ʌ/ is adapted in QA as the low back vowel [a^{+back}] (e.g. /ʌ/ > [a^{+back}], as in *cover* /ˈk**ʌ**v.ər/ > [ˈk**a**.far]). This adaptation pattern can be attributed to the lack of the vowel /ʌ/ in the QA vowel inventory.

Tableau (23) evaluates the adaptation of the foreign vowel /ʌ/ with full specifications [+back, -low, -labial, -long, -high, +vocalic]. According to the contrastive hierarchy of QA vowel inventory, the vowel [a^{+back}] is contrastively specified as [+back, -labial, -long]. Thus, candidate (a), who maintains the input specifications faithfully, is eliminated for fatally violating the co-occurrence constraints *[αLOW, +BACK], *[αHIGH, -LONG] and *[αVOCALIC, -LABIAL]. Candidates (b) and (c) are also eliminated from the competition for incurring a fatal violation of the faithfulness constraint MAX[LABIAL] as they map the input non-labial vowel /ʌ/ to the labial vowels [u] and [oː], respectively. As established previously, the optimal candidate should bear only the contrastive specifications. Thus, output (d) wins by avoiding a violation of the co-occurrence constraints in addition to bearing only the contrastive specifications [+back, -labial, -long] that denote the vowel [a^{+back}] in QA.

Tableau 23

[+back, -low, -labial, -long, -high, +vocalic] = **/ʌ/**	MAX [BACK]	*[αLOW, +BACK]	MAX [LOW]	MAX [LABIAL]	MAX [LONG]	*[αHIGH, -LONG]	MAX [HIGH]	*[αVOC, -LABIAL]	MAX [VOCALIC]	*[F]
a. [+back, -low, -labial, -long, -high, +vocalic] = **/ʌ/**		*!				*		*		******
b. [+back, +labial, -long, +vocalic]=**[u]**			*	*!			*			****
c. [+back, +labial, +long, -high] = **[oː]**			*	*!	*				*	****
☞ d. [+back, -labial, -long] = **[a^{+back}]**			*				*		*	***

6.4.10 Adaptation of English /ɜː/

It has been argued in §6.1.11 that the English /ɜː/ is typically adapted as the QA vowel [eː] (e.g. /ɜː/ > [eː], as in the English loanword *turbo* /ˈt**ɜː**.bəʊ/ which is adapted in QA as [ˈt**eː**r.bu]. This argument is attributed to the influence of the contrastive features of QA. That is, with the assumption that the English vowel /ɜː/ is fully-specified as [-back, -front, -high, -low, +long, +ATR], all the input features are contrastive within the QA vowel inventory, except the features [-front] and [+ATR]. Then, removing these two features out leads to have the following feature specifications [-back, -high, -low, +long]. These remaining features contrastively specify the mid vowel [eː] in QA.

Tableau (24) mirrors the adaptation of the English vowel /ɜː/, which is fully-specified as [-back, -low, +long, -high, +ATR]. As detailed in the previous tableaux, the feature specifications of the input must be refined to allow only the contrastive specifications to surface. Thus, based on the contrastive specifications of the QA vowels provided in (103), the optimal output is required to eliminate the specification [+ATR] and keep the rest of the specification intact. The reason for this elimination is because the feature [ATR] is not a contrastive feature within the contrastive hierarchy of QA vowel inventory. Eliminating [ATR] produces the following specifications [-back, -low, +long, -high]. These specifications contrastively denote the mid vowel [eː] in QA.

Tableau 24

[-back, -low, +long, -high, +ATR] = **/ɜː/**	MAX [BACK]	MAX [LOW]	MAX [LONG]	*[αHIGH, -LONG]	MAX [HIGH]	*[F]	MAX [ATR]
a. [-back, +low, -long] = **[a^-back]**		*!	*		*	***	*
b. [-back, -low, +long, -high, +ATR] =**[ɜː]**						*****!	
☞ c. [-back, -low, +long, -high] = **[eː]**						****	*

As can be seen from tableau (24), candidate (a) is instantly excluded for fatally violating the faithfulness constraint MAX[LOW] by altering the input value [-low] to [+low]. The evaluation of candidates (b) and (c) demonstrates that only the contrastive specifications can surface, and any non-contrastive specification should be removed. Since the feature [ATR] is not a contrastive feature in QA, all QA vowels must not be specified for this feature. Therefore, candidate (b) loses to candidate (c) since the former contains the non-contrastive specification [+ATR]; thus, incurring more violations of the constraint *[F] than the latter candidate (c).

6.4.11 Adaptation of English /ə/

The vowel inventory of QA does not contain the mid-central vowel /ə/. Therefore, it is expected that the English vowel /ə/ is not adapted faithfully. That is, QA speakers will map the English vowel /ə/ to one of the QA vowels. However, it is not expected that the English vowel /ə/ will be mapped to one of the QA back vowels, because this adaptation entails changing the input specification [-back] to [+back]. As established earlier in this chapter, changing the value of the input feature [±back] is considered a fatal violation of the top-ranked feature [back]. Therefore, the prediction of mapping /ə/ to one of the QA back vowels is excluded. Instead, it is anticipated that the English vowel /ə/ will be mapped to one of the front vowels available in QA [i], [eː], or [a^-back]. The results of the adaptation patterns provided in table 28 reveal that the English vowel /ə/ is mapped regularly in QA to the low vowel [a^-back] (as in the English loanword *cassette* /kə̠.ˈset/

which is adapted in QA as [ˈka̱.sit]). Tableau (25) below illustrates how the English vowel /ə/ which is fully-specified as [-back, -front, -low, -long, -high, +vocalic] is mapped to the QA vowel [a^{-back}] that has the contrastive specifications [-back, +low, -long]. Furthermore, the tableau evaluates why the other QA front vowels [i] and [eː] are not acceptable for replacing the English vowel /ə/.

Since the English schwa /ə/ in tableau (25) is specified in the input as [-back, -low] and since these two features [back] and [low] are ranked high in QA, we would expect that the input values [-back] and [-low] are preserved in the output. If this happened, the English schwa is mapped to either [i] or [eː] in QA as these vowels are specified as [-back] and [-low]. However, this mapping contradicts the actual output we have. i.e. the English schwa /ə/ is mapped to the QA low vowel [a^{-back}]. Accordingly, it is necessary to create the markedness constraint *[-BACK, -FRONT] [-LOW] provided in (110) to prevent the surface of the specification [-low] if the input specification includes [-back] and [-front]. This markedness constraint should outrank the faithfulness constraint MAX[LOW].

(110) *[-BACK, -FRONT] [-LOW]: If a vowel is specified in the input as [-back, -front], it can not have a specification [-low] in the surface.

If we do not add this markedness constraint, the QA low vowel [a^{-back}] will not be chosen as an optimal output for the adaptation of the English schwa /ə/. Therefore, adding this constraint is indispensable to allow the optimal output with a different value [+low] of input feature specification [-low] to surface. This means that the optimal output will violate the faithfulness constraint MAX[LOW] by changing the value of the input specification [-low]; however, the purpose of this featural changing is to satisfy the markedness constraint *[-BACK, -FRONT] [-LOW].

As can be seen from tableau (25) that candidates (a), (b) and (c) are removed for incurring a fatal violation of the markedness constraint *[-BACK, -FRONT] [-LOW] by including the specification [-low] in the output. The optimal candidate (d) which maps the English schwa /ə/ to the QA low vowel [a^{-back}] alters the input specification [-low] to [+low] to satisfy the constraint *[-BACK, -FRONT] [-LOW]. Furthermore, the input specifications [-high] and [+vocalic] are deleted from candidate (d) to avoid violating the co-occurrence constraints *[αHIGH, -LONG] and *[αVOCALIC, +LOW]. Finally, candidate (d) omits the input specification [-front] as this feature is not a contrastive feature within the contrastive hierarchy of QA vowel inventory.

Tableau 25

[-back, -front, -low, -long, -high, +vocalic] = **/ə/**	MAX [BACK]	*[-BACK, -FRONT] [-LOW]	MAX [LOW]	MAX [LONG]	*[αHIGH, -LONG]	MAX[HIGH]	*[αVOC, +LOW]	MAX [VOCALIC]	*[F]	MAX[FRONT]
a. [-back, -front, -low, -long, -high, +vocalic] = **/ə/**		*!			*				*****	
b. [-back, -low, +long, -high] = **[e**ː**]**		*!		*				*	****	*
c. [-back, -low, -long, +vocalic] = **[i]**		*!				*			****	*
☞ d. [-back, +low, -long] **= [a$^{\text{-back}}$]**			*			*		*	***	*

6.4.12 Adaptation of English diphthongs /aɪ/ and /aʊ/

Since QA does not permit diphthongs, as stated in §6.1.12, English loanwords that contain diphthongs are adapted in QA with changing the second element of the diphthong into a glide to avoid the presence of two adjacent vowels. For instance, the diphthongs /aɪ/ and /aʊ/ in the English loanwords *diet* /ˈd**aɪ**.ət/ and *foul* /f**aʊ**l/ are mapped to the long vowel [aː] + a glide [ˈd**a**ː**.j**at] and [ˈf**a**ː**.w**il].

To analyse this adaptation pattern into OT framework, I will use the feature [±vocalic] to prevent the surface of two adjacent vowels; that is, the first vowel of the English input diphthong will carry the feature [+vocalic] in the surface level and occupy the nucleus position, while the second vowel of the English diphthong, which occurs in the margin of a syllable (onset or coda) in the surface level, should carry the [-vocalic] feature to avoid violating the markedness constraint *[+VOC]/ MARGIN] presented in (111). This constraint militates against having the feature specification [+vocalic] in the edges of the syllable (onset or coda positions).

(111) *[+VOC]/ MARGIN]: the occurrence of the [+vocalic] specification in a syllable margin is prohibited. (Nevins and Chitoran 2008: 4)

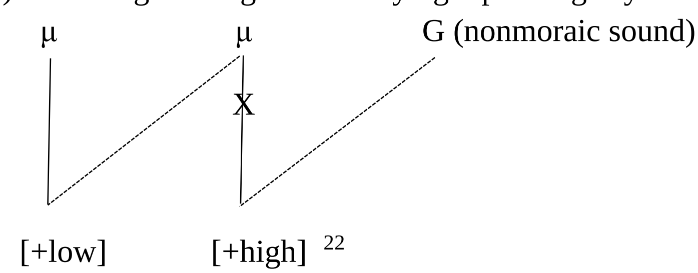
Clements (1986) investigated the distribution of prevocalic vowels in Luganda and found out that the second vowel of the hiatus in Luganda (which is already short in the input) is lengthened in the surface level. He argued that the process of lengthening the input short vowel is an attempt to compensate for the loss of the first vowel-slot. Rosenthall (1997) analysed the surface of prevocalic vowels in several languages (Luganda, Eisako, Yoruba, and Kimatuumbi) that allow only monophthongal vowels. Furthermore, he reanalysed Clements' proposal about vowel hiatus in Luganda but in the framework of OT and argued that lengthening the second vowel is motivated by the constraint MAX-IO-μ which requires preserving the numbers of moras in the input.

Following the analysis of Clements (1986) and Rosenthall (1997), I assume that the surface of underlying diphthong as a long vowel + a glide is the result of a constraint that prohibits the occurrence of two adjacent moras that are linked to two vocalic roots, as shown in (112). Therefore, the process highlighted in (113) is a resolution to the prohibited constraint presented in (112). In (113), the second vocalic root (represented as [+high]) is deleted and relinked to the glide (represented as G). This glide now surfaces as a nonmoraic segment and occupies a syllable margin (either in an onset or a coda position). Then, as a result of compensatory lengthening (like the proposal of Clements (1986) about Luganda), the first vocalic root (represented as [+low]) spreads to occupy the vacant vocalic root [+high] and surfaces as a long vowel with two moras.

(112) Representation of the English underlying diphthongs

```
  *μ      μ
   |      |
[+low] [+high]
```

(113) Resolving the English underlying diphthongs by creating a long vowel + glide in QA



[22]

QA speakers preserve most of the underlying features in this type of adaptation. In other words, the high back vowel /ʊ/ is mapped to the high back glide [w] while the high front vowel /ɪ/ is mapped to the high front glide [j]. Furthermore, the low vowel /a/ is lengthened to surface as [aː].

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[22] This representation is slightly modified from the representation provided by Rosenthall (1997: 148).

In fact, it has been argued that choosing the glide /w/ to resolve vowel hiatus in a replace of the rounded vowel /u/ is triggered by the need to preserve the input feature [labial] (Sabao 2013)

Examples (89) and (90) have demonstrated that an English diphthong, comprising two moras, is mapped in QA to a long vowel + a glide. Since the second moraic vowel of the English diphthong is adapted as the non-moraic glide, I argue that lengthening the first vowel of the diphthong to yield two moras is an attempt to preserve the number of the underlying moras. Consequently, I propose that the faithfulness constraint MAX-μ-IO, which militates against deletion of underlying moras, outranks the faithfulness constraint MAX [LONG], which requires preservation of the value of the feature [long]. These two constraints are given in (114) and (115).

(114) MAX-μ-IO: 'No deletion of moras' (Kager 1999: 176)

(115) MAX [LONG]: preserve the underlying value of the feature [long].

Following the analysis of Rosenthall (1997), I will transfer the process presented in (113) into OT terms. It will be evidenced that an English underlying diphthong should surface as a monophthong in QA. However, the number of underlying moras (i.e. the two moras of the diphthong) will be preserved in the output by the surface of a long vowel. Furthermore, the high vowel (the second moraic element of the English diphthong) will be parsed non-moraically. Two crucial constraints are required in order to account for the adaptation of English diphthongs; namely, MAX-μ-IO and *[+VOC]/ MARGIN.

As noted by Rosenthall (1997) when analysing the distribution of prevocalic vowels in Luganda, I argue that the analysis of the adaptation of the English diphthongs into QA involves in two aspects: first, the segmental analysis by which the English underlying features are mapped to output features that are contrastive in the QA vowel inventory. Second, the prosodic analysis by which the underlying two moras are preserved in the output by a means of vowel length. Therefore, it will be observed from the following tableaux (45) and (46) that the losing candidates will be eliminated by constraints related to the segmental analysis or the prosodic analysis.

Since the adaptation process of the English diphthongs /aɪ/ and /aʊ/ in QA is similar in that they are adapted as the long vowel [aː] + a glide, the evaluation of the adaptation of the English diphthongs will be identical in the following tableaux (27) and (28). Resolving the underlying diphthongs could be achieved in different ways. In tableaux (27) and (28), we have proposed only four options among other options that can be implemented cross-linguistically. First, the two vowels of the diphthongs could be faithfully parsed as two adjacent vowels linked to either one syllable (as a diphthong) or two separate syllables (as vowels hiatus). This option is represented in candidate (a). The second option is that the underlying diphthong could be mapped to monophthongs, as shown in candidate (b). In this option, the second vowel of the underlying diphthong is deleted and its moras is moved to the first vowel of the diphthong to surface as a long vowel. The last two options represented in candidates (c) and (d) are identical in preventing the surface of two adjacent vowels; however, (c) differs from (d) in that the underlying low vowel /a/ surfaces faithfully in candidate (c), whereas the same vowel is lengthened in candidate (d).

Tableau 26

[-back, +low, -labial, -long, -high, +vocalic] [+back, -low, +labial, -long, +high, +vocalic] **/a/ /ʊ/**	MAX [BACK]	MAX [LOW]	MAX [LABIAL]	*[+VOC]/ MARGIN	MAX-μ-IO	MAX [LONG]	MAX [HIGH]	*[αVOC, +LOW]	MAX [VOCALIC]	*[F]
a. [-back, +low, -long] [+back, +labial, -long, +vocalic] **[$\text{a}^{\text{-back}}$] [u]**		*	*	*!			*		*	*******
b. [-back, +low, +long] **[$\text{aː}^{\text{-back}}$]**	*!	*	*			*	*		*	***
c. [-back, +low, -long] [+back, +labial, -long, -vocalic] **[$\text{a}^{\text{-back}}$] [w]**		*	*		*!		*		*	*******
☞ d. [-back, +low, +long] [+back, +labial, -long, -vocalic] **[$\text{aː}^{\text{-back}}$] [w]**		*	*			*	*		*	*******

Tableau 27

-back +low -long -high +vocalic **/a/** -back -low -long +high +vocalic **/ɪ/**	MAX [BACK]	MAX [LOW]	*[+VOC]/ MARGIN	MAX-μ-IO	MAX [LONG]	MAX [HIGH]	*[αVOC, +LOW]	MAX [VOCALIC]	*[F]
a. [-back, +low, -long] [-back, -low, -long, +vocalic] **[a^{-back}]** **[i]**		*	*!			*		*	*******
b. [-back, +low, +long] **[aː$^{-back}$]**	*!	*			*	*		*	***
c. [-back, +low, -long] [-back, -low, -long, -vocalic] **[a^{-back}]** **[j]**		*		*!		*		*	*******
☞ d. [-back, +low, +long] [-back, -low, -long, -vocalic] **[aː$^{-back}$]** **[j]**		*			*	*		*	*******

As mentioned previously, the QA grammar does not permit the surface of two adjacent vocalic roots, whether they are linked to one syllable to appear as a diphthong or two syllables to appear as vowel hiatus. This phonotactic prohibition is driven from the fact that vowel-initial syllables in QA are strictly prohibited. Since the focus is on features, reference is not made to the NODIPHTHONG nor NOVOWELHIATUS constraints. Instead, the prosodic constraint *[+VOC]/MARGIN is sufficient to eliminate the occurrence of two adjacent vowels. This markedness constraint should outrank the faithfulness constraint MAX[VOCALIC]. This ranking is essential for the prevention of any segment specified as [+vocalic] from the surface in the syllable margins. Accordingly, candidate (a) in tableaux (27) and (28) is removed for including the

[+vocalic] segment [u] and [i] in the syllable margin and violating the markedness constraint *[+VOC]/MARGIN. Candidate (b) in the two tableaux attempts to map the underlying diphthong /aʊ/ and /aɪ/ to the monophthong [aː$^{-back}$] by deleting the whole specifications of the segments /ʊ/ and /ɪ/ to satisfy *[+VOC]/MARGIN. However, this mapping entails several violations of most of the faithfulness constraints; thus, this candidate is eliminated. Currently, the competition is between candidates (c) and (d) in the two tableaux, as both map the underlying diphthong to the vowel+glide. Candidate (c) maps the underlying diphthongs /aʊ/ and /aɪ/ to the low vowel [a^{-back}] + the glide [w] and [j], respectively. Adapting the underlying vowels /ʊ/ and /ɪ/ as the glides [w] and [j] entails changing the feature [+vocalic] into [-vocalic]. This mapping aims to preserve most of the feature specifications of the second vowel of the diphthongs and at the same time satisfy the phonotactic constraints of QA by not having [+vocalic] segments in the syllable margins. This step of mapping is on the right track to produce the optimal output. However, it conflicts with the faithfulness constraint MAX-μ-IO as the input contains two moras (i.e. each of the input vowels /aʊ/ and /aɪ/ have two moras) but the output contains only one mora (i.e. since the glides [w] and [j] are nonmoraic segments, only the short vowel [a^{-back}] has one mora). Therefore, candidate (c) is eliminated from the competition for incurring a violation of the constraint MAX-μ-IO. Candidate (d) wins by avoiding the violation of MAX-μ-IO by lengthening the low vowel [aː$^{-back}$] to have two moras in the output.

6.5 Conclusion

This chapter accounts for the adaptation patterns of the English vowels into QA. One major conclusion of this chapter is that the adaptation patterns of English vowels into QA can be accounted for by referring to the contrastive hierarchy of QA vowel inventory. In particular, the input features of the English vowels are mapped to the contrastive features of the QA vowels. The evidence behind the argument that the contrastive features of QA vowels play a main role in the adaptation process of English vowels emerges from adapting the English lax vowels /ɪ/, /ʊ/, /æ/ as their tense counterparts in QA [i], [u] and [a]. I have argued that the reason for this adaptation lies in the fact that the feature [ATR] is not a contrastive feature within the QA vowel inventory. Therefore, by dispensing with the value of the input feature [-ATR], we end up with the tense vowels appearing at the surface level.

Alongside these major findings, the data analysis reveals that the native grammar of QA impacts significantly on some adaptation patterns. In other words, QA prosodic and phonotactic constraints influence the adaptation process of English vowels. For instance, English long vowels are mapped to QA short vowels when they occur word-finally. This change to the length feature is attributed to the phonological fact that long vowels in QA are prohibited word-finally. Further evidence for the effect of QA constraints comes from adapting the English diphthongs as a long vowel + a glide. This adaptation is attributed to the QA constraint, which prevents the occurrence of two adjacent moras, which are linked to two vocalic roots.

This chapter has analysed theoretically the adaptation patterns of the English vowels into QA within the OT framework. The hierarchy of the constraints are driven primarily by the order of the contrastive features of QA. This hierarchy accounts for preserving some of the input features in the outputs (like back and labial) and removing other features from the surface level (like ATR).

In conclusion, the main argument of this chapter is that all the input features should be preserved in the output, unless there are intervening co-occurrence constraints preventing these input features from surfacing. In this case, satisfaction of the co-occurrence constraints is required because they are always ranked above the faithfulness constraints. For instance, the value of the input feature [low] must be preserved in the output as it is a contrastive feature within the contrastive hierarchy of QA vowel inventory; hence, the faithfulness constraint MAX[LOW] is created. However, this feature [low] must be removed from the output in case it co-occurs with the specification [+back] because [low] is not used within the domain of [+back]; hence, the co-occurrence constraint [αLOW, +BACK] is created and ranked above MAX[LOW].

Chapter 7: Conclusion and future research

7.1 Conclusion

This thesis provides a study of loanword adaptations into QA, based on a corpus of approximately 400 English loanwords. The research focused on investigating the segmental adaptation patterns of English loanwords into QA. It revealed that English segments available in the QA inventory are preserved faithfully. However, the following English consonants, which are illicit in QA, are mapped to their phonologically closest consonants: /p/ is mapped to its voiced counterpart [b], /v/ to [f], /tʃ/ to [ʃ], /ʒ/ to [dʒ] and the English velar nasal /ŋ/ to the QA nasal coronal [n]. Furthermore, it demonstrated that the English vowels /i(ː)/ and /uː/ are maintained typically in QA as these vowels are unmarked in QA. Conversely, the following English vowels, which are foreign in QA, are replaced with their phonologically closest match in QA: the English lax vowels /ʊ/, /ɪ/, /æ/ are adapted respectively as the QA tense vowels, [u], [i] and [a], the English mid vowel /e/ is adapted regularly as [i] in QA, the English mid vowel /eɪ/ is almost always adapted as its phonologically-equivalent vowel [eː] in QA, the English vowel /ɑː/ is always replaced with the QA low vowel [a(ː)$^{+back}$], whereas the round one /ɒ/ is most frequently mapped to [u(ː)], the English vowels /əʊ/ or /ɔː/ are adapted regularly as [oː] in QA, the English mid vowels /ə/ and /ʌ/ are respectively adapted as [a^{-back}] and [a^{+back}], the English vowel /ɜː/ is adapted frequently as [eː] in QA and finally the English diphthongs are adapted in QA with changing the second element of the diphthong into a glide.

Alongside these major findings, the data analysis revealed that the native grammar of QA influences QA speakers to produce variable adaptation patterns. In other words, QA prosodic and phonotactic constraints influence the adaptation process of some cases. For instance, English long vowels are mapped to QA short vowels when they occur word-finally. This change to the length feature is attributed to the phonological fact that long vowels in QA are prohibited word-finally. Further evidence of the effect of QA constraints emerges when the English loanword *valve* in QA are adapted as *balf*. We have argued that this is a type of dissimilation to prevent the occurrence of two identical segments in one syllable. Other adaptation patterns that were not consistent with the typical mapping were assumed to be influenced by orthography.

Based on these observations, I propose that the contrastive features of QA play a role in the treatment of the English segments that are not part of the QA inventory. For instance, QA lacks the voicing contrast among labial consonants; thus, the English voiceless and voiced bilabial stops, /p/

and /b/, are adapted as the QA voiced bilabial stop [b]. Furthermore, whereas the vowel inventory of English has distinctive contrast among tense versus lax vowels, QA inventory lacks this contrast; therefore, the absence of the lax-tense contrast within vowels in the QA vowel inventory causes the English lax vowels, /ʊ/, /ɪ/, /æ/, to be adapted respectively as the QA tense vowels [u], [i] and [a].

Since the study has argued that contrastive features of QA play a crucial role in the adaptation of English segments and found that the variable adaptation patterns are motivated by QA prosodic or phonotactic constraints, a theoretical framework is required to consider the segmental adaptations of the English consonants and vowels into QA. Consequently, the Optimality Theory (OT) (Prince and Smolensky 1993) was applied. Within the OT framework, the input is proposed to be fully-specified and the optimal output should carry only the features that are underlyingly contrastive in QA. However, before analysing the adaptation patterns into OT tableaux, it was necessary to specify the QA segments contrastively. Therefore, this study relied primarily on the Contrastive Hierarchy Theory (CHT) proposed by Dresher (2009) to obtain the contrastive features of the QA phonological inventories. Then, the contrastive hierarchies of the QA consonants and vowels features were converted into OT constraints. Rankings of various faithfulness and co-occurrence constraints were proposed according to the contrastive hierarchies of the QA phonological features. The integration of the CHT with the OT correctly predicted and accounted for the phoneme mapping patterns of English loanwords in QA.

According to the analysis of this study's findings, the factors determine how foreign consonants and vowels in English loanwords are adapted in QA are attributed to the phonological features that are underlyingly contrastive in QA. In particular, the study has proposed that English segments are assumed to carry full-specifications, which serve as inputs to QA. Then, the native grammar of QA allowing only the phonological features of inputs to surface that are contrastive in QA. Thus, phonological features that are redundant or non-contrastive in QA are eliminated from outputs.

Furthermore, the phonological analysis proposed in this study demonstrates that the constraints of QA grammar play a role in the adaptation process. This is demonstrated in the evaluations of the potential QA outputs of English foreign segments by the set of QA faithfulness and co-occurrence constraints. These constraints are motivated and ranked according to the ranking of features of QA consonant and vowel inventories. In other words, the order of features within the contrastive hierarchy of QA inventories reflects the ranking of faithfulness constraints. Between these faithfulness constraints, there exist some co-occurrence constraints that are ranked above the faithfulness constraints. In sections 5.4 and 6.4, this study reveals that the QA constraints influence the selection of the optimal output in a sense that the optimal output should respect all the co-occurrence constraints and make fewer violations of the faithfulness constraints than the losing outputs.

Based on the proposed analysis of this study, it is primarily the phonological details of segments that are crucial to the adaptation process. The study demonstrates that the phonological, not phonetic, features that are lexically contrastive in QA shape the segmental adaptation patterns. For instance, the study has demonstrated that the QA vowel inventory contains the high front vowel [i] but lacks its lax counterpart /ɪ/; thus, the English vowels /i/ and /ɪ/ are adapted identically as [i] in QA. I propose that this adaptation is attributed to the contrastive features of QA. In other words, according to the contrastive specifications of the QA vowel inventory, the high front vowel [i] in QA does not contrast with another vowel in the [ATR] feature which entails that the [ATR] is not a contrastive feature in QA. Consequently, removing the specification of [ATR] leads to adapt the English vowel /ɪ/ as the QA vowel [i].

In summary, the analysis of this study's findings broadens our understanding of the effect of the borrowing language's contrastive features in loanword phonology. In particular, the core argument of this study is that the underlying contrastive QA features form the adaptation patterns of English segments into QA. Consequently, the analysis of the segmental adaptations of English consonants and vowels into QA supports the arguments proposed by Hyman (1970), Paradis and LaCharite (1997), Jaccobs and Gussenhoven (2000), Herd (2005), Clements (2001), Batais (2013), Abu-Guba (2016); whereby, the nature of the adaptation process is grounded in the phonological details of the borrowing language (QA).

7.2 Recommendations for future research

In future, it would be intriguing to discover whether the contrastive hierarchy of QA inventories proposed in this study can be applied to acquisition research, whether L2 or L1. In other words, the contrastive hierarchy of QA phonological inventories proposed here can be further tested by applying them to phonological patterns of acquiring English consonants and vowels by QA learners of English.

Incorporating the effect of contrastive features within the OT framework to account for the segmental adaptations can be further tested by applying it to other languages and dialects. In other words, the variable adaptation patterns observed across different dialects of one language could be intrigued by the fact that these dialects differ in ordering contrastive features hierarchically. In the future, the argument of this study can be supported by studies from different languages, which demonstrate the effect of the contrastive hierarchy of a language inventory on accounting for the segmental adaptations of loanwords.

The theoretical analysis of this study could be used to consider the phonological processes of the QA native grammar. For instance, the phonological process of assimilation in QA could be explained by referring to the contrastive hierarchy of QA inventory. Furthermore, the notion of highlighting the effect of the contrastive hierarchy of an inventory on explaining the phonological patterns could be applied to either cross-dialects of Arabic or cross-languages.

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Appendix: English loanwords

APPENDIX

A list of all English loanwords included in the study (in alphabetical order).

	English Word	English IPA transcription	QA IPA transcription
1.	acid	/ˈæs.ɪd/	[ʔaˈsiːd]
2.	action	/ˈæk.ʃən/	[ˈʔak.ʃin]
3.	admin	/ˈædmɪn/	[ˈʔaːd.min]
4.	aerial	/ˈeə.ri.əl/	[ˈʔir.jal]
5.	agenda	/əˈdʒen.də/	[ʔaˈdʒin.da]
6.	AIDS	/eɪdz/	[ʔeːdz]
7.	airbag	/ˈeə.bæg/	[ʔirˈbaːg]
8.	album	/ˈæl.bəm/	[ʔalˈbuːm]
9.	aluminium	/æl.jəˈmɪn.i.əm/	[ʔa.laˈmin.jum]
10.	Amazon TM.	/ˈæm.ə.zən/	[ʔa.maˈzoːn]
11.	ampere	/ˈæm.pɪə/	[ʔamˈbeːr]
12.	anemia	/əˈniː.mi.ə/	[ʔaˈniːm.ja]
13.	April	/ˈeɪ.prəl/	[ʔabˈriːl]
14.	archive	/ˈɑː.kaɪv/	[ʔar.ʃiːf]
15.	Aspirin	/ˈæs.prɪn/	[ʔas.biˈriːn]
16.	assist	/əˈsɪst/	[ʔasˈsist]
17.	Avalon TM.	/ˈæv.ə.lɒn/	[ʔa.faˈloːn]
18.	avocado	/æv.əˈkɑː.dəʊ/	[ʔa.fuˈkaː.du]
19.	bacteria	/bækˈtɪə.ri.ə/	[bakˈtiːr.ja]
20.	balloon	/bə.ˈluːn/	[baˈluːn]
21.	bank	/bæŋk/	[bank]
22.	bar	/bɑːʳ/	[baːr]
23.	Batman	/ˈbæt.mən/	[batˈmaːn]
24.	bazooka	/bəˈzuː.kə/	[baˈzuː.ka]
25.	beige	/beɪʒ/	[beːdʒ]
26.	bermuda	/bəˈmjuː.də/	[barˈmuː.da]

27.	bikini	/bɪˈkiː.ni/	[bikˈkiː.ni]
28.	Blazer ™.	/ˈbleɪ.zəʳ/	[ˈbleː.zar]
29.	block (V)	/blɒk/	[ˈbal.lak]
30.	boarding	/ˈbɔː.dɪŋ/	[boːrˈding]
31.	body	/bɒd.i/	[ˈbɑ.di]
32.	boot	/buːt/	[buːt]
33.	booking	/ˈbʊk.ɪŋ/	/buˈking/
34.	bottle	/bɒt.əl/	[ˈbɑ.tˤil]
35.	bouquet	/bəˈkeɪ/	[buˈkeːh]
36.	bowling	/ˈbəʊ.lɪŋ/	[boːˈling]
37.	bravo	/brɑːˈvəʊ/	[ˈbraː.fu]
38.	bronze	/brɒnz/	[ˈbrun.zi]
39.	Budget ™.	/ˈbʌdʒ.ɪt/	[ˈbadʒ.dʒit]
40.	buffet	/bʊf.eɪ/	[buˈfeːh]
41.	bus	/bʌs/	[bɑːsˤ]
42.	business	/ˈbɪz.nɪs/	[ˈbiz.nis]
43.	cable	/ˈkeɪ.bəl/	[ˈkeː.bal]
44.	cacao	/kəˈkaʊ/	[kaˈkaːw]
45.	cafeteria	/kæf.əˈtɪə.ri.ə/	[ka.faˈtiːr.ja]
46.	caffeine	/ˈkæf.iːn/	[kaˈfiːn]
47.	calcium	/ˈkæl.si.əm/	[ˈkaːl.sjum]
48.	camera	/ˈkæm.rə/	[ˈka.mi.ra]
49.	canary	/kəˈneə.ri/	[kaˈnaː.ri]
50.	cancel	/ˈkæn.səl/	[ˈkan.sal]
51.	candy	/ˈkæn.di/	[ˈkaːn.di]
52.	cappuccino	/kæp.əˈtʃiː.nəʊ/	[ka.butˈʃiː.nu]
53.	capsule	/ˈkæp.sjuːl/	[kabˈsuː.lah]
54.	captain	/ˈkæp.tɪn/	[ˈkab.tin]
55.	capture	/ˈkæp.tʃəʳ/	[ˈkabt.ʃar]
56.	caramel	/kær.ə.məl/	[kaˈraː.mil]
57.	caravan	/ˈkær.ə.væn/	[ka.raˈfaːn]

58.	carbon	/ˈkɑː.bən/	[karˈboːn]
59.	card	/kɑːd/	[kart]
60.	carnival	/ˈkɑː.nɪ.vəl/	[kar.naˈfaːl]
61.	cartoon	/kɑːˈtuːn/	[karˈtuːn]
62.	cash	/kæʃ/	[kaːʃ]
63.	cashier	/kæʃˈɪəʳ/	[kaˈʃeːr]
64.	casino	/kə.ˈsiː.nəʊ/	[ˈka.zi.nu]
65.	cassette	/kə.ˈset/	[ˈka.sit]
66.	catalogue	/kæt.əl.ɒg/	[ka.taˈloːdʒ]
67.	caviar	/ˈkæv.i.ɑːʳ/	[kafˈjaːr]
68.	cement	/sɪˈment/	[ʔisˈmint]
69.	centre	/ˈsen.təʳ/	[ˈsin.tar]
70.	ceramics	/sə.ˈræm.ɪks/	[sa.raˈmiːk]
71.	chalet	/ˈʃæl.eɪ/	[ʃaˈleːh]
72.	charisma	/kəˈrɪz.mə/	[kaˈriz.ma]
73.	check	/tʃek/	[ʃeːk]
74.	chef	/ʃef/	[ʃiːf]
75.	Chimpanzee	/tʃɪm.pænˈziː/	[ʃimˈbaːn.zi]
76.	chips	/tʃɪps/	[ʃibs]
77.	cholesterol	/kəˈles.tər.ɒl/	[ku.listˈroːl]
78.	Christmas	/ˈkrɪs.məs/	[ˈkris.mis]
79.	classic	/ˈklæs.ɪk/	[klaˈsiː.ki]
80.	clip	/klɪp/	[klib]
81.	clutch	/klʌtʃ/	[kaˈlatʃ]
82.	coat	/kəʊt/	[koːt]
83.	Cobra	/ˈkəʊ.brə/	[ˈkoːb.ra]
84.	cocaine	/kəʊˈkeɪn/	[kuˈka.jiːn]
85.	cocktail	/ˈkɒk.teɪl/	[kukˈteːl]
86.	coffee	/ˈkɒf.i/	[ˈkɑ.fi]
87.	Cola TM.	/ˈkəʊ.lə/	[ˈkoː.la]
88.	comedy	/ˈkɒm.ə.di/	[kuˈmiː.di]

89.	compressor	/kəmˈpres.ə^{r}/	[ˈkumb.ri.sir]
90.	computer	/kəmˈpjuː.tə^{r}/	[kumbˈjuː.tar]
91.	congress	/ˈkɒŋ.gres/	[ˈkung.ris]
92.	consul	/ˈkɒn.səl/	[ˈq̠ɑn.sˤɑl]
93.	container	/kənˈteɪ.nə^{r}/	[kanˈteː.nar]
94.	control	/kənˈtrəʊl/	[kuntˈroːl]
95.	corner	/ˈkɔː.nə^{r}/	[ˈkoːr.nar]
96.	Corona	/kəˈrəʊ.nə/	[kuˈroː.na]
97.	counter	/ˈkaʊn.tə^{r}/	[kaːˈwin.tar]
98.	coupon	/ˈkuː.pɒn/	[kuːˈboːn]
99.	cover	/ˈkʌv.ə^{r}/	[ˈka.far]
100.	cream	/kriːm/	[kreːm]
101.	credit	/ˈkred.ɪt/	[ˈkri.dit]
102.	cricket	/ˈkrɪk.ɪt/	[ˈkri.kit]
103.	Cruiser	/ˈkruː.zə^{r}/	[ˈkruː.zar]
104.	crystal	/ˈkrɪs.təl/	[krisˈtaːl]
105.	cup	/kʌp/	[kuːb]
106.	custard	/ˈkʌs.təd/	[ˈkas.tard]
107.	dabble	/ˈdæb.əl/	[ˈda.bal]
108.	December	/dɪ.ˈsem.bə^{r}/	[diˈsam.bar]
109.	deluxe	/dɪˈlʌks/	[diˈluks]
110.	derby	/ˈdɑː.bi/ UK /ˈdɜː.bi/ US	[ˈdeːr.bi]
111.	desk	/desk/	[disk]
112.	Dettol $^{\text{TM.}}$	/ˈde.tɒl/	[diˈtoːl]
113.	diesel	/ˈdiː.zəl/	[ˈdiː.zal]
114.	diet	/ˈdaɪ.ət/	[ˈdaː.jat]
115.	difference	/ˈdɪf.ər.əns/	[difˈrans]
116.	digital	/ˈdɪdʒ.ɪ.təl/	[ˈdi.dʒi.tal]
117.	dinosaur	/ˈdaɪ.nə.sɔː^{r}/	[di.naˈsˤoːr]
118.	disco	/ˈdɪs.kəʊ/	[ˈdis.ku]

119.	discount	/ˈdɪs.kaʊnt/	[dis.kaːˈwint]
120.	dish	/dɪʃ/	[diʃ]
121.	doctor	/ˈdɒk.təʳ/	[dukˈtoːr]
122.	Dodge ™.	/dɒdʒ/	[doːdʒ]
123.	dollar	/ˈdɒl.əʳ/	[duˈlaːr]
124.	doughnut	/ˈdəʊ.nʌt/	[doːˈnaːt]
125.	dozen	/ˈdʌz.ən/	[ˈdar.zan]
126.	drama	/ˈdrɑː.mə/	[ˈdraː.ma]
127.	drill	/drɪl/	[dreːl]
128.	drum	/drʌm/	[draːm]
129.	duplex	/ˈdʒuː.pleks/ UK /ˈduː.pleks/ US	[dubˈliks]
130.	eczema	/ˈek.sɪ.mə/	[ʔikˈziː.ma]
131.	electronic	/ˌel.ekˈtrɒn.ɪk/	[ʔi.lik.tiˈroː.ni]
132.	enzyme	/ˈen.zaɪm/	[ʔinˈziːm]
133.	espresso	/esˈpres.əʊ/	[ʔi.sibˈris.su]
134.	Excel	/ɪkˈsel/	[ˈʔik.sil]
135.	Excess	/ɪkˈses/	[ˈʔik.sis]
136.	express	/ɪkˈspres/	[ʔikˈsib.ris]
137.	extra	/ˈek.strə/	[ʔiˈkist.ra]
138.	Facebook	/ˈfeɪs.bʊk/	[ˈfeːs.buk]
139.	fax	/fæks/	[faːks]
140.	filler	/ˈfɪl.əʳ/	[ˈfi.lar]
141.	film	/fɪlm/	[ˈfi.lim]
142.	filter	/ˈfɪl.təʳ/	[ˈfil.tar]
143.	flash	/flæʃ/	[flaːʃ]
144.	fluoride	/ˈflɔː.raɪd/	[floːˈraː.jad]
145.	folklore	/ˈfəʊk.lɔːʳ/	[fulˈkloːr]
146.	Ford ™.	/fɔːd/	[furd]
147.	format	/ˈfɔː.mæt/	[ˈfar.ma.tah]
148.	foul	/faʊl/	[ˈfaː.wil]

149.	free	/friː/	[fri]
150.	freezer	/ˈfriː.zə^r/	[ˈfriː.zar]
151.	Freon	/ˈfri.ɒn/	[firˈjuːn]
152.	full	/fʊl/	[ful]
153.	fuse	/fjuːz/	[fjuːz]
154.	gallon	/ˈgæl.ən/	[dʒaːˈluːn]
155.	gas	/gæs/	[gaːz]
156.	gateau	/ˈgæt.əʊ/	[gaˈtoːh/
157.	gear	/gɪə^r/	[geːr]
158.	gel	/dʒel/	[dʒil]
159.	gelatin	/ˈdʒe.lə.tiːn/	[dʒi.laˈtiːn]
160.	gene	/dʒiːn/	[dʒiːn]
161.	General ™.	/ˈdʒen.ər.əl/	[dʒi.niˈraːl]
162.	gentle	/ˈdʒen.təl/	[ˈdʒin.til]
163.	glucose	/ˈgluː.kəʊs/	[ˈdʒluː.koːz]
164.	goal	/gəʊl/	[goːl]
165.	golf	/gɒlf/	[gulf]
166.	Google	/ˈguː.gəl/	[ˈgoː.gil]
167.	gorilla	/gəˈrɪl.ə/	[ʁuˈril.la]
168.	gram	/græm/	[graːm]
169.	group	/gruːp/	[gruːb]
170.	guava	/ˈgwɑː.və/	[dʒaˈwaː.fah]
171.	guitar	/gɪˈtɑː^r/	[giˈtaːr]
172.	hamburger	/ˈhæm.bɜː.gə^r/	[hamˈbur.gir]
173.	handle	/ˈhæn.dəl/	[ˈhan.dal]
174.	hanger	/ˈhæŋ.ə^r/	[ˈhan.gar]
175.	hashtag	/ˈhæʃ.tæg/	[haʃˈtaːg]
176.	helicopter	/ˈhel.ɪ.kɒp.tə^r/	[hi.liˈkub.tar]
177.	heroin	/ˈher.əʊ.ɪn/	[hirˈwiːn]
178.	hook	/hʊk/	[huːk]
179.	hormone	/ˈhɔː.məʊn/	[hurˈmoːn]

180.	Hummer ™.	/ˈhʌm.əʳ/	[ˈha.mar]
181.	hydrogen	/ˈhaɪ.drə.dʒən/	[hid.ruˈdʒiːn]
182.	hysteria	/hɪˈstɪə.ri.ə/	[hisˈtiːr.ja]
183.	inch	/ɪntʃ/	[ʔinʃ]
184.	Instagram ™.	/ˈɪn.stə.græm/	[ʔins.tigˈraːm]
185.	insulin	/ˈɪn.sjə.lɪn/	[ʔin.suˈliːn]
186.	internet	/ˈɪn.tə.net/	[ʔinˈtar.nit]
187.	interpol	/ˈɪn.tə.pɒl/	[ʔin.tarˈboːl]
188.	jacket	/ˈdʒæk.ɪt/	[dʒaˈkeːt]
189.	jacuzzi	/dʒəˈkuː.zi/	[dʒaˈkuː.zi]
190.	jeans	/dʒiːnz/	[dʒinz]
191.	Jeep	/dʒiːp/	[dʒeːb]
192.	jelly	/ˈdʒel.i/	[ˈdʒi.li]
193.	joker	/ˈdəʊ.kəʳ/ UK /ˈdʒəʊ.kɚ/ US	[ˈdʒoː.kar]
194.	judo	/ˈdʒuː.dəʊ/	[ˈdʒuː.du]
195.	jumbo	/ˈdʒʌm.bəʊ/	[ˈdʒam.bu]
196.	Kalashnikov ™.	/kəˈlæʃ.nɪ.kɒf/	[kla.ʃinˈkoːf]
197.	ketchup	/ˈketʃ.ʌp/	[ˈkat.ʃab]
198.	kilo	/ˈkiː.ləʊ/	[ˈkiː.lu]
199.	kiwi	/ˈkiː.wiː/	[ˈkiː.wi]
200.	lamp	/læmp/	[ˈlam.bah]
201.	laptop	/ˈlæp.tɒp/	[ˈlaːb.tub]
202.	large	/lɑːdʒ/	[laːrdʒ]
203.	laser	/ˈleɪ.zəʳ/	[ˈleː.zar]
204.	latte	/ˈlæt.eɪ/	[laˈteːh]
205.	lemon	/ˈlem.ən/	[liˈmuːn]
206.	lift	/lɪft/	[lift]
207.	limousine	/lɪm.əˈziːn/	[li.muˈziːn]
208.	liter	/ˈliː.təʳ/	[ˈli.tir]
209.	lobby	/ˈlɒb.i/	/ˈluː.bi/

210.	lotion	/ˈləʊ.ʃən/	[ˈloː.ʃan]
211.	madam	/ˈmæd.əm/	[maˈdaːm]
212.	maestro	/ˈmaɪ.strəʊ/	[maːˈjist.ru]
213.	mafia	/ˈmæf.i.ə/	[ˈmaːf.ja]
214.	make-up	/ˈmeɪk.ʌp/	[ˈmeː.kab]
215.	mall	/mɔːl/	[moːl]
216.	mango	/ˈmæŋ.gəʊ/	[ˈman.ga]
217.	manicure	/ˈmæn.ɪ.kjʊə^r/	[ma.naˈkiːr]
218.	marathon	/ˈmær.ə.θən/	[ma.raˈθoːn]
219.	Marina	/məˈriː.nə/	[maˈriː.na]
220.	market	/ˈmɑː.kɪt/	[ˈmaːr.kit]
221.	mascara	/mæsˈkɑː.rə/	[ˈmas.ka.rah]
222.	massage	/ˈmæs.ɑːʒ/	[maˈsaːdʒ]
223.	mauve	/məʊv/	[moːf]
224.	melamine	/ˈme.lə.miːn/	[mi.laˈmiːn]
225.	menu	/ˈmen.juː/	[ˈmin.ju]
226.	Messenger ™.	/ˈmes.ɪn.dʒə^r/	[maˈsin.dʒar]
227.	meter	/ˈmiː.tə^r/	[ˈmi.tir]
228.	metro	/ˈmet.rəʊ/	[ˈmit.ru]
229.	microphone	/ˈmaɪ.krə.fəʊn/	[mik.ruˈfoːn]
230.	microwave	/ˈmaɪ.krə.weɪv/	[mik.ruˈweːf]
231.	mile	/maɪl/	[miːl]
232.	militia	/mɪˈlɪʃ.ə/	[miˈliːʃ.ja]
233.	milkshake	/ˈmɪlk.ʃeɪk/	[milkˈʃeːk]
234.	million	/ˈmɪl.jən/	[milˈjuːn]
235.	millionaire	/mɪl.jəˈneə^r/	[mil.juˈneːr]
236.	Monopoly	/məˈnɒp.əl.i/	[mu.nuˈboː.li]
237.	montage	/ˈmɒn.tɑːʒ/	[munˈtaːdʒ]
238.	motor	/ˈməʊ.tə^r/	[ˈmoː.tar]
239.	movie	/ˈmuː.vi/	[ˈmuː.fi]
240.	Nescafé	/ˈnes.kə.feɪ/	[nis.kaˈfeːh]

241.	net	/net/	[nit]
242.	nicotine	/ˈnɪk.ə.tiːn/	[ni.kuˈtiːn]
243.	nitrogen	/ˈnaɪ.trə.dʒən/	[nit.ruˈdʒiːn]
244.	Nobel	/nəʊˈbel/	[ˈnoː.bil]
245.	nylon	/ˈnaɪ.lɒn/	[ˈnaːj.lun]
246.	offside	/ɒfˈsaɪd/ UK /ɑːfˈsaɪd/ US	[ʔufˈsˤɑː.jad]
247.	Orbit TM.	/ˈɔː.bɪt/	[ˈʔoːr.bit]
248.	Oscar	/ˈɒs.kəʳ/	[ʔusˈkaːr]
249.	out	/aʊt/	[ˈʔaː.wit]
250.	over	/ˈəʊ.vəʳ/	[ˈʔoː.far]
251.	overtime	/ˈəʊ.və.taɪm/	[ʔoː.farˈtaː.jam]
252.	oxygen	/ˈɒk.sɪ.dʒən/	[ʔuk.siˈdʒiːn]
253.	ozone	/ˈəʊ.zəʊn/	[ʔoːˈzoːn]
254.	Pager	/ˈpeɪ.dʒəʳ/	[ˈbeː.dʒar]
255.	pajama	/pəˈdʒɑː.mə/	[baˈdʒaː.mah]
256.	Pampers TM.	/ˈpæm.pəz/	[bamˈbirz]
257.	pancake	/ˈpæn.keɪk/	[banˈkeːk]
258.	pancreas	/ˈpæŋ.kri.əs/	[ban.kirˈjaːs]
259.	panda	/ˈpæn.də/	[ˈbaːn.da]
260.	panorama	/pæn.ərˈɑː.mə/	[ba.nuˈraː.ma]
261.	parachute	/ˈpær.ə.ʃuːt/	[ba.raˈʃoːt]
262.	party	/ˈpɑː.ti/	[ˈbaːr.ti]
263.	Patriot	/ˈpæt.ri.ət/	[ba.tirˈjoːt]
264.	pedicure	/ˈped.ɪ.kjʊəʳ/	[budiˈkiːr]
265.	penalty	/ˈpen.əl.ti/	[baˈlan.ti]
266.	pentagon	/ˈpen.tə.gən/	[bin.taˈgoːn]
267.	Pepsi	/ˈpep.si/	[ˈbib.si]
268.	petrol	/ˈpet.rəl/	[bit.ˈroːl]
269.	phobia	/ˈfəʊ.bi.ə/	[ˈfoːb.ja]
270.	Photoshop	/ˈfəʊ.təʊ.ʃɒp/	[foːˈtoː. ʃub]

271.	piano	/piˈæn.əʊ/	[ˈbjaː.nu]
272.	Pick up	/ˈpɪk.ʌp/	[ˈbi.kab]
273.	pixel	/ˈpɪk.səl/	[ˈbik.sil]
274.	plasma	/ˈplæz.mə/	[ˈblaːz.ma]
275.	plastic	/ˈplæs.tɪk/	[blasˈtiːk]
276.	platinum	/ˈplæt.ɪ.nəm/	[bla.ˈtiːn.jum]
277.	playstation	/ˈpleɪ.steɪ.ʃən/	[blis.ˈteː.ʃan]
278.	plus	/plʌs/	[blɑsˤ]
279.	pocket	/ˈpɑk.ɪt/	[ˈba.kat]
280.	police	/pə.ˈliːs/	[bu.ˈliːs]
281.	porcelain	/ˈpɔː.səl.ɪn/	[boːr.saˈlaːn]
282.	pound	/paʊnd/	[baːˈwind]
283.	prestige	/presˈtiːʒ/	[brisˈtiːdʒ]
284.	print	/prɪnt/	[brint]
285.	professor	/prəˈfes.ə^{r}/	[bru.fiˈsoːr]
286.	projector	/prə.ˈdʒek.tə^{r}/	[bru.ˈdʒik.tar]
287.	prostate	/ˈprɒs.teɪt/	[brusˈtaːt]
288.	protein	/ˈprəʊ.tiːn/	[broːˈtiːn]
289.	protocol	/ˈprəʊ.tə.kɒl/	[broː.tuˈkoːl]
290.	puncture	/ˈpʌŋk.tʃə^{r}/	[ˈban.ʃar]
291.	Pyrex ™.	/ˈpaɪ.reks/	[baːjˈriks]
292.	radar	/ˈreɪ.dɑː^{r}/	[ra.ˈdaːr]
293.	radiator	/ˈreɪ.di.eɪ.tə^{r}/	[raˈdeː.tar]
294.	radio	/ˈreɪ.di.əʊ/	[ˈraː.du]
295.	rally	/ˈræl.i/	[ˈraː.li]
296.	receiver	/rɪˈsiː.və^{r}/	[riˈsiː.far]
297.	reception	/rɪˈsep.ʃən/	[riˈsib.ʃan]
298.	regime	/reɪˈʒiːm/	[riˈdʒiːm]
299.	remote	/rɪˈməʊt/	[riˈmoːt]
300.	rheumatism	/ˈruː.mə.tɪ.zəm/	[ruːˈma.ti.zim]
301.	robe	/rəʊb/	[roːb]

302.	romance	/rəʊˈmæns/	[roːˈman.si]
303.	rouge	/ruːʒ/	[roːdʒ]
304.	routine	/ruːˈtiːn/	[ruːˈtiːn]
305.	Safari	/səˈfɑː.ri/	[saˈfaː.ri]
306.	salmon	/ˈsæm.ən/	[sa.laˈmoːn]
307.	sandwich	/ˈsæn.wɪdʒ/ UK /ˈsæn.wɪtʃ/ US	[sandˈwitʃ]
308.	satellite	/ˈsæt.əl.aɪt/	[sa.taˈlaː.jit]
309.	sauce	/sɔːs/	[sˤoːsˤ]
310.	sauna	/ˈsɔː.nə/	[saːw.na]
311.	scanner	/ˈskæn.ə^r/	[ˈska.nar]
312.	scooter	/ˈskuː.tə^r/	[ˈskoː.tar]
313.	scrap	/skræp/	[sikˈraːb]
314.	Sedan TM.	/sɪˈdæn/	[siˈdaːn]
315.	semester	/sɪˈmes.tə^r/	[siˈmis.tar]
316.	sex	/seks/	[siks]
317.	shampoo	/ʃæm.ˈpuː/	[ˈʃam.bu]
318.	Shell TM.	/ʃel/	[ʃil]
319.	shift	/ʃɪft/	[ʃift]
320.	shoot	/ʃuːt/	[ʃuːt]
321.	short	/ʃɔːt/	[ʃurt]
322.	silicon	/ˈsɪl.ɪ.kən/	[ˈsi.li.kun]
323.	silk	/sɪlk/	[silk]
324.	slender	/ˈslen.də^r/	[ˈslin.dar]
325.	Snapchat TM.	/ˈsnæp.tʃæt/	[snaːbˈʃaːt]
326.	sodium	/ˈsəʊ.di.əm/	[ˈsˤoːd.jum]
327.	sonar	/ˈsəʊ.nɑː^r/	[soːˈnaːr]
328.	soya	/ˈsɔɪ.ə/	[ˈsˤoː.ja]
329.	spaghetti	/spəˈget.i/	[sbaˈgit.ti]
330.	spare	/speə^r/	[speːr]
331.	speaker	/ˈspiː.kə^r/	[ˈsbiː.kar]

332.	spicy	/ˈspaɪ.si/	[ˈspaːj.si]
333.	spiky	/ˈspaɪ.ki/	[ˈsbaːj.ki]
334.	Splash ™.	/splæʃ/	[ˈsib.laːʃ]
335.	sport	/spɔːt/	[spoːrt]
336.	spring	/sprɪŋ/	[sib.ˈring]
337.	sprint	/sprɪnt/	[sib.ˈrint]
338.	standard	/ˈstæn.dəd/	[ˈstaːn.dar]
339.	steak	/steɪk/	[steːk]
340.	stereo	/ˈster.i.əʊ/	[ʔis.ˈtir.ju]
341.	sticker	/ˈstɪk.əʳ/	[ˈsti.kar]
342.	studio	/ˈstjuː.di.əʊ/	[ʔisˈtid.ju]
343.	style	/staɪl/	[ˈstaː.jal]
344.	subway	/ˈsʌb.weɪ/	[sˤɑb.weː]
345.	suite	/swiːt/	[swiːt]
346.	super	/ˈsuː.pəʳ/	[ˈsuː.bar]
347.	Superman	/ˈsuː.pə.mæn/	[suː.barˈmaːn]
348.	supermarket	/ˈsuː.pə.mɑː.kɪt/	[suː.bar.ˈmaːr.kit]
349.	switch	/swɪtʃ/	[switʃ] [swiːʦ]
350.	system	/ˈsɪs.təm/	[ˈsis.tim]
351.	tactic	/ˈtæk.tɪk/	[takˈtiːk]
352.	tank	/tæŋk/	[ˈtaːn.ki]
353.	taxi	/ˈtæk.si/	[ˈtak.si]
354.	telephone	/ˈtel.ɪ.fəʊn/	[ti.li.ˈfoːn]
355.	telescope	/ˈtel.ɪ.skəʊp/	[ti.lis.ˈkoːb]
356.	tennis	/ˈten.ɪs/	[ˈti.nis]
357.	term	/tɜːm/	[tirm]
358.	theme	/θiːm/	[θiːm]
359.	thermometer	/θəˈmɒm.ɪ.təʳ/	[tir.mu.ˈmi.tir]
360.	thermos	/ˈθɜː.məs/	[ˈtir.mis]
361.	toast	/təʊst/	[tust]

362.	toffee	/ˈtɒf.i/	[ˈtuː.fi]
363.	ton	/tʌn/	[tˤɑn]
364.	trailer	/ˈtreɪ.ləʳ/	[ˈtreː.lah]
365.	transit	/ˈtræn.zɪt/	[tranˈzeːt]
366.	trend	/trend/	[trind]
367.	trillion	/ˈtrɪl.jən/	[ti.rilˈjoːn]
368.	tsunami	/tsuːˈnɑː.mi/	[tsuːˈnaː.mi]
369.	tubeless	/ˈtuːb.les/	[ˈtuːb.lis]
370.	Tulip TM.	/ˈtuː.lɪp/	[tuːˈliːb]
371.	tuna	/ˈtuː.nə/	[ˈtuː.nah]
372.	turbo	/ˈtɜːbəʊ/	[ˈteːr.bu]
373.	Twitter	/ˈtwɪt.əʳ/	[ˈtwi.tar]
374.	valve	/vælv/	[balf]
375.	Van TM.	/væn/	[faːn]
376.	vanilla	/və.ˈnɪl.ə/	[fa.ˈnil.ja]
377.	Vaseline TM.	/ˈvæs.ə.liːn/	[faːzˈliːn]
378.	Vatican	/ˈvæt.ɪ.kən/	[fa.tiˈkaːn]
379.	veto	/ˈviː.təʊ/	[ˈfiː.tu]
380.	video	/ˈvɪd.i.əʊ/	[ˈfid.ju]
381.	villa	/ˈvɪl.ə/	[ˈfil.lah]
382.	Virgin	/ˈvɜː.dʒɪn/	[ˈfeːr.dʒin]
383.	virus	/ˈvaɪə.rəs/	[faːjˈruːs]
384.	VISA	/ˈviː.zə/	[ˈfiːza]
385.	vitamin	/ˈvɪt.ə.mɪn/	[fi.ta.ˈmiːn]
386.	vodka	/ˈvɒd.kə/	[ˈfud.ka]
387.	volt	/vəʊlt/	[fult]
388.	wafer	/ˈweɪ.fəʳ/	[ˈweː.far]
389.	waffle	/ˈwɒf.əl/	[ˈwaː.fil]
390.	watt	/wɒt/	[wɑːtˤ]
391.	weekend	/wiːkˈend/	[wiːˈkind]
392.	whisky	/ˈwɪs.ki/	[ˈwis.ki]

393.	winch	/wɪntʃ/	[winʃ]
394.	wire	/waɪər/	[ˈwaː.jir]
395.	wireless	/ˈwaɪə.ləs/	[waːˈjar.lis]
396.	xenon	/ˈzen.ɒn/	[ˈzi.nun]
397.	yoga	/ˈjəʊ.gə/	[ˈjoː.ga]
398.	YouTube	/ˈjuː.tuːb/	[juːˈtuːb]
399.	zinc	/zɪŋk/	[zink]
400.	zoom	/zuːm/	[zuːm]