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MOHAMED BEN AHMED

FACULTY OF FOREIGN LANGUAGES

DEPARTMENT OF ENGLISH

Phonological Processes in Algerian Arabic as Spoken in Mostaganem: An Optimality Theory Perspective

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Candidate: RADIA BENYOUCEF

BOARD OF EXAMINERS:

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Dedication

I dedicate this work to my deceased mother and my most beloved father and brother. Their support and comprehension were the reason for keeping me going on with this work. I am, thus, lucky to have a family like mine. My dearest aunt also deserves a dedication as she has always tried to make up for my mother's absence and never hesitated to be there for me. To my friends Nariman Larbi and Faiza Hairech I also dedicate this work and wish to express my pride of having friends like them in my life.

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Abstract

The study at hand explores the phonological phenomena peculiar to the Algerian dialect that is spoken in Mostaganem and is known as MostaganeMARabic (MAR). Such phonological phenomena or else processes comprehend assimilation, metathesis, epenthesis, deletion and major class change. Given that these processes represent a fertile area for phonological analysis and theorizing, the present study aims at demonstrating that optimality theory (OT), an approach within the generative phonology tradition, provides an exhaustive and explanatory account of MAR's phonological processes. Furthermore, the present study aims at comparing between OT account of MAR's phonological processes and the account provided by its rule-based predecessor for the same set of processes. In order to materialize the aforementioned set of aims, a qualitative method has been adopted in the present study as a hundred native speakers of MAR pertaining to different gender, age and educational groups have been recorded. Recording sessions took place in various occasions and settings, including taxi, supermarket, beach, family gatherings, restaurant, neighbours' chat, hairdresser's chat. The speeches of the hundred participants were subjected to transcription in order to facilitate the identification of MAR's phonological processes. After the stage of process identification was completed, analysis and account of these processes followed, first from a rule-based perspective, then within an OT framework. Each account relied on different mechanics and principles of phonological description and representation. Effectively, the rule-based account was hinged on phonological rules and the dynamics of their notations and distinctive features. OT account, on the other hand, was grounded in the interaction and hierarchy of markedness and faithfulness constraints. OT account of MAR's processes proved to be more satisfactory and explanatory than the account provided by its rule-based counterpart as OT, unlike the rule-based approach, succeeded in explaining why a certain process occurs, but also why that specific process and not another takes place in a given case. Nevertheless, the relation between OT and its rule-based predecessor remains of a complementary nature since OT is meant to fill the pitfalls of the rule-based approach.

Keywords: Phonological processes, MAR, optimality theory, rule-based phonology, markedness constraints, faithfulness constraints, phonological rules.

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General Introduction

It is a common axiom among linguists and specialists in the field of language study that the realm of sounds involves a division of labour between two branches of linguistics, viz phonetics and phonology. Such a division of labour is traceable to the bilateral nature of human speech sounds which possess both a physical and abstract angle. The physical aspect of sounds is the concern of the branch of phonetics which attempts to establish the elements that are relevant to the articulation, transmission and perception of human speech sounds (Ladefoged and Johnson, 2005). Effectively, phonetics emphasizes those aspects of sounds that can be concretely observed by the linguist whether at the level of articulators, the sound waves or the human ear (Cruttenden, 2001). In retrospect, phonology is concerned with the other aspect of speech sounds, namely their abstract aspect. Indeed, phonology involves the study of the systems and patterns that underlie sounds make-up in a particular language (Hyman, 1979). Thus, phonology deals with the theoretical angle of speech sounds as it emphasizes the abstract sound or else the idea of a sound which is commonly referred to as the phoneme (Spencer, 1996). Phonemes are then sound abstractions that materialize in different forms depending on the system of sounds in a particular language, but also on the phonetic environment in which they occur. Such system may engender a variety of phenomena or else processes which are coined phonological processes.

Any language displays a set of sound phenomena that involve a change in the sounds' articulatory features, the insertion of certain sounds or their deletion among other sound phenomena. Such phenomena are commonly referred to as phonological processes or phonological alternations (Flynn, 2012). It is a tradition among phonologists to distinguish between two sorts of phonological processes across all languages of the world. Effectively, we may recognize a block of phonological processes that involve changing the articulatory feature(s) of a sound so that it becomes similar to an adjacent sound (McCarthy, 2003). Such sort of phonological processes is dubbed assimilatory processes or assimilation. As to the other sort of phonological processes, it includes inserting, deleting sounds, interchanging sound order or major class affiliation. This type of processes is attributed the label non-assimilatory processes which is a label that englobes all processes that do not involve a feature change for agreement with a neighbouring sound (Schane, 1973). We shall look into assimilatory processes in more details in the subsequent section.

Assimilatory processes occur when a sound changes its articulatory featutre(s) in order to become similar to another sound in its vicinity (McCarthy, 2003). Assimilation often occurs in one of two directions, namely a progressive or regressive. Progressive assimilation takes place when a sound assimilates to a preceding sound. Instances of progressive assimilation include changing the /z/ in /kæt-z/ so that it agrees with the preceding /t/ in terms of voicing, thus resulting in [kæts]. As to regressive assimilation, it occurs when a sound assimilates to a following sound. Examples of regressive assimilation comprehend the case of /ɪn-ɡreɪv/ in which the /n/ changes to /ŋ/ in order to be similar to the following /g/ in terms of place.

In addition to the directions of assimilation, assimilatory processes can be classified to a number of categories. Four categories of assimilation may be distinguished, depending on the major class affiliation of the target sound and the conditioning one. Thus, consonants may assimilate to vowels, vowels may assimilate to consonants, consonants may assimilate to other consonants and vowels may assimilate to other vowels. The subsequent sections introduce each category of assimilatory processes in details.

Vowel to consonant assimilation occurs when a vowel acquires a consonant feature in preparation for the articulation of a following consonant or in preservation of a preceding consonant's articulatory feature. Two types of vowel to consonant assimilation can be distinguished, namely nasalization and shortening (Sloat, 1978). We shall describe each type in what follows:

Nasalization occurs to a vowel when it is followed by a nasal consonant (Flynn, 1012). The vowel in this case acquires the secondary feature [nasal] in preparation for the following nasal articulation. Such a process is obtained by lowering the velum in order to block the oral cavity, and thus air escapes from the nasal cavities. The result is a nasalized vowel and instances of such a process include the assimilation of vowels like /æ/ to /n/ in American English words such as /hænd/, /pen/ which are respectively realized as [hæ̃nd], [pẽn] (Sloat, 1978, p. 113).

Shortening is another type of vowel to consonant assimilation which involves the reduction in the length or quantity of a long vowel or diphthong. Such reduction occurs when the consonant following the vowel is voiceless. Indeed, shortening results in the reduction of time duration for vocal cords vibration in anticipation for the following voiceless consonant (Spencer, 1996). Instances of shortening are exhibited in languages like English in which a long vowel such as /i:/ in /bi:t/ 'beat' is shortened because of the following voiceless /t/ (Spencer, 1996, p.67).

Consonant to vowel assimilation, on the other hand, involves the reverse case if compared to the previous class of assimilation, viz vowel to consonant assimilation. As the label of this category of assimilation indicates, consonant to vowel assimilation includes the acquisition of a secondary articulatory feature by a consonant in anticipation for the articulation of the following vowel. Two types of consonant to vowel assimilation can be distinguished, namely palatalization and labialization (Katamba, 1993).

Palatalization occurs when non-palatal consonants such as /k,g/ in English acquire a palatal articulation or else the back of the tongue is sent forward in the production of such consonants. Palatalization is often observed when consonants like /k,g/ precede a front vowel. As a result /k,g/ acquire a front or palatal-like articulation (Katamba, 1989). Instances of palatalization are found in English in words like key /ki:/ , give /giv/, get /get/ which are realized as [k^{j}i:], [g^{j}Iv], [g^{j}et]. In these instances the front vowels /I, i:, e/ bring about the palatalization or fronting of /k, g/ (Katamba, 1993, p. 86).

Palatalization also occurs when a non-palatal consonant is followed by the palatal glide /j/ in casual and fast speech in English. Such a case of assimilation affects the alveolar fricatives /s/ and /z/ which are realized as the alveo-palatal fricatives /ʃ, ʒ/ in case the palatal glide follows them (McCarthy, 2003). Instances of this case of palatalization are included in words like /mis ju:/ ‘miss you’, /lʌvz ju:/ ‘loves you’ which are realized as [miʃ ju:], [lʌvʒ ju:]. This case of palatalization also occurs when the alveo-palatal /ʃ/ follows /s, z/ at word boundaries. Examples include ‘his shoes’ /hIz ʃu:z/, ‘nice shirt’ /naIs ʃɜ:t/ which are respectively realzed as [hIʒʃu:z] and [naIʃʃɜ:t] (katamba, 1993, p.86).

Labialization is another type of consonant to vowel assimilation which occurs when a consonant is followed by a rounded vowel such as /u:/, /ʊ/, /ɔ:/, /ɒ/. As a result, the consonant is produced with rounded lips in preparation for the following rounded articulation. Labialization is observed in English in instances such as /pu:l/ ‘pool’, /tu:l/ ‘tool’, /ʃu:/ ‘shoe’, /lʊk/ ‘look’, /gɒt/ ‘got’ which are respectively realized as [p^{w}u:l], [t^{w}u:l], [ʃ^{w}u:], [l^{w}ʊk], [g^{w}ɒt] (Katamba, 1993, p.87).

Consonant to consonant assimilation involves the change of a consonant’s articulatory feature(s) so that it agrees with another consonant in its vicinity (McCarthy, 2003). Three types of consonant to consonant assimilation may be described, depending on the articulatory feature that is changed. Such types include voice assimilation, place assimilation and manner assimilation. A fourth type of consonant to consonant assimilation may also be distinguished, namely total assimilation which involves a change in voicing and manner specifications, place being similar for both consonants.

Voice assimilation takes place when a consonant changes its voicing feature so that it agrees with a preceding or following consonant. Instances of voice assimilation may be observed in English at word boundaries in cases where words having two obstruents with unpaired voicing specification occur adjacently. The examples ‘five past’ /faIv pa:st/, ‘love to’ /lʌv tə/, ‘has to’ /hæz tə/, ‘loathe to’ /ləʊð tə/ in which the obstruents /v, p/, /v, t/, /z, t/, /v, t/ and /ð, t/, which are different in terms of their voicing specification and occur abuttingly, involve a change in the voicing specification of the voiced obstruents so that they agree with the following voiceless obstruents. The outcomes of such assimilation include [faI**f** pa:st], [lʌ**f** tə], [hæs tə], [ləʊθ tə] (Spencer, 1996, p. 46).

Another type of consonant to consonant assimilation is place assimilation which involves a change in the place feature of a consonant so that it agrees with an adjacent consonant. Such a type of assimilation is often observed for the nasal alveolar /n/ which changes its place in case a non-alveolar consonant follows it. The label nasal homorganic assimilation is attributed to this case of place assimilation which is manifested in English in instances like ‘implausible’ /In-plɒzibl/, ‘ingratitude’ /In-grætItju:d/ which are respectively realized as [Implɒzibl], [IŋgrætItju:d] (katamba, 1993, p.90). The nasal /n/ changes to the bilabial /m/ in order to agree with the following /p/ in implausible and to /ŋ/ to agree with the following /g/ in ingratitude.

Place assimilation is also observed in some dialects of the Arabic language including Classical Arabic (CA). Indeed, in CA /n/ changes its place feature from alveolar nasal to a bilabial nasal when the bilabial /b/ follows it in words such as /ʔanba:ʔ/ ‘news’, /sami:ʕun basi:r/ ‘hears and sees everything’, yielding [ʔamba:ʔ], [sami:ʕum basi:r] (Alfozan, 1989, p.104).

Manner assimilation takes place when a consonant changes its manner feature so as to be similar to another consonant in its vicinity. Instances of manner assimilation include the assimilation of /n/ of the prefix ‘in-’ in English when the following consonant is a liquid like /l, r/. In such a case, voicing and place being similar, /n/ changes its manner from nasal to liquid in order to agree with the following /l, r/ . Words illustrating such a process include /In-lIgl/’illegal’ →[IllIgl], /In-ræʃnl/ ‘irrational’ →[Irræʃnl] (Katamba, 1993, p91).

In case all features are assimilated so that a consonant becomes identical to the neighbouring one, assimilation is total. Total assimilation is observed in languages such as Modern Standard Arabic (MSA). In MSA, /l/ of the definite article /ʔal/ ‘the’ changes its voicing and manner features in order to totally agree with the initial consonant of the word that /ʔal/ defines. Instances of MSA total assimilation include /ʔal ʃams/ ‘the sun’ which is realized as [ʔaʃʃams]. Hence, /l/ changes its voicing and manner in this case from voiced to voiceless and from lateral to fricative in order to totally agree with the following /ʃ/ (Masacro, 2007, p. 724).

Another class of assimilation includes vowel to vowel assimilation or vowel harmony which is a long-distance assimilation as it occurs between vowels across an intervening consonant. Unlike the aforementioned types of assimilatory processes, this type is not a local assimilation. Vowel harmony is observed in different languages including Spanish and Californian Indian languages (McCarthy, 2003, p.321). Other languages such as Turkish also display vowel harmony when the possessive suffix '-im'is added to words that include a back vowel such as /goz-im/ 'my eye', /gul-im/ 'my rose', /kol-im/ 'my arm', /gonul-im/ 'my heart'. As a result, the front vowel of the suffix '-im' is changed to the back vowel /u/ in order to agree with the roots' back vowels, namely /o, u/. The resulting outcomes are [gozum], [gulum], [kolum], [gonulum] (Schane, 1973, p. 52).

After having described and introduced assimilatory processes, it is now worth turning to non-assimilatory processes. Non-assimilatory processes involve metathesis, epenthesis, deletion and major class change among other processes, but for the present study only the four mentioned types are of relevance and concern.

Non-assimilatory processes, on the other hand, include Metathesis, epenthesis, deletion and major class change. Metathesis involves the inversion in the order of sounds for phonological purposes. Instances of metathesis go back to historical change in English as Modern English order of sounds such as /rd/, /or/ used to be inverted in Old English. Hence, Words such as frost, horse and bird used to be realized as forst, hrose, brid in Old English (Spencer, 1996, p.68).

Catalan also displays a case of metathesis when the present forms, called actual in Catalan, are derived from future forms, called non-actual in Catalan. Such derivation results in the inversion of the order of a consonant and the vowel that follows it such as /tʃkut/ 'shoot' →[tʃukt], /xtʃit/ 'scratch' →[xiʃt] (Sloat, 1978, p.119).

Epenthesis is another non-assimilatory process, also dubbed insertion, which involves the insertion of a sound, either consonant or vowel, for some phonological purposes. Epenthesis may be observed in different languages including Walsier German, a dialect of German, in which the vowel /a/ is inserted at the beginning of words that start with /r/ as in /rad/ ‘wheel’, yielding [arad] (Hall, 2011, p.957).

English also exhibits a case of consonant assimilation in post-lexical position. Indeed, the consonant /r/ is inserted in English when two vowels occur in a sequence post-lexically as in /lɔ: Iz/ ‘law is’which is realized as [lɔ:r Iz] (Uffman, 2007, p.465). /r/ epenthesis occurs in this case in order to break the vowel sequence /ɔ: I/.

Deletion or syncope is the omition of a sound, consonant or vowel, for some phonological aim. Deletion occurs in different languages, comprehending Catalan and Sranan, an English creole. In Sranan, a consonant is deleted when it occurs in a tri-consonantal cluster such as /stranga/ ‘strong’ in which the consonant /s/ is deleted, yielding [tranga] to avoid the tri-consonantal cluster /str/ (Alber and Plag, 1999, p.16). Catalan also includes a case of consonant deletion, namely /t/ which is deleted at the end of Catalan words such as /klˈar/ ‘clear’ which is realized as [klˈa] (Kikuchi, 2004, p.2).

Such non-assimilatory process takes place when a sound changes its major class membership from vowel to consonant or vice versa. Major class change is observed in languages such as French and Spanish. In French, an unstressed vowel is turned to a glide when another stressed vowel follows it as /tˈu/ ‘you kill’→[twˈe] ‘to kill’ (Schane, 1973, p.56). As to Spanish, the vowel /i/ is changed to the glide / j/ when the possessive /mi/ ‘my’ is added to a word that starts with a vowel such as /mi ultima/ ‘my last’ which is realized as [mjultima] (Nevins and Chitoran, 2008, p.1987).

The afore described phonological processes seem to occur for a variety of phonological purposes. Given that the role of phonological theory is to explain and provide a formal description of such sound phenomena, the present work will attempt to expose one such theoretical attempt to describe and explain phonological processes. Such a theory is the theory of generative phonology as introduced by Noam Chomsky in the 1950's. The approach of generative phonology which is applied in the study at hand is optimality theory (henceforth OT). However, for comparison's sake a rule-based approach is provided in parallel. The data of the study are taken from a dialect of Algerian Arabic known as MostaganeMARabic (MAR). Such a dialect has rarely been approached from a generative phonology perspective, let alone an optimality theory perspective.

As previously indicated phonological processes can be observed in any language regardless of its historical roots or phonological make-up. Hence, assimilatory processes may be displayed in languages as different and unrelated as Turkish is from English, while non-assimilatory processes are to be found in such different languages as Catalan is from German. This implies that there must be some common general principles that affect the sound patterns of languages and determining these general principles will reveal a lot regarding the recurrence of phonological processes across the languages of the world. Generative phonology is the phonological theory that aims at identifying such general sound principles and providing the analytical tools to describe and explain the phonological processes that result from such general principles in any language. This leads one to wonder if generative phonology may provide analytical tools or else approaches that could account for phonological processes in the Algerian dialect spoken in Mostaganem and known as MostaganeMARabic (henceforth MAR). Thus, the following set of questions are set for the study at hand:

1. Is generative phonology a suitable theory for tackling MAR's phonological processes?

2. Does rule-based phonology succed in accounting for phonological Processes of MAR?

3. Does OT succeed in accounting for MAR’s phonological processes?

4. Which of rule-based and OT accounts is more plausible and reliable than the other?

The above research questions lead to the formulation of the subsequent hypotheses:

1. Generative phonology includes the necessary theoretical and analytical elements that help tackle MAR’s phonological processes.

2. Rule-based phonology succeeds in accounting for some not all processes of MAR.

3. OT succeeds in accounting for all phonological processes of MAR.

4. OT stands in a complementary relation with its rule-based predecessor so that OT is there to fill the pitfalls of rule-based analysis.

The present study aims at highlighting the phonological disclosures that may result from a generative phonology outlook of MAR’s phonological processes. Indeed, the study at hand attempts to demonstrate that the theory of generative phonology purveys approaches that can account for MAR’s phonological processes. However, since more than one approach is attributed to the generative phonology tradition, the aim of this study is to explore the account of two of the most influential approaches of generative phonology, viz rule-based phonology and OT. Eventually, the present study aims at demonstrating that an OT account of MAR’s phonological processes is more explanatory and exhaustive than a rule-based account so that OT account would apply where rule-based phonology fails.

Even though the phenomenon of phonological processes is as old as the beginnings of phonological theory, the phonological processes of some dialects of Arabic are still full of mystery to phonological theorizing. Algerian Arabic and more exactly its Mostaganem spoken variety

(MAR) is one such dialect, for except few studies, no study has attempted a phonological approach of MAR's phonological processes. Besides, few studies have attempted to account for MAR's phonological processes using OT's machinery and theorizing. Thus, the significance of the present study lies in its application of OT in accounting for MAR's phonological processes and also in its attempt to demonstrate that such an account is more reliable and complements a rule-based account.

The present study comprehends five chapters each one of which representing a crucial step in the elaboration and validation of the aforementioned hypotheses and rationale. Thus, a theoretical background, a description of methodology as well as an analytical discussion constitute the study at hand.

The first chapter which is entitled 'Rule-based Phonology and SPE' introduces the approach of rule-based phonology as set in Chomsky's and Halle's (1968) referential book 'Sound Pattern of English (SPE)'. Hence, chapter one presents the machinery and basic components of rule-based phonology, thus providing the necessary insight into this approach in order to assure an understanding of its application in the analytical part of the work. As a result, chapter one provides a description of the theory of generative phonology as it is the theory from which rule-based phonology emerged. Then, chapter one presents the mechanics of rule-based phonology by introducing the element of phonological rules by describing their notational nature. The element of distinctive features is then introduced in chapter one as a crucial constituent of phonological rules. Then, a review of previous works which applied rule-based phonology in order to account for phonological processes in various languages is provided in chapter one. Finally, a number of analytical problems within the rule-based approach are highlighted, thus preparing the ground for OT.

The second chapter which is entitled ‘Optimality Theory’ provides a theoretical background relating to the approach of optimality theory. Thus, chapter two describes the machinery of OT, by introducing its major constituents and principles of analysis. Chapter two then reviews previous literature in which OT has been applied to account for a variety of phonological processes in different languages. Such a review proceeds in a thematic manner, describing OT account of non-assimilatory processes in different languages, then of assimilatory processes are tackled next.

The third chapter which is entitled ‘Scope and Methodology’ provides a description of the scope of the study as well as the methodology adopted in order to collect and analyze data. Hence, chapter three provides insight into the locale of the study in which MAR is spoken, namely Mostaganem. Then, chapter three describes the population of the study and the sample that has been selected for the present study. The methodology used for data collection and analysis is then presented. Finally, a classification of the phonological processes that have been identified for MAR is provided.

The fourth chapter which is entitled ‘Rule-based Account of Phonological Processes in MAR’ discusses and analyzes the findings of the study applying the rule-based approach. Thus, chapter four describes each type of MAR’s phonological processes using the notational system of rule-based phonology. Then, a discussion and analysis is provided for each rule-based account.

The fifth chapter which is entitled ‘OT-based Account of Phonological processes in MAR’ provides an OT account of phonological processes in MAR. Hence, each type of MAR’s phonological processes is described and explained using OT’s machinery so that a constraint-based analysis is set for each process type. Then, a formal tableau-based representation is provided for each phonological process. Finally, each tableau-based presentation is followed by an interpretation.

The study is closed by a conclusion that sums up and compares the accounts that each of rule-based phonology and OT provided. Then, it pinpoints the limitations of the study and provides some suggestions and recommendations for future research relating to the present study’s topic.

1.1. Generative Phonology

One of the most influential theories in the field of phonology is Generative phonology which is a constituent of a linguistic theory that is known as generative linguistics or grammar. It was set forth by the linguist Noam Chomsky around the 1950's and marked a shift in linguistic concerns from a modular description of language to a focus on the native speakers' knowledge about their mother tongue. Indeed, Chomsky (1966) pointed out the difference between what "the speaker of a language knows implicitly" and what "he does" (p.9). He coined the first element competence, and labeled the second performance. Additionally, Katamba (1993) defines competence and performance as "competence is a person's implicit knowledge of the rules of a language that makes the production and understanding of an indefinitely large number of new utterances possible, while performance is the actual use of language in real situations" (p.8). Hence, linguistic competence is the tacit knowledge that enables native speakers of a language to produce and understand an infinite number of sentences in their mother tongue. Furthermore, linguistic competence is the element that allows the native speakers of a language to understand sentences that they have not heard before. Performance, on the other hand, is the actualization of the knowledge that native speakers possess regarding their mother tongue.

According to Chomsky (1966, p.10), linguistic investigation should emphasize linguistic competence rather than performance. In other terms, linguistic study in generative linguistics should be concerned with investigating the nature and constituents of linguistic competence. Indeed, generative linguistics attempts to determine the different rules, mechanisms, and principles that make up linguistic competence. Such rules and principles include the syntactic, semantic and the phonological rules. Syntactic rules provide a description of a sentence (SD's) by deriving its deep structure which is the underlying form of a sentence and its surface structure which is the apparent form of a sentence. Semantic rules provide a semantic or meaning interpretation of a sentence. Phonological rules provide a phonetic interpretation of the sentence. As indicated by Chomsky (1966, p. 16)

> A grammar must, then, consist of three components: a syntactic component which generates SD's each of which consists of surface structure and deep structure; a semantic component which assigns a semantic interpretation to a deep structure; a phonological component, which assigns a phonetic interpretation to a surface structure. Thus the grammar as a whole will associate phonetic representations and semantic interpretations, as required, this association being mediated by the syntactic component that generates deep and surface structures and elements of SD's.

As indicated above, phonological rules are concerned with the phonological aspect of linguistic competence or the rules and mechanisms that underlie phonological phenomena. Such aspect of linguistic competence is the province of generative phonology. This theory has its roots in the *Sound Pattern of English* (SPE) which was put forward by Chomsky and Halle in 1968 at the Massachusetts Institute of Technology (Clark, Yallop and Fletcher 2007, p. 209). Generative phonology is acclaimed for the formalism that it brought to phonological analysis. As indicated in Clark et al (2007, p. 129):

> The Sound Pattern of English (SPE) (1968) begins with a theoretical foundation, arguing that a grammar is a system of rules that relate sound and meaning. There are several components of such a grammar including a phonological component which relates grammatical structures (i.e. grammatically organized strings of morphemes) to their phonetic representations. The heart of SPE deals with how such a component of English grammar can be formally expressed.

As it was formerly alluded to phonologists within the generative tradition were interested in the innate knowledge that native speakers of a given languages possess regarding sound behaviour and phenomena. Indeed, their ultimate aim was to develop certain theoretical machinery that would formally represent or render explicit that kind of knowledge. Such an aim was achieved through the elaboration of a number of phonological approaches within the generative theory. Rule-based phonology or linear phonology was amongst the first approaches that were developed in order to represent phonological knowledge. Furthermore, such an approach was the first to ever attempt to account for phonological processes via its formal representation of phonological knowledge or what Chomsky (1950) referred to as competence. The subsequent sections provide an overview about the rule-based approach and reviews some of the studies in which this approach was applied to account for phonological processes.

1.2. Rule-based Phonology

Amongst the first approaches within the generative tradition to ever attempt to account for phonological processes was known as rule-based phonology or linear phonology. Rule- based phonology or linear phonology is an approach that developed from the generative theory of phonology and drew its major tenets from Chomsky's and Halle's *Sound Pattern of English SPE* (1968). Central to the rule-based approach is the notion of 'rule'. A rule is a formal and economical representation of the knowledge that native speakers have concerning the sound pattern of their mother tongue. As stated by Kenstowicz (1979, p.4) "…the plausibility of a rule is reflected in the relative simplicity of its statement. Concern for simplicity and formal statement became a cornerstone of the generative approach". Thus, rule-base phonology utilized rules as the mechanism that would describe and explain phonological processes. Chomsky (1965, p.16) views a phonological rule as a notation that provides the phonetic representation for an utterance. In other terms, phonological rules are the machinery that the phonological component of the grammar uses to derive the phonetic representation of the surface structure of an utterance that is generated by the syntactic component of the grammar. Phonological rules, then, consist of symbols which represent segments and their environment. More precisely, a rule encompasses a form before it undergoes a phonological process, the form that results from the phonological process and the environment that conditions that process. The existence of two forms, namely one which precedes the application of the phonological process and another that results from it, implies the existence of two levels of representation in phonological rules. The first level is the underlying representation or input which is the form that precedes the application of the phonological process. The second level of representation is called the surface representation or the output and refers to the form that results from a phonological process. To recapitulate, phonological rules include the underlying representation or input, the surface representation or output and the environment that conditions the phonological process.

An instance of a rue-based account of a phonological process can be observed in Kenstowicz and Kisseberth (1979, p.34) which includes an instance of vowel lengthening in English. The rule that accounts for this process is formulated as follows:

(1) [vowel]→[long]/_____[cons]
[voiced]

Rule (1) implies that a vowel is lengthened when it is followed by a voiced consonant in English. In this rule, [vowel] represents the underlying representation, [long] represents the surface representation, the arrow (→) stands for the mapping or change from input to output, while the slash (/) and what follows it represent the conditioning environment.

1.2.1. Distinctive Features Theory

As they set forth their *SPE*, Chomsky and Halle (1968) aimed at developing a system of notation that would capture the generality of phonological processes. Thus, instead of including a single case of phonological processes, a rule should be formulated in such a manner that would represent all similar cases to which that phonological process may apply. In order to achieve that aim, sounds were cut into their constituent distinctive features, and rules include, henceforth, bundles of distinctive features rather than blocks of individual sounds (Kenstowicz and Kisseberth 1979, p.34).

The concept of distinctive features was launched within Prague School phonology which regarded distinctive features as the means that highlights phonological contrast. Indded, distinctive features were the kernel of phonological theory and analysis during that period. Being regarded as the pionneers of Prague School phonology, Trubetzkoy (1939) and Jakobson, Fant and Halle et al (1952) were the first scholars to introduce the concept of distinctive features. As they are defined in Katamba (1989), distinctive features refer to a set of phonological characteristics that constitute a sound or a phoneme, and have as funtion that of distinguishing it from other sounds or phonemes. Indeed, such features tend to indicate the phonological contrast that exists between phonemes of the type /p/ and /b/. Such phonolgical contrast is at the roots of the semantic difference in word pairs or minimal pairs like /pa:k/ ‘park’ and /ba:k/ ‘bark’ which contrast only in one sound (p/b). According to Jakobson and his co-workers (1951), any sound can be broken down to a set of features that are based on phonetic correlates (mainly acoustic ones) and each feature is accompanied with a matrix or a value (+) or (-) which respectively indicate the presence or absence of that feature in a given sound (Katamba, 1989, p.42). Hence, all the distinctive features that were set forth by Jakobsonian theory were of a binary nature which implies that they had two values, namely a (+) or a (-) value.

In order to illustrate the distinctive function of distinctive features, one may make use of the feature [voiced] which refers to the vibrating state of the vocal cords. This feature distinguishes, and thus contrasts between sounds like /p/, /b/. Indeed, /p/ is voiceless as it involves no vibration of the vocal cords, thus it is [-voiced] while /b/ is voiced or it involves a vibration of the vocal cords, thus it is [+voiced].

In spite of the development that the Jakobsonian theory of distinctive features brought about in phonological analysis, it nevertheless possessed some pitfalls. Indeed, as indicated by Katamba (1989, p.42) the type of distinctive features that was introduced by Jakobson (1951) did not cover all the types of phonological contrasts that could be found in a given language. Some features such as [grave] which implied that "most of the acoustic energy used in its (the sound's) production is concentrated in the lower part of the spectrum" (Katamba 1989, p.42) treated sounds like the bilabial /p/ and the velar /k/ as the same while those sounds contrast in words like /pɔː/ 'pore', /kɔː/ 'core'. Hence, an opposition is missed by the Jakobsonian theory of distinctive features. In other terms, the features that Jakobson and his collaboraters introduced were not enough to demonstrate all the phonological oppositions that a language may exhibit.

Soon after launching their *SPE* in 1968, Chomsky and Halle realized the crucialty of having recourse to distinctive features. *SPE'*s distinctive features were mainly regarded as the most appropriate element that would render rule-based account of phonological processes economical and general. Indeed, in addition to their distinctive function, distinctive features also serve to group sounds into natural classes which are the target of a phonological process. If stated differently, phonological processes apply to sounds that share one or more distinctive features. Those sounds form what is known as a natural class which will be elucidated later in this chapter, but first it is pre-requisite to see the different types of distinctive features that were introduced by Chomsky and Halle (1968) and and how their distinctive features theory differed from the Jakobsonian one. In *SPE*, distinctive features were still regarded as binary in value (+or -), yet unlike the Jakobosonian features, SPE features had mainly articulatory correlates rather than just acoustic ones (Katamba 1989, p.42).

Chomsky and Halle (1968) sorted distinctive features into a number of categories. Each category yielded a specific distinction and classification of phonemes. The first category that they provided is the one between consonants, vowels and glides. The features that were comprised in such a category were dubbed major class features as they yield three major or else main distinctions of phonemes, namely true consonants, vowels and glides. The subsequent sub-section introduces this category of features.

1.2.1.1.Major Class Features

This sort of features consists of the feature [consonantal] which divides sounds into true consonants, glides and vowels (Spencer 1996, p.108). This feature refers to those sounds which are produced with contact between the articulators that are responsible for a sound's articulation. The contact could be partial as for fricatives /f, v, θ, ð, s, z, ʃ, ʒ, h/ or complete like with plosives (oral stops) /p, b, t, d, k, g, ʔ/, nasals (nasal stops) /m, n, ŋ/. The liquids /l, r/ also involve a contact between the tongue tip and either the alveolar ridge for /l/ or the rear part of the alveolar ridge for /r/. Hence, the feature [consonantal] includes the plosives, fricatives, nasals and liquids. As to affricates they are also [+consonantal] since their articulation involves a contact that starts as a complete contact for the plosive phase and then turns to a partial contact for the fricative phase such as /tʃ, dʒ/. In retrospect, vowels and glides /w, j/ are [-consonantal] since their articulation does not involve a contact between the articulators. Indeed, the articulation of /w/ involves a raising of the back of the tongue towards the velum, but there is no contact or touching between those articulators. Similarly, the articulation of /j/ involves a raising of the front of the tongue towards the hard palate, but there is no contact between those two articulators. Thus, glides are [-

consonantal] and so are all the vowels in any language since vowels are produced without contact between the articulators. In fact, for vowels' articulation, the parts of the tongue are raised towards, but do not contact the tongue roof (Hyman 1979, p.83-84). Hence, the feature [consonantal] provides two classes of sounds, viz [+consonantal] which includes plosives, fricatives, affricates, nasals and glides and [-consonantal] which includes glides and vowels.

The second major class feature that Chomsky and Halle (1968) introduced is [sonorant]. This feature involves the sounds that are articulated without blockage or obstruction of airstream. Indeed, the existence of a blockage or an obstruction, whether complete or partial, reduces the sonority or resonance of a given sound which makes it [-sonorant] (Spencer 1996, p.109). The feature [sonorant] divides sounds into sonorants [+sonorant] and obstruents [-sonorant]. Hence, nasals and liquids are considered as [+sonorant] since air escapes without blockage from the nasal cavities for nasals and from the rimes for liquids. Glides and vowels are also [+sonorant] since air escapes freely for both of them. However, stops, affricates and fricatives are considered as [-sonorant] since their articulation involves a blockage (Spencer, 1996).

The third major class feature that was introduced by Chomsky and Halle (1968) is the feature [syllabic]. This feature refers to the sounds that occur in nuclear position within the syllable. Given that in all languages only vowels can make up a syllable nucleus, vowels are the only sounds that are [+syllabic]. Glides can never be in nuclear position as they only occur in the margins of syllables. As in /jɔː/, /wɔː/. In those words, the vowel /ɔː/ is the nucleus and /j, w/ are the margins (Spencer, 1996, p.108). Hence, vowels are [+syllabic] while glides, liquids, nasals, fricatives, affricates and sops are [-syllabic].

In spite of the fact that major class features divide sounds to true consonants, glides and vowels and sort true consonants into sonorants and obstruents, another set of features is required to distinguish between members of the classes that distinctive features yielded. In other terms, other distinctive features are required to distinguish between consonants themselves and also between vowels themselves. In order to achieve such a kind of differentiaton, vowel features are required to distinguish between vowels and consonant features are necessary to distinguish consonants. Let us start with vowel features.

1.2.1.2.Vowel Features

Vowel features are defined as the features that relate to the body of the tongue and to the different positions that it takes. In addition, vowel features also relate to the shape of the lips. As indicated in Katamba (1989, p.45) and in Hyman (1979, p.84), SPE set a reference position or else a 'neutral' position for vowel features which is the position of the tongue when producing the vowel in 'bed' /b**e**d/ in English. Such a position refers to the front mid position of the tongue. Hence, as pointed out by Katamba (1989, p.45) "other tongue configurations are regarded as departures from that norm". "Departure" from such a position as put by Katamba (1989) provides two vowel features, namely [back] and [high]. The feature [back] refers to any vowel that is produced in a part of the tongue other than the neutral one which is the front part. Thus, central vowels like [+back] and so are the back vowels like the English /uː, ɒ, ɑː/ (Hyman, 1979). The feature [high] involves any vowel that is produced with the tongue being raised above the neutral position (Hyman, 1979). Thus, the high vowels /iː, uː, I, ʊ/ in English are considered as [+high]. Furthermore, the tongue may take another position in terms of height. Such a position involves the lowering of the tongue below its neutral position. This position is referred to by the feature [low] and includes all low vowels like the English /æ, ʌ, ɑː/ or Classical Arabic's /a/.

In addition to variation in height and tongue advancement which were distinguished respectively by the features [high], [low] and [back], vowels can also be differentiated in terms of tongue tenseness. The feature [tense] refers to the tenseness of the tongue or its state. Indeed, as demonstrated by Katamba (1989, p.48), long vowels and diphthongs are produced with a greater muscular energy at the level of the tongue or a greater constriction than short vowels. Thus, long vowels and diphthongs, like /i:, u: eI/, are considered as [+tense], whereas short vowels, such as /ɒ, ʊ, I/, are [-tense]. However, the feature [tense] was later replaced by the feature [advanced tongue root] or [ATR] (Spencer, 1996, p.120). Indeed, given that long vowels and diphthongs are produced with advanced tongue root or with the root of the tongue being sent forward, then long vowels and diphthongs are [+ATR] while short vowels are [-ATR].

The shape of the lips may also distinguish vowels and group them into a number of classes. Indeed, the vowels /u:, ɒ/ in English are produced with rounded lips and are represented by the feature [round]. Yet, vowels like /e, I, ʌ/ are articulated with unrounded lips and are, thus, [-round] (Hyman, 1979, p.85).

1.2.1.3.Consonant Features

Like vowels, consonants can also be distinguished from one another via distinctive features. Consonant features are subdivided to three categories on the basis of the articulatory features of voicing, place and manner (Spencer, 1996, p.110).

Laryngeal features relate to the state of the vocal cords and their position. In other terms, laryngeal features refer to “different phonation types found in speech sounds” (Spencer, 1996, p.115). Among those features, one may cite the feature [voiced] which refers to the vibrating position of the vocal cords (Katamba, 1989, p.49). Thus, all the consonants that are produced with vibrating vocal cords are [+ voiced] like /b, g, n, r/.

Another laryngeal feature is [constricted glottis] which refers to the vocal cords when they are tightly shut. This position is what results in the glottal stop /ʔ/ (Spencer, 1996, p.110). Thus, /ʔ/ is [+constricted glottis].

Manner features relates to the manner in which air escapes from the vocal tract when a consonant is produced. The first manner feature is the one which relates to the continuity of airflow as contrasted to its interruption. Such a feature is referred to as [continuant] and encompasses all the consonants that are produced with uninterrupted airflow (Spencer, 1996, p.111). Fricatives are regarded as [+continuant] since their articulation involves an uninterrupted airflow which passes through the narrow passage that is so peculiar to fricative articulation. Liquids are also considered as [+continuant] since their articulation involves uninterrupted airflow through the sides of the tongue. Stops and affricates, on the other hand, are viewed as [-cont] since their articulation involves an interruption or stop of airflow. This leaves us with nasals which are regarded by Chomsky and Halle (1968), as reported in Spencer (1996, p.141), as [-continuant]. The explanation for such a position is that a continuant is a consonant that is produced with uninterrupted airflow at the level of the oral cavity. For this particular reason, nasals are alternatively labeled nasal stops. Hence, nasals, stops and affricates are [-continuant], whereas fricatives and liquids are [+continuant].

Another manner feature is [delayed release] which is proper to affricates only. Indeed, this feature corresponds to consonants that involve a delay in the release or parting phase. Affricates are the type of consonants during which articulation, the release of air is delayed to the fricative phase. Hence, affricates are [+delrel] while stops and the other consonants are [-del rel] (Katamba, 1989, p.51).

Nasal consonants are the only consonants that are produced with air escaping through the nasal cavities as a result of the lowering of the velum in order to block the oral cavity. The feature [nasal] refers to this manner feature. Hence, only nasal consonants are [+nasal]. In English, for instance, /m, n, ŋ/ are [+nasal]. The feature [nasal] may be acquired by a vowel if this latter is followed by a [+nasal] consonant as in /hænd/ →[hæ̃nd] (Spencer, 1996, p.112).

Liquids such as /l, r/ are similar in terms of manner in the fact that they are produced by air escaping through the sides of the tongue or the rimes. However, they differ in whether air escapes over or down the sides of the tongue. Indeed, for /l/ air escapes down the sides of the tongue. The feature [lateral] indicates the consonants that are produced with air escaping down the sides of the tongue. Hence, [lateral] distinguishes between the liquids /l/ and /r/. /l/ is [+lateral] while /r/ is [-lateral] as it is articulated with air escaping over the sides of the tongue.

Another manner feature is [strident] which distinguishes between fricatives. Given that fricatives constitute a large group of consonants, [strident] divides this group into two classes. [strident] is a fricative consonant that is produced with more “turbulent noise” (Spencer, 1996, p. 111) or else resonance than the other fricative consonants. Thus, the fricatives /s, z, ʃ, ʒ/ are more turbulent than /θ, ð, f, v/. As a result, /s, z/ are [+strident] while /θ, ð/ are [-strident] (Spencer, 1996).

Place features refer to the organs or articulators that come into contact in order to produce a given consonant (Katamba, 1989, p.43). The most common place feature that SPE introduced is [coronal]. [coronal], as defined by Chomsky and Halle (1968), includes consonants that are articulated with the front part of the tongue. Such a part comprises the tip and blade of the tongue as well as the front of the tongue. Thus, dentals, alveolars, post-alveolars, palato-alveolars and palatals are all considered as [+coronal]. Bilabials, labio-dentals, velars and glottal are all considered as [-coronal].

Another place feature was soon developed by Chomsky and Halle (1968) to distinguish between those sounds that are produced from the alveolar ridge region forward and those that are produced after the alveolar ridge region. This feature was called [anterior]. Hence, bilabials, labio-dentals, dentals and alveolars are considered as [+anterior], whereas alveo-palatals, palatals, velars and glottals are [-anterior] (Spencer, 1996, p.113).

1.2.1.4.Redundancy and Distinctive Features

As a principle of phonological analysis, any phonological study has to conform to the standards of economy in order to be considered reliable. As it is defined in Hyman (197, p.99):

> …economy, then, is a quantitative measure by which a given solution can be evaluated as requiring fewer or more mechanisms (phonemes, rules, conventions, etc) than another solution. This notion is characteristic of phonemic approaches to phonology, and, as we shall see has its application in the history of generative phonology as well.

Hence, economy is a principle of phonological analysis which requires phonological studies to contain the significant and necessary elements only. Thus, all the extra elements which are not requisite to the analysis are to be dispensed with.

The principle of economy is clearly applied in distinctive features theory as not all features need to be listed for a given phoneme or class of phonemes. Most often, certain features are implied from other features. Hence, listing those features would violate the principle of economy. In other terms, listing features that could be implied from other features is an instance of redundancy. Thus, redundancy is the statement of elements that add no necessary information to the analysis. An instance of redundant features is found in Spencer (1996, p.121). This instance relates to nasal consonants like /m, n, ŋ/ in English. In distinctive features terminology, nasals are [+nasal] and any sound that is [+nasal] is necessarily [+sonorant] [+voiced] [-continuant]. Thus, specifying the feature [+nasa] implies the features [+sonorant] [+voiced] [-continuant]. In such a case, only the feature [+nasal] is required for nasal, whereas the features [+sonorant] [+voiced] [-continuant] are redundant.

Redundant features are represented in a set of rules called the "redundancy rules" (Spencer, 1996). These rules indicate redundant features which are generally underspecified in phonological analysis. Redundancy rules generally include the redundant feature(s) as well as the feature from which redundant feature(s) are implied. The redundancy rule for the former case of nasals could be written as follows:

(2) [+nasal] ⇒[+sonorant] [+voiced] [-continuant].

The double arrow ⇒as put by Spencer (1996, p.122) is read "implies". The redundancy rule as a whole is read [+nasal] implies [+sonorant] [+voiced] [-continuant]. The double arrow also indicates the difference between redundancy rules and phonological rules. Indeed, the difference between the two types of rules lies in whether they add or change elements as put by Spencer (1996, p.122):

> A phonological rule changes certain feature specifications or other aspects of structure. Such a rule is not unnaturally called structure changing. However, the redundancy rules add structure, without changing one specification into another. Such rules are generally called structure building.

1.2.1.5.Natural Classes

As it appears from the former sections, distinctive features group the sounds of a given language into categories or classes. Members of each class have as commonality one or more distinctive feature. Given that distinctive features are rooted in articulatory correlates, the commonality between members of the same class is natural rather than arbitrary. Hence, the classes that are built up by phonemes which share one or more distinctive feature are said to be part of a "natural class" (Spencer, 1996, p.130).

An instance of a natural class is /p, b, t, d, k, g, tʃ, dʒ, m, n, ŋ, ʔ/ which are sounds that share the features [+consonantal] [-continuant]. Another natural class is /f, v, θ, ð, ʃ, ʒ, h, l, r/ which are [+consonantal] [+continuant]. Still another natural class is /w, j, ə, ɑ:, u:, ʌ/ which are [-consonantal]. The class /u:, ʊ, i:, ɪ/ is also a natural class as its members are all [+high].

Spencer (1996, p.133) indicated the difference between a natural class and an unnatural class by describing the former as a "conjunction of features" and referring to the latter as a "disjunction of features". He further explained the difference between a natural and an unnatural class by considering the latter as "an unnatural class can be defined as one which requires more feature specifications than does any of its members". As to a natural class Spencer (1996) views it as "one in which the situation (the former for unnatural classes) doesn't obtain. Hence, the total number of feature specifications needed for the whole class does not exceed that needed for the most complex member".

An instance of the distinction between natural and unnatural classes could be found in Spencer (1996, p.131-133). He provides the instance of the class /v, ð, z, ʒ/ as opposed to the class /v, ɑ, r, m/. Spencer (1996, p.131-133) indicates that the features that are required to characterize the class /v, ð, z, ʒ/ does not exceed the features that characterize its members. This phenomenon is illustrated as follows:

(3) /v/:

[+voiced] [-sonorant] [+continuant] [+coronal] [+anterior]

/ð/:

[+voiced] [-sonorant] [+continuant] [+coronal] [+anterior]

/z:/

[+voiced] [-sonorant] [+continuant] [+coronal] [+anterior]

/ʒ/:

[+voiced] [-sonorant] [+continuant] [+coronal] [-anterior]

However, the class /v, ɑ, r, m/ is characterized as follows:

/v/:

[+voiced] [-sonorant] [+continuant] [+coronal] [+anterior]

/ɑ/:

[+syllabic] [+low] [+back] [-round] [-ATR]

/r/:

[+sonorant] [+continuant] [+coronal] [+anterior] [-lateral]

/m/:

[+sonorant] [-continuant] [-coronal] [+anterior] [+nasal]

In the above instances the features that qualify the class /v, ð, z, ʒ/ do not exceed the number of features that are required for each of its members. Indeed, the features that are required for this class are [+voiced] [-sonorant] [+continuant] [+coronal]. Yet, for the second class, there is no commonality between the features that characterize all of its members. Hence, the characterization of this class would require the listing of the features of each of its members without any interaction between the features. The case that is encountered in the class /v, ɑ, r, m/ is what was referred earlier as disjunction. In such a case, the whole set of features that characterize the class /v, ɑ, r, m/ is greater than the set that is used to characterize each of its members. Hence, /v, ð, z, ʒ/ is a natural class, whereas /v, ɑ, r, m/ is an unnatural class.

1.2.1.6.Natural Classes and Phonological Processes

As pointed out by Spencer (1996, p.130), natural classes are a necessary unit in phonological analysis as phonological processes apply to natural classes. As Spencer puts it, “phonological processes apply to natural classes and not just any old assemblage of sounds” (Spencer, 1996, p.132-133). To illustrate his point, Spencer (1996, p.130) has recourse to the process of fricative devoicing in English in examples like: half past /hɑːlv pɑːst/→ [hɑːf pɑːst]. He indicates that this process, in which a voiced fricative is devoiced when followed by a voiceless consonant, applies to the natural class of [+voiced] [-sonorant] [+continuant] sounds which are the voiced fricatives of English. These sounds consist of the class /v, ð, z, ʒ/.

1.2.1.7.Distinctive Features and Phonological Rules

As indicated in the former section on natural classes, phonological processes apply to natural classes. Thus, the target of a phonological rule is a natural class and so is the environment that conditions a certain phonological process. In such a case, distinctive features theory provides economy, generality and formalism. To illustrate those points, one may take the instance of obstruents devoicing in Russian which is indicated in Spencer (1996, p.135). In Russian, the plural of nouns is formed by deleting the final vowel of the singular. Thus, the singular nouns /fraza/ ‘phrase’, /doroga/ ‘road’, /golova/ ‘head’ form their plural by deleting the ultimate vowel /a/. After the vowel is deleted, the consonant which precedes that vowel occupies the final position. If this final consonant is voiced, it will be devoiced in Russian. Hence, /fraza/→[fraz] → [fras], /doroga/→[dorog] →[dorok], /glovo/→[golov]→[golof].

This process, as indicated by Spencer (1996, p.135) can be formerly respresented as follows:

(4) Voiced obstruent → voiceless /______ (end of word).

Yet, this rule lacks the economy, generality, formalism and elegance or sophistication that distinctive features bring about to rules. Hence, a distinctive feature-based rule for obstruents devoicing in Russian would look like the following:

(5) [+voiced]→ [-voiced] /____________)Wd

[-sonorant] [-sonorant]

The symbol ‘) Wd’ represents word–final boundary, whereas the rule as a whole is read: a [+voiced] [-sonorant] changes to [-voiced] [-sonorant] word finally. Indeed, all this set of data is formalized in an economical and elegant fashion thanks to distinctive features. However, the rule is not economical enough as some of its data are redundant as pointed out by Spencer (1996). Indeed, [-sonorant] is redundant in this case because only [-sonorant] consonants can be either voiced or voiceless. Thus, the rule should be rewritten as follows:

(6) [+voiced]→ [-voiced] /____________) Wd

[-sonorant]

Furthermore, another redundant detail needs to be eliminated from the rule in order to assure generalization of the rule or rather a more general statement of the rule. This element is the feature [+voiced]. As a matter of fact, deleting this feature from the rule implies that an obstruent needs to be voiceless word finally. This generalization would make a general statement about the status of obstruents word finally in Russian. Hence, any obstruent voiced or voiceless must have the specification (-) for the feature [voiced] word finally. The rule is rewritten as follows in Spencer (1996, p.136):

(7) [-Sonorant]→ [-voiced] /_________)Wd.

An example of the necessity of including distinctive features within phonological rules is indicated by the case of fricative devoicing in English as in five past /faɪvpɑːst/ in which /v/ is devoiced to /f/ in order to agree with /p/ in voicing. The following rule accounts for such a process:

(8) /v/→/f/________ voiceless consonant (Spencer, 1996, p.46)

The problem with rule (8) is that fricative devoicing is not only limited to /v/ (Spencer, 1996, p.46), but it includes all the voiced fricatives of English. Hence, keeping the rule as in (2) would miss a generalization. For this reason, Chomsky and Halle (1968) proposed to include distinctive features rather than individual sounds. Another reason for the preference of distinctive features is the fact that features provide a more economical account of phonological processes in addition to capturing a generalization. As highlighted in Kenstowicz and Kisseberth (1979, p.4) "when phonological processes are represented as feature matrices sound change can be formalized as the modification of a feature coefficient". The rule in (2) can be rewritten as follows:

(9) [+voice]→[-voice]/_________ [+voice]

[+continuant] [+consonantal]

[-sonorant]

[+strident]

Rule (9) accounts for all the following instances of fricative devoicing and any other similar case:

a. Five past [faɪ**v** pɑːst]→[faɪ**f** pɑːst]
b. Love to go [lʌ**v** tə gəʊ] → [lʌ**f** tə gəʊ]
c. As well as can be [əz wel ə**z** kən be] → [əz wel ə**s** kən be]
d. Loathe to go [ləʊ**ð** tə gəʊ] →[ləʊ**θ** tə gəʊ]

(Spencer, 1996, p.46)

1.2.2. Rule Ordering

Soon after developing their SPE and applying it to different languages, Chomsky and Halle (1968) observed that some languages display the occurrence of more than one phonological process to a given form. Hence, the rules that account for these processes needed to follow a certain order to avoid representative anarchy. The general trend in linear phonology was that rules apply in a successive manner so that the surface form of the first rule is the underlying form for the following rule. As indicated by Chomsky and Halle (1968, p.341) “Rules are applied in linear order, each rule operating on the string as modified by all earlier applicable rules”. Bromberger and Halle (1989) also described the linear ordering of rules as follows:

> Phonological rules are ordered with respect to one another. A phonological rule R does not apply necessarily to the underlying representation; rather R applies to the derived representation that results from the application of each applicable rule preceding R in the order of the rules
>
> (Cited in Bakovic, 2011, p.2)

The successive order of rules sketched above is called feeding which is a relation between phonological rules. As argued by Bakovic (2011, p.2):

Given two rules A, B such that A precedes B
A feeds B iff A creates additional input to B

In other terms, two rules are in a feeding relation if and only if the first provides input to the second, and the second cannot apply unless the first has already been applied.

To illustrate feeding, Bakovic (2011) provided a hypothetical example in which deletion and palatalization rules apply to the same hypothetical form /tue/. The deletion rule deletes the first vowel of the vowel hiatus /ue/, while the palatalization rule turns non-palatal /t/ to /tʃ/ when it is followed by a front vowel which is /e/ in this case. The bleeding order of the deletion and palatalization rules was represented as follows in Bakovic (2011, p.3):

(10) v→Ø/_______v

t→ tʃ/_________[-back]

In (10), the order of the rules is deletion› palatalization (i.e. deletion precedes palatalization in application).

The reason for this order is that /t/ can be palatalized only after the back vowel /u/ is deleted and /t/ and the front vowel /e/ become adjacent. If we reverse the order, palatalization would not apply since /t/ would be followed by the back vowel /u/. Yet, deleting /u/ allows the application of the palatalization rule since the output of the deletion rule includes conditions for palatalization rule, viz the front vowel /e/ is adjacent to /t/. The pair of rules in (5) clarifies the former statements:

(11) u→Ø/ _________ e

t→tʃ/_________ e

Another example of feeding is observed in Katamba (1993, p.122-123). Katamba dealt with the rules of vowel nasalization and consonant deletion in French. Katamba demonstrated that nasalization feeds consonant deletion in French as in (12) and (13) below:

(12) [-CONSONANTAL]→[+NASAL]/_________[+NASAL]

[+CONSONANTAL]{C
#}

[+CONSONANTAL]→Ø/ ____________{C
#}

/an/ ‘year’

(13) a→ã/________/n/

n→∅/ ________ #

Rule (7) indicates that the French oral vowel /a/ in the word /an/ ‘year’ is nasalized to [ã] because it is followed by the nasal consonant /n/. Then, /n/ is deleted as it is word final. If /n/ is deleted before /a/ is nasalized, /a/ remains oral and nasalization cannot apply.

Rules can be in another kind of relation in which rules cannot apply together to the same form. In such cases the application of one rule excludes that of the other(s). This kind of relation is termed bleeding and is defined as follows in Bakovic (2011, p. 2):

Given two rules A, B such that A precedes B,

A bleeds B iff A eliminates potential inputs to B

An instance of bleeding can be found in Katamba (1993, p.125) in which she discusses the rules of place assimilation and stop aspiration in Swahili. In that language, the noun- forming prefix ‘n-’ assimilates the place of articulation of the consonant that follows it as in (14):

(14) /n/ →[+labial]/________________ [+labial]

or or

[+coronal] [+coronal]

or or

[+dorsal] [+dorsal]

Example:

(15) n→m/________b

In n-boga→mboga ‘vegetable’

This example implies that /n/ is realized as the labial nasal /m/ because /n/ is followed by the labial /b/. However, in case /p/ follows /n/, another rule aspirates /p/ which leads to another rule that deletes /n/ as represented in (16) below:

(16) $/p/ \rightarrow [p^h] / n\_\_\_\_\_\_\_\_$

$n \rightarrow \emptyset / \_\_\_\_\_\_\_\_\_\_ [p^h]$

Example:

$/n+pange/ \rightarrow [p^hange]$

In other terms, the rule of assimilation cannot apply after the aspiration and deletion rules have applied since /n/ cannot precede an aspirated $[p^h]$ in Swahili. Furthermore, since /n/ is deleted there is no nasal that needs to assimilate. Thus, the aspiration and deletion rules bleed the assimilation rule.

The approach of linear phonology that has been so far introduced was applied in order to account for different types of phonological processes in different languages. Some of such studies are to be reviewed in the following sections.

1.3.Rule-Based Account of Phonological Processes in Different Languages

1.3.1. Epenthesis

Lema (1978) analyzed the process of epenthesis in three positions, viz initial, medial and final epenthesis, by having recourse to the machinery and formalism of rule-based phonology. As indicated by Lema (1978, p.6), the vowel /e/ is inserted at the beginning of words that start with the cluster /sc/ in instances like /skribir/ ‘to write’ and /spirar/ ‘to breathe out'. After /e/ is inserted, /skribir/ and /spirar/ are realized as [eskribir] and [espirar]. This process was explained in the form of rule (17) in Lema (1978, p.6):

(17) $\emptyset \rightarrow e$ /#___sc

Such a rule means that /e/ is inserted at the beginning of words that start with /sc/. Yet, as indicated by Lema (1978), /e/ epenthesis also occurs in words like /e-slavo/ 'Slavic' and /e-slabon/ 'link'. Hence, rule (17) should be reformulated to include the case of /e/ epenthesis before the cluster /sl/. Lema (1978, p.6) introduced rule (18) below to account for both cases of /e/epenthesis:

(18) $\emptyset \rightarrow e$ /#___s[+consonantal]

This rule implies that /e/ is inserted at the beginning of words that start with /s/ followed by any type of consonant.

Lema (1978, p.11) then considered medial epenthesis in cases like /in-stable/ 'unstable' and /des-sperar/ 'despair' which are realized as [inestable] and [desesperar]. Indeed, when the negative prefix /in/ and opposite prefix /des/ are added to the stems /stable/ and /sperar/, the vowel /e/ is inserted between the prefix and the stem. Lema (1978) highlighted the fact that the morphological process of prefixiation precedes the phonological process of epenthesis.

Lema (1978, p.11) points out to the fact that the position where /e/ is epenthesized is determined by morphemic boundaries rather than phonological ones. He demonstrated that the rule that accounts for this case of medial epenthesis should include the symbol (#) which represents stem boundaries as in (19) below:

(19) $\emptyset \rightarrow e$ /#________[+cons][+cons]

[+cor]

[+ant]

[+cont]

[+stri]

(Lema, 1978, p.11)

Indeed, the fact of applying stem boundaries in rule (13) indicates that /e/ is to be inserted before the stem /stable/ and after the prefix /in/. This rule can be contrasted to rule (18) for initial epenthesis. Nay, in the case of rule (18), /e/ is inserted at the beginning of the word /slavo/ which rewrites rule (12) as follows:

(20) $\emptyset \rightarrow e$ /##___s[+cons]

(Lema, 1978, p.11)

The symbol (##) refers to word- boundaries, whereas the symbol (#) which was introduced in rule (19) refers to stem-boundaries since /e/ is inserted before the stem-boundary in /inestable/ rather than before a word-boundary as in /eskribir/. In other words, rule (18) which is rewritten as (20) represents a case of initial epenthesis or else prosthesis, while rule (19) represents a case of medial epenthesis (Lema 1978, p.11).

Lema (1978, p44) then moved to final epenthesis in Spanish. He demonstrated that the vowel /e/ is also inserted at the end of some Spanish words. Lema (1978, p.46) explains final epenthesis in Spanish as being the repair strategy for consonant clusters at the end of Spanish words. Instances of these words include /berd/ →[berde] ‘green’, /ambr/→[ambre] ‘hunger’,

/karn/→[karne] 'meat' (Lema 1978, p.47). Lema (1978) accounts for this process by having recourse to the following rule:

(21) $\emptyset \rightarrow$ e /CC___##

Rule (21) implies that the vowel /e/ is inserted at the end Spanish words after consonantal clusters (CC).

Zahrani (1995, p.18) analyzed the process of vowel insertion in Malay. He demonstrated that the vowel /ə/ is inserted in Malay verbs to which the nasal prefix 'məŋ-' which indicates the active form, is added. Instances of such a case include /məŋ-pam/ 'to pump' and /məŋ-lap/ 'to wipe' which are respectively realized as [məŋəpam] and [məŋəlap]. Zahrani (1995, p.18) demonstrated that this process occurs when the prefix 'məŋ-' is added to words that start with non-velar consonants as /p, b, t, d, tʃ, j, s, z, ʃ, m, n, l, r, w/, while epenthesis does not occur before velar consonants like /k, g, x/. Furthermore, /ə/ epenthesis happens only when the word to which the prefix 'məŋ-' is added is monosyllabic. Thus, the process of /ə/ insertion was reformulated and accounted for in the form of the following rule:

(22) $\emptyset \rightarrow \begin{bmatrix} \text{V} \\ \text{+mid} \\ \text{-low} \\ \text{-coronal} \end{bmatrix} \;/\; \begin{bmatrix} \text{C} \\ \text{+nasal} \\ \text{-anterior} \end{bmatrix}+\_\_\_\_\_\_\_\_\_\_+\text{CVC}\#$

(Zahrani, 1995, p. 18)

However, two other rules apply to the same input of the Malay case of vowel insertion (Zahrani, 1995, p.19). One of those rules assimilates the nasal /ŋ/ of the prefix 'məŋ-' to the following consonant in terms of place features. Examples include /məŋ-baka/ →[məmbaka] ‘to read’, /məŋ-dakap/ →[məndakap] ‘to hug’. The other rule that applies to the same input is a rule that deletes the nasal /ŋ/ when it is followed by a sonorant consonant as in /məŋ-lukis/ →[məlukis] ‘to draw’, /məŋ-rasa/ →[mərasa] ‘to taste’. Zahrani (1995) indicates that the assimilation rule, deletion rule and epenthesis rule occur in a sequential order which is of the bleeding type. In other terms, the application of the epenthesis rule blocks the application of the assimilation rule and the deletion rule. Indeed, the fact of inserting /ə/ between /ŋ/ and the following consonant makes /ŋ/ no longer adjacent to that consonant and the assimilation rule fails to apply. Moreover, inserting /ə/ renders the deletion rule inapplicable because /ŋ/ is no longer followed by a sonorant, but rather by the vowel /ə/. The order of the formerly alluded to rules is displayed as follows:

(23) Underlying representation

/#məŋ+pam#/ /#məŋ+lap#/

Epenthesis rule

məŋəpam məŋəlap

Nasal assimilation rule

——————————

Deletion rule

——————————

Surface representation

[məŋəpam][məŋəlap]

(Zahrani, 1995, p.19)

1.3.2. Assimilation

Sobkowiak (1985) considered the process of nasal assimilation of the nasal /n/ in the prefix 'in-' in English. Sobkowiak (2006) observed that English exhibits two types of nasal assimilation, viz partial and complete nasal assimilation. Partial assimilation is observed in words like /In.bɔːn/ →[Imbɔːn] 'inborn', /IngreIn/ →[IŋgreIn] 'ingrain'. In such an example, /n/ assimilates the place of articulation of the following consonant. Hence, in [Imbɔːn] it is produced as the labial /m/, while in [IŋgreIn] it is realized as the velar /ŋ/ (Sobkowiak, 2006, p. 82). However, as indicated by Sobkowiak (2006, p. 94) when /n/ is followed by a liquid /l or r/, /n/ totally assimilates to it by acquiring its place and manner features. Instances of total nasal assimilation include /In.lɒdʒɪkəl/ 'illogical' and /In.regjʊlə/ 'irregular' which are respectively realized as [Illɒdʒɪkəl] and [Irregjʊlə]. Sobkowiak (2006, p.94) accounted for the process of total assimilation via rule-based phonology. He pointed out to the fact that this process can be described and explained by the following rule:

(23) [+nasal]→[+liquid]
[+coronal]

Rule (24) could be rewritten as follows:

(24) [+nasal]→[+liquid]/________ [+liquid]
[+coronal]

As to the process of partial nasal assimilation which is illustrated by [Imbɔːn] and [IŋgreIn], Sobkowiak (2006, p.96) accounted for it through the following rule:

(25)

$$\begin{bmatrix}+\text{nasal}\\ +\text{coronal}\end{bmatrix} \rightarrow \begin{bmatrix}\alpha\text{anterior}\\ \beta\text{coronal}\\ \gamma\ \text{distributed}\end{bmatrix} / \underline{\qquad\qquad} \begin{bmatrix}\alpha\text{anterior}\\ \beta\text{coronal}\\ \gamma\ \text{distributed}\end{bmatrix}$$

Rule (26) implies that the nasal /n/ acquires the place feature of the sound that succeeds to it. If that sound is [+anterior], or produced in the part of the mouth that comprises the alveolar ridge, teeth or lips, /n/ will be realized as the anterior /n/. If the sound that follows /n/ is [-anterior] such as palatals and velars, then /n/ is realized as the [-anterior] (/ŋ/). Finally, if the sound that follows /n/ is [-coronal] , /n/ is realized as a [-coronal] which implies the labial /m/. As to the feature [distributed] if /n/ is followed by a sound that is produced with the blade of the tongue as dentals /θ,ð/, then /n/ is produced as a [+distributed], whereas if /n/ is followed by a [-distributed] sound or a sound that is produced by the tip of the tongue (e.g., /s/), then /n/ is realized as [-distributed].

Sutomo (2012) analyzed the process of progressive voice assimilation in English for the contracted form of English ‘is’ which is (‘s). Stutomo (2012, p.9) studied the process by which contracted ‘s assimilates the voice feature of the consonant that precedes it in instances like ‘it’s here’ /It Iz hIə/→[Its hIə] and ‘that’s all’ /ðæt Iz ɔːl/ →[ðæts ɔːl]. He demonstrated that the /z/ of ‘is’ assimilates the voice feature of the consonant that precedes it when ‘is’ is used in the contracted form (‘s). Thus, since in both instances the consonant that precedes /z/ is the [-voice][+cor][+ant][-cont][-son] /t/, then /z/ is realized as its voiceless counterpart /s/ which is [-voice]. This process was accounted for by use of the following rule in Sutomo (2012, p.9):

(26)

	/z/	/s/	/t/
	[+cons]→	[+cons]/	[+cons]
	[+cor]	[+cor]	[+cor]
	[+ant]	[+ant]	[+ant]
	[+cont]	[+cont]	[-cont]
	[+voice]	[-voice]	[-voice]

1.3.3. Syncope

Sutomo (2012) further studied the process of deletion in English or else stop elision. He (2012, p. 9-10) considered the case of 'next door' /nekst dɔː/ which is realized as [nekdɔː] in rapid speech. In such a case /t/ is deleted because it is followed by its voiceless counterpart /d/. Sutomo (2012, p.10) explained this process through the following rule:

(27)

	/t/		/d/
	[+cons]→∅	____________	[+cons]
	[+cor]		[+cor]
	[+ant]		[+ant]
	[-voi]		[+voi]

Sutomo (2012, p.10) then demonstrated that /t/ is dropped not only before /d/ but also before /g,m,n/ in each of 'must go' /mʌst gəʊ/ →[mʌs gəʊ], last month /læst mʌnθ/→[læs mʌnθ] and 'must not' /mʌstnt/→[mʌsnt]. Hence, Sutomo modified rule (29) as follows:

(28) /t/ →∅/__________ [-cont]

The feature that is common to all of those sounds is that they are all stops. Some like /d and g/ are oral stops, while others like /m, n/ are nasal stops.

1.4.Rule-based Account of Phonological Processes in Arabic

Jaber (2001) also applied rule-based phonology in order to account for vowel epenthesis in Jordanian Arabic (JA). He pointed out to the fact that the vowel /i/ is inserted between the first and second consonant of a tri-consonantal cluster. Instances of this case include /tardʒamtlha/ ‘I translated to her’ which is realized as [tardʒamtilha] and /katabtlha/ ‘I wrote to her’ which is realized as [katabtilha]. Jaber (2001, p. 49) accounted for this process by the following rule:

(29) $\emptyset \rightarrow V\ /C\_\_\_\_\_CC$

Rule (30) implies that the vowel /i/ is inserted in (JA) to break the /tlh/ cluster. Indeed, insertion simplifies the syllabification process with /t/ as onset and /l/ as coda of the syllable /til/ and /h/ as onset of the syllable /ha/ in [tar.dʒam.til.ha] and the same applies for the sequence /tlh/ in [ka.tab.til.ha].

Elramli (2012) accounted for the process of voice assimilation of the inperfective tense prefix ‘t-’ in Misrata Lybian Arabic (MLA). He indicated that the prefix ‘t-‘ is added to verbs to represent the second person singular or plural or third person feminine singular or plural in the imperfective tense. Elrami (2012, p.38) demonstrated that if /t/ is added to a word that starts with a voiced consonant, /t/ is realized as /d/. Instances of this process include /t-da:fiʕ/ ‘you/she defend(s)’, /t-ga:bil/ ‘you/she meet(s)’, /t-zu:r/ ‘you/she visit(s), /t-ʒahhiz/ ‘you/she prepare(s)’ which are respectively realized as [dda:fiʕ], [dga:bil], [dzu:r], [dʒahhiz]. Elramli (2012, p.40) explains and describes this process via the following rule:

(30) t→d /#_____+C

[+voice]

Rule (31) means that the voiceless /t/ is realized as the voiced /d/ when it is followed by a voiced consonant.

1.5.Defects within Rule-based Phonology

In spite of the revolution that the rule-based approach instigated within phonological analysis, it was at the roots of yet many pitfalls in phonological analysis and theorization. Indeed, among the earliest defects that were identified within the rule-based approach was the disregard that the latter developed towards the unit of the syllable. Such a disregard triggered many difficulties in phonological account of certain phonological processes. Nay, those processes obviously required reference to syllable structure and syllable boundaries in order to be described and explained. Such processes fall under the categories of epenthesis, deletion and any other process which is conditioned by syllable structure and syllable boundaries. The former statement justifies the shortage in previous studies which applied the rule-based approach to account for either epenthesis or deletion.

The formerly alluded to kinds of disregard was accentuated by Kahn as early as (1976) in his PhD dissertation. Kahn (1976) pointed out to the lack of adequacy which results from a rule-based account that discards the unit of the syllable and puts the segments and their distinctive features on a pedestal. His evidence was drawn from English and more exactly from the non-rhotic accents of English in which /r/ is dropped at the end of words or before a consonant. Kahn (1976, p.23) indicates that r-deletion in non-rhotic accents of English is accounted for by the following rule in the rule-based approach:

(31) $r \rightarrow \emptyset$ / ____ {C
#}

However, as highlighted by Kahn (1976, p.23) the environment {C or #} does not conform to the principle of SPE which requires the environment that conditions a given phonological process to form a natural class of distinctive features of the sort [-continuant][+cons][-voic] and so on. Indeed, the elements C and # do not have anything in common as one (C) stands for consonant and the other (#) symbolizes the word boundary. Kahn (1976, p. 27) then argued that the process of r-deletion in non-rhotic accents of English would be successfully described and explained if syllable boundaries were introduced to rule notation. In such a case, r-deletion would be described and explained as occurring at the end of syllables either within simple or complex codas as in /ka:**r**.tel/'cartel' and and /ka:**r**t/ 'cart' respectively (Khan, 1976, p. 22).

Furthermore, it is requisite to mention that if SPE granted some attention and concern to the syllable, the feature [syllabic] which was introduced in the distinctive features theory would not be necessary as the notion of syllabicity would be inherent in the structure of the syllable (Spencer, 1996, p.108). In plainer terms, the analyst would not need to develop the feature [syllabic] since such a feature could be deduced from the structure of the syllable which will be tackled in details in the next chapter.

1.6.Conspiracies

In his article "On the Functional Unity of Phonological Rules", Kisseberth (1970) pinpointed a serious defect within the rule-based approach to phonology. He (1970, p.291) discerned that the machinery of rule-based phonology allows a set of rules which share a similarity in structure to be collapsed into one general rule. He provided the instance of the following pair of rules in order to illustrate his point:

(32) $\emptyset \rightarrow V / C\_\_\_\_ C\#$

(33) $\emptyset \rightarrow V / C\_\_\_\_ CC$

Kissseberth (1970, p.291) then demonstrated that the rules (33) and (34) can be collapsed to the following rule:

(34) $\emptyset \rightarrow V / C\_\_\_\_ C\{\#$

$C\}$

The reason for such a collapse Kisseberth (1970) argues is the fact that both rules are structurally analogous. Such an analogy is the fact that a vowel is inserted.

Kisseberth (1970, p.293) signaled the existence of another phenomenon which could be regarded as the reverse case to the instance of structural analogy which was introduced above. He (1970, p.293) pointed out to the existence of a pair of rules like the following:

(35) $\emptyset \rightarrow V / C\_\_\_\_ CC$

(36) $C \rightarrow \emptyset / CC+\_\_\_\_$

In this instance of Yawellmani, which is a dialect of Yokuts; an African language, either a vowel is inserted between consonants of a tri-consonantal cluster or a consonant of a tri-consonantal cluster is deleted. Kisseberth (1970, p.293) remarked that this pair of rules cannot be collapsed into a single unified rule because the two rules are "quite dissimilar; the present notational conventions permit no significant collapsing of these rules, and thus say that their cooccurence [sic] in a grammar would be accidental" (Kisseberth, 1970). However, the two rules are similar in another respect. Indeed, Kisseberth (1970, p.293) demonstrated that the two rules, even if dissimilar structurally, have the same goal or function which is to avoid tri-consonantal clusters. Hence, the two rules are an instance of what Kisseberth (1970) coined a conspiracy. In other terms, two rules which apparently have a common goal are treated as two separated and unrelated rules. Such a treatment misses an important generalization and, in fact, violates the principle of economy in phonological analysis.

1.7.The Duplication Problem

In addition to conspiracies, rule-based phonology possesses other shortcomings. Another problem that this approach triggered was introduced by Kenstowicz and Kisseberth (1977) in their book "Topics in Phonological Theory". In this book as reviewed by Clayton (1979), Kenstowicz and Kisseberth (1977) pointed out to the issue of determining the relation between rules and phonotactic constraints. Indeed, Kenstowicz and Kisseberth (1977) discovered that a functional similarity exists between phonological rules and constraints on morpheme structure. Hence, a rule that inserts a vowel to avoid consonant cluster has the same goal as the constraint on morpheme structure which requires a vowel to be inserted between a prefix or a suffix that consists of a consonant and a stem that starts or ends with a consonant. To put it differently, a vowel is to be inserted between two concatenated morphemes that have a consonant in their boundaries (Kager, 1999, p.56).

Hence, an overt similarity between rules and constraints is discarded by rule-based phonology. This phenomenon came to be known as the duplication problem.

1.8.Mixed Models of Analysis

As indicated by Kager (1999, p.56), constraints started to gain significance in phonological analysis, especially after the duplication problem had been identified by

Kenstowicz and Kisseberth (1977). Indeed, some phonologists started to mix between constraints and rules in their pohonological studies. Such a mixture resulted in models like *Constraints and Repair Strategies* by Paradis (1988) and *Persistent Rule Theory* by Myers (1991). Those models set forth constraints that either trigger or block the application of phonological rules. Hence, a rule which deletes an unstressed vowel would result in the violation of the constraint that disallows consonant clusters since the vowel that separates the two consonants is deleted and the consonants become part of a cluster. Thus, another rule is introduced to repair such a violation of the constraint (Kager, 1999, p.57).

As indicated in Kager (1999, p.57), the problem with mixed models was that they engender “an overlap in theoretical machinery”. Furthermore, the principles of interaction between rules and constraints are complicated (Kager, 1999) since a rule which violates a constraint would lead to the development of another rule that would repair for such a violation. Plus, it is to be checked if the repair rule does not violate another constraint of the grammar.

As far as one is concerned, it appears that rule-based phonology possesses a number of defects. Indeed, the machinery of rules in the rule-based approach was at the roots of many problems in phonological theorization and analysis. Such problems pushed certain phonologists to dispense with the tool of the rule altogether and turn to constraints. This turn in phonological concern was a prelude to a new wave of phonological theorizing which came to be known as constraint-based approach or optimality theory. This approach to phonology relied solely on constraints and utilized their principles of interaction and satisfaction versus violation in order to account for different sorts of phonological processes. The next chapter will provide a theoretical background about this approach.

After discovering the several shortcomings and problems that the rule-based approach manifests, some phonologists resolved to abandon rules as a tool for accounting for phonological processes and centered attention and focus on constraints or else those phonological conditions that are at the roots of phonological processes. Those new resolutions represented the premises for a new approach in phonological analysis and theorizing. This approach was built around phonological constraints and was correspondingly known as the 'constraint-based approach' or more commonly as 'optimality theory'.

2.1. Optimality Theory: Tenets and Architecture

Optimality theory, henceforth OT, was set forth by Alan Prince and Paul Smolensky (1993) and later modified by John McCarthy and Alan Prince (1995). OT is another approach within the generative tradition, nevertheless its tenets and theorizing are innovative and tend to depart from the linear representation of its rule-based predecessor. Effectively, in OT constraints are the core of phonological account. As indicated by Prince and Smolensky (1997, p.1604) constraints help the analyst capture the commonalities that exist between languages or else language universals but likewise their disanalogies or language specific properties. Indeed, Prince and Smolensky (1993) view the grammar of any language or the implicit phonological knowledge of its native speakers as enclosing a set of constraints that all other languages' grammars possess. Such constraints have been divided to two main categories, namely markedness constraints or structure constraints and faithfulness constraints (Prince and Smolensky, 1997, p.1605).

2.1.1. Markedness Constraints

Markedness constraints relate to the concept of 'marked' which implies a form that is uncommon and usually banned. The markedness of such a form may result from its rarity in the languages of the world or its clash with the principle of ease of pronunciation (Kager, 1999, p.5).

Indeed, some forms are avoided in most languages of the world because their articulation may require more efforts than their alternative forms. As put by Prince and Smolensky (1997, p.1605) "Grossly speaking, an element of linguistic structure is said to be marked if it is more complex than an alternative along the same dimension: the relevant dimensions may sometimes correlate with comprehension, production, memory, or related physical and cognitive functions". An instance of a marked form is the sequence of a voiceless and voiced consonants in a consonant cluster as in /pæsd/ 'passed' or /læpz/ 'laps'. Indeed, producing the sequences /sd/ and /pz/ would require extra efforts of articulation as the vocal cords would adopt the open state for the voiceless /s/ and /t/ and would then switch to the vibrating state for /d/ and /z/. Contrastively, the alternative forms /pæst/ and /læps/ involve an easier articulation as one vocal cords' state will be adopted which is the open non-vibrating state for both consonants in the cluster /st/ and /ps/ (Prince and Smolensky, 1997, p. 1605).

The alternative forms that were introduced above, viz /pæst/ and /læps/ are an instance of what id dubbed the unmarked forms since they are common to all languages of the world and are easier to articulate if compared to their marked counterparts. Unmarked forms are hence the sort of forms that markedness constraints require and are also equated to the concept of well-formedness (Prince and Smolensky, 2002, p.2).

2.1.2. Faithfulness Constraints

Contrary to markedness constraints which apply exclusively to surface forms as they require them to be well-formed or unmarked, faithfulness constraints apply to both the underlying form or input and surface form or output. Indeed, faithfulness constraints require output and input to be alike. As put by Prince and Smolensky (2002, p.2) "Faithfulness constraints evaluate the relationship between input and output forms, demanding exact replication of the input along some specified structural dimension”. Thus, any sound, or sound feature should be kept unchanged in both the input and output. In other terms, any disanalogy between the input and output forms is regarded as a violation of faithfulness constraints.

As proposed by Prince and Smolensky (2004, p.2) faithfulness constraints are those constraints that are “responsible for maintaining the faithful preservation of underlying structures in the output”. Hence, if an input form consists of a voiced sound, such feature should be preserved in the output so that the consonants /d/ and /z/ of the input forms /pæsd/ and /læpz/, mentioned earlier, should preserve their voicing feature in the output. Similarly, if an input form includes a consonant cluster or a vowel sequence, each sound of the cluster or sequence should be present in the output. Moreover, if any vowel or consonant is identified in the output, it should possess its counterpart in the input.

2.1.3. Constraint Hierarchy

From the previous sketches of OT constraints, it is obvious that markedness constraints and faithfulness constraints conflict as to their requirements. Let us take the instance of /pet-z/ in English. This input form includes the root ‘pet’ and the plural morpheme ‘s’ which is underlyingly represented as /z/ (Schane, 1973, p.51). Markedness constraints would require the voiceless and voiced consonants cluster /tz/ to agree in voicing, whereas faithfulness constraints would require the cluster consonants /tz/ to preserve their voicing feature in the output. Such clash in the requirements that each of markedness and faithfulness constraints make is an important component of OT’s theorizing. As indicated by Prince and Smolensky (2004, p.2):

> Departing from the usual view, we do not assume that the constraints in a grammar are mutually consistent, each true of the observable surface of some level of representation. On the contrary, we assert that the constraints operating in a

> particular language are highly conflicting and make sharply contrary claims about well-formedness of most representations.

The conflict that follows from the requirements of markedness and faithfulness constraints is resolved through constraint hierarchy in OT. Effectively, if the set of markedness constraints and faithfulness constraints is universal, their ranking is language specific or else determined by languages' specific grammars (Kager, 1999, p.10-13).

To illustrate the language specific ranking of constraints, Kager (1999, p.14-17) contrasts between Dutch and English by indicating that the same constraint set may be ranked differently by different languages, thus provoking language typology. The constraints that Kager (1999, p.17) uses for illustration are *Voiced Coda and IDENT-IO. * Voiced Coda is a markedness constraint which bans voiced obstruents from appearing in coda position while IDENT-IO is a faithfulness constraint which requires features, voicing in this case, to be similar for the input and output. This constraint set is universal as it is common to all languages of the world, yet its ranking varies between Dutch and English (Kager, 1999, p.17).

In Dutch, the markedness constraint *Voiced Coda is higher ranked than the faithfulness constraint IDENT-IO. Yet, in English the reverse ranking applies. OT's theorizing prioritizes the satisfaction of higher ranked constraints at the expense of lower ranked constraints (Prince and Smolensky, 2004, p.2). Hence, for an input like /bed/ 'bed' in Dutch the output form is the one that satisfies the higher ranked *Voiced Coda even though it violates the lower ranked IDENT-IO. Indeed, violation is inevitable in OT since constraints have conflicting requirements. Thus, the output of /bed/ in Dutch is [bet] (Kager, 1999, p.17).

Contrastively, in English IDENT-IO dominates *Voiced Coda in constraint hierarchy. Thus, the output for /bed/ ‘bed’ in English is the form that preserves the voicing feature of the obstruent /d/. So, the output of /bed/ in English is [bed]. (Kager, 1999, p.17).

2.1.4. OT’s Framework

OT grammar encompasses a set of components that work together to accomplish input-output mapping. Such components involve two different stages of phonological representation and analysis. The first component is called the generator (GEN) and the second is called the evaluator (EVAL).

2.1.4.1. The Generator (GEN)

The generator is the component of OT which generates or else derives the candidate forms that could be output to the input form. In other terms, the generator derives all possible forms or output proposition (Kager, 1999, p.20). Thus, the generator generates all possible candidates for output position. Such derivation is reinforced by OT’s principle of ‘freedom of analysis’ which makes it possible for the generator to generate any “conceivable output candidate for some output” (Kager, 1999, p.20). However, the candidates that GEN generates must consist of “licit elements... of linguistic representation” (kager, 1999, p.20). Such licit elements include distinctive features, moras, syllables, feet, among others. Thus, for an input form like /pet-z/, GEN generates the candidates [pets], [pedz], [petz], [peds]. The candidates that the generator generates are submitted to the other agent in OT’s machinery. This agent is called the evaluator (EVAL).

2.1.4.2. The Evaluator (EVAL)

The evaluator (EVAL) is the component of OT which assesses the harmony of the candidates with regard to constraint hierarchy (Kager, 1999, p.20). EVAL is the OT device which detects constraint violation and determines the eventual output form through elimination procedures. Higher ranked constraints must be satisfied, thus candidates which violate theMARe eliminated by EVAL. Eliminations continue till only one candidate is left. This candidate is the most harmonious with constraint hierarchy or else it causes the least costly violation of constraints as it satisfies higher ranked constraints even if it might violate lower ranked ones. This candidate is accordingly called the optimal candidate and is, thus, the eventual output. According to Kager (1999, p. 22) EVAL prioritizes the satisfaction of higher ranked constraints in its evaluation. Hence, the violation of a higher ranked constraint results in the sanction of the candidate even though this candidate satisfies all other lower ranked constraints. This principle is called strict dominance and is a key characteristic of OT's machinery.

Strict dominance considers violation of a higher-ranked constraint as irremediable regardless of the satisfaction of lower-ranked constraints. In other terms, satisfaction of lower-ranked constraints cannot compensate for the violation of higher-ranked ones. As indicated by Kager (1999, p.23) "lower-ranked constraints cannot team up against a higher-ranked constraint".

To illustrate the principle of strict dominance, one may take the instance of German. In this language, vowel hiatus is disallowed and the remedy for this issue is to insert the glottal stop /ʔ/ between two vowels like in 'beamte' /bəamtə/ (civil servant) which is realized like [bəʔamtə] (Féry and de Viyver, 2003, p.5). Three constraints interact in this case, namely *Hiatus which disallows vowel sequences, DEP-IO which forbids sound insertion and MAX-IO which prohibits sound deletion. The hierarchy of these constraints in German posits *Hiatus in the dominating position followed by MAX-IO then DEP-IO (Féry and Vijver, 2003, p.5). Thus, any candidate which violates Hiatus even though it satisfies both lower-ranked MAX-IO and DEP-IO is eliminated by EVAL. Such a candidate can be [bəamtə] whose satisfaction of the lower ranked MAX-IO and DEP-IO does not save it from elimination since it violates the higher-ranked *Hiatus.

OT uses a Tableau in order to represent the functioning of its machinery and account for phonological processes. Tableau 2.1 below illustrates OT's Tableau:

Tableau 2.1. OT's Architecture

/ bəamtə/	*Hiatus	MAX-IO	DEP-IO
[bəamtə]	*!		
[bə mtə]		*	
☞ [bəʔamtə]			*

Tableau 2.1 above includes the input in the first column on the left which is followed by columns on the horizontal axe that represent the constraints and their hierarchy. The forms in the rows under the input represent the candidates that the generator generates. The asterisk (*) represents marks of constraint violation, while the exclamatory mark (!) represents serious or irremediable violation of constraints often because the constraint in question is a higher ranked constraint. The index ☞ indicates the optimal candidate which is selected by EVAL as the eventual output form.

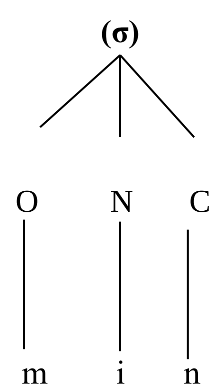
As aforementioned, OT's machinery serves to account for phonological processes like assimilation, epenthesis and deletion. The latter processes as proved in chapter one require reference to syllable structure for their account. Accordingly, the syllable possesses a pivotal status in OT. The subsequent section tackles this point.

2.2. Syllable Theory in OT

2.2.1. Syllable: An Overview

A syllable is a prosodic unit that is represented by the node (σ). As indicated by Prince and Smolensky (2004, p.96), a syllable node dominates a set of daughter nodes which are respectively referred to as onset, nucleus and coda. These nodes are, then, associated with consonants and vowels. The nucleus is the only obligatory part of a syllable and is generally associated with a vowel, while onsets and codas are associated with consonants. Yet, in some languages, as Berber, consonants may also be syllable nuclei (Prince and Smolensky, 2004, p.11). Onset and coda are optional as some syllables may be onsetless or codaless. Onset and coda must dominate consonants and never vowels. Furthermore, they may be associated with more than one consonant. In such cases, onsets or codas are complex. Syllable structure can be illustrated by a word like the Arabic definite article /min/ ’from’ whose syllable structure can be represented by the following tree diagram:

(1)



Languages display different types of syllables. However, the CV-type which represents a syllable that consists of an onset and a nucleus, but has no coda exists in all languages. As stated by Jakobson (1962) “There are languages lacking syllables with initial vowels and/ or syllables with final consonants, but there are no languages devoid of syllables with initial consonants or of syllables with final vowels" (cited in Prince and Smolensky, 2004, p.93). The CV-syllable type represents the basic syllable or else the unmarked syllable type. As indicated by Kager (1999, p.94), the fact that CV-type is the basic syllable type is based on articulatory and perceptual grounds as well as on typological grounds. CV- syllable type is manifested in all languages, and thus it is cross linguistically preferred. Furthermore, as signaled by Kager (1999, p.94), "the best starting point for a vowel is a preceding consonant" from both articulatory and perceptual perspectives. Hence, onsetful syllables are preferred to onsetless ones because of the formerly mentioned articulatory and perceptual motivation. Similarly, open syllables are favoured to closed syllables because of articulatory and perceptual reasons. As assumed by Ohala (1990) and Steriade (1995) "coda consonants particularly those standing before another consonant, tend to be unreleased and hence lack perceptual cues that are present in prevocalic consonants, which are released" (cited in Kager, 1999, p.94).

2.2.2. The Syllable's Status in OT

The structure of the syllable serves to account for non-assimilatory processes like epenthesis and deletion. As indicated in chapter one, disregarding the unit of the syllable in accounting for epenthesis and deletion results in cases of conspiracies as demonstrated by Kisseberth (1970) in the Koryak instance of vowel epenthesis. Rule-based account of this process in Koryak, as indicated by Kisseberth (1970, p.291) devotes two different and unrelated rules to account for just two different cases of the same process. The rules are replicated below:

(2) $\emptyset \rightarrow V / \#C\_\_\_\_\_ C$

(3) $\emptyset \rightarrow V / VCC\_\_\_\_\_ C$

Such a conspiracy is the outcome of the discard of the syllable in rule-based phonology. Indeed, if syllable structure were included in the account of the former cases of vowel epenthesis in Koryak, the similarity that is inherently present between rules (2) and (3) could be captured. Furthermore, rules (2) and (3) could be compressed to a single unified rule. Effectively, both rules account for vowel epenthesis which applies in order to avoid complex syllable onsets. In rule (2), the complex onset is in a word initial syllable, while in rule (3) the complex onset is in a word medial syllable. Indeed, syllabification of the sequence VCCC in rule (3) parses VC under one syllable and CC as the onset of the second under another syllable.

OT's proponents (Prince and Smolensky 1993 and McCarthy and Prince 1995) were well aware of the crucialty of the syllable in accounting for phonological processes like epenthesis and deletion. For this particular reason, they developed a set of markedness constraints that require the preservation of syllable structure. This type of markedness constraints was correspondingly attributed the label of syllable structure constraints.

Syllable structure constraints were developed by Prince and Smolensky (1993) to preserve what is known as the preferred syllable type in language typology. This syllable type is a syllable which has an onset, but lacks a coda. This syllable type is also called an open onsetful syllable and symbolized by CV. As indicated by Féry and de Vijver (2003, p.6):

> It has been repeatedly observed that all languages have syllables of the form CV but not necessarily other forms (Jakobson 1906, Prince and Smolensky 1993, Belvins 1995), which follows from certain typological generalizations. First, if a language has syllables without onsets (V), it also has syllables with onsets (CV). Second, if a language has closed syllables (CVC), it also has open ones (CV). Furthermore, if a language has syllables with complex onsets (CCV), it also has

CV syllables. And finally, if a language has syllables with complex codas, it also has CVC syllables and therefore also CV ones.

Thus, syllable structure constraints aim at preserving the preferred CV-syllable type. In other terms, syllable structure constraints require syllables to have onsets and to lack codas. Syllable structure constraints are introduced below as indicated in Prince and Smolensky (2004, p.96):

(4) Syllable structure constraints

NUC (nucleus)

Syllables must have nuclei.

ONS (onset)

A syllable must have an onset.

-COD (no coda)

A syllable must not have a coda.

***COMPLEX**

No more than one C or V may associate to any syllable position node.

The above set of constraints, then, requires a syllable to have a nucleus and an onset and to lack a coda. Furthermore, the constraint *COMPLEX militates against clusters of consonants in both onset and coda as well as vowel sequences. Two different members of the parent constraint *COMPLEX were developed to either refer to the prohibition of complex onset or to that of complex codas. Such a distinction is necessary to describe languages which allow complex onsets, but ban complex codas or vice versa. These constraints are formulated as follows in Kager (1999, p.97)

(5) ***COMPLEX ONS**

*σ [CC ('Onsets are simple').

***COMPLEX COD**

*CC] σ ('Codas are simple').

*COMPLEX was then restricted only to clusters of consonants and another constraint known as NO HIATUS was introduced to prohibit sequences of vowels. NO HIATUS bans vowels to appear in a sequence without being interrupted by a consonant (Fanslow & Féry, 2000, p.17).

In spite of the typological as well as articulatory and perceptual motivations for the unmarkedness of the CV syllable type, languages do contain other syllable types such as V, VC, VCC, CVC, CCV, CCVC, CVCC, CCVCC. Such syllable types often result when faithfulness constraints which require agreement of the input and output dominate the syllable structure constraints that were introduced above. Two theories of faithfulness developed from OT, namely containment theory and correspondence theory. Each theory advanced a set of faithfulness constraints some of which relate to syllable structure. The following subsections provide a brief overview of each theory.

2.2.3. Faithfulness Theories

2.2.3.1. Containment Theory

Containment theory is a theory of faithfulness that was introduced by Prince and Smolensky (1993). Two types of faithfulness constraints were set forth by such theory, namely PARSE and FILL. PARSE and FILL require, as indicated in Prince and Smolensky (2004, p.94), that every input segment be associated with a syllable position, viz onset, nucleus or coda. PARSE and FILL are formulated as follows in Prince and Smolensky (2004, p.94):

(6) PARSE

Underlying segments must be parsed into syllable structure.

(7) FILL

Syllable positions must be filled with underlying segments.

FILL is violated when a new syllable position is inserted, but there is no segment in the input to fill such position. PARSE is violated when an input segment is not associated with a syllable position or is not parsed into a syllable position.

The notion of 'containment' implies that "the input is contained in the output" (Kager, 1999, p.99). In cases of deletion, for instance, the segment which is deleted is not completely erased: it is contained in the input, but it is left phonetically unpronounced, and is thus not present in the output (cf. 'Stray Erasure' in autosegmental phonology in McCarthy, 1979).

PARSE and FILL are violated if they are dominated by the markedness constraints that were introduced earlier. In such case, either epenthesis or deletion result, depending on whether it is FILL or PARSE that is the lowest ranked. In containment theory, syncope is called underparsing since a segment that is deleted is not parsed into a syllable position. Epenthesis, on the other hand, is termed overparsing in containment theory as epenthesis creates a new syllable position that has no input segment that could fill it.

2.2.3.2. Correspondence Theory

Correspondence theory is another theory of faithfulness that was introduced by McCarthy and Prince (1995). Instead of viewing faithfulness as a "one-to-one correspondence" between input segments and syllable positions, as in containment theory (Prince and Smolensky, 2004, p.94), correspondence theory considers faithfulness as a one-to-one correspondence between input segments and their output counterparts. Correspondence is defined as follows in McCarthy and Prince (1995, p.14):

Correspondence

> Given two strings S1 and S2, correspondence is a relation R from the elements of S1 to those of S2. Elements α E S1 and β E S2 are referred to as correspondents of one another when α R β.

A number of faithfulness constraints were set forth by correspondence theory. Among such constraints DEP-IO (Dependency Input-Output) and MAX- IO (Maximality Input-Output) are of special concern since they relate to syllable-structure processes such as epenthesis and deletion. DEP-IO and MAX-IO are formulated as follows in McCarthy and Prince (1995, p.16):

(8) DEP-IO

Every segment of the output has a correspondent in the input. (prohibits phonological epenthesis)

(9) MAX-IO

Every segment of the input has a correspondent in the output (no phonological deletion)

Hence, any output form that includes an epenthetic segment violates DEP-IO since it includes a segment that has no input counterpart. Similarly, any output form from which a certain sound is deleted violates MAX-IO as an input segment has no counterpart in the output.

Languages often resort to processes like epenthesis and deletion to obtain the preferred CV syllable type. Within an OT framework, such processes are explained as being the result of the domination of one of the syllable-structure constraints that were mentioned earlier over the faithfulness constraints FILL and PARSE or DEP-IO and MAX I-O, depending on the theory of faithfulness that is adopted.

In some cases, faithfulness constraints may dominate syllable structure constraints. MAX-IO may dominate –COD, for instance, which would result in closed syllables. When codas are allowed, a markedness constraint called CODA CONDITION (CODA COND) restricts the set of consonants that may appear in coda position. CODA CONDITION is formulated as follows in Prince and Smolensky (2004, p.109):

(10) CODA COND

A coda consonant can have only coronal place or place shared with another consonant.

CODA COND allows only coronal consonants or a consonant that is homorganic with the onset of a following syllable to occupy coda position. Furthermore, CODA COND may differ from one language to another. For example, in Sranan, which is an English creole that is spoken in the Caribbean Islands, CODA COND allows only nasal consonants to occupy coda position (Alber and Plag 1999, p.14).

2.2.4. OT-based Account of Koryak Vowel Epenthesis

The former instance of conspiracy introduced by Kisseberth (1976) can be accounted for successfully using OT's syllable structure constraints and faithfulness constraints relating epenthesis. Indeed, vowel epenthesis in both cases of Koryak is the outcome of interaction between the markedness constraint *Complex Onset and the faithfulness constraints MAX-IO and DEP-IO. Given that in both word initial cluster CC and word medial cluster VCCC a complex onset CC is encountered, a vowel is inserted between the two consonants to avoid complex onsets. Such insertion is the outcome of the domination of the markedness constraint *Complex Onset over the faithfulness constraints MAX-IO and DEP-IO respectively in Koryak. Furthermore, epenthesis rather than deletion takes place because the anti-deletion faithfulness constraint MAX-IO dominates the anti-epenthesis faithfulness constraint DEP-IO in Koryak. OT's Tableau provides an elegant description and explanation of vowel epenthesis in Koryak. The following Tableau includes the instance of /t-pəŋlon/ 'I aske him' (Spencer, 1996, p.171):

Tableau 2.2. Vowel Epenthesis in Koryak

/t-pəŋlon/	*Complex Onset	MAX-IO	DEP-IO
[tpəŋlon]	*!		
[təŋlon]		*	
☞ [təpəŋlon]			*

Tableau 2.2 indicates that [təpəŋlon]is the optimal candidate since it is the most harmonious with constraint hierarchy, violating the lower ranked DEP-IO in order to satisfy the higher ranked *Complex Onset. [tpəŋlon] is ruled out as it violates the higher ranked *Complex Onset which is a serious violation. [təŋlon] is also excluded as it satisfies lower ranked DEP-IO at the expense of higher ranked MAX-IO. Indeed, since MAX-IO dominates DEP-IO in Koryak, the candidate which satisfies MAX-IO is privileged over the one which violates MAX-IO. Thus, [təpəŋlon] is the winner of the selection as it satisfies both higher ranked constraints *Complex Onset and MAX-IO as opposed to [təŋlon] which violates the higher ranked MAX-IO even though it satisfies the higher ranked *Complex Onset.

The representational elegance and adequacy of OT pushed a number of phonologists, first among them OT's proponents Prince and Smolensky (1993) and McCarthy and Prince (1995) to apply OT in accounting for different types of phonological processes, namely assimilation, epenthesis and deletion in different languages. The following sections highlight the most influential studies that applied OT in accounting for cases of assimilation, epenthesis and deletion.

2.3. OT-based Account of Epenthesis, Deletion and Assimilation

2.3.1. OT-based Account of Epenthesis and Deletion

Prince and Smolensky (1993) is among the earliest studies which applied OT in order to account for a phonological process. In this study, Prince and Smolensky (1993) attempted to describe and explain vowel deletion in Lardil, an indigenous language that is spoken in Mornington Island in northern Australia. Prince and Smolensky (1993) reported that Lardil's vowel deletion is the outcome of the syllable structure constraint ONSET dominating the containment-theory faithfulness constraint PARSE. Indeed, deletion occurs after the accusative suffix '-in' is added to Lardil nouns such as /yukarpa/ 'husband' (Prince and Smolensky, 2004, p.108) which results in /yukarpain/. Such morphological process results in a phonologically offensive structure as it creates the onsetless syllable /in/ (/yu.kar.pa.in/), thus violating the syllable structure constraint ONS. Lardil resolves such offensive structure by deleting /i/ of /in/, thus yielding the syllabification [yu.kar.pan] in which all syllables possess an onset. Deletion of /i/, therefore, allows the satisfaction of the syllable structure constraint ONS, but leads to the violation of the faithfulness constraint PARSE which militates against the underparsing or else deletion of a sound. Obviously, Lardil's resolution to deletion in that case is triggered by its constraint hierarchy which ranks ONS higher than PARSE (Prince and Smolensky, 2004, p.108).

Another study which applied OT in accounting for yet another type of non-assimilatory process was conducted by McCarthy and Prince (1995). In this study, McCarthy and Prince (1995) indicated how glide insertion in Madurese, a language spoken in Indonesia, could be accounted for from an OT perspective, using correspondence theory. They considered such a process as the result of the markedness constraint ONS dominating the faithfulness constraint DEP-IO which disallows epenthesis. Effectively, the glide /j/ is inserted in Madurese words such as /seaŋ/ 'afternoon' to avoid having an onsetless syllable /aŋ/. The outcome is the output [sejaŋ] which satisfies ONS at the expense of DEP-IO which is lower-ranked in the language. (McCarthy and Prince, 1995, p.27).

Alber and Plag (1999) is another study in which OT was applied to account for epenthesis and deletion in Sranan, an English Creole that is spoken in Suriname a Caribbean Island. The English word 'because', for instance, is realized as [bikasi] in Sranan with a final epenthetic /i/. Alber and Plag (1999, p.14) reported that epenthesis of /i/ in [bikasi] is the outcome of the requirement of the markedness constraint CODA COND which in the case of Sranan allows only nasals to occupy coda position. Given that /s/ is not a nasal, it cannot occupy coda position. Thus, /i/ is inserted after /s/ in order to avoid violation of CODA COND. According to Alber and Plag (1999, p.14), the occurrence of epenthesis in Sranan words like [bikasi] is justified by the fact that CODA COND is higher ranked in Sranan than the anti-epenthesis constraint DEP-IO. Furthermore, epenthesis rather than deletion occurs in the case of [bikasi] since the anti-deletion constraint MAX-IO is higher ranked than DEP-IO in Sranan, while it is left unranked with respect to CODA COND. The following Tableau indicates why [bikasi] is the optimal realization of /bikoz/ 'because' as demonstrated in Alber and Plag (1999, p.15):

Tableau 2.3. Selection of the Optimal Output of /bikɒz/

bikɒz	CODA COND	MAX-IO	DEP-IO
☞ a.bikasi			*
b. bikas	*!		
c. bika		*!	

Candidate (a) is preferred to (b) and (c) since unlike (b) it avoids violation of the higher ranked CODA COND thanks to its epenthetic /i/ which creates an open syllable /si/. Moreover, (a) is favoured upon (c) since it preserves its final /s/ and thus, does not violate MAX-IO which is violated by (c).

Alber and Plag (1999, p.16) also accounted for consonant deletion in Sranan within an OT framework. In Sranan, a consonant is often deleted to avoid complex onsets and codas. Generally, tri-consonantal clusters are unacceptable in Sranan so that an English loanword, such as /strɒng/ 'strong' is realized as [tranga]. Deletion applies in such a case since the cluster /str/ violates the markedness constraint Sonority Sequencing Principle (SSP) which requires that “Sonority must increase towards the peak” (Alber and Plag, 1999 p.16). /s/ is more sonorous than /t/, yet /t/ is closer to the peak than /s/. Furthermore, /s/ is deleted and not /t/ in order to preserve contiguity of segments or “the linear sequence of segments” (Alber and Plag, 1999, p.17). Deletion of /t/ would produce the non-contiguous /sranga/. Hence, /s/ is deleted rather than /t/ in order to satisfy the requirement of the faithfulness constraint NOSKIP. NOSKIP disallows the deletion of the second consonant of a tri-consonantal cluster in order to avoid a non- contiguous string (Alber and Plag, 1999, p.17). Insertion of a vowel between /s/ and /t/ to satisfy (SSP) is rejected by another contiguity constraint which is called NO INTRUDE. NO INTRUDE bans the interruption of the linearity of a string by a vowel. The following Tableau explains why the deletion of /s/ in /strɒng/, yielding [tranga], is the best resolution of the complex onset /str/ as sketched in Alber and Plag (1999, p.20):

Tableau 2.4. Selection of the Optimal Output of /strɒng/

strɒng	SSP	CODA COND	NO INTRUDE	NO SKIP	MAX-IO	DEP-IO
☞ a.tranga					*	
b. sranga				*!	*	
c. si.tranga			*!			*
d. stranga	*!					
e. i.stranga	*!					*
f. is.tranga		*!				*

Candidate (a) is the optimal candidate as it satisfies the higher ranked constraint SSP unlike candidates (d) and (e) which include the offensive string /str/. Furthermore, (a) satisfies the higher ranked CODA COND as opposed to (f) which contains the impermissible coda /s/. Candidates (b) and (c) are also excluded as they violate NO SKIP and NO INTRUDE, respectively.

Ghadoua (2000) was among the earliest studies in which OT was used in order to account for epenthesis in Arabic. In this study, Ghadoua (2000) analyzed epenthesis in Quranic Arabic (QA). In QA, a glottal /ʔ/ and the vowel /i/ or /a/ are inserted to avoid complex onsets as in /mraʔah/ ‘woman’ and /qalamu/ ‘pen’ which are respectively realized as [ʔimraʔah] and [ʔalqalamu]. Ghadoua (2000, p.77) indicates that epenthesis in QA is motivated by the constraints *COMPLEX

ONSET and ONSET. Complex onsets like /mr/ in /mraʔah/ are avoided through the epenthesis of /i/ before /mr/ which leads to the syllabification /im.ra.ʔah/. Then, the glottal stop is inserted to the onsetless syllable /im/ in order to satisfy ONSET. Tableau 2.5 indicates why [ʔim.ra.ʔah] is the optimal output of /mraʔah/:

Tableau 2.5. Selection of the Optimal Output of /mraʔah/

mraʔah	ONS	*COMPLEX ONS	Fill $_{ONS}$	Fill $_{NUC}$
☞a.ʔim.ra.ʔah			*	*
a. im.ra.ʔah	*!			*
b. mraʔah		*!		

(Ghadoua, 2000, p.77)

Tableau 2.5 demonstrates that candidate (a) is the optimal candidate. (a) is favoured upon candidate (b) as it satisfies ONS by including the epenthetic /ʔ/ as onset to the onsetless syllable /im/, unlike (b) which leaves such syllable onsetless. Moreover, candidate (a) is preferred to (c) since it satisfies both *COMPLEX ONS and ONS by containing the vowel /i/ before the complex onset /mr/ which splits the cluster into two different syllables, namely [ʔim] [ra], and also by including the glottal stop /ʔ/ before the onsetless syllable /im/.

Another OT-based study that is worth reviewing is Eddington's (2001) study of vowel prosthesis in Spanish. Indeed, a vowel tends to be inserted before the complex onset /sp/ in Spanish words like /spera/ 'to wait' to avoid the impermissible onset /sp/. Epenthesis is employed in such a case in order to satisfy the markedness constraint SONORITY which is the same as Alber and Plag's (1999) Sonority Sequencing Principle (SSP). SONORITY requires that "the most sonorous elements must be the closest to the nucleus" (Eddington, 2001, p.40). Given that /sp/ decreases in sonority towards the nucleus, it violates SONORITY. The vowel /e/ is then inserted before /sp/, yielding the syllabification [es.pe.ra]. Eddington (2001, p.40) reports that epenthesis occurs before the cluster rather than within it because of the markedness constraint Morpheme Contiguity (M-CONT) which "prohibits the insertion of elements into a morpheme" (Eddington, 2001, p.40). The following tableau demonstrates why [es.pe.ra] emerges as the optimal output of the input /spera/ as indicated in Eddington (2001, p.41):

Tableau 2.6. Selection of the Optimal Output of /spera/

spera	M-CONT	SONORITY	FAITH-V	NO CODA
a. spe.ra		*!		
b. se.pe.ra	*!		*	
☞ c. es.pe.ra			*	*

It appears from tableau 2.6 that candidate (c) is the optimal candidate. As opposed to (a), (c) satisfies the higher ranked constraint SONORITY by splitting the impermissible cluster /sp/ into two separate syllables. Moreover, (c) is preferred to (b) as it satisfies the higher ranked M-CONT via the insertion of /e/ before the cluster rather than within it. Violation of the lower ranked FAITH-V in (c) is necessary in order to satisfy SONORITY. Similarly, violation of the lower ranked NO CODA in (c) is also required so as to satisfy the higher ranked M-CONT.

Lee (2001) also applied OT model in accounting for epenthesis in English loanwords that are used in Korean. Korean does not allow complex onsets and codas. Hence, a vowel like /i/ is inserted in English loans like /disk/ ‘disk’ which is realized as [disik^{h}i] to break the coda cluster. Lee (2001, p.5) demonstrates that epenthesis is triggered by the markedness constraint *COMPLEX which prohibits complex onsets and codas. Epenthesis rather than deletion applies in Korean since the anti-deletion constraint MAX-IO is higher ranked in Korean than the anti-epenthesis constraint DEP-IO. Furthermore, splitting the cluster /sk/ by syllabifying /s/ as coda of the first syllable and /k/ as onset of the first syllable [dis.ki] is prevented by CODA COND which allows only the consonants [p, t, k, m, n, ŋ, l] to occupy coda position in Korean (Lee, 2001, p.3). The following tableau indicates why [disik^{h}i] is the optimal output of /disk/ in Korean:

Tableau 2.7. Selection of the optimal output of / disk/

‘disk’	*COMPLEX	CODA COND	MAX-IO	DEP-IO
☞a. disik^{h}i				**
a. disk	*!			
b. disi			*!	*
c. di.ski	*!			*
d. idisik^{h}i				***
e. dis.k^{h}i		*!		*

Lee (2001, p.5)

It appears from tableau 2.7 that (a) is the winning candidate as it satisfies the higher ranked *COMPLEX, unlike (b) and (d), by breaking the impermissible cluster /sk/ through epenthesis.

Moreover, (a) is selected over (f) since (a) includes no coda that violates CODA COND in Korean, while (f) violates CODA COND by including the coda /s/ which is not among the segments that are allowed by CODA COND in Korean. Candidate (c) is excluded too as it misses one segment of the input which is /k/ and thus, violates MAX-IO. Candidate (e) is excluded since it incurs three violations of DEP-IO. The prosthesis of /i/ before /d/ is unnecessary, and thus does not respect OT's principle of economy.

Galal (2004) is another study in which OT was used in order to account for epenthesis in Arabic. This study dealt with epenthesis in the English loanwords that are adopted in Cairene Arabic (CA) and which do not conform to the syllable structure of CA. Two kinds of epenthesis usually take place in order to adapt such loans to the syllable structure of CA. Indeed, Galal (2004, p.6) indicated that a vowel is, first, inserted before English loans like /stub/ 'stub', yielding [istub] since complex onsets are prohibited in CA. A glottal stop /ʔ/ is then inserted before /i/ to avoid an onsetless syllable which is also disallowed in CA. CA vowel epenthesis, as stated by Galal (2004, p.7), is triggered by the markedness constraint *COMPLEX ONS which bans consonants clusters in onset position. Furthermore, glottal stop insertion is considered the outcome of the constraint ONSET which requires syllables to have onsets. Tableau 2.8 indicates why [ʔistub] is the optimal output of /stub/ as demonstrated in Galal (2004, p.7):

Tableau 2.8. Selection of the Optimal Output of /stub/

stub	ONS	*COMPLEX	MAX-IO	DEP-IO
☞ a. ʔistub				*
b. istub	*!			*
c. stub		*!		

Tableau 2.8 indicates that (a) is the winning candidate as it satisfies ONS, unlike (b), through the epenthetic /ʔ/ at the beginning of the onsetless /is/. Furthermore, (a) is favoured upon (c) since it satisfies *COMPLEX ONS by containing an epenthetic vowel that separates the complex onset /st/. After /i/ is inserted, /s/ syllabifies as the coda of the first syllable and /t/ as onset to the second syllable.

Kikuchi (2004) accounted for the process of final /r/ deletion in Catalan using the model of OT. /r/ is deleted in Catalan when it is final in a stressed syllable. Kikuchi (2004, p.2) considers /r/ deletion in Catalan since it is “too sonorous to be in coda position of a stressed syllable”. In other terms, a sonority hierarchy of margins in stressed syllables considers liquids, and thus, /r/ as being marked in “marginal position of a stressed syllable” (Kikuchi, 2004, p.2). Such sonority hierarchy is called Margin Sonority Hierarchy in stressed syllables and is formulated as follows:

Margin Sonority Hierarchy in Stressed Syllables
// *M (σ́)/ vowel » *M (σ́)/ glide » *M (σ́)/ liquid » (σ́)/ nasal » (σ́)/ obstruent//

(Kikuchi, 2004 p.2)

Margin Sonority Hierarchy in stressed syllables was inspired from Margin Sonority Hierarchy which is formulated as follows in Kikuchi (2004, p.2):

The Margin Sonority Hierarchy
//*M/ vowels » *M/ glide »*M/ liquid » *M/ nasal » *M/ obstruent//

Thus, /r/ is deleted when it is final in a stressed syllable as a result of the Margin Sonority Hierarchy in stressed syllables which considers /r/ as being a marked margin in a stressed syllable. Hence, the input /klἀr/ ‘clear’ is realized as [klἀ] without the final /r/. Tableau 2.9 indicates why [klἀ] is the optimal output of the input /klἀr/:

Tableau 2.9. The selection of the optimal output of /klἀr/

klἀr	*M (σ́)/ liquid	MAX-IO	*M/ liquid
a. klἀr	*!		*
☞b. klἀ		*	

(Kikuchi, 2004, p.2)

It appears from Tableau 2.9 that candidate (b) is the optimal candidate since it satisfies the higher ranked constraint *M (σ́)/ liquid which considers /r/ as being a marked margin in stressed syllables. Unlike (a), (b) satisfies *M (σ́)/ liquid through the deletion of the final /r/. It is worth noting that *M (σ́)/ liquid is a context-sensitive constraint which considers liquids as being marked margins in stressed syllables only, while *M/ liquid is a context sensitive constraint which considers liquids as marked margins in both stressed and unstressed syllables. The optimal candidate (b) satisfies both types of constraints.

Kikuchi (2004, p.2) then demonstrates that /r/ is not deleted when it is a margin of an unstressed syllable. The /r/ in an unstressed syllable as in /mἶsər/ ‘miserable’ is not deleted since the higher ranked *M (σ́)/ liquid considers /r/ as a marked margin in stressed syllables only. Thus, *M (σ́)/ liquid is inactive in such case and /mἶsər/ is realized as [mἶzər]. Even though such output violates the lower ranked *M/ liquid, such violation is necessary in order to avoid an unnecessary violation of the higher ranked MAX-IO.

Louriz (2004) also applied OT in her account of the deletion process which is observed in French loans that are used in Moroccan Arabic (MA). When a French loan starts with a vowel as in /agrese/ ‘to attack’, the initial vowel of such loan is deleted, yielding the realization [grisa]. According to Louriz (2004, p.8), such deletion is motivated by the markedness constraint ONSET which requires syllables to have onsets. Given that /ag/ in /agrese/ is onsetless, MA resorts to the deletion of initial /a/ to repair for the violation of ONSET. Tableau 2.10 demonstrates how [grisa] wins over other candidates as the output of /agrese/ as sketched in Louriz (2004, p.9):

Tableau 2.10. Selection of the Optimal Output of /agrese/

agrese	ONSET	DEP-IO	MAX-IO
☞ a.(grisa)			*
a. ʔa(grisa)		*	
b. a (grisa)	*		

Tableau 2.10 indicates that candidate (a) is the optimal candidate as it satisfies the higher-ranked constraint ONSET, unlike (c), through the deletion of the vowel /a/ which occupies an onsetless syllable. Candidate (a) is favoured over (b) since it satisfies DEP-IO through avoidance of epenthesis. It appears that (a) is preferred to (b) because DEP-IO dominates MAX-IO in MA. Thus, violation of MAX-IO is less costly than that of DEP-IO.

Btoosh (2006) used OT to account for epenthesis in Karak Arabic (KA), a dialect of Jordanian Arabic. KA does not allow syllables that lack an onset. Thus, the glottal stop /ʔ/ is inserted to repair onsetless syllables. Btoosh (2006, p.196) indicated that /ʔ/ is inserted in onsetless syllables like the proper name /aħmad/ 'Ahmed', yielding [ʔaħ.mad] as a result of the markedness constraint ONSET which requires syllables to have onsets. Tableau 2.11 demonstrates why [ʔaħ.mad] is the optimal candidate of /aħmad/ as indicated in Btoosh (2006, p. 197):

Tableau 2.11. Selection of the Optimal Output of /aħmad/

aħmad	ONSET	DEP-IO
a. aħ.mad	*!	
☞ b. ʔaħ.mad		*

It appears from tableau 2.11 that candidate (b) is the optimal candidate as it satisfies the higher ranked constraint ONSET. Candidate (b) wins over (a) since it satisfies ONSET by containing the epenthetic /ʔ/ which fills the empty onset node of the syllable /aħ/. However, there is nothing in the analysis that indicates why is /ʔ/ inserted and not part of the input /aħmad/?

Aba-Alkh (2007) appiled OT in his analysis of epenthesis in Taifi Arabi (TA), an Arabic dialect that is spoken in Saudi Arabia. As indicated Aba-Alkh (2007, p.41) Complex codas are allowed in TA, yet epenthesis applies within complex codas when they violate Sonority Sequencing Principle (SSP). According to Aba-Alkh (2007, p.42) SSP requires complex codas to rise in sonority towards the peak. The word /ħibr/, for example, is realized as [ħibir] in TA since the complex coda /br/ rises in sonority towards the margin rather than towards the peak, and thus violates SSP. Tableau 2.12 shows why [ħibir] is the optimal output of /ħibr/:

Tableau 2.12. The selection of the optimal output of /ħibr/

/ħibr/	ONS	PARSE	SSP	FILL	-COD
a. ħibr			*!		*
b. ħib		*!			*
☞ c. ħi.bir				*	*
d. ħib.ri				*	*

Aba-Alkh (2007, p.49)

Tableau 2.12 indicates that candidate (c) is the optimal candidate as it satisfies the higher ranked PARSE, unlike (b), through avoidance of deletion. (c) is chosen rather than (a) since it incurs no violation of SSP by containing a vowel /i/ between the complex coda /br/ which violates SSP.

Al-Mohanna (2007) is another study which includes an OT analysis of epenthesis in Taifi Arabic (TA), an Arabic dialect spoken in Saudi Arabia. As indicated by Al-Mohanna (2007, p.41), complex codas are allowed in TA, yet epenthesis applies within complex codas when they violate Sonority Sequencing Principle (SSP). SSP requires complex codas to rise in sonority towards the peak (Al-Mohana, 2007, p.42). The word /ħibr/, for example, is realized as [ħibir] in TA since the complex coda /br/ rises in sonority towards the margin rather than towards the peak, and thus violates SSP. Even though the insertion of /i/ results in the violation of the lower ranked FILL, such violation is necessary to satisfy the higher- ranked SSP (Al-Mohana, 2007, p.49).

Uffmann (2007) also used OT model in his analysis of the process of English /r/ epenthesis postlexically. When a vowel sequence occurs at word boundaries in English, it is usually resolved through consonant insertion. Consonant insertion is motivated by the markedness constraint ONS which requires syllables to have onsets (Uffmann 2007, p.460). The phrases ‘key is’ and ‘zoo is’ illustrate cases of vowel hiatus where the second syllable /ɪz/ is onsetless. Uffmann (2007, p.465) stated that a glide is inserted when the first vowel of the hiatus is a high vowel so that the outputs of /kiː ɪz/ ‘key is’ and /zuː ɪz/ ‘zoo is’ are [kiː jɪz] and [zuː wɪz]. Uffmann (2007, p.465) then indicated that in case the first vowel of the hiatus is not high, /r/ is inserted to satisfy ONS. The selection of /r/ rather than any other consonant to resolve vowel hiatus in words like /lɔː ɪz/ ‘law is’ which is realized as [lɔː rɪz] is justified by the markedness scale for intervocalic consonants which is formulated as follows in Uffmann (2007, p.465):

*V_V/ Lar » *V_V/ Obs » *V_V/ Nas » *V_V / l » *V_V/r » *V_V/V

After vowels, /r/ is considered the least marked segment that can appear intervocalically. According to Uffmann (2007, p.465), glide insertion in such cases as / lɔː ɪz/ is impeded by the faithfulness constraint DEP (hi) which prohibits the feature [high] from being present in the output if it is not found in the input. In other words, if the input contained a high vowel like /iː/ in /kiː ɪs/, /j/ can be inserted since the feature [+high] would spread from the vowel /iː/ to the epenthetic segment. Another constraint *G[-hi] which considers non- high glides like /ɤ/ as being marked (Uffmann, 2007, p.465) prevents the epenthesis of a non-high glide. Thus, r-insertion is the best solution for vowel hiatus at word boundaries as in /lɔː ɪz/. The following tableau indicates why [lɔː rɪz] is the optimal output of /lɔː ɪz/ as indicated in Uffmann (2007, p.466):

Tableau 2.13. Selection of the Optimal Output of /lɔː ɪz/

lɔː ɪz	ONS	*G [-hi]	DEP (hi)	DEP-IO	*V_V/Lar	*V_V/r	*V_V/ V
a. lɔː ɪz	*!						
b. lɔː wɪz			*!	*			*
c. lɔː ɣɪz		*!		*			*
☞ d.lɔː rɪz				*		*	
e. lɔː ʔɪz				*	*!		

Tableau 2.13 indicates that candidate (d) is the optimal candidate as it satisfies ONS, unlike (a), by including an epenthetic /r/ that syllabifies as onset of the syllable /ɪz/. (d) is preferred to (c) as it satisfies *G[-hi] and DEP (hi) by containing /r/ rather than a glide as an epenthetic segment. Finally, (d) is preferred to candidate (e) since it contains an epenthetic segment that is more sonorous than the epenthetic segment in (e). As a matter of fact, the epenthetic segment in (e) is /ʔ/ which is the least sonorous segment on the sonority scale, and is thus more marked than /r/ intervocalically.

Aljumah (2008) made use of OT to account for epenthesis in Al-Ahsa Arabic (AA) which is an Arabic dialect spoken in Saudi Arabia. Al-Ahsa Arabic disallows onsetless syllables and thus, the glottal stop /ʔ/ is often inserted to repair onsetless syllables. Such process is exemplified by the word /isbir/ ‘be patient’ which is realized with an inserted glottal stop at the beginning of the onsetless syllable /is/. The resulting output is selected on the basis of constraint hierarchy in AA which priviledges the markednes constraint ONSET over the faithfulness constraint DEP-IO.

Tableau 2.14 demonstrates why [ʔis.bir] is the optimal candidate of /is̲bir/ as indicated in Aljumah (2008, p.167):

Tableau 2.14. Selection of the Optimal Output of /isbir/

is̲bir	ONSET	MAX-IO	PARSE-seg	DEP-IO	NO-CODA
a. is̲bir	*!				*
☞ b. ʔis̲bir				*	*
c . ʔis̲.bi		*!		*	*
d . ʔis̲.bi.r			*!	*	*

It appears from tableau 2.14 that candidate (b) is the optimal candidate as it satisfies the higher ranked constraint ONSET, unlike (a), by containing an epenthetic /ʔ/ which provides the onset of the onsetless syllable /is/. (b) is favoured upon (c) since it satisfies MAX-IO by avoiding the deletion of /r/ unlike (c) in which /r/ is deleted. Finally, (b) is favoured upon (d) since it satisfies PARSE-seg which requires that “every segment must belong to a syllable” (Aljumah, 2008, p.165). As a matter of fact, all the segments in (b) belong to a syllable, unlike (d) in which /r/ is unparsed.

Mwita (2009) also had recourse to OT in his analysis of vowel epenthesis and consonant deletion in Kiwahili or Swahili. As reported by Mwita (2009, p.55), vowel epenthesis and consonant deletion affect Arabic loans that include geminates. In the Arabic loan /hadd/ ‘until’ which is used in Swahili /i/ is inserted in /hadd/ to avoid a closed syllable, resulting in [had.di]. The latter output is still not optimal as it violates the markedness constraint NO CODA which prohibits closed syllables. The syllabification [ha.ddi] is also rejected as it violates *COMPLEX and leads to a complex onset. Thus, /d/ is deleted to satisfy NO CODA, yielding the optimal output [ha.di].

Hall (2011) likewise used OT framework in his account of vowel prosthesis in Walsier German, a dialect of German. The vowel /a/ is generally inserted at the beginning of Walsier German words that start with /r/ such as /rad/ 'wheel' which is realized as [arad]. Hall (2011, p. 957) indicated that prosthesis in Walsier German is the result of the markedness constraint *R (*Rhotics) which considers /r/ as marked at word margins. Such constraint results from word edge hierarchy which is formulated as follows:

*w[G » *w[R » *w[L » *w[N » *w[O (Hall, 2011, p. 958).

Word Edge Hierarchy ranks segments from the most marked to the least marked margins of phonological words. Hall (2011, p. 953) underlined the fact that it is the phonological word rather than the syllable which represents the domain for /a/ prosthesis in Walsier German. Phonological words correspond to "monomorphemic lexical words (e.g., verbs, nouns, adjectives)" (Hall, 2011, p.954). The above margin hierarchy indicates that /r/ is the most marked word margin after glides. Such markedness is due to its high degree of sonority. Indeed, the margin hierarchy is inspired from SONORITY HIEARCHY which is formulated as follows:

"SONORITY HIERARCHY

Vowels (V) > Glides (G) > Rhotics (R) > Laterals (L) > Nasals (N) > Obstruents (O)" (Hall, 2011, p.958).

Hence, the word /rad/ is realized as [arad] since the markedness constraint *R considers /r/ as a marked word margin. Other possibilities such as the deletion of /r/ or the insertion of a less marked word margin before /r/ are respectively excluded by the faithfulness constraint MAX-C which bans consonant deletion and DEP-C which disallows consonant epenthesis. Tableau 2.15 shows why [arad] wins over its competing candidates as the optimal output of the input /rad/ as indicated in Hall (2011, p.964).

Tableau 2.15. Selection of the Optimal Output of /rad/

rad	*R	MAX-C	DEP-C	IDENT	ONS	DEP-V
c. rad	*!					
☞ b. arad					*	*
c. lad				*!		
d. ad		*!			*	
e. trad			*!			

It appears from tableau 2.15 that candidate (b) is the optimal candidate. It is chosen over (a) because it satisfies *R by including the prosthetic vowel /a/ which prevents /r/ from being a word margin. Furthermore, (b) is selected instead of candidate (d) since it satisfies the higher ranked MAX-C through the avoidance of /r/ deletion. (b) wins over (e) since it satisfies DEP-C by inserting a vowel rather than a consonant. Finally, (b) is preferred to (c) as it satisfies IDENT by preserving the same segment in the input which is /r/.

In addition to non-assimilatory processes like epenthesis and deletion, OT was also useful in accounting for various cases of assimilatory processes. The subsequent sections highlight the most common studies that applied OT in accounting for assimilation in different languages, including Arabic.

2.3.2. OT-based Account of Assimilation

Amongst the earliest studies in which OT was applied in order to account for assimilation is Lombardi's (1995). In this study, Lombardi (1995) analyzed regressive and progressive assimilation and used data from English and Dutch for her OT analysis. In her analysis of regressive voice assimilation, Lombardi (1995, p.3) used hypothetical inputs like /pigpen/ which she assumed would be realized as [pikpen] as a result of the markedness constraint AGREE which requires adjacent sounds to agree in their voice feature. It is /g/ which assimilates to /p/ and not the reverse since a positional faithfulness constraint known as IDENT ONSET LARYNGEAL (IDONSLAR) requires onset consonants of the input to preserve their voice feature in the output. Given that /p/ is onset of the syllable /pen/, it preserves its voice feature which is [-voice] and /g/ assimilates to it in order to satisfy AGREE. Devoicing of /g/ takes place, even though such devoicing results in the violation of the faithfulness constraint IDENT LARYNGEAL (ID LAR) which requires the voice feature of the input to be preserved in the output. Violation of ID LAR is necessary in order to satisfy AGREE which must be higher ranked in the hypothetical language (Lombardi, 1995, p.2). Tableau 2.16 indicates why [pikpen] is the optimal output of the hypothetical input /pigpen/ as sketched in Lombardi (1995, p.3):

Tableau 2.16. Selection of the Optimal Output of /pigpen/

pigpen	AGREE	IDONSLAR	IDLAR
a. pigpen	*!		
☞ b.pikpen			*
c. pigben		*!	*

Tableau 2.16 indicates that candidate (b) is the optimal candidate as it satisfies the higher ranked constraint AGREE, as opposed to (a) which violates it. In (b) /g/ acquires the voicing feature of its neighbouring sound /p/. (b) is preferred to (c) since (b) satisfies IDONSLAR, whereas (c) violates it. In (b) the onset /p/ preserves its input voice feature, while the coda /g/ assimilates to it.

Lombardi (1995, p.6) also studied progressive assimilation in English plurals using OT's notion of constraint interaction. The /z/ in /kætz/ 'cats' assimilates the voice feature of the preceding consonant and is realized as [s]. According to Lombardi (1995, p.6), assimilation is progressive in this case since a markedness constraint called Harms' generalization (Harms' genl.) states that "voiced obstruents are more sonorous than voiceless, and thus must be closer to the syllable nucleus" (Lombardi, 1995, p.6). In /kætz/ the most sonorous segment /z/ is not close to the nucleus, and is thus devoiced to avoid a violation of Harms' genel. Tableau 2.17 indicates why [kæts] is the optimal candidate of /kætz/ as demonstrated in Lombardi (1995, p. 6):

Tableau 2.17. Selection of the Optimal Output of /kætz/

kætz	Harms' genl.	IDLAR	*LAR
a. kætz	*!		*
b. kædz		*	*!*
☞ c.kæts		*	

It appears from tableau 2.17 that candidate (c) is the optimal candidate which satisfies the higher ranked Harm's genl., unlike (a) which violates it. In (a) the most sonorous segment /z/ is not close to the nucleus, while in (c) /z/ is devoiced to /s/, and thus it is not required for it to be close to the nucleus. Candidate (c) is favoured upon (b) since it satisfies *LAR as opposed to (b) which violates *LAR. * LAR requires obstruents to be voiceless or as put by Lombardi (1995, p. 2) "*LAR: Don't have laryngeal features". In (c) both sounds of the cluster /ts/ are voiceless, while in (b) they are both voiced.

Lombardi (1995) also accounted for progressive assimilation in Dutch within an OT framework. In Dutch, a voiced fricative is devoiced when it is preceded by a voiceless stop. According to Lombardi (1995, p. 275), such process is the outcome of the markedness constraint Fric Voice (fricative Voice) which considers voicing of fricatives after voiceless obstruents as being marked: *[-Son] [-Son]

[+Cont]

[+Voice] (Lombardi, 1995, p.10)

Hence, a word like / ɔp-vure/ 'perform' is realized with a devoiced fricative [ɔpfurə] since the markedness constraint Fric Voice considers the cluster /pv/ as marked (Lombardi, 1995, p.10). Note that progressive assimilation occurs in Dutch when the derivational prefix 'ɔp-' is added to a base form like /vurə/ 'carry' (Lombardi,1995, p.10).

Kang (1996) made use of OT in order to account for nasal assimilation in English. Kang (1996, p.483) considers the assimilation of a nasal to a velar as being the result of the markedness constraint *[…n {k, g}…] Foot/morpheme which "bans the sequence of /n/ and /k/ or /g/" (Kang, 1996, p.483) in the same morpheme or foot. Other possibilities like the deletion of one of the segments in the impermissible sequence /nk/ or /ng/ is excluded by the markedness constraint PARSE which is formulated as follows in Kang (1996, p.484) "PARSE: Every element of S2 in (S1, S2) has a correspondent in S1 (where S2= input, S1 output)". Thus, assimilation of /n/ to the following velar, such as /g/ in /cɒngres/ [sic]‘congress’, which is realized as [cɒŋgres] [sic] is the best solution to the offensive sequence /ng/. According to Kang (1996, p.483), [cɒŋgres] [sic] is the optimal realization of /cɒngres/ even though it violates SPREAD which is a markedness constraint that bans features from spread from one segment to another. Such violation is necessary to satisfy *[…n {k, g}…] f/m.

When nasals are followed by labial consonants they acquire their place feature as in /ɪnposɪbl/ ‘impossible’ which is realized as [ɪmposɪbl]. Kang (1996, p.486) indicated that such type of place assimilation is triggered by the markedness constraint *n [+labial] which considers the sequence of /n/ and a labial sound as being marked. Hence, /n/ is realized as a labial [m] to solve the problematic sequence /n/ + [+labial]. [ɪmposɪbl] is the optimal realization of /ɪnposɪbl/ even if it violates SPREAD as the feature [+labial] spreads from /p/ to /n/. Furthermore, [ɪmposɪbl] violates another constraint *MC (Multiple Correspondence) which stipulates that elements of the input and output must stand in a one-to-one correspondence relationship with each other” (Lamontagne and Rice, 1995 cited in Kang, 1996, p.485). The feature [+labial] is associated with two segments in the output /m/ and /p/, while in the input it is associated with one segment only which is /p/. However, violations of both SPREAD and *MC are necessary to satisfy the higher-ranked *n [+labial]. Other competing candidates like [ɪnposɪbl] are ruled out since they violate the highe- ranked *n [+labial] even though they satisfy the lower-ranked SPREAD and *MC.

Borowsky (2000, p.26) also dealt with nasal assimilation in Dutch. Contrary to the familiar pattern of nasal assimilation in which a nasal assimilates the place feature of the following obstruent, in Dutch the consonant that follows the nasal assimilates its place feature. Such type of place assimilation occurs in Dutch when the diminutive suffix ‘-tje’ is added to a base form that ends with a nasal consonant as /duim-tje/ 'thumb' which is realized as [duimpje]. Borrowsky (2000, p.26) assumes that such type of assimilation is triggered by the markedness constraint NAS-AGREE which requires adjacent nasals and obstruents to agree in place feature. However, assimilation is progressive rather than regressive in this case since the constraint IDWF (IDENT WORD FINAL) requires the word final /m/ to preserve its place feature which is [labial], while /t/ is realized as the labial /p/ to satisfy NAS-AGREE.

According to Borrowsky (2000, p.26), [duimpje] is the optimal candidate output for /duim-tje/ as it satisfies the constraint NAS-AGREE and IDWF which are higher ranked in Dutch and dominate other constraints like IDONSPL (IDENT ONSET PLACE) which requires the input place feature of the onset to be preserved in the output. Such constraint is violated by the optimal [duimpje]. Yet, such violation is necessary to satisfy the higher ranked NAS-AGREE. [duimpje] is preferred to other candidate outputs generated by GEN as [duintje] and [duimtje] since they respectively violate IDWF and NAS-AGREE. [duintje] violates IDWF as /m/ does not preserve its input place feature, while [duimtje] violates NAS-AGREE since the consonants of the cluster /mt/ do not agree in their place feature.

Grijzenhout (2000) likewise accounted for regressive voice assimilation in both English and Dutch. In English, a word like /fivθ/ 'five' is realized as [fifθ] as a result of the markedness constraint AGREE which requires adjacent obstruents to agree in their voicing. Grijzenhout (2000:8) reports that assimilation is progressive in this case because the faithfulness constraint FINAL DEV (FINAL DEVOICING) which requires syllable-final obstruents to be voiceless (note that the identity constraint that makes assimilation regressive in this case is PRODODIC WORD FINAL DEVOICING (PW FIN DEV) since /v/ is final in the prosodic word /fiv/, but not in the syllable /fivθ/ in which it is part of the complex coda /vθ/). Thus, /θ/ preserves its voice feature and /v/ assimilates to it to satisfy AGREE.

Grijzenhout (2000) then accounted for regressive voice assimilation in Dutch within an OT framework. Such type of assimilation, which is observed in Dutch compound words like /zak-doek/ 'handkerchief' which is realized as [zag-doek], is considered the result of the markedness constraint AGREE. The direction of assimilation in this example is determined by the faithfulness constraint IDENT ONSET PROSODIC WORD STOP (VOICE) (IDENT ONS PW STOP (VOICE)) which requires the plosives which are onsets in prosodic words which corresponds to a monomorphemic word, as is /d/ in /doek/, to preserve their input voice feature. Thus, /k/ is realized as /g/ to satisfy AGREE. Both AGREE and IDENT ONS PW STOP (VOICE) are higher ranked in Dutch which explains why [zag-doek] is the optimal candidate output for /zak-doek/.

Grizenhout and Martin (2000) is another study in which OT was applied in order to account for voice assimilation in Dutch. Dutch provides instances of progressive assimilation between the final consonant of the first word in a compound and the initial consonant of the second word in the compound as in /sla:p.zak/ 'sleeping bag' which is realized as [sla:p.sak]. Furthermore, Dutch also manifests cases of progressive assimilation between the last consonant of a stem and the initial consonant of a suffix as in /klap-də/'clapped' which is realized as [klaptə]. Grinzenhout and Martin (2000, p.71) consider voice assimilation in both former instances of assimilation as being the outcome of the constraint Surface Identity [Voice] (S-IDENT) which requires an "identity relation among surface elements" (Martin, 2000, p.71). In other terms, S-IDENT requires adjacent obstruents in a string to agree in their voicing feature. Grizenhout and Martin (2000, p.71).

Grizenhout and Martin (2000, p.73) views the compound /sla:p.zak/ as consisting of two prosodic words, namely /sla:p/ and /zak/. Assimilation is progressive in the case of /sla:p.zak/ as a result of the faithfulness constraint IDENT Prosodic Word Onset Stop (IDENT PWOS) which requires prosodic word onsets which are stops to preserve their input voice feature in the output (Grizenhout and Martin, 2000, p.72). In addition to IDENT PWOS, a markedness constraint termed *[+Voice]$_w$ (w stands for prosodic word) also determines the direction of assimilation. *[+Voice]$_w$ stipulates "prosodic word final obstruents are voiceless" (Grizenhout and Martin, 2000, p.72). Thus, /z/ assimilates to /p/ in /sla:p.zak/ since /z/ is voiced and is not a stop, and thus does not conform to the requirement of both *[+Voice]$_w$and IDENT PWOS. The following tableau is taken from Grizenhout and Martin (2000, p.73) and indicates why [sla:p.sak] is the optimal output of /sla:p.zak/:

Tableau 2.18. The selection of the optimal output of /sla:p.zak/

sla:p.zak	S-IDENT	IDENT PWOS	*[+Voice]$_w$
a. sla:b.zak			*!
b. sla:p.zak	*!		
c. sla:b.sak	*!		*
☞d. sla:p.sak			

It appears from Tableau 2.18 that candidate (d) is the winning candidate as it satisfies S-IDENT, IDENT PWOS and *[+Voice]$_w$ (d) is selected over both (b) and (c) since it satisfies S-IDENT by having both /p/ and /s/ agreeing in laryngeal feature, unlike (b) and (c) in which one of the obstruents contrasts with its neigbour. (d) is preferred to both (a) and (c) since it satisfies *[+Voice]$_w$ by including only voiceless obstruents /p/ and /s/. In (a) both obstruents /b/ and /g/ are voiced, while in (c) one obstruent /b/ is voiced.

Grizenhout and Martin (2000, p.73) did equally analyze progressive assimilation in affixed words as /klap-də/ 'clapped' which is realized as [klaptə] applying the same set of constraints that were applied for assimilation in compounds. Grizenhout and Martin (2000, p.74) demonstrated that /d/ becomes /t/ as a result of S-IDENT. Furthermore, they indicated that assimilation is progressive in this case and not regressive due to the markedness constraint *[+Voice]$_w$ which requires obstruents to bevoiceless. Hence, /d/ is devoiced rather than voicing /p/. The following tableau is taken from Grizenhout and Martin (2000, p.74) and indicates why [klaptə] is the optimal output of /klap-də/:

Tableau 2.19. The selection of the optimal output of /klap-də/

klap-də	S-IDENT	*[+Voice]$_w$	IDENT STOP (Voice)	IDENT (Voice)
a. klabdə		**	*!	*
b. klapdə	*!	*		
c. klablə	*!	*	**	**
d. ☞klaptə				*

Tableau 2.19 shows that candidate (d) is the optimal candidate as it satisfies the higher ranked constraints S-IDENT, *[+Voice]$_w$ and IDENT STOP (Voice). (d) is favoured upon (b) and (c) since it satisfies S-IDENT by including a pair of adjacent obstruents /p/ and /t/ that agree in voicing. The same pair is, however, made up of obstruents which disagree in voicing in each of (b) and (c). (d) is also preferred to (a), (b) and (c) since it satisfies *[+Voice]$_w$ by including only voiceless obstruents /p/ and /t/. (a), (b) and (c), on the other hand, violate *[+Voice]$_w$ by including either one obstruent or two.

Al-Harbi (2005) also applied OT in his account of regressive voice assimilation in English. Al-Harbi (2005, p.11) reported that /v/ becomes /f/ when followed by the suffix /θ/ in English words like /fivθ/ 'fifth' as a result of the markedness constraint AGREE. Furthermore, assimilation is regressive in this case since the faithfulness constraint IDENT (Voice)$_{Affix}$ is ranked higher than AGREE in the language and requires that "correspondent input and output segments in a root affix have the same specification for the feature [Voice]" (Al-Harbi, 2005, p.10). Hence, the suffix /θ/ must preserve its input voice feature to satisfy IDENT (Voice)$_{Affix}$, while /v/ assimilates its voice feature to satisfy AGREE. The following tableau. demonstrates why [fifθ] wins the contest against other output candidates for /fivθ/ as sketched in Al-Harbi (2005, p.11):

Tableau 2.20. Selection of the Optimal Output of /fivθ/

fivθ	IDENT (Voice)$_{Affix}$	AGREE	IDENT [+Voice]	IDENT [-Voice]
a. fivθ		*!		
b. fifð	*!			*
☞ c.fifθ			*	

Tableau 2.20 indicates that candidate (c) is the optimal candidate as it satisfies the higher-ranked constraints IDENT (Voice)$_{Affix}$ and AGREE. It is preferred to (b) as it satisfies IDENT (Voice)$_{Affix}$ by preserving the input voicing feature of the suffix /θ/. (c) is selected rather than (a) since it satisfies AGREE by assimilating /v/ to /θ/ in terms of voicing.

Among the studies which applied OT in accounting for voice assimilation in Arabic, one may cite Hall (2006) in which regressive voice assimilation of Mekkan Arabic, a dialect spoken in Mecca, Saudi Arabia, was analyzed from an OT perspective. In this dialect, a voiced obstruent is realized as voiceless when it is followed by a voiceless obstruent as in /ʔagsam/ ‘he swore an oath’ which is realized as [ʔaksam] (Hall, 2006, p.2). Such a type of assimilation is triggered by the markedness constraint NO Voiced Obstruents (NO VCD OB$_S$) which prohibits voiced obstruents (Hall 2006, p.5). Such constraint leads to the devoicing of /g/ to /k/ in /ʔagsam/ rather than the voicing of /s/ to /z/. Furthermore, assimilation occurs as a result of the markedness constraint AGREE (VOICE).

Other candidate outputs for /ʔagsam/ as [ʔagzam] and [ʔagsam] are excluded as they respectively violate NO VCD OB$_S$ and AGREE (VOICE). [ʔagzam], for instance, violates NO VCD OBsasit contains two voiced obstruents, namely /g/, /b/. [ʔagsam], on the other hand, incurs a violation of AGREE (VOICE) since it contains the cluster /gs/ whose consonants disagree in voice feature.

Mustafawi (2006) employed OT to explain the process of fronting or affrication of /k/, /g/ to /tʃ/, /dʒ/ in Qatari Arabic (QA). In this study, she (2006) used a recent model of OT to account for the application and blocking of fronting in QA. Such model is a developed version of OT that was introduced by Anttilla (1997) and which states that:

> …there can be a number of constraints that are crucially unranked with respect to each other. This results in different orderings of these constraints in different occasions. When at least some of these orderings result in different optimal candidates, variation arises.
>
> (Mustafawi, 2006, p.62)

On the basis of Antilla's approach, Mustafawi (2006) accounted for the application and blocking of affrication of /k/, /g/ to /tʃ/ and /dʒ/ in terms of the different rankings of the two constraints [k]/ [g] <--> ¬ [i(:)] which considers the dorsals /k/, /g/ as being marked before the vowel /i/, and MAX-IO (dorsal) which requires "every dorsal specification in the input is present in the output" (Mustafawi, 2006, p.67). She (2006, p.69) reports that when [k]/ [g] <--> ¬ [i(:)] dominates MAX-IO (dorsal), affrication of /k/ and /g/ occurs as in /lakin/ 'but' and /ligan/ 'a large dish' which are respectively realized as [latʃin] and [lidʒan]. Yet, when MAX-IO (dorsal) dominates [k]/ [g] <--> ¬ [i(:)] no affrication occurs so that /lakin/ is realized as [lakin] and /ligan/ as [ligan].

Petrova et al (2006) had recourse to OT in their analysis of voice assimilation in Russian, Hungarian and Turkish. In Russian, regressive assimilation is observed in words like /ledka/ 'ice' is realized as [letka] where /d/ devoices to /t/ to satisfy AGREE. Assimilation is regressive in Russian since a faithfulness constraint known as IDENT Pre-sonorant Voice (IDpresonvoi) which requires "An obstruent in presonorant position must be faithful to the input specification for voice" (Petrova et al, 2006, p.5). Thus, /k/, precedes a sonorant, and /d/ is realized as /t/ to satisfy AGREE. Thus, [letka] is the optimal realization of /ledka/ as it satisfies the higher ranked AGREE and IDpresonvoi. Other candidate outputs such as [ledka] and [ledga] are excluded as they respectively violate AGREE and IDpresonvoi. [ledka] violates AGREE as it includes a cluster /dk/ which disagrees in voicing, while [ledga] viotesIDpresonvoi as the presonorant /g/ does not preserve its input voice feature (Petrova et al, 2006, p.8).

Petrova et al (2006) did also account for regressive voice assimilation in Hungarian using OT model. In Hungarian, a consonant like /k/ in /rɔkd/ ‘put’ assimilates to the following voiced consonant /d/. Such assimilation is the outcome of the markedness constraint AGREE. As to the direction of assimilation, it is determined by the faithfulness constraint IDENT word final voice (IDwfVoi) which requires word final obstruents like /d/ in the example at hand to preserve its voice feature (Petrova et al, 2006, p.10). Thus, /k/ is realized as /g/ to satisfy AGREE. Hence, [rɔgd] is the optimal candidate of /rɔkd/ as it satisfies the higher ranked constraints AGREE and IDwfVoi. Other candidates as [rɔkd] and [rɔkt] are excluded as they violate AGREE and IDWF Voi respectively. [rɔkd] violates AGREE as the obstruents in the cluster /kd/ disagree in their voice feature, while [rɔgd] violates IDwfVoias /t/ does not its input voice feature.

Masacro (2007) based his account of total assimilation in Baix Emporda Catalan which is spoken in Catalonia, Spain on OT. In this language, the infinitive marker /r/ assimilates totally to /l, n, t, s/. Masacro (2007, p.725) proposes to consider /r/ as having the allomorphs /r, l, n, t, s/. Such allomorphs are listed in the input and each output candidate that is generated by GEN includes one of these allomorphs, and thus satisfies the faithfulness constraint IDENT (F). However, only the candidate that includes total assimilation of /r/ to the following consonant /r, l, n, t, s/ will win the contest. In the case of a form like /puzar-lə/ ‘to put it’ the input is /puza{r, l, n,t, s}-lə/. Such input will have as output candidates [puzarlə], [puzallə], [puzatlə], [puzanlə] and [puzaslə]. All such candidates would satisfy IDENT (F) (Masacro, 2007, p. 725). Yet, only [puzallə] emerges as the optimal output as it satisfies AGREE/C (AGREE/Consonant) which requires "total identity of adjacent consonants" (Masacro, 2007, p.724).

In addition to Catalan, Masacro (2007) studied total assimilation of the definite article /ʔal/ 'the' in Modern Standard Arabic (MSA) from an OT perspective. Masacro (2007, p.727) demonstrates that in MSA /l/ of /ʔal/ totally assimilates to the consonants /t, θ, d, ð, r, l, n, z, s, s̱, ḏ, ṯ, ð̱/. Masacro (2007, p.727) assumes that the morpheme /ʔal/ possesses the allomorphs /ʔal, ʔat, ʔaθ, ʔad, ʔað, ʔar, ʔan, ʔaz, ʔas, ʔas̱, ʔaḏ, ʔaṯ, and ʔað̱/. Such allomorphs are included in the input. Thus, the input /ʔal-ʃams/ 'the sun' includes all the allomorphs of /ʔal/ (/ʔa{l, t, θ, d, ð, r, n, z, s, s̱, ḏ, ṯ, ð̱}-ʃams/). Then, each candidate that GEN generates includes one of these allomorphes. However, the optimal output would be the one that satisfies the higher-ranked markedness constraint AGREE/C which, as mentioned earlier, requires "total identity of any adjacent consonant" (Masacro, 2007, p.724). In the case of forms like /ʔal-ʃams/, GEN generates candidates like [ʔalʃams], [ʔatʃams], [ʔaθʃams], [ʔasʃams], [ʔaʃʃams] and so on. Yet, [ʔaʃʃams] is optimal as it satisfies AGREE /C, whereas the other candidates violate it.

Gonzalez (2008) applied OT in her account of place assimilation in north central Spanish. According to Gonzalez (2008, p. 180), the velar /k/ is realized as /θ/ when it is followed by a coronal consonant. Such type of place assimilation is the outcome of the markedness constraints CORONAL PLACE AGREEMENT and OCP [MANNER]. The former constraint requires that "a consonant agrees in tongue tip orientation with an immediately following coronal" (Gonzalez, 2008, p.180). OCP [MANNER], on the other hand, stipulates "identical contiguous consonants are dispreferred" (Gonzalez, 2008, p.179). Hence, an input form like /ak.tor/ 'actor' is realized as [aθtor]. Such output satisfies OCP [MANNER] as /θ/ and /t/ differ in their manner feature. Indeed,

/θ/ is [+continuant], while /t/ is [-continuant]. Furthermore, [aθtor] is the optimal output since it satisfies CORONAL PLACE AGREEMENT by containing the cluster /θt/ whose consonants agree in the place feature [CORONAL]. The optimal [aθtor] is preferred to other candidate outputs such as the faithful [aktor] since it violates the higher ranked OCP [MANNER] and CORONAL PLACE AGREEMENT, even though it satisfies the lower ranked constraint IDENT [CONT] (continuant) which requires "correspondent segments in the input and output have identical values for the feature [Continuant]" (Gonzalez, 2008, p.179). The optimal [aθtor] violates IDENT [CONT] as the output /θ/ which is [+CONT] does not preserve the same value for the feature [CONTINUANT] of the input /k/ which is [-CONT]. However, such violation is inevitable in order to satisfy the higher ranked constraints OCP [MANNER] and CORONAL PLACE AGREEMENT.

Al-Omar (2009) studied the process of pharyngealization in Syrian Aarbic (SA) within the framework of OT. Al-Omar (2009, p.20) reports that in SA the feature [+Retracted Tongue Root] [+RTR] spreads from an emphatic consonant like /s̲/ to a consonant in its vicinity. Once a sound is pharyngealized it is pronounced "with a retraction of the root of the tongue towards the upper part of the pharynx, hence producing a constriction in the upper pharynx" (Jarrah 1993 cited in Al-Omar, 2009, p.20). Thus, the sound /f/ in /s̲e:f/ 'summer' is pharyngealized, yielding [s̲e:f̲] as the place feature [+RTR] spreads from /s̲/ to /f̲/. According to Al-Omar (2009, p.21), pharyngealization in cases like [s̲e:f̲] is the result of the requirement of the markedness constraint SPREAD [RTR] which stipulates "assign the feature [RTR] to all the segments in the emphatic domain" (Al-Omar, 2009, p.21). Satisfaction of this constraint through pharyngealization leads to violation of the faithfulness constraint IDENT-IO [RTR] which requires input and output correspondents to possess the same value for the feature [RTR] (Al-Omar, 2009, p.21). Given that pharyngealization occurs in SA, SPREAD [RTR] must dominate IDENT-IO [RTR].

As to the direction of pharyngealization which is rightward in the case of [se:f], Al-Omar (2009, p.21) indicates that it is determined by the alignment constraint ALIGN ([RTR], right, word, right) which requires [RTR] spread to be aligned with the right edge of the word. ALIGN [RTR] Right which is shortened to [RTR]-RIGHT is unranked with respect to SPREAD [RTR]. Furthermore, both of these constraints dominate IDENT-IO [RTR].

The optimal output for a word like /se:f/ is [se:f] as it satisfies both SPREAD [RTR] and RTR-RIGHT. [se:f] is optimal even though it violates IDENT-IO [RTR] as /f/ is underlyingly [-RTR] and surfaces as [+RTR]. Such violation is necessary in order to satisfy the higher-ranked SPREAD [RTR]. Note that pharyngealization is a type of consonant harmony or long distance place assimilation (Bakovic, 2006, p.335).

Abu-Abbas, Zuraiq and Al-Tamimi (2010) also had recourse to OT in their analysis of regressive voice assimilation in Irbid Urban Arabic (IUA), a dialect of Jordanian Arabic. Regressive voice assimilation is observed in forms like /faːt dukaːneh/ 'he entered his shop' which is realized as [faːd dukaːneh] (Abu-Abbas et al, 2010, p.72). This type of assimilation is considered the outcome of the markedness constraint AGREE dominating the faithfulness constraint IDENT (voice) (Abu-Abbas et al, 2010, p.72). Abu-Abbas et al (2010, p. 69) report that voice assimilation occurs only when the consonant which undergoes assimilation (/t/ in the previous example) agrees with the consonant to which it assimilates (/d/ in the previous example) in both place and manner features. Hence, regressive voice assimilation applies in the case of /faːt dukaːneh/ since /t/ and /d/ share the same place and manner features, being both coronal stops. Yet, regressive voice assimilation is blocked in forms like /walad saʕiːd/ 'happy boy' since /d/ and /s/ disagree in their manner feature as /d/ is a stop, whereas /s/ is a fricative.

Abu-Abbas et al (2010, p. 69) accounted for the blocking of regressive voice assimilation in such cases as /walad saʕiːd/ using the notion of ‘local conjuntion’ that was introduced by Smolensky (1993). Abu-Abbas et al (2010, p.66) define local conjunction as the sum of two constraints such as AGREE and IDENT (voice). A locally conjoined constraint is violated if both constraints that constitute it are violated. Abu-Abbas, Zuraiq and Al-Tamimi (2010, p.71) reported that the blocking of voice assimilation in forms like /walad saʕiːd/ which is realized as [walad saʕiːd] is explained through the locally conjoined constraint [AGREE & IDENT (voice)] stem-stem. This constraint is satisfied by the optimal output [walad saʕiːd] as it violates only one of the constraints that make up [AGREE & IDENT (voice)] stem-stem which is AGREE, but satisfies the other constraint i.e IDENT (voice). Other output candidates as [walat saʕiːd] are excluded since they violate both constraints that make up [AGREE & IDENT (voice)] stem-stem. Indeed, such output candidate violates AGREE as /t/ and /s/ do not agree in their manner feature, and violates IDENT (voice) since /t/ does not preserve its input voice feature (Zuraiq and Al-Tamimi, 2010, p.72). In the case of /walad saʕiːd/ [AGREE & IDENT (voice)] stem-stem must dominate the constraints AGREE and IDENT (voice) in order to assure blocking of voice assimilation. tableau 2.21 illustrates such ranking logic and how it results in the blocking of regressive voice assimilation in /walad saʕiːd/ as indicated in Abu-Abbas, Zuraiq and Al-Tamimi (2010, p.72):

Tableau 2.21. Selection of the Optimal Output of /walad saʕiːd/

walad saʕiːd	[AGREE & IDENT (voice)] stem-stem	AGREE	IDENT (voice)
☞ a.walad saʕiːd		**	
b. walat saʕiːd	*!	*	*

Dvorak (2010) accounted for regressive voice assimilation in Czech from an OT. In this language, an obstruent assimilates the voicing feature of the following obstruent. In Czech words like /sbjɛr/ 'collection' which is made up of the prefix 's-' plus the stem 'bjɛr' (collect), /s/ assimilates the voice feature of /b/. Dvorak (2010, p.12) reports that assimilation is regressive in cases like the above since a faithfulness constraint called IDENT STEM ONSET (LAR) requires stem onsets to maintain their voice feature. Such constraint is ranked higher in Czech together with AGREE (LAR) and leads to regressive assimilation of /s/ to /b/ rather than the reverse. Thus, [zbjɛr] is the optimal realization of /sbjɛr/ 'collection' and is preferred to other output candidates as [sbjɛr] and [spjɛr] as it satisfies both higher-ranked AGREE (LAR) and IDENT ONSET (LAR), respectively. [sbjɛr], on the other hand, violates AGREE (LAR) as /s/ and /b/ disagree in their voicing, whereas [spjɛr] violates IDENT STEM ONSET as underlying stem onset /b/ does not maintain its voice feature in the output.

Kabrah (2011) likewise dealt with regressive voice assimilation in Cairene Arabic (CA) within an OT framework. In CA, an obstruent like /s/ in /masduːd/ 'blocked' is realized as /z/ in order to agree with the following voiced obstruent /d/, yielding the output [mazduːd]

(Kabrah, 2011, p.26). He attributes the cause of regressive assimilation in cases like the above to the markedness constraint AGREE Voice (OBSTRUENTS) which requires obstruents to agree in their voice feature (Kabrah, 2011, p.25). As to the direction of assimilation, it is determined by the positional faithfulness constraint IDENT ONSET VOICE (IDON VOICE) which requires obstruents in onset position to preserve their input voice feature (Kabrah, 2011, p. 27). As a result, the onset /d/ preserves its input voice feature, while /s/ is realized as /z/ to satisfy AGREE Voice (OBs). Tableau 2.22 indicates why candidate [mazduːd] emerges as the optimal output of /masduːd/ as sketched in Kabrah (2011, p.26):

Tableau 2.22. Selection of the Optimal Output of /masduːd/

masduːd	IDON VOICE	AGREE Voice (OBs)	ID Voi
a. masduːd		*!	
☞ b. mazduːd			*
c. mastuːd	*!		*

It appears from Tableau 2.22 that candidate (b) is the optimal candidate as it satisfies the higher-ranked AGREE Voice (OBs) and IDON VOICE. It satisfies AGREE Voice through voice assimilation of /s/ to /d/, while it satisfies IDON VOICE by preserving the input voice feature of the onset /d/ in the output. Candidates (a) and (c) are excluded since they respectively violate AGREE Voice (OBs) by including a cluster which does not agree in their voice feature, while (c) violates IDONS VOICE as underlying onset /d/ does not preserve its voicing feature in the output.

Kabrah (2011, p.8) indicated that regressive voice assimilation also occurs in clusters that occupy coda position. The word /nasb/ ‘cheating’, for instance, is realized as [nazb] in CA to satisfy AGREE Voice (OBs). Given that both obstruents are part of the coda, the constraint IDON VOICE is inactive in this case. Another positional faithfulness constraint known as IDENT-WORD-FINAL-Voice (IDWF Voi) is responsible for the orientation of assimilation in this case. IDWF Voi requires that the word final obstruent, which is /b/ in the present instance, preserves its input voice feature in the output. Hence, /s/ assimilates to /b/ in its voice feature in order to satisfy AGREE Voice (OBs) (Kabrah, 2011, p.27).

It appears from the previous review that assimilation is the outcome of interaction between two families of constraints, namely the AGREE family which is a set of markedness constraints and the IDENT family which is a set of faithfulness constraints. As stated in Abu-Abbas et al (2010, p.64):

> Assimilation results from a conflict between faithfulness constraints demanding identity between input and output feature on the one hand, and syntagmatic constraints which demand adjacent output segments to agree in feature specifications.

The AGREE family of constraints is formulated as follows:

(11) AGREE (F): a sequence of segments have identical values for feature [F].

(Abu-Abbas et al, 2010, p.65)

The IDENTITY family of constraints is formulated as follows:

(12) IDENT (F): correspondent segments have identical values for feature [F]. (Abu-Abbas et al, 2010, 65)

Assimilation then emerges as the result of the requirements of AGREE [F] outranking those of IDENT [F]. [F] may either refer to voice features [±Voice], place features [labial], [coronal], [dorsal], [guttural], manner features [±continuant], [±strident], [±nasal], [±lateral] or major class features like [±consonantal], [±syllabic] [±sonorant]. Other features include [±RTR] which relates to cases of emphasis spread or pharyngealization.

Other constraints may interact with AGREE [F] and IDENT [F] to determine the direction of assimilation or its type. IDENT ONSET [F], IDENT Word Final [F] are among the positional identity constraints which determine whether assimilation is regressive or progressive. *Laryngeal, for instance, is a markedness constraint which leads to devoicing rather than voicing assimilation when it is higher ranked in the language. The following list includes the different types of constraints that have been mentioned so far and which are the most relevant to most cases of assimilation:

(13) AGREE (VOICE)

Adjacent obstruents should agree in their voice feature

(14) IDENT (VOICE)

Input and output correspondents should share the same value for the feature [voice].

(15) AGREE [PLACE]

Adjacent consonants should share the same place feature.

(16) IDENT (PLACE)

Input and output correspondents should share the same place feature.

(17) AGREE [MANNER]

Adjacent consonants should agree in their manner feature.

(18) AGREE/ C (consonant)

Adjacent consonants should totally agree in all features.

(19) IDENT-IO

Output segments should preserve the features of the input segments.

(20) IDENT ONSET (F) (IDONF)

Syllable onsets should preserve their input feature (voice, place, manner and so on) in the output.

(21) IDENT Word ONSET (F) (IDWOF)

Word onsets should preserve their input feature in the output.

(22) IDENT STEM (F) (ID STEM F)

Stem segments should preserve their input features in the output.

(23) IDENT Word Final (F) (ID WF (F))

Word final segments should preserve their input feature in the output.

(24) *Laryngeal

Voiced obstruents are marked.

Obviously, OT is an adequate tool for describing and explaining different cases of assimilatory and non-assimilatory processes. The following chapters will demonstrate how OT can be applied in order to account for different types of phonological processes in MAR and will compare such account with a rule-based account of those processes in MAR.

The present chapter sketches the scope, methodology and findings of the present study. It, thus, describes the locale of the study which is the city of Mostaganem and introduces the dialect under study which is MostaganeMARabic, henceforth MAR. Then, it provides insight about the population of the study as well as the sampling procedure that was adopted. An outline is later set regarding the data collection procedure and data analysis, including a specification as to the type of method that was adopted in analyzing the corpus of the study. Eventually, the findings of data collection are then exposed in the chapter at hand.

3.1. Mostaganem: Origins and Description

Mostaganem is a seaside town that is located in the northwest of Algeria. Certain historical records suggest that the roots of Mostaganem go back to the period when Romans occupied Africa. As indicated by Dr. Shaw (1962-1751)

> La force et la bonté de ses murailles particulièrement au N-O portent à croire qu'elles sont l'ouvrage de Romains. Il est vrai que je n'y ai trouvé aucun débris d'architecture ancienne mais Mostaganem et Mazgran sont si bien situés et bien pourvus d'eau qu'il n'est pas douteux que les Romains ne s'y soient pas établis.
>
> (Cited in Belhmissi, 1982, p.24).

Thus, the architectural fashioning of Mostaganem as well as its strategic location pushed certain historians like Dr. Shaw to believe that Romans were the first to occupy Mostaganem, and thus, according to such historians Mostaganem has Roman origins. As indicated by Belhmissi (1982, p.23) Mostaganem has its origins in Roman Africa during the reign of the Roman emperor Gallien in the 3rd century. During that period, septentrional Africa could have been shaken by an earthquake which swallowed a number of cities of the coastline including the Roman city Murustaga which was situated in what is now Mostaganem. This would explain the absence of Roman ruins in Mostaganem.

In retrospect, other historians as G. Marçais deny such possibility and attribute the origins of Mostaganem to Arabic roots. Indeed, G. Marcais points out to the fact that no Roman traces or ruins can be identified in this city as he reports “la ville n’occupe le site d’aucun établissement antique identifiable, d’ailleurs aucun port naturel n’existe en cet endroit” (cited in Belhmissi, 1982, p.27). Consequently, the origins of Mostagenem seem to be quite unknown since no solid piece of evidence seems to exist regarding its assumed Roman roots.

According to other historians like Levy-Provencal (1932), Mostaganem was founded in the middle ages around the 10^{th} century by the Almoravid dynasty (Belhmissi, 1983, p.27). Yousouf Ibn Tachoufin, the founder of the Almoravid dynasty is reported to have constructed the bridge “Bordj” which is known as “Bordj al Mahal” named after the powerful tribe of the “Mahals”.

As it was eventually concluded by Belhmissi (1983, p.29), the origins of Mostaganem cannot be attributed to one specific period of history or dynasty. Rather, Mostaganem is a piece of earth that has been inhabited by different groups of individuals that saw in that city an advantageous place to live in.

Constructed as an amphitheatre two miles from the shore, Mostaganem lies in the Gulf of Arzew in the Mediterranean Sea and is bordered by Al-Dahra mountains in the east and Al-Macta river in the West (Belhmissi, 1982, p.14). The surface area of Most aganem amounts to 2269 km^2 and it is equipped with a coastline of 124 km. Mostagnem is divided to two agglomerations by a fertile small valley in which a lake called Ain Es-Safra used to flow.

The first agglomeration consists of what is called 'Al-Blad' and also of 'Al-Matemare'. 'Al-Blad' which is situated in the south of the city used to be inhabited by the Turks and was the district reserved to aristocracy. An important number of ancient religious and administrative edifices can be found in 'Al-Blad', including Sidi Yahia Mosque, Al-Mahal bridge and the Palace of Bey Muhammed Al Kabir (Belhmissi, 1982, p. 16-17). Opposite to 'Al-Blad', 'Al Matemare' which was named after the silos that the area covered. 'Al-Matemare' was occupied by a group of people called 'Al-Hadhar' who were also upper class people. Al-Hadhar held commercial shops in Al-Matemare and some of nowadays Hadhar practice the same profession as their forefathers in the same site, that is, Al-Matemare.

The second agglomeration is situated in the northwest and is known as 'Tigdit'. This district is a simple district that was inhabited by the common men (Belhmisssi, 1982, p.17). During the colonial period, Tigdit was the refuge of Mostaganem's indigenous people and was then called 'the Muslim city' as opposed to the 'modern city' which was peopled by the colonizers.

Mostaganem is a harbour town, and thus, its economy is fuelled by fishing industry. Furthermore, Mostaganem's economy also relies on the exportation of agricultural products such as grapes, pomegranates, oranges among other products. As to animal breeding, sheep's and equidae's exportation also contribute to its economy.

The climate of Mostaganem is a suitable kind of environment especially for agriculture. It is known as the Mediterranean climate as it is marked by hot and dry summers and mild and wild winters. Mostaganem's climate is, thus, characterized by mild temperatures with an annual average of temperature being 17°C (Belhmissi, 1982, p.15). Indeed, the fact that Mostaganem is a seaside city reduces the cold of winter and the heat of summer. Such seaside location, thus, makes of Mostaganem's climate a mild type of climate.

The appellation 'Mostaganem' has always been source of debate as to its origins. Indeed, different assumptions were set forth regarding the meaning and origins of the name 'Mostaganem'. One of these assumptions divides the term Mostaganem, in Arabic, to 'machta' which means 'winter station' and 'Ghanem' which refers to a shepherd's name. Hence, Mostaganem used to be the sheperd's called 'Ghanem' winter station, thus the appellation Mostaganem was the result of the amalgamation of the two Arabic terms 'machta and Ghanem'.

Another assumption considers the name 'Mostaganem' as deriving from the combination 'marsa- ranem' which means loot harbour. Hence, Mostaganem was the place where Romans used to keep their loot and is thus named after the combination 'marsa-ranem'.

In another assumption, the appellation 'Mostaganem' originated from the terms 'misk' and 'ghanem' which refers to sheep abundance. Still another assumption views the name 'Mostaganem' as being composed of the Arabic terms 'machta' meaning 'cabin' and 'ghanem' meaning 'reed'.

Some historians attribute the origins of the appellation 'Mostaganem' to the Marinid Sultan Abu Abd Allah. When the Marinid Sultan arrived at the city which was then but a simple village, he met two children one of whom was holding a sugar stick and offered it to the second child telling him 'mass karanam'. According to this assumption, the Marinid Sultan adopted this name for the city.

Other historians consider the origins of the name 'Mostaganem' as going back to the Roman occupation of Africa when the Romans constructed a harbour in the city of Mostaganem and called Murustaga. The name 'Mostaganem' then originated from the Roman Murustaga (Belhmissi, 1982, p.12-13). However, as reported by Belhmissi (1982, p.30) no piece of evidence seems to prove any of the former assumptions regarding the origins of the appellation 'Mostaganem'. Thus, the origins of such a name are still an enigma. After having described the locale of the study, it worth providing a sketch of its spoken variety of Algerian Arabic, viz MostaganeMARabic.

3.2. MostaganeMARabic (MAR)

Algeria includes an important number of cities each one of which possesses its spoken variety of Algerian Arabic which differs from other spoken varieties of Algerian Arabic at the phonological and lexical levels. Effectively, the variety of Algerian Arabic which is spoken in Mostaganem or else MostaganeMARabic (MAR), for instance, possesses lexical and phonological features that distinguish it from other spoken varieties of Algerian Arabic.

3.2.1. Lexical Features of MAR

Even though MAR is a variety of an Arabic dialect, Algerian Arabic, it nevertheless contains loans from other languages such as Spanish, Turkish and French. Such loans were borrowed as the result of the linguistic interaction that occurred between the indigenous of Mostaganem and Spanish, Turkish or French occupiers. Such linguistic interaction followed from the Spanish, Ottoman and French occupations of the city. Hence, Spanish, Turkish and French loans together with Arabic terms build up a lexical cocktail which is so peculiar to MAR and distinguish it from other spoken varieties of Algerian Arabic.

As aforementioned, Spanish loans that are found in MAR are the outcome of Spanish occupation of Algeria, and thus, of Mostaganem which dates back to 1505. Such occupation resulted from the Spanish crusades on central and oriental Maghreb and continued for more than fifty years (Belhmissi, 1982, p.51-53). A number of Spanish loans exist in MAR. A small selection of these loans is presented below together with the original Spanish words and their respective meanings in English.

(1)	**Spanish loans in MAR**	**Spanish original terms**	**Gloss**
	ruːxu	Rojo	‘blond’
	kola	Cola	‘queue’
	rokna	Rincon	‘corner’
	kabesa	Cabeza	‘head’
	karantika	Calantita	‘a Spanish dish’
	tʃangla	Chancla	‘flip flop’
	bunja	Punjo	‘fist’
	ljaːn	Llano	‘flat plate’

These loans were adapted from Hamerlain (2001, p.6) and Guerrero (2015, p.229).

Turkish loans also add to the lexical cocktail of MAR. Such loans were borrowed by MAR speakers during the period of Ottoman occupation of Mostaganem. This occupation started in 1517 when the Barbaroussa brothers moved to Algeria in order to rescue it from the Spanish colonizers. Instances of Turkish loans that are commonly used in MAR comprise [tabsi] ‘plate’ [baxnuq] ‘cloth’ [qahwadʒi] ‘coffee-seller’ [ɦalwadʒi] ‘sweet-maker’ (Hamerlain, 2001, p.6).

French loans are by far the most dominant type of loansin MAR. Indeed, the period of French occupation was the longest period of colonization as it lasted for a century and 32 years. French occupation started with officer's Damrémont occupation of the city on December 14th, 1830. Such a long period of French occupation in Algeria, and thus, Mostaganem, left its linguistic imprint on MAR as the latter is rife with French loans. The following selection of loans illustrates some of the most common loans that are part and parcel of MAR:

(2)

French loans in MAR	**French original words**	**Gloss**
bulisija	Police	'police'
valiza	Valise	'suitcase'
luːki	Loquet	'latch'
blasa	Place	'seat, area'
kulwar	Couloir	'hallway'
kartab	Cartable	'schoolbag'
sakado	Sac-au-dos	'backpack'
krijuːn	Crayon	'Pencil'
stiːlu	Stylo	'pen'
bariːṭ	Barrette	'hairpin'
futaj	Fauteuil	'sofa'
brosa	Brosse	'comb'
bala	Pelle	'shovel'
brika	Briquet	'lighter'

In addition to Spanish, Turkish and French loans, MAR contains an important number of Arabic words. Some of these words may differ from Modern Standard Arabic (MSA) forms in their phonology as well as morphology. Instances of these words are presented below:

(3)

MAR forms	Arabic original forms	Gloss
baːb	baːb	‘door’
ʃrab	ʃaraba	‘he drank’
gaṭ	qiṭ	‘cat’
ʕajn	ʕajn	‘eye’
fuːg	fawq	‘up, above’
kla	ʔakala	‘he ate’
sʕiːb	saʕb	‘difficult’
kursi	kursi	‘chair’
qra	qaraʔa	‘he read’
kbir	kabir	‘big’
dxal	daxala	‘he entered’
xradʒ	xaradʒa	‘he went out’
gʕad	qaʕada	‘he sat’
wgaf	waqafa	‘he stood up’

As it appears from the above instances, MAR words may differ from MSA words at the level of pronunciation of certain sounds like MSA /q/ which is realized as [g] in each of [gaṭ] ‘cat’, [gʕad] ‘he sat’, [wgaf] ‘he stood up’. Furthermore, the morphology of certain MAR words is different from that of their MSA counterparts. MAR words [dxal] ‘he entered’, [gʕad] ‘he sat’, [wgaf] ‘he stood up’, [xradʒ] ‘he went out’ illustrate a morphological difference between MAR and MSA. Indeed, MSA’s morpheme /a/, which is found at the end of MSA words [daxala] ‘he entered’, [qaʕada] ‘he sat’, [waqafa] ‘he stood up’, [xaradʒa] ‘he went out’ and which represents the third person singular masculine past tense morpheme, is not present in MAR counterpart instances.

In addition to lexical properties, MAR possesses phonological features that distinguish it from other spoken varieties of Algerian Arabic. The subsequent sub-section highlights the phonological properties of MAR.

3.2.2. Phonological Properties of MAR

MAR is different from other spoken varieties of Algerian Arabic in some phonological respects, including its phonemic inventory and its syllable typology. Each phonological property is outlined below.

3.2.2.1. Phonemic Inventory of MAR

MAR’s phonemic inventory differs in some respects from MSA’s phonemic inventory as it includes certain phonemes that do not exist in MSA. Furthermore, the phonetic realization of certain phonemes in MAR is different from their phonetic realization in MSA. The first difference is at the level of the phoneme /q/ which is realized as [q] in Algiers Spoken Arabic in all phonetic instances of the phoneme /q/ which makes of Algiers spoken variety of Algerian Arabic similar to MSA in this respect. Yet, as regards MAR, the phoneme /q/ is realized as [g] in most phonetic contexts, except for some cases where the substitution of /g/ for /q/ results in a meaning difference as in /qla/ ‘he fried’, /gla/ ‘he cooked in the oven’. In such a case /q/ is realized as [q] and /g/ as [g], thus making of /q/ and /g/ different phonemes in such an instance. Thus, the case of phonemic overlapping which was introduced by Bloch (1941) is observed in the case of MAR /q/ and /g/.

Indeed, /q/ and /g/ are respectively realized as [q] and [g] in instances like [qla], [gla], whereas, other instances like [ga:l] 'he said', [gʕad] 'he sat', [gri:b] 'close', /q/ of MSA is realized as [g] in MAR (c.f. [qa:la], [qaʕada], [qari:b]. Hence, the allophone [g] belongs to both /q/ and /g/ phonemes.

As indicated by Cantineau (1940) and Chachou (2009), the realization of /q/ as [g] in MAR is the outcome of rural migration to the city of Mostaganem. Such migration brought about a number of changes in MAR's phonology, including the substitution of the rural [g] for the oppidan [q]. The [q] allophone of /q/ is, however, preserved in some words like [qahwa] 'coffee', [qarfa] 'cinamon', [bri:q] 'jug', [qosbar] 'coriander', [qurʔa:n] 'Quran', [qdi:m] 'old', [qafəz] 'dynamic', [qli:l] 'few'. Thus, the phoneme /q/ has two allophones in MAR, viz [g] and [q]. The principle of complementary distribution applies in this case since [g] never occurs in contexts where [q] occurs and vice versa. Hence, MAR speakers will never say [gahwa] or [garfa], for instance. Yet, complementary distribution does not apply always since as we observed in the case of [qla] and [gla], [q] and [g] constitute a minimal pair and are allophones of two different phonemes, namely /q/ and /g/.

In sum, one may conclude that two different phonemes exist in MAR, namely /q/ and /g/. The phoneme /q/ is sometimes realized as [q] and most of the time as [g], whereas the phoneme [g] is nearly always realized as [g] as in the former instance of [gla]. Exceptions to the phonetic realization of /g/ can be observed when a phonological process, like voice assimilation, applies. In such cases /g/ is realized as [k] (check chapters 4 and 5).

The phoneme /dʒ/ also displays some similarity to the phoneme /q/ in MAR. Effectively, /dʒ/ is realized as [dʒ] in most cases as in [dʒa:b] 'he brought', [dʒaps] 'plaster', [dʒu:dʒa] 'female judge', [tfaradʒ] 'he watched', [dʒa:dʒa] 'chicken', [ħa:dʒa] 'something'. However, in some other cases /dʒ/ is realized as [ʒ], especially when it constitutes a cluster with the /d/ sound as in [ʒdi:d] 'new', [ʒdab] 'he danced with his head'. Thus, the allophones [dʒ] and [ʒ] are in complementary distribution since [ʒ] occurs before the alveolar stop [d], while [dʒ] occurs elsewhere.

MSA's inter-dental fricatives /θ, ð/ are replaced by the alveolar stops /t, d/ in MAR. Thus, MSA [ðul] 'humiliation' is realized like [dul] in MAR. The same applies for /θ/ which is replaced by [t] in MAR in cases like the following:

(4)

MSA form	MAR form	Gloss
θawm	tu:m	'garlic'
θulata:ʔ	tla:ta	'Tuesday'
θaʔlab	taʔlab	'fox'
θaqi:l	tqi :l	'heavy'

The emphatics of MSA, namely /ṭ, ḍ, ṣ, ð̣/ are described as involving a secondary articulatory feature known as velarization. Indeed, the emphatics of MSA involve the primary articulatory features of /t, d, s, ð/ in addition to the secondary feature of velarization which involves moving the tongue's back towards the velar region and retracting the tongue's root, thus, creating a narrowing in the pharyngeal region (Younes, 1994, p.216).

In MAR, the voiced inter-dental fricative emphatic /ð/ is replaced by the non-emphatic voiced alveolar stop /d/. Instances of such a case include the following:

(5)

MSA form	MAR form	Gloss
ðahr	dhar	‘back’
ðulm	dulm	‘unfairness’
ðala:m	dalma	‘darkness’
ðuhr	dhor	‘Dhor prayer’

(6)

MAR form	Gloss
ṭwi:l	‘tall’
ṭbi:b	‘doctor’
ṭabaʕ	‘stamp’
ḍrab	‘he hit’
ḍaw	‘light’
ḍarsa	‘molar’
ṣa:b	‘he found’
ṣabri	‘be patient’

The other emphatics, namely /ṭ, ḍ, ṣ/ are preserved in MAR. Instances of words which include the emphatics /ṭ, ḍ, ṣ/ in MAR are presented below.

The glottal stop /ʔ/ is found in some words of MAR. Yet, such words are generally of MSA origin as the words [qurʔa:n] ‘Quran’, [ʔaja] ‘Quranic verse’, [ʔadrar] ‘Adrar; a city in Algeria’, [ʔanwar] ‘Anouar; masculine proper noun’, [ʔina:s] ‘Inesse; a proper noun’.

The consonants /p/, /v/ are also found in MAR as a result of French loans. Instances of MAR words which contain /p, v/ are listed below.

(7)

MAR form	**Gloss**
portaj	‘gate’
patisi	‘patisserie’
portabl	‘mobile phone’
valisa	‘suit case’
viza	‘visa’
vista	‘jacket’

The Spanish /tʃ/ also occurs in MAR as part of Spanish loans like [latʃa] ‘variant of sardines’. The following table indicates the consonant phonemes of MAR along with an articulatory description of each phoneme as well as an instance of a word that contains each consonant phoneme:

Table 1. The phonemic inventory of MAR (Consonants)

Consonant	Description	Example	Arabic representation of consonants
p	Voiceless bilabial stop	/**p**ari/ ‘Paris’	
b	Voiced bilabial stop	/**b**aː**b**/ ‘door’	ب as in باب ‘door’
t	Voiceless alveolar stop	/**t**iliviziu/ ‘television’	ت as in تلفزيو ‘television’

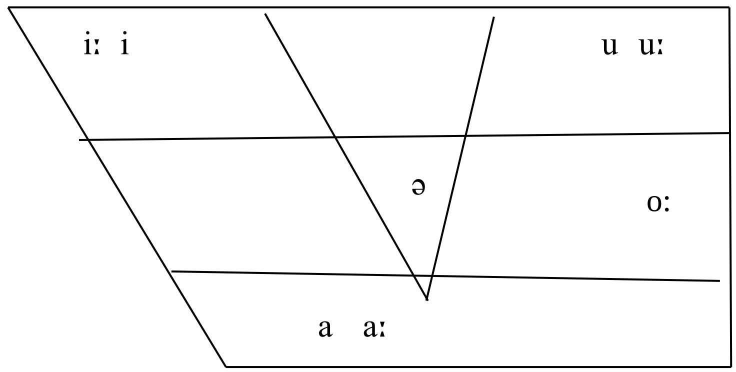
d	Voiced alveolar stop	/**d**a:q/ 'he tasted'	د as in داق 'he tasted'
ṭ	Emphatic voiceless alveolar stop	/**ṭ**a:laʕ/ 'going up'	ط as in طالع 'going up'
ḍ	Emphatic voiced alveolar stop	/**ḍ**rab/ 'he turned'	ض as in ضرب 'he hit'
k	Voiceless velar stop	/**k**bir/ 'big'	ك as in كبير 'big'
g	Voiced velar stop	/**g**ri:b/ 'close, near'	
q	Voiceless uvular stop	/**q**ahwa/ 'coffee'	ق as in قهوة 'coffee'
ʔ	Voiceless glottal stop	/**ʔ**ani:sa/ 'miss'	أ as in أنيسة 'miss'
f	Voiceless labio-dental fricative	/**f**u:g/ 'above'	ف as in فوق 'above'
v	Voiced labio-dental fricative	/**v**ali:sa/ 'suitcase'	
s	Voiceless alveolar fricative	/**s**ṭar/ 'he covered'	س as in سطر 'he covered'

z	Voiced alveolar fricative	/**z**iːt/’oil’	ز as in زيت ‘oil’
ṣ	Emphatic voiceless alveolar fricative	/**ṣ**oːf/ ‘wool’	ص as in صوف ‘wool’
ʃ	Voiceless palatal fricative	/**ʃ**oːrba/ ’soup’	ش as in شوربة ‘soup’
x	Voiceless velar fricative	/**x**aːtam/ 'ring’	خ as in خاتم ‘ring’
ɣ	Voiced velar fricative	/**ɣ**iːra/ ' jealousy'	غ as in غيرة ‘jealousy’
ħ	Voiceless pharyngeal fricative	/**ħ**amja/ 'hot’	ح as in حامية ‘hot’
ʕ	Voiced pharyngeal fricative	/**ʕ**ajn/ 'eye'	ع as in عين ‘eye’
tʃ	Voiceless alveo-palatal affricates	/**tʃ**araːk/ 'a variety of cake'	
dʒ	Voiceless alveo-palatal affricate	/**dʒ**aːdʒ/ ' chicken'	ج as in جاج ‘chicken’

m	Voiced bilabial nasal	/**m**udiːr/ 'director'	م as in مدير 'director'
n	Voiced alveolar nasal	/**n**qal/ 'he moved'	ن as in نقل 'he moved'
l	Voiced alveolar lateral	/**l**aːm/ 'he blamed'	ل as in لام 'he blamed'
r	Voiced alveolar trill	/**r**aː ħ/ 'he went away'	ر as in راح 'he went away'
w	Voiced bilabial approximant	/**w**aːsaʕ/ 'roomy'	و as in واسع 'roomy'
j	Voiced palatal approximant	/**j**aːbas/ 'hard'	ي as in يابس 'hard'

The vowel inventory of MAR differs from that of MSA since MAR vowel inventory includes more vowels than MSA vowel inventory. In addition to MSA's ternary vowel inventory which consists of the vowels /i, a, u/, MAR includes their long counterparts, that is, /i:, a:, u:/ together with /ə, o:/. Instances of MAR words which include the vowels /i, a, u/ comprise [d**i**rah] 'do it', [g**a**lb] 'heart', [kunt] 'I was, you were'. As to the vowels /i:, a:, u:/, instances of words that include them comprehend [sʕi:b] 'difficult', [ra:ħ] 'he left', [fu:la] 'a broad bean'. Examples of the remaining /ə, o:/ include the words [ragəd] 'asleep', [ro:ħi] 'go, you feminine'. The following diagram indicates the monophthongs of MAR:

(8)



In addition to the eight former monophthongs, MAR possesses, two diphthongs, namely /aj/ and /aw/. Examples of MAR words which include the diphthongs /aj/ and /aw/ comprise [xajfa] ‘afraid, female’, [rajħa] ‘going, female’, [bajta] ‘staying overnight, female’, [ħawʃ] ‘yard’, [qaws] ‘bow’.

The diphthong /aj/ is, nevertheless, replaced by the monophthong [i:] in MAR in some words. Such words include the following:

(9)

Original form	**MAR form**	**Gloss**
ħajṭ	ħi:ṭ	‘wall’
bajḍ	bi:ḍ	‘eggs’
xajṭ	xi:ṭ	‘thread’
bajt	bi:t	‘room’

The above phenomenon is known as compensatory lengthening and involves the deletion of the non-high vowel /a/ of the diphthong /aj/. /j/ is then replaced by /i/ in order to avoid having syllables that lack nuclei, namely [bjt], [ħjṭ], [xjṭ], [bjḍ]. The substitution of /i/ for /j/ yields [bit], [ħiṭ], [xiṭ], [biḍ]. The vowel /i/ is then lengthened in compensation of the deleted /a/. Hence, the resulting words are [bi:t], [ħi:ṭ], [xi:ṭ], [bi:ḍ].

3.2.2.2. Syllable Typology

MAR includes different types of syllables, nevertheless the most common and basic type is the open syllable type (CV) which possesses an onset and a nucleus, but has no coda. Instances of CV-syllables are observed in MAR words like [roħi:] 'go, you feminine' (CV.CV), [**ra**gəd] 'asleep' (CV.CVC), [**ki:**ra:n] 'buses' (CV.CVC) in which the syllables /ro:/, /ra:/, /ki:/ are CV-type syllables. In addition to the basic CV-type, MAR possesses the CVC type which has both an onset and a coda as in [xa:f] 'he was scared', [ka:s] 'glass', [ħi:ṭ] 'wall', [ħawʃ] 'yard'. MAR also possesses consonants with complex onsets either open; of the type CCV or closed of the CCVC type as in [kra] 'he rented', [kwa] 'he hurt using hot iron', [bra] 'he is healed' and [blaʕ] 'he swallowed', [ktab] 'he wrote', [sbaʕ] 'lion'. Complex coda syllables are also observed in MAR in instances such as [galb] 'heart', [larḍ] 'floor', [karʃ] 'belly'. MAR's syllable types are sketched below.

(9)

Syllable structure	Example	Gloss
CV	dʒa	'he came'
	ma	'water'
CCV	ʃra	'he bought'
	kla	'he ate'
CVC	ʃak	'he doubted'
CVCC	faʃ	'he deflated'
	lamm	'he gathered'
	ʃadd	'he held'
CVVC	soːg	'auction'
	fuːg	'above'
CCVC	dxal	'he came in'
	ʃrab	'he drunk'

3.2.2.3. Accents of MAR

In addition to the city, Mostaganem has rural areas, thus what was described earlier regarding the phonological properties of MAR are, in fact, the properties of MAR that is spoken in the city of Mostaganem, namely Urban MAR. Yet, another accent of MAR is spoken in its rural areas, viz Rural MAR. Hence, two accents are spoken in Mostaganem, namely Urban MAR and Rural MAR. Urban MAR is the accent of MAR which is spoken in the city, whereas Rural MAR is spoken in the rural areas of Mostaganem like Masra, Siraat, Achaacha, Bouski, Bougiraat. The difference between the two accents of MAR relates to the pronunciation of certain sounds like the diphthong /aj/ which is replaced by /i:/ in Urban MAR, but is preserved in Rural MAR. Thus, Urban MAR words like [bi:ḍ], [ħi:ṭ] are realized as [bajḍ] [ħajṭ] in Rural MAR. The sound /q/ is also pronounced differently in Rural MAR or else the [g] realization of /q/ is more dominant in Rural MAR than it is in Urban MAR. Hence, Urban MAR pronunciations like [qarʕa] 'bottle', [marqa] 'sauce', [qassam] 'he distributed' are realized as [garʕa], [marga], [gassam] in Rural MAR. Furthermore, the inter-dentals /θ, ð/ and the emphatic /ð̣/ which are replaced by the alveolars /t, d/ in Urban MAR are preserved in Rural MAR. Hence, Urban MAR pronunciations [tu:m] 'garlic', [du:q] 'taste' [dhar] 'back' are realized as [θu:m], [ðu:q], [ð̣har] in Rural MAR.

3.2.2.4. Code-Switching to French

MAR native speakers may code-switch to French in their speech. Such code- switching may occur either at word boundaries (intra-sentential) or sentence boundaries (inter-sentential). Instances of intra-sentential code-switching may be observed in the following MAR utterances:

(10)

MAR utterances	**Gloss**
[naʃarbu ã kafe məmbaʕd nroːħu]	‘We’ll drink coffee and then we’ll go’
[nasapquha lla fak wə hija təlħagna]	‘We’ll go to the university and she’ll meet us up later’
[qriti hadaːk lə livʁ əlli gutlak ʕlih]	‘Did you read the book I told you about’
[smaʕtiː la ʃõsõ taħħa əttalija]	‘Did you listen to her last song?’

As it appears from those instances, MAR speakers tend to switch to French often, though not consciously, to indicate a certain educational level or language competence in French. Indeed, the word [ã kafe] ‘a coffee’ in the first instance possesses an MAR counterpart, namely [qahwa]. Yet, the MAR speaker switches to the French word. Similarly, in the second example, the word [la fak] ‘the university’ has an MAR counterpart which is [əl dʒamiʕa]. However, the speaker switches to the French [la fak]. The same can be observed in the third and fourth examples in which the words [lə livʁ] ‘the book’ and [la ʃõsõ] ‘the song’ have both MAR counterparts, namely [kta:b] and [ɣunja], but the speaker switches to the French words.

MAR speakers’ inter-sentential code switching to French may be illustrated by the following utterances:

(11)

MAR utterances	Gloss
[ila ma ʕadʒbakʃ əl ħaːl pxõ tez afeːʁ edəoːʁ]	'If you're not satisfied, take your belongings and get out'
[si se pa kleːʁ nʕawəd nfahamkum]	'If it is not clear, I'll re-explain'
[ʃafətni mliːħ e apxe el ma injoʁe]	'She saw me very well, then she ignored me'
[fawatnaha ʕalama el a ʁate yn txe bel okaziõ]	'We spent a wonderful time, she missed a very good opportunity'

In the above instances of inter-sentential code-switching, MAR speaker also switches to French counterparts which in these cases are either clauses, like [si se pa kleːʁ] 'if it's not clear', or sentences such as [el a ʁate yn txe bel okaziõ] 'she missed a very good opportunity'. Such type of code-switching is often intended to indicate a certain educational level or language competence just as the other type of code-switching. After describing the dialect that is object to the present study, it is worth presenting the population and sample that were subjected to this study.

3.3. Population and Sampling

The population of the present study includes MAR native speakers who are the inhabitants of Mostaganem and use MAR as a means for their daily life communication. Mostaganem's population was estimated to around 162 885 inhabitants according to 2008 census. These inhabitants are from different areas of Mostaganem and can eventually be divided to the city dwellers and the countrymen. City dwellers, as the name indicates, inhabit the city of Mostaganem, countrymen live in the rural areas of Mostaganem such as Masra, Siraat, Achaacha, Bouski, Siyada, Twahriya among other rural areas. The city dwellers speak what was earlier referred to as Urban MAR, whereas countrymen speak what was earlier called Rural MAR.

Different groups of inhabitants tend to exist inside the city of Mostaganem, namely the Hadhar, the Hacham and migrants from rural areas. The Hadhar are a group of inhabitants who have Turkish origins, while the HachaMARe of Arabic Bedouin origin. The Hacham used to live in the area known as El-Hacham in the outskirts of the city. Then, they moved inside the city and adapted to its habits, including the linguistic habits. The third group includes the inhabitants of rural area of Mostaganem, like Achaacha, Siraat, Masra, who migrated to the city.

The sample that was selected for the present study includes about a hundred native speakers of MAR. These speakers are all inhabitants of Mostaganem and thus they speak Urban MAR. Such participants belong to different age groups, comprehending children, teens, adults and elderly people. Thus, the age range of the present study's participants is 8-75. Both genders were involved in the study with the percentage of female participants (54%) slightly exceeding that of male participants (46%). The educational background of participants varied since the sample included lay people, housewives, primary, middle, high school and university students and teachers, taxi drivers, salespersons, restaurant receptionists, waiters and waitresses and hairdressers. However, age, gender and education variables are not taken into account in the present study since it is a descriptive qualitative study.

The sample includes members of the family of the researcher, her relatives, neighbours, but also strangers with whom she interacted in restaurants, supermarkets, taxis, at the hairdresser's, in the beach, university, shops among other settings. After describing the population and sample of the study, let us turn to data collection and analysis procedures.

3.4. Data Collection Procedures

A number of procedures were undertaken by the researcher in order to obtain the present study's corpus of data. The first procedure involved the selection of the appropriate settings for recording sessions. Such selection targeted settings in which speakers of MAR are talkative, and thus settings which require calm and silence, such as the library and mosque, were excluded from the selection. In retrospect, settings which induce talking and conversations were favoured in the selection. Such settings include taxi, restaurant, supermarket, beach, and occasions like family gatherings, neighbours chat and so on.

The second procedure in data collection involved insuring that the participants' speech is spontaneous and natural in order to avoid any awkwardness during recording sessions. In order to attain such a goal, the researcher did not inform the participants about the object of the study or its topic, but only described the recordings as being necessary for a research work without specifying which kind of research it is. The duration of recording sessions ranged from 2 minutes to two hours, depending on the availability of the participants as well as the length of their conversations. Thus, interactions with salespersons, waiters and taxi-drivers did not exceed 10 minutes, while family members' chats, neighbours' chats, chats at the hairdresser's reached two hours.

Speech recording was accomplished through a digital voice recorder model: Olympus, series: VN-850PC. Such a recording device is equipped with a miniature microphone on its surface which serves to amplify the sounds that are produced by the participants, and thus facilitates the task of sounds identification for the researcher. After having outlined the procedures that were followed by the researcher in the collection of data, it is now worth describing the methodology that the researcher followed in order to indentify data.

3.5. Data Identification Procedures

Once the recording sessions were over, the recorded speech was subject to identification procedures. The first procedure involved the listening stage. The recordings were played in a recurrent fashion in order for the researcher to be familiar with the different talks and conversations. After getting familiar with the recorded speech, the researcher played the recordings another time in order to transcribe the speech. Transcription included IPA symbols, namely the symbols that were introduced earlier in this chapter and which correspond to MAR consonants and vowels. The transcribed speech was then analyzed in order to indentify the phonological processes that are present in sample MAR conversations and chats. After the processes were identified, a classification of such processes into different types was established.

3.6. Data Analysis Procedures

After the identification of phonological processes was achieved and their classification into different types was completed, the analysis of each type of phonological processes was carried out. Such analysis branched into different accounts, viz a rule-based account and an OT account.

Rule-based analysis of the identified phonological processes occurred in steps. The first step involves the decomposition of each sound which undergoes phonological processes into its constituent distinctive features together with the distinctive features of the contextual sound that might trigger the process under study. The processes are then formulated in the form of a phonological rule. Each rule's construction requires the identification of the input form for the output that was identified in the transcribed speech. Furthermore, each rule requires the setting of the environment which triggered the mapping from input to output in each case of a given phonological process. The rules are then interpreted and explained.

OT-based analysis also involved different steps. The first step includes the identification of the input form for the output provided by the transcribed speech. Then, the constraints that are involved in the phonological process under study are identified. The mapping from the input to the output in each phonological process is described and explained in terms of constraint hierarchy as well as generator and evaluator functions within the machinery of OT. OT account is then formulated in the form of OT's tableau which sketches the dynamics of OT.

The above analysis procedures make of the present study a qualitative kind of study as it aims at describing and explaining a phonological phenomenon which in this case are phonological processes. Indeed, the present study does not compare between the produced speeches of different groups such as males and females or old and new generations. Furthermore, it does not quantify those differences using statistic methods like T-test or ANOVA. It is, thus, not a quantitative study. The following section presents the classification of the phonological processes that were identified from the recorded speech of the hundred participants of the study at hand.

3.7. Classification of Phonological Processes in MAR

Different types of phonological processes were identified in the corpus of the study, namely assimilation, metathesis, epenthesis, deletion and major class change. The following sections enumerate the findings of each type of phonological process.

3.7.1. Assimilatory Processes in MAR

3.7.1.1. Voice Assimilation

majəgʕotʃ fiːh ‘He does not sit on it.’

liːq jkuːn **fuːkkul** waħad mənna ‘He has to be above each one of us.’

təsapħu pxiːr ‘Good night!’

kuːn jkuːn ʕi fi wast̠hum waħad ʔafqah mənnu robama ʔəl ʔumuma ma **ddʒuːsʃ** ‘If someone is more jurist than him, then maybe his Imamhood is not allowed.’

ʃa **ddiːr** fiːh əl biːd̠? ‘What does she put in it? Eggs?’

normalmõ **ddawʃi** w tbadli ‘You (singular feminine) have a shower and change your clothes.’

mliːħ dʒaj taʕ **muʃtamaʕ** maʃi ‘It is good. It is a social series, isn’t it?’

ʔana **manətfarattʃ** ʕlət̠ t̠naːʕəʃ ‘I do not watch TV at midnight.’

jəssahru w **jsapħu** ragdiːn ‘They stay up late and they sleep in.’

ħsaptha ragdat ʕlət-tasʕa ‘I thought she slept at nine.’

maʃi ħabbast **ɣajapt** ʃħaːl ‘I did not stop attending, I was absent for a long time.’

ʕalama ʔəl dʒamaʕ tətʕalmi **ddʒawdi** ‘I like mosque courses; you learn tajweed in these courses.’

dʒaːt **təpki** w dʒaːt ħaltha ki dajra ‘She came in crying and in tatters.’

səttu fəddora wimma kajən əl **pħar** ‘I found him in the turning where there is the beach.’

ʃabba **ʔəlpsiha** ‘It is beautiful wear it.’

masaptʃ xadidʒa hnaja ‘I did not find Khadidja here.’

ʔaja **təpqa** laxiːr ‘Good bye.’

bugalmona **rapħat** ‘Bougalmona had her diploma.’

ʔakkatt mʕaːh gutlu salaman bəd-daːt galli waːh ‘I made it sure with him. I told him, “Is Salamane (district name) the center?” He said, “Yes”.’

ʕila tradʒʕak galmona xawja kuːn ʕi galmona mʕamra **matɣiːtʃ** ‘She will turn you into an empty hood. If only it were a full hood, you would not attract compassion.’

nhaːr **əs-sapt** ‘On Saturday’

la ʕla **ṯapsi** ‘No, it just a plate.’

tqiːqa nəglaʕ **dʒalapti** w ndʒi ‘Just a minute I will take off my gown and come back.’

miːmti mən **kabatti** ‘My mom is my liver.’

ma gutt waːlu taːni **ddawri** ʕlina ʔəṯ-ṯapsi ‘I did not say anything. Do not be mad at us.’

ma **ʕallaktʃ** əl kadr taʕ ma meːr ilja a peːn dœzõ ‘I hung my mother’s frame just two years ago.’

ʔana **hrapt** taʕarfi ʔila gabaltiha ‘I ran away. If you sit with her it is a tragedy.’

jqad ila **maqatʃ** ʕawəd wəlli ‘It is enough. If it is not, come back.’

ʔəs-safaja **xsaltiha** hijaʔ ‘she washed the sieve?’

gullha ku:n **hawətti** ku:n wəlli:ti ʕi qdi qdi ‘Tell her if she went, she would have started doing housework.’

gatti dʒamila **saptha** xadra ‘Djamila told me, “I found her pale”.’

maʃi **ddʒafaf** ‘She does not sweep the floor.’

ddalamli hakka ‘She obscures the room foe me.’

ddibarasi təxsal əl maʕi:n ‘She cleans up and washes the dishes.’

fatiħa **ddal** təhdar fi:ha ‘Fatiha keeps on talking in her back.’

tətħasha bəlkla:m ‘She hurts her feelings through words.’

ʔanaja nəbɣi nsaffi **raqapti** ‘I want to ease my conscience.’

matraħapʃ bi:ha ‘She does not welcome her.’

ʔana **gʕatt** nzaʕaq mʕaha ‘I was joking with her.’

sapħat tqi:la ‘She appeared to have less energy in the morning.’

ka:nət **tətħak** mʕana ‘She was laughing with us.’

matəxratʃʃ ‘She does not get out.’

kulma **ddʒi** ‘Every time she comes.’

jguːl dʒaptha mliːħa ‘He says, “When I brought her, she was fine”

ta mʕa ʔəl **ħʃija** w rwaħi ‘Do not come till the afternoon.’

ħna xlaʕna ʔana kutt mənna **wakfa** ‘He shocked us. I was standing there, then I saw him.’

wila **majṯiːkʃ** jsoːm? ‘What if he cannot fast?’

waqiːla **rgatti** ‘It seems like you slept.’

ʔəl dʒara dguːl ldʒaratha **xaraʃtlak** fraʃək ləʃ-ʃams ‘The neighbor tells her neighbor,”I took your bedding out to the sun”.

kuːn **zattu** ʔənxlaʕtu ‘You would have had another shock.’

waːh bəssaħ miːn **ħapsat** əṯ-ṯarawiːħ ‘Yes, but when the Taraweeh prayer was over.’

ddʒamaʕ ħdaja w taħki mʕaja ‘She sits with me and talks to me.’

miːn **nott** ʔana galli ki najḏa ʔana hada wiːn ni daːxəl nərgod ‘When I woke up, he told me, “Are you up?”, I am just going to sleep.’

xaliːha **ddabar** rasha ‘Let her do what she wants.’

saji **xraʃt** mər-rejõ taʕ le rolœr ‘That’s it. You went out of the rollers section.’

ʔaliki əṯ-ṯwawi ɣadiːk **dduxi** ‘Look to the pans over there. They will make you dazed.’

kuːn **dʒapt** zuːdʒ ‘You should have brought two.’

ʃario xiːr ʕlabalki labɣaːt təʃri ʕi ħadʒa le sõsiel **matərfatʃ** ‘The trolley is better, you know, even though you buy one thing. All that matters is that you do not lift.’

la hija bɣaːt **ddoːr** ‘No, she wanted to wander.’

ɣaja **ʕapqader**? ‘Are you ok, Abkader?’

3.7.1.2. Place Assimilation

kaːm mriːd? ‘Was he ill?’

jwaru ʔəl **ʔambijaːʔ** ‘They show the prophets.’

məmbaʕd ʕawdu ħjaw ‘Then they resurrected.’

səttu fəd-dora **wimma** kajən əl pħar ‘I found him in the turning where there is the beach.’

liːq **məm** bidajat əs-sana təbda ‘You should start from the beginning of the year.’

qisi kulʃi **məm** baːlak ‘Chase all bad thoughts from your mind.’

ʔana ʔəl ħadʒa təbɣi ʔəl klimatizœr **məm** maj ‘My mother likes the air-conditioner to be switched on in May.’

kuːm makaːʃəl- qrajanxaliːha tətfaradʒ ‘If there is no school, I would let her watch TV.’

ʃətti ki wəllaːt **tbaːm** miːn kʃafnaha ‘Did you see the look on her face when we caught her.’

3.7.1.3. Total Assimilation

gaːllək daːrulu waħd əl ʕamalija taʕ əl galb bəssaħ maʃi galləkwaħd **ət.tuqba** gaːllək operasiõ sahla ma fiːha waːlu ‘They say, “he had a heart operation, but it is not… they say, the hole”. They say an easy operation.’

ʔana gaːluli **fəṯ-ṯabla** maːt ‘They told me he died on the table.’

haw **əz-zwaːq** bəzaːf maʃi mliːħ ‘Too much decoration is not good.’

ʔət-tapijaːt gudaːm **əd-daxla** taʕ ramdaːn jfarʃuhum ‘They will set the carpets before the beginning of Ramadan.’

liːq jkuːn fuːk kul waħəd mənnaħija **əd-dinija** ‘He has to be above all from the religious aspect.’

haːd **əs-soːg** xassarha ‘This week he blew it.’

taʕ **əṯ-ṯʕaːm** ‘It is for couscous.’

ʔəṯ-ṯʕaːm **fəʃ-ʃkajər** ‘Couscous in cases.’

nədʒbad **əṯ-ṯmar** ‘Can I take out the dates?’

maʃi fəl garadʒ fəl hadiːk **əddebara** ‘It is not in the garage, it is in the storeroom.’

jwaru **kənnuːr** ‘They show as a light.’

səmma **ʔənnhaːr** gaːʕ ma jsaluːʃ ‘So they do not pray all day.’

jdʒi bniːn xiːr mən taʕ **əs-sokar** ‘It is more delicious than that of sugar.’

ta̱ta̱ faṯma gattək **əṯ-ṯaksi** dawar bija gaːʕ baːʃ wassalni ‘Aunt Fatma said, “The taxi rode around all the district before he brought me here”.’

ʕlabaːlkum **ərrasm** gaːʕ liːkulkum dda la mwajeːn ‘You know all your school passed the drawing course.’

ʃajali **ʔən-noqṯa** ʔəl ʔaxiːra hija ʔəl maːt ‘The last mark was that of mathematics.’

hada ħaːmi **ʔər-rfiːs** ‘This cake is warm.’

nhaːr **əs-sapt** ‘On Saturday.’

hatili tʃu diːk **əz-zlafa əs-sɣiːra** ‘Hand that small bowl.’

sidaħmed u waħd **əd-draːri** ‘Sidahmed and some children.’

guttha gaːʕ **əs-sadaqa** taʕ ʕaʃora naʕṯohalha ‘I told her that we will give her all of Ashura’s charity.’

ʕandak **əṯ-ṯafla**? ‘Do you have a girl?’

bəssaħ miːn taxwa **ʔəd-daʕwa** ‘But when the house will be empty, you will see.’

bəssaħ kajən **ən-naʕnaːʕ**? ‘But is there mint?’

ʔəssafaja xsaltiːha dʒamiːla ‘Did you watch the sieve?’

malika maʃi gattu dʕi ʕliːh daʕwat **əʃ-ʃar** ‘Malika did not tell him, “Curse him.”’

ʔəl baraħ griːb **əṯ-ṯnaʕəʃ** bah ṯlaʕ ‘Yesterday, he did not leave until almost midnight.’

jəbɣu ʔəl qodjaːn u haːd **əʃ-ʃkiːl** ‘They like housework and that nonsense.’

ddiːr **ət-tiːr** fi ʕdʒuːzatha ‘She ill-treats her mother-in-law.’

daxluːha **fəz-zʕaːf** ‘They blamed on anger.’

fəd-darba taʕ əl muːt dʒa ‘He came in the funeral.’

bəssaħ ʕlaːh tamiːn **ət-talja** bah dʒaw jsamħu? ‘Why did they wait till the end to come and ask for forgiveness?’

bəzaːf **ən-naːs** daxlu ‘A lot of people came in.’

mən diːk **əs-sahra** saji ‘It was the last evening.’

lesõsiel **əs-samʕ** ‘What matters is listening.’

ri taħsab **bəs-swajəʕ** ‘She is counting in terms of hours.’

ʃħaːl mən saʕa rana naklu ʕla daːk **əʃ-ʃhar** ‘We eat during a lot of hours, a month is nothing.’

təbɣi **ʔəd-danja** tahbal ‘People want people almost become crazy.’

jəbrad fija **ʔəd-dam** ‘Blood cools within me.’

gallək **ən-nu** liːl w nhaːr ‘He said, “there is rain night and day”.’

ddʒiha **ʔəd-duxa** ‘She feels dazed.’

galli **ʔəs-sawt** taʕ radja kima taʕ zohra ‘He said, “Radia’s voice is like zohra’s voice”.’

papa ktalhum **bəd̠-d̠aħk** ‘Dad killed them with laughter.’

ħat̠iːnhumənna ʕi **fət̠-t̠raːb** ‘They deposited them just on earth.’

nəʃri **ʔəs-siːru** taʕ ər-rgaːd ‘I buy drowsiness syrup.’

hadik **əʃ-ʃorba** liːq tkuːn ‘Soup should be present.’

naʕt̠i **ʔəʃ-ʃoːrba ləʃ-ʃiːraːt** ‘I will give the apron to the girls.’

makkaːʃ **ət-tasjaːq** ‘There is no sweeping of the floor.’

tqassaħ taʕ **əd-darb** ‘He was hurt from the beating.’

ʔana darwak rani **fən-nuːm əs-sabaʕ** ‘Now I am deep asleep.’

wəlla jroːħ ʕliːhum **əd-doː** ‘Electricity used to go off.’

ndʒamʕu **fəʒ-ʒardã** ‘We will sit in the garden.’

miːn tsiːb tsiːb wħəd **fəz-zmaːn** ‘If you find, you will find one in a million.’

swalaħna ʕi taʕ **ət-taʕb** ‘Our traditions are tiresome.’

ʔəd-darsa katlatni ‘My tooth is killing me.’

taʕt̠ini **lər-raːs** ‘It hurts me in my head.’

kima ʔəl maʃta ramdaːn ta l**ət-tmania** w ma jaɣbanʃ ‘As in winter, Ramadan could be up to eight and you will not get tired.’

huwa ʕandu lyziːn taʕ **əz-ziːt** ‘He has an oil factory.’

balʕat **əṯ-ṯriːg** baːṯəl ‘She unnecessarily blocked the passage.’

ʔaliki **ʔəṯ-ṯwawi** ‘Look to the pans.’

ddi **ʔət-taħtanija** ‘Take the one that is underneath.’

tʕalmu jdiːru **dər-riːħa** ‘They learnt to put on that perfume.’

jʕullu w **əs-snaːn** ‘They are dull and the sweating.’

roħi tʃufi ɣadiːk ʕand **ən-naxla** ‘Go to the palm.’

ʕandhum **əd-daxla** mənna ‘Their entrance is from that side.’

saji balʕu **ʔər-riduwaːt** ‘That is it, they shut the curtains.’

hadaːk əlli ħdaːna wimma raːm jəbnu **ʔəʃ-ʃnawa** ‘The one next to us where the Chinese are building.’

maʃi taʕ **əs-sbiːka** ‘Not the one of the railway.’

nroːħu **bəṯ-ṯonobiːl** ‘We go by car.’

ʔəz-zwdʒa twafaːt ‘My wife passed away.’

ma ddiruːʃ **əz-zga** ‘Do not make noise.’

3.7.2. Non-Assimilatory Processes in MAR

3.7.2.1. Metathesis

dxal reda wə **daxlat** xtah muraːh

‘Reda came in then his sister followed him’

wah fəl ʕurs huwa **ʃtaħ** mʕa xtah w hija **ʃatħat** mʕa xuha

‘Yes, he danced with his sister and she danced with her brother in the wedding celebration’

waldiːh **katbuːlu** əddar ʕla ʔismu wə huwa əl bahluːl raħ **ktabha** ʕla ʔismha

‘His parents registered the house under his name and he, the idiot, registered it under her name’

rakbat dʒadda wə ṭlaʕ muraha wə **rkab** ħdaːha

‘Grandma got in the car and he got in the car later and sat next to her’

ki huwa ki hija huwa **slak** mən hadiːk əl ɣbiːna taʕəddruːdʒ wəhija **salkat** mən haduː k əl dʒwariːn

‘both of theMARe relieved; he got rid of the problem of stairs and she got rid of the neighbours’

klaːtlu rasuː ħatta **xradʒ** mən daːrhum w ziːd miːn **xardʒuː** huwa w hija ma galu samhuː nna ma walu

‘She kept on pushing him till he left his parents’ house and when they left they did not even apologize’

haw miːn **ṭalʕat** fəddruːdʒ sabtah ṭajaħ twaləm raːh min **ṭlaʕ** daːx

‘Yes, when she went upstairs, she found him down. It seems that when he went upstairs he felt dazed’

mi:n kla: w **ʃbaʕ** ga:lhum ma ħaṭṭituli:ʃ bəza:f gatlu: mart xu:h ħaṭṭi:nalak ga:ʕ ktar mənn a ha rihi ʔasma ħaṭṭinalha ʃwaja hija ṭṭi:g tgu:l ma **ʃabʕatʃ**

‘After he was done eating, he said I am not full yet, so his sister-in-law told him: “we gave you the largest ration. Look at Asma she was given the smallest ration, she can say I am not full yet”

wa:h bənti: gatli mama l ʕri:s **ʃrab** əl ħli:b bəssaħ əl ʕro:sa ma **ʃarbatʃ**

‘Yes, my daughter told me: “Mom! The groom drunk milk, but the bride didn’t”

bessaħ **ħgarni** tʕarfi: ha:di:k li kunna ngulu: qbiħa ma **ħagratniʃ** kifu

‘But he was unfair. You know the one we used to think is mean was not as unfair as him’

3.7.2.2. Epenthesis in MAR

jli:qalha **təstaʕraf**

‘She has to acknowledge.’

ʔəl ʕalam **nəstaʕamru**

‘I colonize the world.’

jəktum əs-sar

‘He keeps a secret.’

nxaːf ila **jətkassar**

‘I am afraid it breaks.’

makkaːʃ əlli **jəgʕod** fuːg lard̲

‘No one stays on earth.’

ʔana ? waːh **nətfaradʒ**

‘Me? Yes, I watch.’

təbɣiːni w **nəbɣiːk**

‘You love me and I love you.’

nədʒbad ət̲-t̲mar?

‘Can I get the dates out?’

təsħaqu ngullah jziːd?

‘Do you need, do I tell him to bring more?’

bəssaħ əlla jbaːrək **tətfakar**

‘But Allah bless her, she remembers.’

ʔanaja **nəkrahha**

‘Me? I hate her.’

tkuːni **tətmaʃaj** jt̲iːg jdʒiːk txãt miːl

'You are walking, it could amount to thirty thousands.'

kulʃi ʕandum ɣaːli **jəzbar** 'Everything is expensive.'

ʔəl ma ʔəlli dartiːh ra **jəɣli**

'The water that you put is boiling'.

jəssahru w **jəssapħu** ragdiːn

'They stay up late and they sleep in.'

jətwadaw u jsallu

'They do the ablutions and they pray.'

haw ʃkuːn **jəʃrili** jana?

'Who buys me the things I need?'

ʔana **jəʕdʒabni** dʒamʕɪ famili '

I like Djamai Family (a TV show).'

jətʕaʃaw u **jəʕt̠u** ʔər-riːħ lə karʕiːhum

'They have dinner and they leave.'

dʒaːt **təpki**

'She came in crying.'

jətwadar fi salaman!

'He gets lost in Salamane!'

haw wiːn **nəddiːk** ntija?

'Then, where do I take you?'

jədʒʕal jgoʕdu hakka fəl-lisi

'I hope they stay that way in high school.'

tətlaqaw fəl-lisi

'You meet in high school.'

rah **jədʒri** muraha

'He is running after her.'

jətmaʃa w **jədħak**

'He walks and laughs.'

tqiːqa **nəglaʕ** dʒalapti

'Just a minute. I will take off my gown and come back.'

ʔən-nsa jdʒu **jəʃʃarbu** ʔəl qahwa

'Women come to drink coffee.'

tsiːbi ʃkuːn **jərfdak**

'You will find who takes care of you.'

ʔəs-sultaːn bət-taːdʒ w **jəħtadʒ**

‘The sultan, even with a crown, needs help.’

nabila **təxradʒ** bəkri məl xadma

‘Nabila gets out early from work.’

galli malika ri **tətnarva**

‘He told me, “Malika gets upset”.’

gaːʕ əs-sadaqa taʕ ʕaʃora **nəʕt̠ohalha**

‘We give her all of Ashora’s charity.’

baːʃ nəʕt̠uːk ħwadʒ drahəm ila rabbi **jəktab**

‘So that we will give you clothes, money if Allah will.’

bəssaħ miːn **təxwa** ʔəd-daʕwa tʃufi

‘But, when the house gets empty, you will see.’

waːh təmmaːk **tədxul**

‘Yes, it enters there.’

nʃallah **jərħamha** w jwassaʕ ʕliːha

‘May Allah bless her.’

ʔana **nədʕɪ** daʕwat əʃ-ʃar ʕla wəldi?

‘I, curse my son?’

ma bɣaːʃ gaːʕ **jət̲laʕ**

‘He did not want to go home.’

jəblaɣ nʃalah ‘I will pass your regards.’

hija mən nijatha **təxdam**

‘She works with all her heart.’

maʃi **nəlʕabha**

‘I do not pretend.’

təglaʕ gaːʕ əl mt̲aːraħ

‘She takes off all the mattresses.’

tənfad̲ u tfaraʃ

‘She shakes and sets the beddings.

tgulli **nəfat̲ru**

‘She tells me, “Shall we have lunch now?”.’

təxsal əl maʕiːn

‘She cleans the dishes.’

nətkaslu w **nəħku**

‘We relax and talk.’

jəsmaʕ lə mu

‘He listens to his mother.’

təxradʒ kima **təbɣi**

‘She goes out as she wants to.’

maʃi ddʒi muk **təbda** tmaʕni ʕliːha

‘I do not want your mother to imply things about her.’

miːn tʃuːfak **tət̠laʕalha** la t̠õsiõ

‘When she sees you, her blood pressure increases.’

gaːʕ ma **təndʒamhumʃ**

‘She cannot stand them.’

nxaːf ila **nəndar**

‘I am afraid I get hurt.’

baːʃ **təgbad** əl swaːm ttawʕak

‘So that you know the prices’

ʃkuːn **jəʃrili jana**

‘Who buys the things I need.’

ħawdʒi jana ħsapt la fami ttaʕək raːm fəl pħar

'Oh! My God. I thought your family is the beach.'

rani **ʕi jana** w malika

'It is just me and Malika.'

gatli jana rani rajħa lə faːri

'She told me, "I am going to my house".'

ʕlabali jana ʃa kajən

'I know what is going on.'

ɣadi **jdiːruli jana** w malika lanaliːz

'They will do to me and to Malika medical analyzes.'

jəxt̠oni jana w hija ddabar rasha

'They leave me alone and she deals with her business.'

rani ʕarfa ɣadi **jfuːtuni jana.**

'I know they will bail on me.'

3.7.2.3. Deletion in MAR

saħħa ntija **ʕajt̠i** 'Ok! You call.'

gudaːm əd-daxla taʕ ramdaːn **jfarʃuhum**

‘Before the beginning of Ramadan, they will set them.’

səmma **ħakmiːn** fiːh

‘So, they rule him.’

məmbaʕd **ʕawdu** ħjaw

‘Then, they resurrected.’

bənthum **rajħa** lə sbanja

‘Their daughter is going to Spain.’

dublaw **ʕandkum** waqila rabʕa

‘Four did not pass in your class.’

jzajru roħum

‘They work hard.’

ma **jħaʃmunaːʃ**

‘They should not humiliate us.’

tradʒʕak galmona xawja

‘She turns you into an empty hood.’

kuːn ʕi galmona **mʕamra** ma tɣiːttʃ

‘If only it were a full hood, it would not be pitiful.’

tʕaʃʃi tgawədha w **tgawdak**

'You take her by the hand and she takes you by the hand.'

hahum raːm **waʒdiːn**

'Here they are. They are ready.'

səmma ri tətfaradʒ ri **gabda**

'So, she watches, she is grabbing.'

tħawsi ʕlija ndawəʃ?

'You want me to take a shower.'

jħawsu **jdaxlu** ʔəl ɣaːʃi

'They want to make people come in.'

nt̲ajbu darwak?

'Do we cook now?'

tkuːn **ragda**

'She must be sleeping.'

liːq tkuːni **fahma** w **ʕaqla**

'You have to be wise and kind.'

xalaːt durija **salħa**

‘She left good children.’

ns̠iːb zohra **rafda** sidahmed

‘I find Zohra carrying Sidahmed.’

manaʕrat gaːʕ wiːn **msawriːn**

‘I do not know where their picture was taken.’

ʃətthum ki ʃuɣl **mʃaɣbiːn**

‘I saw them as if grouchy.’

ʔət̠-t̠afla **dʒajba** roħħa

‘The girl has a good figure.’

liːq ta **jkamlu**

‘We have to wait till they finish.’

kajna hna lavabo?

‘Is there a sink here?’

ʔamiːna **rajħat**?

‘Did Amina recover?’

hadu raːm **katliːni**

‘These are killing me.’

ħnaja **ʕaqliːn**

‘We are kind.’

kullaʃ ddirah ma dguːlak **ʕawnini**

‘She does everything; she does not tell you help me.’

taʕarfiːh miːn **tsafri** mʕaːh

‘You will know him if you travel with him.’

raki **ɣal<u>t</u>a**

‘You are mistaken.’

rani **mtzawdʒa** mʕa muː ?

‘Am I married to his mother?’

miːn maːt **ʕalgulu** ʕadʒuːn

‘When he died, they hang him a fascicle of dates.’

samħa maʃi samħa rəbbi ʕalləm

‘Whether she forgave or not Allah knows.’

huma raːm **ɣajbiːn**

‘They are absent.’

ʔəl malajka taħħum raːm **ħa<u>d</u>riːn**

‘Their angels are present.’

gaːʕ **tlajmu**

‘They all gathered.’

tbadlat

‘She changed.’

gabda ʔəl fonara

‘She had a scarf in her hands.’

xaṯər ntija **ħafda** ʔəl ʕaqlija

‘Because you know her mentality by heart.’

ma **səlmuːʃ** ʕliːha

‘They did not greet her.’

taʕ li **dajrathum** fi la list nwar

‘The ones she puts in the black list.’

xardʒi bəntak ‘Get your daughter out.’

ma **təndʒmiːʃ** ramdaːn

‘You cannot bear Ramadan.’

ʕanna səbʕ swajaʕ **naklu**

‘We have seven hours to eat.’

məmbaʕd nwallu **ndʒahdu**

‘Then we start striving.’

xurdʒi **tgasri** ‘

Get out to have a chat.’

rana **mdʒamʕiːn**

‘We are conversing.’

ma niːʃ **ʕarfa**

‘I do not know.’

təsbaħ **karha**

‘When she wakes up she feels fed up.’

meːm əl dʒadʒ u **jdʒajfuːh**

‘They slaughter even the chicken.’

jzaʕqu ʕla papa

‘They make fun of dad.’

ts̠iːbina **mwaʒdiːn** əl ft̠oːr

‘You find that we prepared lunch.’

nəfaṯru fi raħba w **trajħi**

‘We have lunch together and you rest.’

mi:n təpqaj **tfatʃi**

‘When you look for something.’

rabbi dʒabənna hadu:k **mgabli:nna**

‘Allah brought us those who live next door.’

ʔəllah **jərħamha**

‘Allah blesses her soul.’

dalmat əd-da:r

‘It obscured the house.’

ʔəṯ-ṯomperatyr **naqsi**

‘Diminish the temperature.’

dawah **jfawtu** ʕli:h

‘They took him for a medical visit.’

ʕa:m **ɣamdi** ʕajnak jfu:t

‘A year, close your eyes and it is over.’

tfarħi waldi:k

'You make your parents happy.'

wiːn **jsajqu**?

'Where do they sweep the floor?'

kaːnu **jtfardʒu** fəl fiːm

'They were watching the movie.'

ri **ħasla** fi diːk əl blasa

'It is stuck in that place.'

ʔasma **mwaslatlak** əs-slaːm

'Asma passes you her regards.'

dʒadatha taʕ mha **bajna**

'Her maternal grandmother it is obvious.'

barra ʔəz-zunqa ʔər-rdʒala **xardʒiːn**

'Outside, men were out.'

maʃi ra ʕarəf bəlli maːtət **ʕlabalki**

'He does not know that she is dead, you know.'

baɣi **jsagmu** ʔəl karte taʕna

'They want to improve our district.'

ħna bə ʕquːlna w **nxasru**

'We have all our senses and sometimes we say nonsense.'

galllənna **ʕawnuhum**

'He told us help them.'

tfahmu baːʃ **jʕamru** ʔəl mazoːt̲

'They agreed to fill oil.'

ndʒu ʕandak **ndʒamʕu**

'We come to visit you.'

ma t̲tgiːʃ ta **tətnafsi**

'You cannot even breath.'

huwa miːn ʃaːf hadiːk **ʕajba** daːr bə ranja

'When he saw that she is handicapped, he tuned to Rania.'

ʔəʃta **sahla**

'Winter is easy.'

raːkum **tgasru**

'You stay up late.'

ri **mwalfa**

‘She is used to staying alone.’

jətwaħʃu ʔəl blaːd

‘They miss their country.’

jħasbak rabbi ħna xwataːt

‘Allah judges you. We are sisters’.

ma **tħatmuːʃ** ʕləd-drari jsoːmu

‘Do not force children to fast.’

wimma nroħu **nxanzuha**

‘Wherever we go we blow it up.’

ri **xajfa**

‘She is scared.’

raːm **mʃabʕiːhum** xjana

‘They exaggerate in robbery.’

raːm **ʕajʃiːn**

‘They are living a good life.’

bəssaħ **dajqa**

‘But it is narrow.’

mʕamrah qad qad

‘He filled it quite well.’

tʕalmu jdiːru dər-riːħa

‘They learnt to put that perfume.’

ni **rajħa** ʔəl tniːn

‘I am going on Monday.’

wəllah ilaː ʕla (**i**)smah katbulah əddar

‘I swear they registered the house under his name’

mama (**ə**)l ʕriːs ʃrab əl ħliːb

‘Mom! The groom drunk’

fatima (**ə**)ddrari raħuː

‘Fatima! The kids went away’

karima (**ə**)ddi mʕaːk lə ddaːr

‘Karima! Take some with you to your home’

kima (**a**)na ma nruːħʃ

‘Just like me, I won’t go’

waːh daħħakni miːn gaːl klaː (**ə**)l hwa

‘Yes, it was funny when he said: “he’ll eat air”.

haw baːbah ʃraː (**ə**)ddwa

‘Yes, her father bought the medicine’

ha ʕtiːniː (**ə**)l ktaːb

‘Give me the book’

radʒʕi (**ə**)l kursiː lə blaːstu

‘Put the chair back where you found it’

ziːduː (**ə**)ṭṭʕaːm ra mənnah wə ʕliːh

‘take more of that dish, there is plenty of it left’

baɣja nəʃri (**ə**)l ħwajadʒ

‘I want to buy clothes’

3.7.2.4. Major Class Change

məmbaʕd ʕawdu **ħjaw**

‘Then they resurrected.’

jʔadan **jətwadaw** u jsallu

‘After the call for prayer they purify their bodies for prayer and pray.’

jəbdaw mʔa ʔammi rida jəlʕbu

‘They start playing with my uncle Reda.’

jətʕaʃaw u jaʕt̠u ərriħ lə karʕiːhum

‘They have dinner and leave.’

tətlaqaw fəllisi

‘You meet in high school.’

dublaw ʕandkum waqila rabʕa

‘I think four did not pass in your class.’

ʃa **ddaw** lə ʃmiːs

‘What did they take to Chemise (proper noun).’

kaːnu kaljiːn ət̠-t̠ʕaːm ma **klawʃ**

‘They did not eat it because they had already eaten couscous.’

təpqaj laxiːr ‘Goodbye!’

narvawni

‘They upset me.’

tgasri w **tənsaj**

‘You (singular feminine) stay up late and forget your pains.’

ʔaja ha **barkaw**

‘Stop it.’

ngullha goʕdi **tətʕaʃaj**

‘I tell her, “Stay for dinner”.’

səmma hada wiːn **jəbdaw** jsaju

‘It is just now that they start trying.’

la **ʔardʒaj** duːk nguːllak əs-suma mima

‘No, wait! I will tell you the price granny.’

ʃrawhumli mən ʕand rəbraːb

‘They bought me these from Rabrab (a supermarket’s name).’

kaːnu jərgdu bəzaːf nəʕqal miːn kunna **naqraw**

‘They used to sleep a lot, I remember, when we used to have class.’

dʒaw ʃafuːh

‘They came to see him.’

ɣadwa **lonsaw** yn vag dœ ʃalœr

‘They announced a heat wave for tomorrow.’

kunti **tətmaʃaj** fəl pħar

‘You were walking in the beach.’

ʃa ma **tətmanaj** jəthaqaqlak

'Everything you wish for will come true.'

roħi **tətwakaj**

'Go and lie on the bed.'

liːqlak **təthalaj** fiːh

'You have to take care of him.'

ʃraw əl ħam

'They bought meat.'

qlaw əl ħuːt

'They fried fish.'

kraw əl bart̠ma lxuːh

'They rented the apartment to his brother.'

ksawhum u thalaw fiːhum

'They gave them clothes and took care of them.'

ʔəd-drari **dʒraw** ta ʃabʕu

'The children ran till they had enough.'

raħu **ʃkaw** biːh

'They went and complained about him.'

flaw əd-daːr bəssaħ ma sabu waːlu

‘They searched everywhere I the house, but they found nothing.’

ʃkiːt **u** gaːluːli raki ɣi ḍḍajʕi fi waqtak

‘I complained and they told me that I am wasting my time’

huwa gaːl **u** hija samʕat bla ma trod

‘He spoke and she listened without answering’

ʃajṭoːh **u** bahadluːh baːʃ ʕtawah hadiːk əl ħsajsa

‘They humiliated him before they gave him that share of money’

klaːt **u** raːħət ma naqqat ma waːlu

‘She ate and left. She did not clean up at all’

xallast **u** xraʃt nsiːt ma diːtʃ əssarf

‘I paid my dues and left. I forgot to take the change’

kima kaːnət tguːl dʒadda saːkət **u** hamuː taħtu naːbət

‘As grandma used to say: “each reserved person has a hidden story’

dʒibi hadaːk əl ktaːb **u** kaji w rwaħi llahna

‘Bring that book and a copybook and come here’

ṭabakt **u** daxxalt əl ħwajadʒ

‘I folded the clothes’

hija xtaːrat **u** ʃraːt əssalõ

'She chose and bought the lounge furniture'

ragsat **u** daːrət rajha fəl ʕurs

'She danced and had so much fun at the wedding celebration'

After providing a description of the locale of the study, as well as its sample, corpus, methodology and findings, it is worth analyzing such findings using the theoretical machinery of rule-based phonology and OT. The following chapter demonstrates how a rule-based account of the aforementioned types of phonological processes in MAR can be achieved.

The present chapter presents a rule-based account of the phonological processes peculiar to MAR. Hence, each type of process is described through rule-based machinery. As far as assimilatory processes of MAR are concerned, their rule-based account includes distinctive features in order to preserve the principle of generality which is an essential component within the rule-based approach in particular and generative phonology in general. Thus, each sound that undergoes an assimilatory process is decomposed into its constituent distinctive features. Then, after redundancy rules apply, only the distinctive features are preserved and any redundant feature is dispensed with. Eventually, the feature that undergoes the change is highlighted and analyzed from a rule-based perspective. Furthermore, each type of phonological process in MAR is illustrated through a sample which is extracted from the findings of the process of data collection.

4.1. Assimilatory Processes in MAR

4.1.1. Voice Assimilation: A Rule-based Account

MAR exhibits a case of regressive voice assimilation in which an obstruent changes its voice feature in order to be in harmony with the following adjacent obstruent. This case of regressive voice assimilation is mainly observed when two obstruents which are dissimilar in terms of voicing become adjacent as a result of morphological processes such as affixation or inflection. The following sample illustrates one specific type of regressive voice assimilation in MAR:

(1)

Underlying representation	Surface representation	Gloss
t-diːr	**d**diːr	'She does'
t-dawʃi	**d**dawʃi	'You-feminine- shower'

t-dawri	**d**dawri	'You-feminine- wander'
t-dʒafaf	**d**dʒafaf	'She sweeps the floor'
t-dalmi	**d**dalmi	'You-feminine- obscure'
t-ḍal	**ḍ**ḍal	'She keeps on'
t-dibarasi	**d**dibarasi	'She cleans up'
t-dʒi	**d**dʒi	'She comes'
t-dʒamaʕ	**d**dʒmaʕ	'She sits'
t-dabbar	**d**dabbar	'She looks for something'
t-duːxi	**d**duːxi	'You-feminine- will be dazed'
t-doːr	**d**doːr	'She turns'

4.1.1.1. Prefix 't-' Voice Assimilation

In the above sample the obstruent /t/ changes to /d/ in order to agree with the following /d/ in terms of voicing. Indeed, the obstruent /t/ changes its voicing feature only if it is adjacent to a voiced obstruent, otherwise the prefix 't-' which is the second person singular present morpheme, but also the third person singular feminine present morpheme, is realized as the voiceless obstruent /t/. The following sample illustrates the preservation of the voiceless specification of /t/ in case a voiceless obstruent or any other voiceless consonant follows it:

(2)

Underlying representation	Surface representation	Gloss
t-soːg	tsoːg	‘She drives’
t-kassar	tkassar	‘She breaks’
t-ʃuːfi	tʃuːfi	‘You-feminine- see’
t-fuːt	tfuːt	‘She passes’
t-kammal	tkammal	‘She finishes’
t-ṣawwar	tṣawwar	‘She films’
t-luːmi	tluːmi	‘You-feminine- blame’
t-roːħi	troːħi	‘You-feminine- go’
t-waːlfi	twaːlfi	‘You-feminine-get used to’
t-nabhi	tnabhi	‘You-feminine- warn’

After having illustrated the process of ‘t-’ regressive assimilation in MAR, it is now worth accounting for it from a rule-based perspective. Indeed, the regressive voice assimilation of the /t/ in prefix ‘t-’ involves a change in the value of one of the constituent distinctive features of /t/. In order to determine and account for this feature’s change, it necessary to decompose /t/ to its constituent distinctive features. The following section demonstrates how distinctive feature theory applies to /t/:

4.1.1.1.a. Distinctive Features of MAR’s /t/

MAR’s /t/ is produced with a complete contact between the tip of the tongue the back of the upper teeth, and is thus a [+consonantal] since its articulation involves a contact between the articulators. Furthermore, /t/ is [-sonorant] since the blockage that is created by the contact between the articulators reduces of the resonance and sonority of the sound. Finally, /t/ is [-syllabic] as it is never found in syllable nucleus position. As a result, /t/ is classified among the marginal obstruent true consonants of MAR.

As to manner features, /t/ of MAR is a [-continuant] as it is produced with an interruption of airflow through the complete blockage that is created by the articulators. Furthermore, /t/ is [-delayed release] as its production does not involve any delay of the release stage. Indeed, in /t/ production air is released once the obstruction is parted. /t/ is [-nasal] since air escapes from the oral cavity for the /t/ of MAR. Moreover, /t/ is [-lateral] as air escapes from the center of the mouth while producing it. Hence, /t/ of MAR is an oral stop.

The place feature of MAR’s /t/ is [CORONAL] as its articulation involves the front part of the tongue. Given that /t/ is a [CORONAL], it needs to be distinguished from the other coronals. In order to attain such distinction, the feature [anterior] is required. Indeed, the fact that /t/ is produced in the anterior region which is the dental region, MAR’s /t/ is [+anterior], and is thus, different from other posterior coronal consonants. Thus, /t/ of MAR is an anterior coronal.

The laryngeal feature of MAR’s /t/ is [-voiced] as it is realized without a vibration at the level of the vocal cords. As result, /t/ of MAR is a voiceless stop.

It appears from the above decomposition of /t/ into its constituent distinctive features that it is a voiceless anterior coronal oral stop obstruent marginal consonant. Such a description is inferred from the following features of /t/ in MAR:

(3) /t/

[+consonantal]

[-sonorant]

[-syllabic]

[-continuant]

[-delayed release]

[-nasal]

[-lateral]

[CORONAL]

[+anterior]

[-voiced]

After having decomposed the target consonant to its constituent features, it is now essential to apply redundancy rules in order to exclude all unnecessary features and keep only the distinctive features. Redundancy rules are applied below:

(4) [-Sonorant] ⇒ [+consonantal]

[-sonorant] ⇒ [-syllabic]

[-sonorant] ⇒ [-nasal]

[-continuant] ⇒ [-lateral]

The former redundancy rules indicate that the features [+consonantal], [-syllabic], [-nasal] and [-lateral] are redundant features for MAR's /t/. Indeed, if a sound is [-sonorant], then it is automatically implied that it is [+consonantal], [-syllabic] and [-nasal] since all obstruents are [+consonantal], [-syllabic] and [-nasal]. Thus, it is not necessary to include these three features in the description of /t/ in MAR because they are implied from the feature [-sonorant]. Furthermore, the feature [-lateral] is implied from the feature [-continuant] since a lateral is [+continuant], so if a consonant is [-continuant], then it is automatically [-lateral]. Hence, the feature [-lateral] is redundant for /t/ in MAR. After redundancy rules were applied to the feature constituents of /t/ in MAR, the following description is obtained for /t/:

(5) /t/

[-sonorant]

[-continuant]

[-del rel]

[CORONAL]

[+anterior]

[-voiced]

After having identified the distinctive features of the target sound /t/, it is now necessary to turn to its vicinity or else adjacent sound which is the conditioning sound for this case of voice assimilation. In the above sample, the conditioning sound is the obstruent /d/. The distinctive features of MAR’s /d/ are introduced in the subsequent sub-section:

4.1.1.1.b. Distinctive Features of MAR’s /d/

MAR’s /d/ is produced with a complete contact between the tongue tip and the back region of the upper teeth. Hence, /d/ is [+consonantal]. Moreover, /d/ is [-sonorant] since the complete contact between the articulators blocks airflow and thus reduces the sonority of the sound. Finally, /d/ is [-syllabic] since it cannot be found in nucleus position within a syllable in MAR. Consequently, /d/ of MAR is an obstruent marginal true consonant.

As to manner features /d/ of MAR is produced with an interruption of airflow via the complete obstruction that is created by the articulators. Thus, /d/ of MAR is [-continuant]. Furthermore, /d/ is [-delayed release] since the stage of air release is not delayed for /d/ as it occurs after the blockage is unbarred. Besides, /d/ is produced with air escaping through the oral cavity, and is thus, [-nasal]. Moreover, /d/ is produced with air escaping along the center of the mouth, and is thus, [-lateral]. Obviously, /d/ of MAR is among the oral stops.

The place feature of /d/ in MAR is [CORONAL] since /d/ is articulated with the front part of the tongue (tongue tip). Moreover, /d/ is [+anterior] since it is articulated in the anterior teeth region. Thus, /d/ of MAR is an anterior coronal.

The laryngeal feature of /d/ in MAR is [+voiced] since its production involves the vibration of the vocal cords. Thus, /d/ is a voiced oral stop. All in all, MAR’s /d/ is a voiced anterior coronal oral stop obstruent marginal consonant. The following distinctive features can be attributed to MAR’s /d/:

(6) /d/

[+consonantal]

[-sonorant]

[-syllabic]

[-continuant]

[-del rel]

[-nasal]

[-lateral]

[CORONAL]

[+anterior]

[+voiced]

It is worth noting that not all of the aforementioned features are distinctive as some are redundant, and thus violate the principle of economy. Therefore, redundancy rules need to be applied in order to preserve only the distinctive features. Redundancy rules are represented below:

(7) [-Sonorant] ⇒ [+consonantal]

[-sonorant] ⇒ [-syllabic]

[-sonorant] ⇒ [-nasal]

[-continuant] ⇒ [-lateral]

The above redundancy rules exclude the features [+consonantal], [-syllabic], [-nasal] and [–lateral] from the description of MAR's /d/ since they can be implied from other features. Indeed, the feature [+cons] is implied by the feature [-son] since all obstruents are [+cons]. Moreover, the feature [-syll] is also implied from the feature [-son] as all obstruents are [-syll]. The feature [-nas] is also implied from the feature [-son] since nasals are [+son] and any [-son] is [-nas]. Finally, the feature [-lat] is also implied from the feature [-continuant] since lateral sounds are [+continuant], and thus any [-cont] is [-lat]. Applying the redundancy rules preserves the following distinctive features for MAR's /d/:

(8) /d/

[-sonorant]

[-continuant]

[CORONAL]

[-del rel]

[+anterior]

[+voiced]

A comparison between the distinctive features of the target /t/ and the conditioning /d/ indicates that the two sounds agree in all of their distinctive features except the laryngeal feature [voiced] which is has the value (-) for /t/ and (+) for /d/. Such a comparison is represented below:

(9)

/t/	**/d/**
[-sonorant]	[-sonorant]
[-continuant]	[-continuant]
[-del rel]	[CORONAL]
[CORONAL]	[-del rel]
[+anterior]	[+anterior]
[-voiced]	[+voiced]

Thus, the /t/ of the prefix 't-' in MAR changes the value of its laryngeal feature [voiced] from (-) to (+) in order to agree with the following /d/ in different instances as /t-di:r/ [ddi:r], /t-do:r/ [ddro:r]. This type of regressive voice assimilation can be represented in the following phonological rule:

(10)

[-sonorant]→	[-sonorant]	/______	[-sonorant]
[-continuant]	[-continuant]		[-continuant]
[-del rel]	[-del rel]		[-del rel]
[CORONAL]	[CORONAL]		[CORONAL]
[+anterior]	[+anterior]		[+anterior]
[-voiced]	[+voiced]		[+voiced]

The above rule is more general than the plain and most common:

(11) /t/ →[d] /__________________ voiced consonant

In fact, the aforementioned rule erroneously predicts that the /t/ of the prefix ‘t-’ in MAR changes to [d] whenever a voiceless consonant succeeds to it. Thus, forms like /t-lu:m/ ‘she blames’, /t-ro:ħ/ ‘she goes’, /t-no:d/ ‘she stands up’, /t-gu:l/ ‘she says’, /t-ba:t/ ‘she stays overnight’ would be realized respectfully as [dlu:m], [dro:ħ], [dno:ḍ], [dgu:l], [dba:t]. hence, /t/ changes its voicing feature in these instances in order to agree with the following voiced consonants which are /l, r, n, g, b/ if one abides by the description that the rule in (11) provides. However, the /t/ of the prefix ‘t-’ in the preceding instances does not change its voicing specification in MAR. Hence, /t-lu:m/, /t-ro:ħ/, /t-no:d/, /t-gu:l/, /t-ba:t/ are realized as [tlu:m], [tro:ħ], [tno:ḍ], [tgu:l], [tba:t] respectively in MAR. Effectively, /t/ of the prefix ‘t-’ changes its voice specifications from (-) to (+) only when the root to which it is prefixed starts with /d/. It is, in fact, no coincidence that only /d/ triggers voice assimilation as /d/ and /t/ agree in all other features except for the feature [voiced]. Thus, the first rule which includes distinctive feature specifications is more adequate for accounting for /t/ voice assimilation in MAR as it is more precise regarding the environment that conditions this assimilatory process. In order to clarify the former point, let us decompose the sounds /l, r, n, g, b/ in each of [tlu:m], [tro:ħ], [tno:ḍ], [tgu:l], [tba:t] into their distinctive features. Such features are represented below:

(12)

/t/	/l/	/r/	/n/	/g/	/b/
[-son]	[+son]	[+son]	[+son]	[-son]	[-son]
[-cont]	[+cont]	[+cont]	[+cont]	[-cont]	[-cont]
[-del rel]	[+lat]	[-lat]	[+nas]	[-del rel]	[-del rel]
[COR]	[COR]	[COR]	[COR]	[DOR]	[LAB]
[+ant]	[+ant]	[+ant]	[+ant]	[+voic]	[+voic]
[-voic]	[+voic]	[+voic]	[+voic]		

As it appears from the above decomposition of /l, r, n, g, b/ into their respective features, these sounds differ from /t/ in either its major class features, manner or place features in addition to the laryngeal feature [voiced]. Indeed, /l/ and /r/ differ from /t/ in the feature [sonorant] which is (+) for /l, r/ and (-) for /t/ in addition to the feature [continuant] which is (+) for /l,r/ and (-) for /t/. The /n/ is different from /t/ in the features [son] and [nas] which are (+) for /n/ and (-) for /t/, whereas /g/ and /b/ differ from /t/ at the level of place features. In fact, /g/ is [DOR] while /t/ is [COR]. Subsequently, /t/ does not assimilate to these sounds since they do not agree with /t/ in other features in addition to the feature [voiced].

4.1.1.2. Root-obstruent Voice Assimilation

Apart from the case of regressive voice assimilation that is observed with the /t/ of the prefix ‘t-’, another case of regressive voice assimilation is observed in MAR. such a case occurs when a root obstruent is followed by another obstruent either as a result of suffixation or morpheme concatenation. As a result, two obstruents which disagree in voicing are adjacent to each other which culminates with the assimilation of the root obstruent to the following obstruent in terms of voicing. The following sample illustrates this case of regressive voice assimilation:

(13)

Input	**Output**	**Gloss**
ma-jəgo**d**-ʃ	ma-jəgʕo**t**ʃ	‘He doesn’t stay’
təs**b**aħ	təsap**ħ**u	‘You wake up (singular and plural)
ħsa**b**-t	ħsa**p**t	‘I thought’
ɣaja**b**-t	ɣaja**p**t	‘I was absent’
r**b**aħ	ra**p**ħat	‘She won’
ʔakka**d**-t	ʔakka**t**t	‘I made sure’
ma-tɣiː**d**-ʃ	matɣiː**t**ʃ	‘She does not attract compassion’
dʒala**b**-ti	dʒala**p**tiː	‘My gown’
kaba**d**-ti	kaba**t**tiː	‘My liver’
ʕalla**g**-t	ʕalla**k**t	‘I hanged’
hra**b**-t	hra**p**t	‘I ran away’

It appears from the above sample that the voiced obstruents /b, d, g/ change their voicing feature in order to agree with the following voiceless obstruent. However, the target and conditioning obstruents vary in this instance of regressive voice assimilation as contrasted to the former case of 't-' voice assimilation in which the target obstruent id /t/ and the conditioning obstruent is always /d/. Furthermore, as pointed out earlier /t/ changes its voicing feature only when /d/ follows as /t/ and /d/ are similar for all their constituent distinctive features except for the laryngeal feature [voiced]. Hence, it is worth decomposing the target obstruents into their constituent distinctive features. Let us start with /b/:

4.1.1.2. a. Distinctive Features of Target /b/

As to its major class features, /b/ is produced with a full contact between the lips and is thus a [+consonantal]. Furthermore, /b/ is [-sonorant] since the full contact that is established between the lips results in a complete blockage of airstream. Thus, sonority or resonance is reduced for /b/. In addition, /b/ is [-syllabic] since it can never be the nucleus of a syllable. Hence, /b/ is classified as an obstruent marginal true consonant.

As to its manner features, /b/ is produced with interrupted airstream as a result of the blockage that is created by the lips, and thus, /b/ is [-continuant]. Moreover, /b/ is produced without a delay in the release stage and is thus [-delayed release]. Finally, /b/ is produced with air escaping through the oral cavity and through the center of the mouth. Hence, /b/ is [-nasal] [-lateral] and is classified among the oral stops.

The place features of /b/, include the feature [LABIAL] since /b/ is articulated with the lips. Moreover, the laryngeal feature of /b/ is [+voiced] since it produced with the vibration of the vocal cords.

It appears from the former decomposition of /b/ that it is a voiced labial oral stop obstruent marginal consonant. The following figure represents the constituent features of (14) /b/:

(14)

[+cons]

[-son]

[-syll]

[-cont]

[-del rel]

[-nas]

[-lat]

[LAB]

[+voi]

The aforementioned features for /b/ are not all distinctive. Thus, redundancy rules need be applied in order to eliminate all the redundant features and preserve only the distinctive features. Indeed, the features [+cons] and [-syll] can be implied from the feature [-son]. Thus, only the feature [-son] is distinctive for /b/. The following redundancy rules indicate which features are distinctive and which are redundant:

(15) [-Sonorant] ⇒ [+consonantal]

[-sonorant] ⇒ [-syllabic]

As to the feature [-lat], it is implied from the feature [-cont] since all laterals are [+cont]. Moreover, the feature [-nas] is also implied from the feature [-son]. The following redundancy rules represent the redundant features of /b/:

(16) [-sonorant] ⇒ [-nasal]

[-continuant] ⇒ [-lateral]

Effectively, the distinctive features of /b/ are listed below:

(17) /b/

[-son]

[-cont]

[-del rel]

[LAB]

[+voi]

The distinctive features of /d/ have been present /d/ have been presented above. Yet, for convenience's sake, the distinctive features of /d/, after redundancy rules were applied, are re-introduced below:

(18) /d/

[-son]

[-cont]

[-del rel]

[COR]

[+voic]

The voiced obstruent /g/ needs also be decomposed into its constituent distinctive features. The following sub-section achieves such preliminary step in our analysis.

4.1.1.2.b. Distinctive Features of Target /g/

/g/ is produced with a contact between the dorsum of the tongue and the velum. Thus, /g/ is among the true consonants as it is [+consonantal]. Furthermore, the contact that is established between the dorsum of the tongue and the velum represents an obstruction that reduces the sonority of the sound /g/, and thus /g/ is [-sonorant]. Finally, /g/ always occurs in the margins of a syllable in MAR, but never in the nucleus, and is thus [-syllabic]. As a result, /g/ is an obstruent marginal true consonant.

As to its manner features, /g/ is [-continuant] as its articulation involves a contact between the tongue's dorsum and the velum which interrupts the airstream. Furthermore, the release stage for /g/ which makes of /g/ [-delayed release]. Moreover, /g/ is produced with air escaping from the center of the oral cavity which implies that /g/ is [-nasal] [-lateral]. Consequently, /g/ of MAR is among the oral stops.

As to place features, /g/ is [DORSAL] as it is produced with the tongue's dorsum. Furthermore, /g/ is produced with a vibration of the vocal cords and is thus [+voic]. Obviously, /g/ is a voiced dorsal oral stop obstruent marginal consonant. The following figure sums up its constituent features:

(19) /g/

[+consonantal]

[-sonorant]

[-syllabic]

[-continuant]

[-delayed release]

[-nasal]

[-lateral]

[DORSAL]

[+voiced]

However, not all of the above features are distinctive as some of them can be implied from the others. Thus, redundancy rules are required in this case in order to dispense with all the redundant features and keep only the distinctive ones.

The redundant features for /g/ are [+consonantal] [-syllabic] [-nasal] which are implied by the feature [-sonorant]. The feature [-lateral]is also redundant for /g/ as it is implied by the feature [-continuant]. The following rules represent the application of redundancy rules:

(20)

[-Sonorant] ⇒ [+consonantal]

[-sonorant] ⇒ [-syllabic]

[-Sonorant] ⇒ [-nasal]

[-continuant] ⇒ [-lateral]

After redundancy rules have applied, the following features are considered distinctive for /g/:

(21) /g/

[-sonorant]

[-continuant]

[-delayed release]

[DORSAL]

[+voiced]

After having decomposed each of /b, d, g/ into their constituent distinctive features, it appears that all three obstruents share the following distinctive features:

(22) /b, d, g/

[-sonorant]

[-continuant]

[-delayed release]

[+voiced]

Hence, /b,d, g/ are voiced stop obstruents and this commonality between /b, d, g/ makes of them a natural class and justifies the application of regressive voice assimilation to them.

Let us now turn to the conditioning environment that leads to assimilation in this case. The sounds that are observed after /b, d, g/ are /t, k, ʃ,ħ/. These sounds are voiceless obtruents. Yet, it is worth decomposing each obstruent into its constituent distinctive features in order to obtain a precise and concise picture of the commonality between these sounds.

4.1.1.2.c. Distinctive Features of Conditioning Obstruents

The sound /t/ has previously been decomposed into its distinctive features, yet for convenience's sake these features are introduced below:

(23) /t/

[-sonorant]

[-continuant]

[-del rel]

[CORONAL]

[+anterior]

[-voiced]

The /k/ sound is produced with complete contact between the tongue's dorsum and the velum which implies that it is [+consonantal]. Such a contact creates a blockage that reduces sonority which classifies /k/ as [-sonorant]. Furthermore, /k/ is never found in syllable nucleus position, and thus /k/ is [-syllabic]. As a result, /k/ is an obstruent marginal true consonant.

The manner in which air escapes is influenced by the tongue's dorsum and the velum. Indeed, the continuity of air is interrupted by such a blockage. As a result, /k/ is [-continuant].

Furthermore, /k/ is produced with air being released without any delay which implies that it is [-delayed release]. Moreover, /k/ is produced with air escaping from the center of the oral cavity which classifies /k/ as [-nasal], [-lateral].

Given that /k/ is produced with a contact between the tongue's dorsum and the velum, /k/ is [DORsal]. Furthermore, /k/ is produced with non-vibrating vocal cords. Thus, /k/ is [-voiced].

It appears from the previous decomposition of /k/ that the following distinctive features can be attributed to /k/:

(24) /k/

[-sonorant]

[-continuant]

[-del rel]

[DORAL]

[-voiced]

/ʃ/ is produced with a partial contact between the front of the tongue and the hard palate, and thus, /ʃ/ is among the [+consonantal]. Such a contact represents an obstruction of air which reduces sonority and classifies /ʃ/ among [-sonorant]. Moreover, /ʃ/ does not occur in nucleus position in MAR which makes of /ʃ/ [-syllabic].

The continuity of air is not interrupted by the obstruction of the front of the tongue and the hard palate as the closure is partial and air escapes uninterrupted through the narrow passage that is left between the articulators. Thus, /ʃ/ of MAR is classified among the [+continuant]. Moreover, /ʃ/ is produced air escaping through the center of the oral cavity which makes of it [-lateral].

The articulation of /ʃ/ involves a contact between the front of the tongue and the hard palate. Thus, /ʃ/ is a [CORONAL] [-anterior]. Moreover, /ʃ/ is produced with non-vibrating vocal cords and is thus [-voiced].

It appears from the above decomposition that /ʃ/ is a voiceless continuant obstruent marginal true consonant. These features are represented below:

(25) /ʃ/

[+consonantal]

[-sonorant]

[-syllabic]

[+continuant]

[-lateral]

[CORONAL]

[-anterior]

[-voiced]

/ħ/ is produced with a contact between the tongue's root and the upper pharynx which makes of /ħ/ [+consonantal]. This contact creates a partial blockage that reduces sonority and thus

/ħ/ is [-sonorant]. Furthermore, /ħ/ never occurs in syllable nucleus position in MAR, and thus /ħ/ is [-syllabic].

/ħ/ is [+continuant] as it is produced with uninterrupted air which escapes through the narrowing that is left by the partial contact between the articulators. Besides, /ħ/ is [-lateral] as it is produced with air escaping from the center of the mouth.

/ħ/ is a [GUTTURAL] since it is produced at the pharyngeal region. Moreover, /ħ/ is [-voiced] as its articulation does not involve the vibration of the vocal folds.

It appears from the above decomposition of /ħ/ that it is among the voiceless guttural continuant obstruent marginal true consonant. Such distinctive features of /ħ/ are represented below:

(26) /ħ/

[+consonantal]

[-sonorant]

[-syllabic]

[+continuant]

[-lateral]

[GUTTURAL]

[-voiced]

The voiceless obstruents /t, k, ʃ,ħ/ are described below in terms of distinctive features. Such description excludes redundant features:

(27)

/t/	**/k/**	**/ʃ/**	**/ħ/**
[-son]	[-son]	[-son]	[-son]
[-cont]	[-cont]	[+cont]	[+cont]
[COR]	[DOR]	[DOR]	[GUT]
[-voic]	[-voic]	[-voic]	[-voic]

If one compares between the features in the above list, one finds that the features [-son] and [-voic] are the features that are common between the sounds /t, k, ʃ, ħ/. Thus, /t, k, ʃ, ħ/ are part of the natural class of voiceless obstruents.

After having set the required tools for accounting for regressive assimilation (root obstruents), it is possible to describe such a process in the form of a phonological rule. The rule is represented below:

(28)

[-son]	→	[-son]	/ ______	[-son]
[-cont]		[-cont]		[-voic]

[-del rel] [-del rel]

[+voic] [-voic]

The rule above implies that a voiced oral stop changes to a voiceless oral stop in order to agree with the following voiceless obstruent in the value of its laryngeal feature [-voiced].

The former rule respects the principle of economy and generalization which are important in rule-based phonology. As opposed to the former rule, a number of rules need to be developed in order to account for all cases of root obstruent regressive voice assimilation, especially if distinctive features are excluded from the description. The following rule illustrates such a point:

(29) /b/ →/p/ /___________{t}

{k}

{ħ}

/d/ →[t] /_________ {t}

{ʃ}

/g/ → [k] /_________ /t/

It appears from the cases of voice assimilation discussed earlier that voiced obstruents change the value of their laryngeal feature [voiced] to (-) if a voiceless obstruent follows. Yet, the voiceless obstruent /t/ of the prefix ‘t-’ changes its voicing feature to (+) only when /d/ follows which reinforces the unmarkedness of voiceless obstruents as opposed to voiced obstruents.

In addition to voice assimilation, MAR also displays place assimilation. The following section accounts for place assimilation in MAR from a rule-based perspective.

4.1.2. Place Assimilation in MAR: A Rule-based Account

MAR involves a case of place assimilation in which the nasal /n/ changes to /m/. The following sample illustrates this type of place assimilation which is often referred to as nasal homorganic assimilation:

(30)

Input	Output	Gloss
kaː**n** mriːḍ	kaː**m** mriːḍ	'He was ill'
mə**n** baʕd	mə**m** baʕd	'After, later on'
ʔa**n**bijaːʔ **n**abij	ʔa**m**bijaːʔ	'The messengers'
wi**n** ma	wi**m** ma	'Wherever'
mə**n** badjət	mə**m** badjət	'From the beginning'
mə**n** baːlək	mə**m** baːlək	'From your mind'
mə**n** maj	mə**m** maj	'From May'
kuː**n** makkaːʃ	kuː**m** makkaːʃ	'If there is not'
tbaː**n** miːn	tbaː**m** miːn	'It shows when'

As it appears from the former sample, /n/ changes to /m/ when it is followed by either /m/ or /b/. Such a change is accounted for in terms of distinctive feature change as indicated in the following subsection.

4.1.2.1. Distinctive Feature Analysis of /n/ Place Assimilation in MAR

The first step in our analysis is to decompose the target /n/ to its constituent distinctive features. The /n/ is produced with contact between the tongue tip and the alveolar ridge which classifies /n/ as [+consonantal] sound. Moreover, /n/ is produced with free air escaping from the nasal cavities, thus it is [+sonorant]. Furthermore, /n/ can never be a nucleus in MAR syllables and is thus [-syllabic].

The /n/ of MAR is produced with interrupted air at the level of the mouth due to the contact between the tongue tip and the alveolar ridge. Thus, /n/ is among the [-continuant] sounds. Besides, /n/ is produced with air escaping through the nas al cavities and is thus [+nasal].

The /n/ of MAR is produced with a contact between the tongue tip and is thus among the [CORONAL] consonants. Furthermore, /n/ is produced in the alveolar ridge region of the mouth and is thus [+anterior].

As to its laryngeal features /n/ is [+voiced] as its articulation involves the vibration of the vocal cords. In sum, /n/ is a voiced nasal stop coronal sonorant marginal consonant. The constituent features of /n/ are listed below:

(31) /n/

[+consonantal]

[+sonorant]

[-syllabic]

[-continuant]

[-del rel]

[+nasal]

[-lateral]

[CORONAL]

[+anterior]

[+voiced]

The above features are not all distinctive as some are redundant. Hence, redundancy rules need be applied in order to eliminate the superfluous features. The redundancy rules are represented below:

(32)

[+consonantal] ⇒ [-syllabic]

[+nasal] ⇒ [-continuant]

[+nasal] ⇒ [-del rel]

[+nasal] ⇒ [-lateral]

[+nasal] ⇒ [+anterior]

[+nasal] ⇒ [+voiced]

As a matter of fact, the feature [+nasal] is quite distinctive for /n/ as it implies many features. All nasals are [-continuant] as they are produced with interruption of airflow at the level of the mouth. Moreover, all nasals are [-lateral] and [-del rel]. As to the feature [+anterior], it is implied from the feature [+nasal] and [CORONAL] since only one coronal nasal exists in MAR and this coronal nasal is /n/ which is [+anterior]. Hence, the feature [+anterior] is redundant for /n/. The distinctive features of /n/ are presented below:

(33) /n/

[+consonantal]

[+sonorant]

[+nasal]

[CORONAL]

Let us now turn to the conditioning sounds which are the triggers of place assimilation. These sounds are /m/ and /b/ as indicated in the former illustrative sample.

4.1.2.2. Distinctive Feature Analysis of /m/

MAR’s /m/ is produced with a contact between the lips, thus it is [+consonantal]. Moreover, while producing /m/ air escapes unblocked from the nasal cavities and is thus [+sonorant]. /m/ is also never found in nucleus position and is, thus, [-syllabic].

MAR’s /m/ is articulated with the velum lowered blocking the oral cavity and air escaping through the nasal cavities, thus /m/ is [+nasal]. Moreover, /m/ is articulated with interrupted air and is thus [- continuant].

MAR’s /m/ is produced with a contact between the lips, thus /m/ is classified as a [LABIAL]. As to its laryngeal features, /m/ is [+voiced] as its articulation involves the vibration of the vocal folds. Obviously, /m/ is a voiced labial nasal stop sonorant marginal consonant. The following features represent the constituent features of MAR's /m/:

(34) /m/

[+consonantal]

[+sonorant]

[-syllabic]

[+nasal]

[-continuant]

[-lateral]

[-del rel]

[LABIAL]

[+voiced]

As it appears, not all the afore-exposed features of /m/ are distinctive as some are redundant and can be implied by others. Thus, redundancy rules are needed to delete the redundant features. The redundancy rules for /m/ are represented below:

(35)

[+consonantal] ⇒ [-syllabic]

[+nasal] ⇒ [-continuant]

[+nasal] ⇒ [-del rel]

[+nasal] ⇒ [-lateral]

[+nasal] ⇒ [+voiced]

After the application of redundancy rules, the following features are considered distinctive features for MAR's /m/:

(36) /m/
[+consonantal]

[+sonorant]

[+nasal]

[LABIAL]

If one compares the target /n/ and the conditioning /m/, one deduces that they are similar for all their distinctive features as both are nasal stops. The only difference is at the level of place feature specification which is [CORONAL] for /n/ and [LABIAL] for /m/. After /n/ assimilates to /m/ in words like /winma/ 'wherever' → [wimma], /n/ changes its place feature from [CORONAL] to [LABIAL]. This change can be accounted for in one of two ways. The first way is by using the exact sounds /n/ and /m/, while the second way is by having recourse to distinctive features. Both accounts take the form of a phonological rule as follows:

(37)

/n/ →/m/ /____________/m/

(38)

[+consonantal]	→ [+consonantal]	/ ________________	[+consonantal]
[+sonorant]	[+sonorant]		[+sonorant]
[+nasal]	[+nasal]		[+nasal]
[CORONAL]	[LABIAL]		[LABIAL]

The second rule seems more appropriate as it captures the generality of the process. Unlike the second rule, the first rule is case specific, and thus violates the principle of generalization.

In addition to /m/, /b/ is also encountered as a conditioning sound. Distinctive feature decomposition and description of /b/ have already been introduced in section 4.1.1.2. of the present chapter, yet for convenience's sake, /b/ features are reproduced below:

(39) /b/

[-sonorant]

[-continuant]

[-del rel]

[LABIAL]

[+voiced]

After having sketched the distinctive features of /b/, it appears that the nasal stop /n/ assimilates to the oral stop /b/ because they both agree on their manner feature [-continuant] as they both involve interruption of airflow at the level of the mouth. The distinctive features of both /n/ and /b/ are sketched below for comparative purposes:

(40)

/n/	**/b/**
[+consonantal]	[-sonorant]
[+sonorant]	[-continuant]
[+nasal]	[-del rel]
[CORONAL]	[LABIAL]
	[+voiced]

Hence, place assimilation of /n/ to /b/ in words like /mən baːlək/ 'from your mind'→[məm baːlək] involves changing the place feature of /n/ from [CORONAL] to [LABIAL], thus yielding the labial nasal stop /m/ which agrees with the labial oral stop /b/ in terms of place. The following rule describes such a change:

(41)

[+consonantal] →	[+cons]	/_________	[-Sonorant]
[+sonorant]	[+sonorant]		[-continuant]
[+nasal]	[+nasal]		[LABIAL]
[CORONAL]	[LABIAL]		

The above is more general in its application than the specific rule that follows:

(42) /n/ → /m/ /____________ /b/

Yet, the rule is not general enough as it accounts for the case of coronal nasal stop changing to a labial nasal stop in order to agree with the following labial oral stop. Indeed, this rule is specific to the case when a labial oral stop follows /n/, while rules 36 and 37 account for the case when a labial nasal stop follows /n/ as aforementioned.

A more general rule is then required as such a rule needs to enclose both cases of place assimilation in MAR. This rule could be developed if the feature that is common to both conditioning /m/ and /b/ is preserved, whereas al other features that distinguish between theMARe dispensed with altogether. The following rule could serve such a purpose:

(43)

[+consonantal] →	[+cons] /_________	[LABIAL]
[+sonorant]	[+son]	
[+nasal]	[+nas]	
[CORONAL]	[LABIAL]	

After having accounted for place assimilation in MAR from a rule-besed perspective, let us turn to total assimilation in MAR. The following section presents a rule-based account of total assimilation in MAR.

4.1.3. Total Assimilation in MAR: A Rule-based Account

A case of total assimilation is observed in MAR when /l/ of the definite article /əl/ ‘the’ changes its manner feature and sometimes both its voice and manner features in order to agree with the following consonant in terms of voicing and manner. The following sample illustrates such a case of total assimilation in MAR:

(44)

Input	**Output**	**Gloss**
ə**l**-daxla	ə**d**daxla	‘The entrance’
ə**l**-zwaq	ə**z**zwaq	‘The decoration’
ə**l**-tuːta	ə**t**tuːta	‘The blackberry’
ə**l**-soːg	ə**s**soːg	‘The week’
ə**l**-ʃkajər	ə**ʃ**ʃkajər	‘The case’
ə**l**-noːr	ə**n**noːr	‘The light’
ə**l**-rasm	ə**r**rasm	‘The drawing’

The /l/ of /əl/ also acquires the secondary feature of emphasis if it is followed by an emphatic consonant. The following sample illustrates this case:

(45)

Input	**Output**	**Gloss**
əl-ṭabla	ə**ṭ**-ṭabla	‘The table’
əl-ṭʕaːm	ə**ṭ**-ṭʕaːm	‘The couscous’
əl-ṭmar	ə**ṭ**-ṭmar	‘The dates’
əl-ṣɣiːra	ə**ṣ**-ṣɣiːra	‘The little’
əl-ṣaffaja	ə**ṣ**-ṣaffaja	‘The stove’
əl-ḍarba	ə**ḍ**-ḍarba	‘The occasion’
əl-ḍaħk	ə**ḍ**-ḍaħk	‘The laughter’
əl-ḍarṣa	ə**ḍ**-ḍarṣa	‘The molar’

However, total assimilation of /l/ in /əl/ does not apply in the following cases:

(46)

Input	**Output**	**Gloss**
əl-baːb	əl-baːb	‘The door’
əl-futaj	əl-futaj	‘The sofa’
əl-valiza	əl-valiza	‘The suitcase’

əl-muːdʒa	əl-muːdʒa	'The wave'
əl-kursi	əl-kursi	The chair'
əl-guffa	əl-guffa	'The basket'
əl-juːm	əl-juːm	'Today'
əl-watʃ	əl-watʃ	'The face'
əl-ħawʃ	əl-ħawʃ	'The yard'
əl-hna	əl-hna	'The peace of mind'
əl-ʕaːm	əl-ʕaːm	'The year'
əl-qahwa	əl-qahwa	'The coffee'

In order to account for this case of total assimilation from a rule-based perspective, it is worth decomposing the target sound /l/ into its constituent distinctive features.

MAR's /l/ is a [+consonantal], [+sonorant] and [-syllabic] as it is produced with a contact between the tongue tip and the alveolar ridge. However, air escapes freely from the sides of the tongue. Moreover, /l/ is never found in syllable nucleus position. Thus, /l/ of MAR is a sonorant marginal true consonant.

As to manner features, /l/ is [+lateral] as it is produced with air escaping down the sides of the tongue. Furthermore, /l/ is [+continuant] since air escapes continuously from the sides of the tongue.

MAR's /l/ is among the [CORONAL] sounds since it is produced with the tongue tip, and thus involves the front part of the tongue in its articulation. Moreover, /l/ is [+anterior] as it is articulated at the alveolar ridge region.

As to laryngeal features, /l/ is [+voiced] since its articulation involves the vibration of the vocal cords. In sum, /l/ is a voiced coronal lateral sonorant marginal consonant. The following features represent the distinctive features of /l/:

(47) /l/

[+consonantal]

[+sonorant]

[-syllabic]

[+continuant]

[+lateral]

[CORONAL]

[+anterior]

[+voiced]

Some of the former features are redundant, thus redundancy rules need to be applied in order to preserve only the distinctive features. Redundancy rules for /l/ features are represented below:

(48) [+consonantal] ⇒ [-syllabic]

[+lateral] ⇒ [+continuant]

[+lateral] ⇒ [-+anterior]

[+lateral] ⇒ [+voiced]

Thus, the features [-syll], [+cont], [+ant], [+voic] are redundant for /l/ since they are implied by other features, namely [+cons] and [+lat]. Hence, only the following features are distinctive for /l/:

(49) /l/

[+consonantal]

[+sonorant]

[+lateral]

[CORONAL]

As it appears from samples (43), (44), /l/ is followed by different sounds. Yet, in all cases, it assimilates either the voice or the manner features of the following sound or both its voice and manner features. Indeed, the sounds that follow /l/ in the sample include /t, d, s, z, z, ʃ, n, r/. These sounds are different from /l/ in terms of manner features. As a matter of fact, /t, d/ are oral stops /s, z, ʃ/ are continuant obstruents, /n/ is a nasal stop, while /r/ is a non-lateral liquid. Furthermore, /l/ is different in terms of laryngeal features from the sounds /t, s, ʃ/ which are [-voiced]. However, there is one feature which is common between /l/ and the sequence /t, d, s, z, ʃ, n, r/ , such a feature is place as all of these sounds are coronal and so is /l/. Moreover, all of /t, d, s, z, ʃ, n, r/ are [+anterior], [CORONAL] which is another commonality they share with /l/. Such a commonality justifies /l/ total assimilation to the sequence /t, d, s, z, ʃ, n, r/. Moreover, for precision's sake, one would point to the fact that /l/ totally assimilates to /t, s, ʃ/ while it assimilates to /d, z, n, r/ in terms of manner only as these sounds are already similar to /l/ in terms of voicing feature. Manner assimilation could be accounted for with specific reference as follows:

```
(50) /l/ →{ t  /____________ {t
           d                  d
           s                  s
           z                  z
           ʃ                  ʃ
           n                  n
           r}                 r}
```

However, this rule is quite plain and simple and does not demonstrate the reason behind the process as a whole. The following rules are, in fact, more inclusive and serve a more descriptive representation of the process under study:

(51)

```
[+consonantal] →      [-sonorant] /_________   [-son]
[+sonorant]           [-continuant]            [-cont]
[+lateral]            [-del rel]               [-del rel]
```

[CORONAL]	[CORONAL]	[COR]

(52)

[+consonantal] →	[-sonorant] /__________	[-son]
[+sonorant]	[-continuant]	[-cont]
[+lateral]	[-del rel]	[-del rel]
[CORONAL]	[CORONAL]	[COR]
	[-voiced]	[-voic]

(53)

[+consonantal] →	[-sonorant] /__________	[-son]
[+sonorant]	[+continuant]	[+cont]
[+lateral]	[CORONAL]	[COR]
[CORONAL]		

(54)

[+consonantal] →	[-sonorant] /__________	[-son]
[+sonorant]	[+continuant]	[+cont]
[+lateral]	[CORONAL]	[COR]
[CORONAL]	[-voiced]	[-voic]

(55)

[+consonantal] →	[+nasal] /_________	[+nas]
[+sonorant]	[CORONAL]	[COR]
[+lateral]		
[CORONAL]		

(56)

[+consonantal] →	[+cons] /_________	[+cons]
[+sonorant]	[+son]	[+son]
[+lateral]	[-lat]	[-lat]
[CORONAL]	[CORONAL]	[COR]

As to the cases of total assimilation that are represented in the second sample, let us assume that a secondary distinctive feature exists which is called [emphatic] so that only the MAR sounds /t, d, s/ have a (+) value for it, whereas all the non-emphatics would be [-emphatic]. In case of /l/ total assimilation to the emphatics /l/ would change the value of the feature [emphatic] from (-) to (+) as is the case for [əṭ-ṭafla] 'the girl', [əḍ-ḍoː] 'the light' and [əṣ-ṣaffaja] 'the sieve'. Rules number (56) and (57) account for this case of total assimilation:

(57)

[+lateral]→	[-cont] /_________	[-cont]
[CORONAL]	[-del rel]	[-del rel]

[-emphatic]	[-lat]	[COR]
	[COR]	[+empha]
	[+empha]	

(58)

[+lateral]→	[-son] /__________	[-son]
[CORONAL]	[+cont]	[+cont]
[-emphatic]	[-lat]	[COR]
	[COR]	[+empha]
	[+empha]	

In retrospect, the failure of total assimilation to apply in sample (45) is triggered by the fact that the sounds that follow /l/ are not coronal sounds or more exactly anterior coronal sounds. Hence, only sounds that share the place features [+anterior], [CORONAL] are the conditioning sounds for /l/ total assimilation in MAR. Effectively, /j/ in [əl-ju:m] 'today' is a coronal sound, yet it is [-anterior]. Plus, /j/ is [-consonantal] unlike /l/.

In addition to assimilatory processes, MAR also displays cases of non-assimilatory processes. The first non-assimilatory process that is worth approaching from a rule-based perspective is metathesis. The following section accounts for such a process within a rule-based framework.

4.2. Metathesis in MAR: A Rule-based Account

Metathesis is manifested in MAR when either the third person singular feminine past suffix 'at' or the third person plural suffix /u:/ are added to a verb. In such a case, the root sound /a/ interchanges its position with the root consonant that precedes it. As a result, the order of root /a/ and the consonant that precedes it is inverted. The following sample illustrates metathesis in MAR:

(59)

Input	**Output**	**Gloss**
dxal-at	d**ax**lat	'She entered'
ʃṭaħ-at	ʃ**aṭ**ħat	'She bought'
ktab-uː	k**at**buː	'They wrote'
rkab-at	r**ak**bat	'She got in'
slak-at	s**al**kat	'She rid of'
xradʒ-uː	x**ar**dʒuː	'They went out'
ṭlaʕ-at	ṭ**al**ʕat	'She went up'
ʃrab-at	ʃ**ar**bat	'She drunk'
ħgar-at	ħ**ag**rat	'She was unfair'

If one compares these complex words with the simple basic form which is the singular third person masculine past form, one finds that the order of the root /a/ and the consonant that precedes it is inverted after the suffixes ‘at’ or ‘u is added. The following sample illustrates such a change in the order:

(60)

Simple form	**Complex form**
dxal	d**ax**lat
ʃṭaħ	ʃ**aṭ**ħat
ktab	k**at**buː
rkab	r**ak**bat
slak	s**al**kat
xradʒ	x**ar**dʒuː
ṭlaʕ	ṭ**al**ʕat
ʃrab	ʃ**ar**bat
ħgar	ħ**ag**rat

The present process of metathesis represents an issue of representation in the rule-based approach since special symbols need to be developed in order to represent the inversion in order. A rule can be developed out of the available tools to account for such a process, this rule is introduced below.

(61) C a→a C /____________ {-at
-u:}

This rule is read as follows any consonant preceding /a/ is inverted with /a/ in case the suffixes '-at' or '-u:' are added to the verb. Such a rule satisfies the principle of generality as it is more general than the following set of rules:

(62)

xa→ax/________________'-at'

ṭa→ aṭ/________________'at'

ka→ak/________________'-u:'

la→ al/________________'-at'

ba→ab/________________'-at'

ra→ ar/________________'-at'

ga→ag/________________'-at'

However, neither rule (61) nor the set of rules in (62) do explain why metathesis occurs. Indeed, the addition of the suffixes '-at' or 'u:' seem to be a reason, yet this is more of a morphological explanation than a phonological one. There must be a phonological explanation for metathesis to occur in this particular case and not in others. In other terms, the addition of the suffixes '-at' and '-u:' must trigger a change in the phonological structure of the verb which undergoes suffixation. However, Chomsky's and Halle's model of rule-base phonology does not provide any tools in order to explain such a case of metathesis in MAR.

Metathesis is not the only non-assimilatory process that MAR displays. Other non-assimilatory processes exist in MAR such as epenthesis, deletion and major class change. Let us start with epenthesis.

4.3. Epenthesis in MAR: A Rule-based Account

The findings of the recordings of the present study reveal two types of epenthesis, namely vowel epenthesis and glide insertion. Let us start with vowel epenthesis.

4.3.1. Vowel Epenthesis in MAR: A Rule-based Account

Vowel epenthesis involves the insertion of the vowel /ə/ between the second and third consonants of a tri-syllabic cluster at the beginning of MAR verbs. The following sample illustrates vowel epenthesis in MAR:

(63)

Input	**Output**	**Gloss**
t-staʕraf	təstaʕraf	'she admits'
n-staʕmar	nəstaʕmar	'we conquer'
j-ktum	jəktum	'he conceals'

j-tkassar	jətkassar	‘it breaks’
j-gʕod	jəgʕod	‘he sits’
n-tfaradʒ	nətfaradʒ	‘I watches’
t-bɣini	təbɣini	‘you love me’
n-dʒbad	nədʒbad	‘I get something out’
t-ħaqu	təsħaqu	‘you deserve’
t-tfakkar	tətfakkar	‘you remember’
n-krahha	nəkrahha	‘I hate her’
t-tmaʃaj	tətmaʃaj	‘you (feminine) walk’
j-zbar	jəzbar	‘it is expensive’
j-twadaw	jətwadaw	‘they do ablution’

It appears that epenthesis takes place in order to avoid tri-consonantal clusters at the beginning of MAR words. Such cluster results from the addition of the prefixes ‘n-, t-, j-’ which refer to the first-person present, the second person present and the third person present respectively. Such prefixes build up tri-consonantal clusters with the di-consonantal clusters of the verbs to which they are added. As a result, /ə/ is inserted between the prefix consonants /n, t, j/ and the stem verb’s initial consonant. However, if the verb to which the prefixes /n, t, j/ are added starts with a single consonant, /ə/ epenthesis fails to apply as illustrated in the following sample:

(64)

Input	**Output**	**Gloss**
n-roħ	nroħ	‘I go’
n-baːt	nbaːt	‘I sleep in’
n-ʕawəd	nʕawəd	‘I do it again’
n-fuːt	nfuːt	‘I pass’
t-luːm	tluːm	‘You blame’
t-soːm	tsoːm	‘You fast’
t-qarri	tqarri	‘You teach’
j-guːl	jguːl	‘He says’
j-noːḍuː	jnoːḍuː	‘They stand up’
j-roːħuː	jroːħuː	‘They go’

It seems that a rule-based account of /ə/ epenthesis in MAR could either be established by representing by representing the different cases of epenthesis or by adopting a general representation. The following rules represent both ways of accounting for /ə/ epenthesis in MAR:

(65) $$\emptyset \rightarrow /\text{ə}/\ /\ \left\{\begin{array}{c} n \\ t \\ j \end{array}\right\}\underline{\qquad\qquad}CC$$

(66) Ø→ /ə/ /____________CC

The second rule (66) is more general than the first rule (65) as it indicates that each time a tri-consonantal cluster occurs at the beginning of an MAR word, such offensive cluster is solved by inserting /ə/ between the first and the second consonants of the cluster. Indeed, this implies that vowel epenthesis is not only to /n, t, j/ prefixation, but also occurs each time a word starts with three consonants whether as a result of morpheme concatenation or at word boundaries. Let us consider the following instances:

(67)

Input	**Output**	**Gloss**
roħt ʃrapt	roħt **ə**ʃrapt	‘I went to drink’
kunt lʕapt	kunt **ə**lʕapt	‘I had already played’
rdʒaʕt rkapt	rdʒaʕt **ə**rkapt	‘I got in again’
ʕawətt staʕraft	ʕawətt **ə**staʕraft	‘I acknowledged again’
məmbaʕd dxalt	məmbaʕd **ə**dxalt	‘Then I went in’
mʕah sbaqna	mʕah **ə**sbaqna	‘With him we advanced’

Rule (66) is more suitable for accounting for this case of vowel insertion than rule (65) which is more specific and accounts only for the case of /n, t, j/ prefixation. The second type of epenthesis that is displayed in MAR is glide insertion. The following subsection describes such a type of epenthesis.

4.3.2. Glide Insertion in MAR: A Rule-based Account

MAR displays the process of glide insertion at word boundaries as the glide /j/ is inserted between two vowels at word boundaries. The following sample illustrates such a type of epenthesis in MAR:

(68)

Input	Output	Gloss
jəʃriliː ana	jəʃriliː **j**ana	‘he buys for me’
jəʕdʒabniː ana	jəʕdʒabni **j**ana	‘I like him’
ħawdʒiː ana	ħawdʒiː **j**ana	‘oh my God’
ʕi ana	ʕi **j**ana	‘Just I’
gattiː ana	gattiː **j**ana	‘She said, “I….’
ʕlabali ana	ʕlabali **j**ana	‘I know’
jədiruːliː ana	jədiruːliː **j**ana	‘They do to me’
jəxṭoːniː ana	jəxṭoːniː **j**ana	They leave me alone’
jfutuːniː ana	jfutuːniː **j**ana	‘They bail on me’

It appears from the former sample that the glide /j/ is inserted when a word that ends with a vowel like /əʕdʒabniː/ is followed by another that starts with a vowel such as /ana/. The glide /j/ and not another consonant is inserted because /j/ shares with the preceding vowel which is /iː/ in all cases the feature [high]. Indeed, both /iː/ and /j/ are produced with a movement of the front of the tongue towards the palate. Such movement gets the front of the tongue quite close the palate which is the high position of the tongue. As a result, a consonant that is similar to the vowel /iː/ is inserted between /i:/ and /a/ in order to break the vowel sequence which is obviously disallowed in MAR. The following rule accounts for such a case of glide insertion:

(69) Ø→j /V_____________V

Another rule could be developed with distinctive feature constituents. Such rule is as follows:

(70) Ø →	[-cons]	/	[-cons]	________________	[-cons]
	[-syll]		[+syll]		[+syll]
	[+front]		[+front]		[-front]
	[+high]		[+high]		[-high]

In addition to epenthesis, deletion is also observed in MAR. The following section approaches deletion in MAR from a rule-based perspective.

4.4. Deletion in MAR: A Rule-based Account

Analogously to epenthesis in MAR, deletion is also of two types in MAR, more specifically two different types o vowel deletion are observed in MAR. Let us start with the first type of vowel deletion which is /ə/ deletion within a word. The vowel /ə/ is deleted in MAR words to which the suffixes ‘-i:’ or ‘-u:’ are added. These words generally end with the vowel /ə/ followed by a single consonant and are often verbs. After the second person-singular feminine suffix ‘-i:’ or the plural suffix ‘-u:/ are added to such verbs, the vowel /ə/ is deleted. The following sample illustrates such a type of deletion in MAR:

(71)

Input	Output	Gloss
ʕajət-iː	ʕajtiː	‘Call (you feminine singular)’
jfarəʃ-uː	jfarʃuː	‘They set’
ʕawəd-uː	ʕawduː	‘They did it again’
jzajər-uː	jzajruː	‘They work hard’
jħaʃəm-uː	jħaʃmuː	‘They embarrass’
tradʒəʕ-iː	tradʒʕiː	‘You (singular feminine) turn’
tgawəd-iː	tgawdiː	‘You (singular feminine) take by the hand’
tħawwəs-iː	tħawwsiː	‘You (singular feminine) look for’
jdaxxəl-uː	jdaxxluː	‘They make something enter’
nṭajəb-uː	nṭajbuː	‘We cook’
jkaməl-uː	jkamluː	‘They finnish’
ʕawən-iː	ʕawniː	‘Help (you singular feminine)’

This type of deletion is also observed in adjectives and participles. The following sample illustrates such as a case:

(72)

Input	**Output**	**Gloss**
ħaːkəm-iːn	ħaːkmiːn	‘Be in control, masculine plural’
rajəħ-a	rajħa	‘Going, singular feminine’
raːfəd-a	raːfda	‘Carrying, singular feminine’
mʕamər-a	mʕamra	‘Full, singular feminine’
waːʒəd-iːn	waːʒdiːn	‘Ready, plural masculine’
gaːbəd-a	gaːbda	‘Grabbing, singular feminine’
raːgəd-a	raːgda	‘Sleeping, singular feminine’
faːhəm-a	faːhma	Wise, singular feminine’
ʕaːqəl-a	ʕaːqla	‘Kind, singular feminine’
saːləħ-a	saːlħa	‘Good, singular feminine’

In the above sample /ə/ is deleted after the feminine singular suffix ‘-a’ or the masculine plural suffix are added to an adjective or a participle. This type of deletion is quite problematic for a rule-based account since a rule could describe this process, but it cannot explain why just /ə/ is subject to deletion and why it such deletion occurs only when the suffixes /i:, u:, a, i:n/ are added to a verb that ends with /ə/ +C. The following rule broadly describes this type of deletion in MAR:

(73) $/\text{ə}/ \rightarrow \emptyset / \underline{\qquad\qquad} \; C \left\{ \begin{array}{c} +a \\ i{:}n \\ i{:} \\ u{:} \end{array} \right\}$

Indeed, one is short of explanations as to why /ə/ is deleted in the former cases as indicated in samples (70) and (71), whereas it is preserved in the basic singular masculine forms as indicated below:

(74) Verbs

Input	**Output**	**Gloss**
ʕajət	ʕajət	‘call (you masculine singular)’
jfarəʃ	jfarəʃ	‘he sets’
ʕawəd	ʕawəd	‘he did it again’
jzajər	jzajər	‘he works hard’
jħaʃəm	jħaʃəm	‘he embarrasses’
tradʒəʕ	tradʒəʕ	‘you (singular masculine) turn’
tgawəd	tgawəd	‘you (singular masculine) take by the hand’
tħawwəs	tħawwəs	‘you (singular masculine) look for’

jdaxxəl	jdaxxəl	‘he makes something enter’
nṭajəb	nṭajəb	‘he cooks’
jkaməl	jkaməl	‘he finishes’
ʕawən	ʕawən	‘help (you, singular masculine)’

(75) Adjectives/participles

Input	**Output**	**Gloss**
ħaːkəm-	ħaːkəm	‘Be in control, masculine singular’
rajəħ	rajəħ	‘Going, singular masculine
raːfəd	raːfəd	‘Carrying, singular masculine’
mʕamər	mʕamər	‘Full, singular masculine
waːʒəd	waːʒəd	‘Ready, singular masculine’
gaːbəd	gaːbəd	‘Grabbing, singular masculine’
raːgəd	raːgəd	‘Sleeping, singular masculine’
faːhəm	faːhəm	Wise, singular masculine
ʕaːqəl	ʕaːqəl	‘Kind, singular masculine’
saːləħ	saːləħ	‘Good, singular masculine’

Vowel deletion also occurs for the vowel /ə/ in the definite article /əl/ 'the' in MAR. Moreover, other vowels may undergo deletion such as the vowel /a/ in /ana/ 'I' or /i/ in /ism/ 'name'. The following sample illustrates such type of deletion in MAR:

(76)

Input	**Output**	**Gloss**
ʕlaː **i**smah	ʕlaː smah	'Under his name'
mama **ə**l	mama l	'Mom, the…'
faṭima **ə**ddrari	faṭima ddrari	'Fatima, the kids'
kima **a**na	kima na	'Like me'
klaː **ə**l	klaː l	'He ate the'
ʃraː **ə**ddwa	ʃraː ddwa	'He bought the medicine'
ʕṭa **ə**l	ʕṭinaha l	'He gave'
radʒaʕuː **ə**l	radʒaʕuː l	'They put back the'
ziːduː **ə**ṭṭʕaːm	ziːduː ṭṭʕaːm	'Have more couscous'

It appears from the former sample that the vowels /ə/, /i/ and /a/ in the words /əl/ 'the', /ismah/ 'his name' and /ana/ 'I' are deleted in case the preceding word ends with a vowel. Indeed, deletion occurs in order to avoid vowel sequence which is obviously disallowed in MAR. However, one may wonder as to why vowel sequence is resolved through deletion of one of the vowels in this case, while in the former case of [jəʕdʒabniː jana] ‘I like him’, the glide /j/ is inserted in order to break the vowel sequence. One explanation may be the fact that in the case of [jəʕdʒabniː jana], the first vowel of the sequence is [+high]. Thus, inserting the glide /j/ which is also [+high] is possible in this case. However, in /kima **a**na/ the first vowel is [-high], and thus inserting the [+high] /j/ in this case is not possible as it would require an extra assimilatory process that would change non-high /a/ to high and since there is no high /a/ in MAR or a high counterpart of that vowel, assimilation is simply ruled-out. Hence, deletion is preferred in this case. This type of vowel deletion in MAR can be represented in the following phonological rule:

(77)

$$\left\{ \begin{matrix} \text{a} \\ \text{ə} \\ \text{i} \end{matrix} \right\} \rightarrow \emptyset \ / \ \text{V}\underline{\qquad\qquad}$$

However, this rule is not general enough. If one substitutes V for the vowels /a, ə, i/, a more general rule could be obtained as demonstrated below:

(78) $\text{V} \rightarrow \emptyset \ /\text{V}\underline{\qquad\qquad}$

Rule (78) is nevertheless too general as it implies that each time a vowel is preceded by another vowel, the first vowel is deleted. This is not always the case as cases of glide insertion represent another way of dealing with vowel sequence in MAR. Thus, another rule needs to be designed in order to avoid erroneous generalizations. This rule needs to include distinctive features and is as follows:

(79) $$\begin{array}{l} [\text{-cons}] \\ [\text{+syll}] \end{array} \rightarrow \emptyset \; / \begin{array}{l} [\text{-cons}] \\ [\text{+syll}] \\ [\text{-high}] \end{array} \_\_\_\_\_\_\_\_$$

Rule (79) implies that if a vowel is preceded by a non-high vowel, the second vowel is deleted. It is worth noting that deletion occurs only when /a, ə, i/ are preceded by non-high vowels. Hence, in case a consonant precedes them, deletion does not take place. The following sample illustrates the absence of deletion when a consonant precedes /ə, a, i/:

(80)

Input	**Output**	**Gloss**
drapt əddrari	drapt əddrari	‘I hit the kids’
ʃrapt əlma	ʃrapt əlma	‘I drank water’
naʕraf ismah	naʕraf ismah	‘I know his name’
smaʕt əl xbar	smaʕt əl xbar	‘Why me ?’
kliːt əl dʒaːdʒ	kliːt əl dʒaːdʒ	‘I heard the news’
kriːt əl ħanuːt	kriːt əl ħanuːt	‘You ate chicken’
ʃriːthum əssbaħ	ʃriːthum əssbaħ	‘I rented a shop’
		‘I bought them this morning’

In addition to deletion, MAR displays another non-assimilatory process, namely major class change. The following section describes and accounts for that process from a rule-based perspective.

4.5. Major Class Change in MAR: A Rule-based Account

Two cases of major class change were observed in the data of the present study. The first type of major class change occurs to avoid vowel sequences while the other type occurs in order to avoid some disallowed consonant clusters. Let us start with the first type of major class change, namely vowel-sequence motivated major class change.

4.5.1. Vowel to Glide Major Class Change

This type of major class change occurs when the suffixes '-uː' (plural) and '-iː' (third person singular feminine) are added to verbs that end with the vowel /a:/. In such a case, /u:/ and /i:/ turn to the glides /w/ and /j/. The following sample illustrates such a type of major class change:

(81)

Input	**Output**	**Gloss**
ħjaː-uː	ħjaːw	'They resurrected'
jətwadaː-uː	jətwadaːw	'They do ablution'
jəbdaː-uː	jəbdaːw	'They start'
jətʕaʃaː-uː	jətʕaʃaːw	'They have dinner'
tətlaqaː-uː	tətlaqaːw	'You (plural) meet'
dublaː-uː	dublaːw	'They did not pass'
klaː-uː	klaːw	'They ate'
təpqaː-iː	təpqaːj	'You (feminie) stay'
tənsaː-iː	tənsaːj	'You (feminine) forget'

ʔərdʒaː-iː ʔərdʒaːj ‘Wait (you feminine)’

As it appears from the above sample, the vowels /u:/ and /i:/ change their major class from vowels to the glides /w/, /j/. The reason for such a change being the preceding vowel /a:/ in the stem. Such a change occurs at the level of the major class feature [syllabic] as the vowels /u:/ and /i:/ and the glides /w/and /j/ are similar in all other major class features, namely [consonantal], [sonorant] since they are both [+son], [+cons]. Yet, /u:/ and /i:/ are [+syllabic] whereas /w/ and /j/ are [-syllabic]. Moreover, /u:/, /i:/, /w/, /j/ share the feature [high], and /u:/ and /w/ are [+back] while /i:/ and /j/ are [-back]. The following rule could account for this case of major class change in MAR:

(82) u: →w /V______________

(83) i: →j /V_______________

More elaborate rules could be developed out of distinctive feature specifications.

These rules could be represented as follows:

(84)

[+syll] → [-syll] / [+syll]____________________

[+high] [+high]

[+back] [+back]

(85)

[+syll] → [-syll] / [+syll]____________________

[+high] [+high]

[-back] [-back]

These rules could be collapsed into one general rule as follows:

(86)

[+syll] → [-syll] / [+syll]__________________

[+high] [+high]

The former instance of major class change does not apply if the verb to which the suffixes ‘-u:’ and ‘-i:’ are added ends with a consonant. Consider the following instances:

(87)

Input	**Output**	**Gloss**
takl-uː	takluː	‘You eat, plural’
təlʕb-iː	təlʕbiː	‘You play, feminine’
jəfaṭr-uː	jəfaṭruː	‘They have lunch’
tbaːt-iː	tbaːtiː	‘You stay overnight, feminine’
jmuːt-uː	jmuːtuː	‘They die’
təssamʕ-iː	təssamʕi	‘You hear, feminine’
tərgd-iː	tərgdiː	‘You sleep, feminine’
tnuːm-iː	tnuːmiː	‘You dream, feminine’

As aforementioned, major class change occurs in this case in order to avoid having a vowel sequence, namely stem vowel /a/ and either one of the vowel suffixes /u:/ or /i:/. However, one may wonder why the vowel sequence is not broke through glide insertion or vowel deletion as in the former cases. The reason for the adoption of major class change in this case rather than glide insertion as was the case for /jəʕdʒabniː ana/ → [jəʕdʒabniː ana] is the fact that in this case the first vowel of the sequence is not a high vowel. Indeed, in all cases the [-high] /a/ is the first vowel in the sequence even though the following vowel is high /i:, u:/.Thus, for a glide to be inserted, the high vowel needs to be the first in the sequence.

As to vowel deletion, it is not an option in this case because the vowel that is added is a suffix, and thus it adds some semantic specification to the verb to which it is added. The stem's vowel is also important semantically, and thus deleting it would affect the meaning of the overall verb. In retrospect, deleting /ə/, /i/ or /a/ in each of /kla: əl/ → [kla: l], /ʕla ismah/ → [ʕla smah] and /kima ana/ → [kima na] would not affect the meaning of the word or phrase.

4.5.2. Glide to Vowel Major Class Change

The other type of major class change in MAR involves the change of the glide /w/ which is the conjunction used in Arabic and is equivalent to the English 'and'. The glide /w/ changes to the vowel /u/ when the conjunction 'w' links a word that ends with a consonant and another that starts with a consonant. The following sample illustrates this case of major lass change in MAR:

(88)

Input	**Output**	**Gloss**
ʃkiːt w gaːluːliː	ʃkiːt **u** gaːluːliː	'I complained and they told me'
gaːl w hija	gaːl **u** hija	'He said and she'

ʃajṭoːh w bahadloːh	ʃajṭoːh **u** bahadloːh	‘They humiliated him’
klaːt w raːħət	klaːt **u** raːħət	‘She ate and left’
xallast w xraʃt	xallast **u** xraʃt	‘I paid and left’
saːkət w hamuː	saːkət **u** hamuː	‘He is a fake calm’
ktaːb w kaji	ktaːb **u** kaji	‘A book and copybook’
ṭabbakt w daxxalt	ṭabbakt **u** daxxalt	‘Folded the clothes and put them in the closet’

As it appears from the above sample, the process of major class change takes place only when /w/ is between two consonants. Indeed, if the /w/ is not flanked by consonants, major class change does not take place as illustrated in the following instances:

(89)

Input	**Output**	**Gloss**
roːħiː w kuːliː	roːħiː **w** kuːliː	‘Go and eat’
suktiː w qraj	suktiː **w** qraj	‘Keep quiet and study’
raħuː w dʒa	raħuː **w** dʒa	‘They left and came back’
ʃkaː w pkaː	ʃkaː **w** pkaː	‘He complained and he cried’
kraː w baːʕ	kraː **w** baːʕ	‘He rented and sold’

ʃarbiː w guːliliː	ʃarbiː **w** guːliliː	'Drink and tell me'
hadruː w kamluː	hadruː **w** kamluː	'They are done talking'
balʕuː w xatruː	balʕuː w xatruː	'They closed the house and travelled'

As mentioned in the preceding section, /w/ changes to /u/ and not any other vowel because they are both [+high] and [+back]. Moreover, it appears that the consonant sequence CWC is not allowed in MAR. Hence, a rule like the following could be developed in order to account for this process:

(90) /w/ →/u/ /C________C

Another rule could be one that includes distinctive features and would be more elaborate then the first one. This rule may be presented as follows:

(91)

[-syll] → [+syll] / [+cons]__________ [+cons]

[+high] [+high]

[+back] [+back]

As far as one concerned, rule-based account succeeded in providing an elaborate and general representation of phonological processes in MAR. Moreover, it appears that the inclusion of distinctive features rendered rule-based account of assimilatory processes and some non-assimilatory processes more general, and thus satisfied the principle of generalization that is so peculiar to generative phonology. However, it appears that some non-assimilatory processes, namely epenthesis, metathesis and deletion required more elaborate descriptions and explanations.

The next chapter will present an OT account of these very same processes. After such an account is provided, one can determine whether an OT account is more elaborate and satisfactory than the rule-based account that was presented in this chapter.

The chapter at hand provides an alternative account to the rule-based account that was presented in the previous chapter. Such an account is the constraint-based account of OT. Hence, this chapter presents an OT-based account of the same MAR phonological processes that were presented in the previous chapters within the methodological and analytical parts of the present study. Each process is described and explained on the basis of constraints interaction and OT's principles of constraint domination and ranking. Furthermore, each case of these processes is accounted for through the operative functions of OT's GEN and EVAL.

5.1. Assimilatory Processes in MAR: An OT-based Account

5.1.1. Voice Assimilation: An OT-based Account

As indicated in the previous chapter (chapter 4), two cases of voice assimilation are manifested in MAR, namely prefix 't-' voice assimilation and root obstruent voice assimilation. Let us start with the first case of prefix 't-' voice assimilation.

As aforementioned, the prefix 't-' which either refers to the second person (singular plural) or the third person (singular feminine) changes its voice specification from voiceless to voiced. Thus, /t/ turns to its voiced counterpart /d/ when it is prefixed to a verb that starts with the voiced obstruent /d/. The illustrative sample for such a case of voice assimilation is re-introduced below for convenience's sake.

(1)

Input	**Output**	**Gloss**
t-diːr	**d**diːr	'She does'

t-dawʃi^{j}	**d**dawʃi	'You-feminine- shower'
t-dawri	**d**dawri	'You-feminine- wander'
t-dʒafaf	**d**dʒafaf	'She sweeps the floor'
t-dalmi	**d**dalmi	'You-feminine- obscure'
t-ḍal	**ḍ**ḍal	'She keeps on'
t-dibarasi	**d**dibarasi	'She cleans up'
t-dʒi	**d**dʒi	'She comes'
t-dʒamaʕ	**d**dʒmaʕ	'She sits'
t-dabbar	**d**dabbar	'She looks for something'
t-duːxi	**d**duːxi	'You-feminine- will be dazed'
t-doːr	**d**doːr	'She turns'

Voice assimilation involves the interaction of a major markedness constraint, namely AGREE Voice with a major faithfulness constraint, viz IDENT-IO (voice). AGREE voice requires two adjacent sounds to agree in their voicing specification so that both should be either voiceless or voiced. IDENT-IO (voice), on the other hand, requires that output segments preserve the voicing specification of their input counterparts. The fact that /t/ changes to /d/ is the outcome of the domination of AGREE Voice over IDENT-IO (Voice) in the constraint hierarchy of MAR. Such hierarchy is represented below:

(2) AGREE (voice) » IDENT-IO (Voice)

The following tableau describes such a case of voice assimilation taking as instance /t-do:r/ 'she turns':

Tableau 5.1. Selecting the optimal output for /t-do:r/

/t-doːr/	AGREE (Voice)	IDENT-IO (Voice)
[tdoːr]	*!	
☞ [ddoːr]		*

The description that is provided in Tableau 5.1 above seems quite simple and not detailed enough. To prove such a point, let us consider the instances in the following sample:

(3)

Underlying representation	**Surface representation**	**Gloss**
t-soːg	tsoːg	'She drives'
t-kassar	tkassar	'She breaks'
t-ʃuːfi	tʃuːfi	'You-feminine- see'
t-fuːt	tfuːt	'She passes'
t-kammal	tkammal	'She finishes'

t-ṣawwar	tṣawwar	'She films'
t-lu:mi	tlu:mi	'You-feminine- blame'
t-ro:ħi	tro:ħi	'You-feminine- go'
t-wa:lfi	twa:lfi	'You-feminine-get used to'
t-nabhi	tnabhi	'You-feminine- warn'

In this sample, /t/ is followed by sounds that disagree with it in terms of voicing specification, but voice assimilation does not take place. Thus, AGREE (Voice) needs to be narrowed in order to be applied to the case of prefix 't-' voice assimilation. A more specific constraint within the AGREE (Voice) family is AGREE (Voice) Obs which requires obstruents to agree in their voice specification. Hence, the sonorants /l, r, n, w/ are not included in the requirements of AGREE (Voice) Obs which explains why /t/ does not assimilate to them in terms of voicing in sample (3). As to the remaining instances in sample (3), the sounds that follow /t/ are voiceless obstruents, and thus no vibration of AGREE (Voice) Obs is committed. Thus, AGREE (Voice) Obs needs to be substituted for AGREE (Voice) in the constraint hierarchy of prefix 't-' voice assimilation in MAR. Such a hierarchy is represented below:

(4)

AGREE (Voice) Obs » IDENT-IO (Voice)

Such a specification in the markedness constraint AGREE (Voice) Obs is represented in the following Tableau.:

Tableau 5.2. Selecting the optimal output for /t-do:r/ (modified description)

/t-doːr/	AGREE (Voice) Obs	IDENT-IO (Voice)
[tdoːr]	*!	
☞ [ddoːr]		*
? [ttoːr]		*

Tableau 5.2 presents a descriptive and explanatory issue as two of the candidates that GEN generated for the input /t-do:r/, namely [ddo:r] and [tto:r] have aqual violation and satisfaction of the constraints. Indeed, both candidates satisfy the higher ranked constraint AGREE (Voice) Obs and violate the lower ranked IDENT-IO (Voice). Thus, on the basis of OT's principle of strict dominance, both [ddo:r] and [tto:r] are optimal candidates. Yet, EVAL can select only one optimal candidate which is the eventual output. In order to solve such an issue, it is necessary to introduce another constraint, a faithfulness constraint that explains why /t/ assimilates to /d/ and not the reverse. Such a constraint is IDENT Stem which requires input stem sounds to preserve their voicing specification in the output. IDENT Stem dominates AGREE (Voice) Obs to avoid the selection [tto:r] as the eventual output of /t-do:r/. The final ranking for prefix 't-' voice assimilation is as follows:

(5) IDENT Stem » AGREE (Voice) Obs » IDENT-IO (Voice)

The following Tableau describes and explains voice assimilation of /t-do:r/, including all interacting constaints:

Tableau 5.3. Selecting the optimal output for /t-do:r/ (final description)

/t-doːr/	IDENT Stem	AGREE (Voice) Obs	IDENT-IO (Voice)
[tdoːr]		*!	
☞ [ddoːr]			*
[ttoːr]	*!		*

As it appears from Tableau 5.3 [ddo:r] is the optimal candidate as it costs the least serious violations. Indeed, [ddo:r] satisfies both higher ranked IDENT Stem and AGREE (Voice) Obs. The candidate [tdo:r] is eliminated as it violates the higher ranked AGREE (Voice) Obs since /t/ disagrees with /d/ in terms of voicing. As to the candidate [tto:r], it is not chosen since it violates the higher ranked IDENT Stem by including an output stem [t] which is different from the input stem /d/ in its voice specification.

After having accounted for the first case of voice assimilation in MAR from an OT perspective, let us now turn to the second case of voice assimilation in MAR, namely root-obstruent voice assimilation. As indicated in chapter four, this case of voice assimilation results from suffixation or from morpheme concatenation. Indeed, in cases like /ħsab-t/ → [ħsapt] 'I thought', the suffix '-t' leads to voice assimilation since /b/ and /t/ differ in terms of voicing, whereas in other cases like /təsbaħ + uː/ → /təsabħ-uː/ → [təsapħuː] 'you wake up in the morning' /b/ assimilates to /ħ/ in terms of voicing since they become adjacent after the suffix '-u:' is added. For convenience's sake, the sample illustrating root obstruent voice assimilation in MAR is reintroduced below.

(6)

Input	Output	Gloss
ma-jəgo**d**-ʃ	ma-jəgʕo**t**ʃ	‘He doesn’t stay’
təs**b**aħ	təsap**ħ**u	‘You wake up (singular and plural)
ħsa**b**-t	ħsa**p**t	‘I thought’
ɣaja**b**-t	ɣaja**p**t	‘I was absent’
r**b**aħ	ra**p**ħat	‘She won’
ʔakka**d**-t	ʔakka**t**t	‘I made sure’
ma-tɣiː**d**-ʃ	matɣiː**t**ʃ	‘She does not attract compassion’
dʒala**b**-ti	dʒala**p**tiː	‘My gown’
kaba**d**-ti	kaba**t**tiː	‘My liver’
ʕalla**g**-t	ʕalla**k**t	‘I hanged’
hra**b**-t	hra**p**t	‘I ran away’

This case of voice assimilation is obviously the outcome of the domination of AGRRE (Voice) Obs on IDENT-IO (Voice). Indeed, an input as /ħsab-t/ ‘I thought’ has two obstruents, namely /b/ and /t/ which disagree in voicing specification, and thus /ħsab-t/ does not correspond to the requirement of AGREE (Voice) Obs. As aforementioned, AGREE (Voice) Obs dominates IDENT-

IO (Voice) in MAR. Thus, one of the obstruents in /ħsab-t/ needs to change its voice specification in order to satisfy the higher ranked AGREE (Voice) Obs even though it implies violating the lower ranked IDENT-IO (Voice). The following tableau describes voice assimilation in /ħsab-t/:

Tableau 5.4. Selecting the optimal output of /ħsab-t/

/ħsab-t/	AGREE (Voice) Obs	IDENT-IO (Voice)
[ħsabt]	*!	
☞ [ħsapt]		*
? [ħsabd]		*

Tableau 5.4 presents the issue of directionality that was described in the other case of voice assimilation in MAR. Indeed, even though [ħsapt] is the eventual output of /ħsab-t/, [ħsabd] seems to be also optimal as it has the same costs of constraints violation as [ħsapt]. Another constraint is missing in Tableau 5.4, namely IDENT Stem which requires stem obstruents to preserve their voicing specification in the output. In the former case of voice assimilation, IDENT Stem was considered as dominating AGREE (Voice) Obs in MAR. If one applies the same ranking to account for voice assimilation in /ħsab-t/, one ends up with the following result as indicated in Tableau 5.5 below.

Tableau 5.5. Selecting the optimal output of /ħsab-t/ (modified description)

/ħsab-t/	IDENT Stem	AGREE (Voice) Obs	IDENT-IO (Voice)
[ħsabt]		*!	
? [ħsapt]	*!		*
☞ [ħsabd]			*

Tableau 5.5 illustrates a descriptive issue which results from broad selection of constraints. Indeed, it appears that [ħsabd] is the optimal candidate after IDENT Stem has been added to the hierarchy. However, our data in sample (6) indicate that [ħsapt] is the output of / ħsab-t/ in MAR. The reason for this issue resides in the constraint IDENT Stem which is not specific enough to explain this case of voice assimilation. As a matter of fact, a more specific version of IDENT Stem is IDENT Stem ONS (Voice) which requires the input stem obstruent to preserve its voice specification in the output when it is in syllable onset position. Such a requirement is satisfied in the former case of voice assimilation of /t-do:r/ since stem /d/ is in onset position. Yet, in the case of / ħsab-t/ /b/ is in coda position, and thus the requirement of ID ONS Stem (Voice) does not apply to it. Thus, [ħsabd] is not the optimal candidate as stem /b/ is in coda position and may change its voice specification without violating ID ONS Stem. Yet, another constraint is required to explain why /b/ changes its voice specification rather than /t/. This constraint belongs to the IDENT famimy of faithfulness constraints and is ID AFFIX which requires an input affix to preserve its voice specification in the output. This constraint dominates AGREE (Voice) OBS and is dominated by ID ONS Stem in MAR which explains why in the former case of /t-do:r/, the candidate [ddo:r]

emerged as the eventual output since such a candidate satisfies higher ranked ID ONS Stem at the expense of violating ID AFFIX which is lower in the hierarchy than ID ONS Stem in MAR. The following tableaus describe and explain the selection of both [ddo:r] and [ħsapt] as the outputs for /t-do:r/ and /ħsab-t/ respectively:

Tableau 5.6. Selecting the optimal output for /t-do:r/

/t-doːr/	IDENT Stem	ID AFFIX	AGREE (Voice) Obs	IDENT-IO (Voice)
[tdoːr]			*!	
☞ [ddoːr]		*!		*
[ttoːr]	*!			*

Indeed, the violation committed by [tto:r] is more offensive than that of [ddo:r] as the former violates ID ONS Stem which is higher ranked than ID AFFIX which is violated by the optimal [ddo:r]. Let us now turn to /ħsab-t/ as demonstrated by tableau 5.7 below.

Tableau 5.7. Selecting the optimal output of /ħsab-t/ (final description)

/ħsab-t/	IDENT Stem	ID AFFIX	AGREE (Voice) Obs	IDENT-IO (Voice)
[ħsabt]			*!	
☞ [ħsapt]				*
[ħsabd]		*!		*

As it appears from Tableau 5.7, [ħsapt] is the optimal candidate as it commits the least costly violations of constraints. Indeed, [ħsapt] does not violate ID ONS Stem since the stem obstruent that changes its voice specification is /b/ which is in coda rather than onset position. Furthermore, [ħsapt] satisfies the following higher ranked constraints in the hierarchy which is ID AFFIX since the suffix /t/ preserves its voice specification in [ħsapt]. [ħsapt] also satisfies the higher ranked markedness constraint AGREE (Voice) Obs since /b/ changes to the voiceless /p/ to agree with the following voiceless /t/. The candidate [ħsabd] is excluded since it violates the higher ranked ID AFFIX as the suffix /t/ is changed to the voiced /d/ in that candidate. Finally, [ħsabt] is eliminated because it violates the markedness constraint AGREE (Voice) Obs as the obstruents /b/ and /t/ disagree in their voice specification in that candidate. As indicated earlier in the study, voice assimilation is not the only type of assimilation that exists in MAR, other types such as place assimilation and total assimilation also exist. Let us start with place assimilation.

5.1.2. Place Assimilation in MAR: An OT-based Account

Place assimilation, as aforementioned in chapter 4 occurs when the nasal /n/ is followed by a labial sound as the result of morpheme concatenation. Hence, /n/ changes its place specification from coronal to labial if a labial follows it. Instances of such a process are introduced in the following sample:

(7)

Input	**Output**	**Gloss**
kaː**n** mriːḍ	kaː**m** mriːḍ	‘He was ill’

mə**n** baʕd	mə**m** baʕd	‘After, later on’
ʔa**n**bijaːʔ **n**abij	ʔa**m**bijaːʔ	‘The messengers’
wi**n** ma	wi**m** ma	‘Wherever’
mə**n** badjət	mə**m** badjət	‘From the beginning’
mə**n** baːlək	mə**m** baːlək	‘From your mind’
mə**n** maj	mə**m** maj	‘From May’
kuː**n** makkaːʃ	kuː**m** makkaːʃ	‘If there is not’
tbaː**n** miːn	tbaː**m** miːn	‘It shows when’

This case of place assimilation in MAR is the outcome of a markedness constraint from the AGREE family dominating IDENT-IO. Given that the feature that changes in that case is place feature, the markedness constraint is AGREE (Place), while the faithfulness constraint is IDENT-IO (Place). The following tableau describes OT's account of place assimilation in words like /mən ba:lək/:

Tableau 5.8. Selecting the optimal output of /mən baːlək/

/mən baːlək/	AGREE (Place)	IDENT-IO (Place)
[mən baːlək]	*!	
☞ [məm baːlək]		*
? [mən daːlək]		*

Tableau 5.8 presents the problem that both [məm baːlək] and [mən daːlək] seem to be optimal if the same ranking and set of constraints is preserved. Indeed, both candidates have the same kind of violation as they both satisfy the higher-ranked AGREE (Place) and violate the lower ranked IDENT-IO (Place) The reason for such a problem is the fact that the markedness constraint AGREE (Place) is not specific enough as changing the place of either /n/ or /b/ would satisfy AGREE (Place), thus both [məm baːlək] and [mən daːlək] seem to be optimal. However, [məm baːlək] is the eventual output of /mən baːlək/ in MAR as indicated in sample 7. Hence, another markedness constraint of the AGREE family is involved in this case of place assimilation in MAR. This constraint dominates AGREE (Place) in the hierarchy and is AGREE (Labial). Indeed, the requirement that two sounds agree in their labiality is prior to the requirement that two sounds agree in place in general. The following ranking represents constraints hierarchy for place assimilation in MAR:

(8) AGREE (Labial) » AGREE (Place) » IDENT-IO (Place)

The following tableau represents OT account of place assimilation with the inclusion of AGREE (Place) in the hierarchy:

Tableau 5.9. Selecting the optimal output of /mən baːlək/ (modified description)

/mən baːlək/	AGREE (labial)	AGREE (Place)	IDENT-IO (Place)
[mən baːlək]	*!	*!	
☞ [məm baːlək]			*
[mən daːlək]	*!		*

It appears that the inclusion of AGREE (Labial) solves the problem that was met earlier in Tableau 5.8. The candidate [mən daːlək] is excluded in this case because the agreement it includes is not in labiality but in another place feature. Another markedness constraint is, nevertheless, involved in this case of place assimilation in MAR. This constraint is what asserts that place assimilation takes place only when /n/ is followed by a labial and not any consonant other than /n/. Hence, in /ħroz ba:lək/, for instance, no place assimilation takes place even though a coronal /z/ is followed by the labial /b/. Indeed, only when /n/ is followed by a labial, place assimilation takes place in MAR. The markedness constraint that assures that is *n [labial] which considers the sequence /n/ followed by [labial] as marked. The following tableau represents OT account of place assimilation in /mən baːlək/ including the markedness constraint *n [labial]. Note that a discontinuous line separates *n [labial] from AGREE (Labial) to demonstrate that they are at the same level since their requirements do not conflict:

Tableau 5.10. Selecting the optimal output of /mən baːlək/ (final description)

/mən baːlək/	*n[labial]	AGREE (labial)	AGREE (Place)	IDENT-IO (Place)
[mən baːlək]	*!	*!	*!	
☞ [məm baːlək]				*
[mən daːlək]		*!		*

After having accounted for place assimilation in MAR, let us now turn to total assimilation.

5.1.3. Total Assimilation in MAR: An OT-based Account

Total assimilation, as demonstrated in the previous chapter, occurs to the /l/ of the definite article /əl/ in MAR. /l/ changes its voicing and manner when it is followed by coronals. The illustrative sample of such a process is reproduced below for convenience's sake:

(9)

Input	**Output**	**Gloss**
ə**l**-daxla	ə**d**daxla	'The entrance'
ə**l**-zwaq	ə**z**zwaq	'The decoration'
ə**l**-tuːta	ə**t**tuːta	'The blackberry'
ə**l**-soːg	ə**s**soːg	'The week'

ə**l**-ʃkajər	əʃʃkajər	'The case'
ə**l**-no:r	ə**n**no:r	'The light'
ə**l**-rasm	ə**r**rasm	'The drawing'

The reason for total assimilation is the requirement of the markedness constraint AGREE which dominates IDENT-IO in this case in MAR. Given that assimilation is total, the type of AGREE that is involved in this case in MAR is AGREE/C which requires a sound to completely assimilate to a following sound. As to IDENT-IO constraint, the version of IDENT-IO that is involved in this case is IDENT (F) which requires all features (voicing, place and manner) to be preserved in the output. Constraint hierarchy for this case of total assimilation in MAR is represented below.

(10) AGREE/C » IDENT (F)

The following tableau describes OT account of total assimilation in instances like /əl- zwa:q/:

Tableau 5.11. Selecting the optimal output of /əl-zwa:q/

/əl-zwa:q/	AGREE/C	IDENT (F)
[əl-zwa:q]	*!	
☞ [əz-zwa:q]		*
? [əl-lwa:q]		*

Tableau 5.11 presents two candidates that are seem to be optimal according to the constraint set and hierarchy. These candidates are [əzzwaq] and [əllwa:q]. Such an issue would be avoided if a

constraint from the ID family is added to the hierarchy, such a constraint would assure that the coronal of the main noun or else the of the NP /zwa:q/ ‘decoration’ in our instance preserves its voice and manner feature. Indeed, the phrase /əl-zwa:q/ is a noun phrase that consists of a determiner /əl/ and a noun /zwa:q/ which is the head of the NP and the main noun or else the content word. A version of such ID constraint could be developed as follows:

(11) ID (F) HEAD: input sounds in a head should preserve their voice and mannee features in the output. ID (F) is higher ranked than ID (F) and is dominated by AGREE/C in MAR. Such hierarchy is represented below.

(12) AGREE/C » ID (F) HEAD » ID (F)

The following Tableau describes OT account of total assimilation of /əl-zwa:q/ in MAR after the identity constraint ID (F) HEAD is added to the hierarchy:

Tableau 5.12. Selecting the optimal output of /əl-zwaːq/ (modified description)

/əl-zwaːq/	AGREE/C	ID (F) HEAD	IDENT (F)
[əl-zwaːq]	*!		
☞ [əz-zwaːq]			*
[əl-lwaːq]		*!	*

It appears that the candidate [əz-zwaːq] is the optimal candidate as it is the most harmonious with constraint hierarchy and requirements. Such a candidate satisfies AGREE/C unlike [əl-zwaːq] which violates it by including the pair /l/ and /z/ which disagree in voicing and manner.

Furthermore, [əz-zwaːq] satisfies ID (F) HEAD which is violated by [əl-lwaːq] in which the head's sound /z/ changed its manner. Even though, [əz-zwaːq] violates the lower ranked ID (F) which is unavoidable in order to satisfy AGREE/C.

Tableau 5.12 also accounts for cases of /l/ total assimilation to emphatics as indicated in the sample below:

(13)

Input	**Output**	**Gloss**
əl-ṭabla	ə**ṭ**-ṭabla	'The table'
əl-ṭʕaːm	ə**ṭ**-ṭʕaːm	'The couscous'
əl-ṭmar	ə**ṭ**-ṭmar	'The dates'
əl-ṣɣiːra	ə**ṣ**-ṣɣiːra	'The little'
əl-ṣaffaja	ə**ṣ**-ṣaffaja	'The stove'
əl-ḍarba	ə**ḍ**-ḍarba	'The occasion'
əl-ḍaħk	ə**ḍ**-ḍaħk	'The laughter'
əl-ḍarṣa	ə**ḍ**-ḍarṣa	'The molar'

AGREE/C refers to complete assimilation of /l/ including secondary features like emphasis. Hence, [ə**ḍ**-ḍarṣa] for instance is the result of the domination of AGREE/C over ID (F). Tableau 5.13 below represents OT account of total assimilation in instances like /əl-ḍarṣa/ in MAR.

Tableau 5.13. Selecting the optimal output of /əl-ḍarṣa/

/əl-ḍarṣa/	AGREE/C	ID (F) HEAD	IDENT (F)
[əl-ḍarṣa]	*!		
☞ [əḍ-ḍarṣa]			*
[əl-larṣa]		*!	*

However, the previous account of total assimilation in MAR possesses a flaw in description since /l/ does not always totally assimilate the following sounds. Indeed, in the following sample, total assimilation does not take place.

(13)

Input	**Output**	**Gloss**
əl-ba:b	əl-ba:b	'The door'
əl-futaj	əl-futaj	'The sofa'
əl-valiza	əl-valiza	'The suitcase'
əl-mu:dʒa	əl-mu:dʒa	'The wave'
əl-kursi	əl-kursi	The chair'
əl-guffa	əl-guffa	'The basket'

əl-juːm	əl-juːm	'Today'
əl-watʃ	əl-watʃ	'The face'
əl-ħawʃ	əl-ħawʃ	'The yard'
əl-hna	əl-hna	'The peace of mind'
əl-ʕaːm	əl-ʕaːm	'The year'
əl-qahwa	əl-qahwa	'The coffee'

The failure for total assimilation to apply in this case is the outcome of the fact that the sounds that follow /l/ are not coronal sounds. Thus, AGREE/C needs to be satisfied to include only cases where /l/ is followed by coronal sounds. A more specific version of AGREE/C can be developed and would be /l/ [CORONAL] AGREE/C which requires /l/ to totally agree with a following sound if and only if it is a coronal sound.

Including the new specific version of AGREE/C yields the following OT account of total assimilation in /əl-zwaːq/ as demonstrated in Tableau 5.14 below:

Tableau 5.14. Selecting the optimal output of /əl-zwaːq/ (final description)

/əl-zwaːq/	/l/ [Coronal] AGREE/C	ID (F) HEAD	IDENT (F)
[əl-zwaːq]	*!		
☞ [əz-zwaːq]			*
[əl-lwaːq]		*!	*

The inclusion of /l/ [CORONAL] AGREE/C also explains why in cases like /əl-ba:b/ total assimilation is blocked. Tableau 5.15 below demonstrates such a case:

Tableau 5.15. Blocking total assimilation for /əl-ba:b/

/əl-ba:b/	/l/ [Coronal] AGREE/C	ID (F) HEAD	IDENT (F)
☞ [əl-ba:b]			
[əb-ba:b]			*
[əl-la:b]		*!	*

In the case of /əl-ba:b/, total assimilation is not required because /b/ is not a coronal. Thus, /l/ does not need to totally assimilate to it. As a result, the optimal candidate in this case is [əl-ba:b] as it commits no violation of constraints unlike the remaining candidates which violate either the higher ranked ID (F) HEAD (for [əlla:b]) or ID (F) for [əbba:b]. Indeed, violation of ID (F) in the case of [əbba:b] is fatal in this case since no compensation is made for that violation. Indeed, [əb-ba:b] does not satisfy /l/ [coronal] AGREE/C since /b/ is not a coronal, and thus changing /l/ to /b/ does not satisfy this constraint. The violation of ID (F) in this case is unnecessary since no compensation for that violation is made.

Total assimilation in MAR can be accounted for differently via another model. Such a model is adapted from Maszcro's (2007) account of /l/ assimilation in /ʔəl/ in Standard Arabic (SA). Just like /ʔəl/ of SA, /əl/ of MAR is a morpheme that has a number of allomorphs, including

/əl, ər, ən, ət, əd, əṭ, əḍ, əs, əz, əṣ, əʃ, əʒ/. These allomorphs are part of the input of any form that is subject to total assimilation. Thus, for instance, /əl-zwa:q/ has the input /ə {l, r, n, t, d, ṭ, ḍ, s, z, ṣ, ʃ, ʒ}-zwa:q/. The candidates that GEN generates include each one of these allomorphs. Given that allomorphs are part of the input, then no candidate violates ID (F). However, the optimal candidate is the one that satisfies AGREE/C. The tableau below presents OT account of total assimilation in /əl-zwa:q/ applying Masacro's model.

Tableau 5.16. Selecting the optimal output of /əl-zwaːq/ (Masacro's model):

/ə{l, r, n, t, d, ṭ, ḍ, s, z, ṣ, ʃ, ʒ}-zwaːq/	AGREE/C	IDENT (F)
[əl-zwaːq]	*!	
[ər-zwaːq]	*!	
[ən-zwaːq]	*!	
[ət-zwaːq]	*!	
[əd-zwaːq]	*!	
[əṭ-zwaːq]	*!	
[əḍ-zwaːq]	*!	
[əs-zwaːq]	*!	
☞ [əz-zwaːq]		

[əṣ-zwaːq]	*!	
[əʃ-zwaːq]	*!	
[əʒ-zwaːq]	*!	

This model also explains why total assimilation is blocked in the case of /əl-ba:b/. However, another constraint needs to be added as adopted from Masacro (2007). This constraint is the faithfulness constraint PRIORITY which has as requirement that the eventual output includes the unmarked allomorphs /əl/ (Masacro 2007:725). Indeed, to explain this idea, one may establish a scale of allomorphs ranging from the top unmarked to the bottom marked. Such a scale would look as follows:

(14)

/əl/

/ər/

/ən/

/ət/

/əd/

/əṭ/

/əḍ/

/əs/

/əz/

/əṣ/

/əʃ/

/əʒ/

PRIORITY dominates AGREE/C and IDENT (F) in this case to assure the selection of the unmarked /əl/ over any other allomorph in scale 14. The following tableau indicates why total assimilation is blocked in the case of /əl-ba:b/:

Tableau 5.17. Selecting the optimal output of /əl-baːb/ (Masacro's model)

/ə{l, r, n, t, d, ṭ, ḍ, s, z, ṣ, ʃ, ʒ}-baːb/	PRIORITY	AGREE/C	IDENT (F)
☞ [əl-baːb]		*	
[ər-baːb]	*!	*	
[ən-baːb]	*!	*	
[ət-baːb]	*!	*	
[əd-baːb]	*!	*	
[əṭ-baːb]	*!	*	

[əḍ-baːb]	*!	*	
[əs-baːb]	*!	*	
[əz-baːb]	*!	*	
[əṣ-baːb]	*!	*	
[əʃ-baːb]	*!	*	
[əʒ-baːb]	*!	*	

It appears that the optimal candidate in this case is [əl-baːb] since it is the most harmonious with constraint hierarchy. Indeed, [əl-baːb] is the only candidate that satisfies the higher ranked constraint PRIORITY.

It seems from comparison of the two models that have been applied to account for total assimilation in MAR that the first method is more reliable than Masacro's model for a number of reasons. First, the constraint ID (F) seems to be inactive in Masacro's model as all candidates satisfy it, whereas in the previous model it contributed in the selection of the optimal candidate for /əl-baːb/. Moreover, if one preserves the ranking PRIORITY » AGREE/C in accounting for /əl-zwaːq/ total assimilation, [əl-zwaːq] would emerge like the optimal candidate for /əl-zwaːq/ since it satisfies the higher ranked PRIORITY while the eventual output in MAR [əz-zwaːq] violates PRIORITY. Finally, the previous model that was adopted in accounting for total assimilation in MAR is more economical and less complex than Masacro's model.

After having accounted for assimilatory processes from an OT perspective, let us now turn to non-assimilatory processes. We will look into the case of metathesis first.

5.2. Non-assimilatory Process in MAR: An OT-based Account

5.2.1. Metathesis in MAR: An OT-based Account

It has been demonstrated in chapter 4 that metathesis takes place after the suffixes '-at' and '-u:' are added to a monosyllabic verb that ends with a consonant and has a consonant cluster at its beginning. Instances include /dxal-at/ which is realized as [daxlat]. Hence, the vowel /a/ and the preceding consonant are inverted in cases of metathesis. The illustrative sample is re-introduced below for the sake of clarity.

(15)

Input	**Output**	**Gloss**
dxal-at	d**ax**lat	'She entered'
ʃṭaħ-at	ʃ**aṭ**ħat	'She bought'
ktab-uː	k**at**buː	'They wrote'
rkab-at	r**ak**bat	'She got in'
slak-at	s**al**kat	'She rid of'
xradʒ-uː	x**ar**dʒuː	'They went out'
ṭlaʕ-at	ṭ**al**ʕat	'She went up'

ʃrab-at	ʃ**ar**bat	'She drunk'
ħgar-at	ħ**ag**rat	'She was unfair'

Metathesis as demonstrated in the above sample involves inverting the vowel /a/ with the consonant that precedes it if the suffixes '-at' and '-u:' are added to a monosyllabic verb. It appears that the reason for such segmental inversion is stress placement and syllable weight. Indeed, after '-at' is added, the monosyllabic word /dxal/ turns to a di-syllabic word. The markedness constraint Onset would require the second syllable to have an onset. Thus, /l/ syllabifies as its onset resulting in the following syllabification /dxa.lat/.

Syllable weight would classify /dxa/ as a light syllable since it includes a short vowel and is an open syllable, whereas /lat/ would be considered a heavy syllable as it is a closed syllable. Stress placement principles predict stress to fall on the second syllable as it is heavy. Thus, the following stress pattern would obtain for /daxˈlat/: oO. Thus, there must be a markedness constraint that requires stress to fall on heavy syllables. Such a constraint would be ˈHeavy syllable and would require heavy syllables to receive the main stress in a word. However, if one applies the requirements of ˈHeavy syllable, stress would fall on the syllable /lat/, whereas the stem /dxa/ would be unstressed. Nevertheless, stress generally falls on the stem syllable in Arabic, and thus in MAR. Thus, there must be a markedness constraint that requires main stress to fall on syllables that include the stem. Let us name this constraint ˈStem syllable with the symbol (ˈ) standing for stress. Metathesis is obviously the result of the requirement of ˈStem syllable. Indeed, after inverting the /a/ with /x/ in /dxa/, the resulting syllable /dxa/ is a heavy syllable since it is closed. Thus, main stress would fall on it, satisfying both ˈStem syllable and ˈHeavy syllable. Constraint hierarchy for mrtathesis in MAR is presented below:

(16) ˈStem syllable » ˈHeavy syllable, Onset.

However, there must be a faithfulness constraint that is in conflict with the above markedness constraints. Such a faithfulness constraint requires the order of sounds in the input to be kept identical in the output. This constraint is ID [sequence] and is dominated by each of ˈStem syllable, ˈHeavy syllable and Onset. The following tableau presents OT account of metathesis in the instances /dxal-at/:

Tableau 5.18. OT Account of metathesis in /dxal-at/ in MAR

/dxal-at/	ˈStem syllable	ˈHeavy syllable	ONS	IDENT [sequence]
[ˈdxal.at]			*	
[dxa.ˈlat]	*!			
☞ [ˈdax.lat]				
[dxa.ˈlat]		*!		*
[dax.ˈlat]	*!	*!		*

As it appears from tableau 5.18, [ˈdax.lat] is the optimal candidate as it is the most harmonious with constraint hierarchy since it satisfies the higher-ranked ˈStem syllable. Moreover, [ˈdax.lat] satisfies the higher ranked ˈHeavy syllable as stress falls on a heavy syllable, namely /dax/ unlike the candidate [dxa.ˈlat] which violates it. The optimal candidate [ˈdax.lat] also satisfies the higher ranked constraint Onset since both syllables in that candidate have an onset unlike [dxa.ˈlat] in which the second syllable /at/ lacks an onset. Even though [ˈdax.lat] violates the lower ranked ID [sequence], such a violation is allowed since ID [sequence] is dominated by ˈStem syllable, ˈHeavy syllable and Onset which are all satisfied by the optimal [ˈdax.lat].

After having dealt with metathesis within an OT framework, it is now worth turning to the following non-assimilatory process in MAR which is epenthesis. The following section presents an OT account of epenthetic processes in MAR.

5.2.2. Epenthesis in MAR: An OT-based Account

As mentioned earlier in chapter 4, epenthesis is of two kinds in MAR, namely vowel epenthesis and glide insertion. We shall start with vowel epenthesis then move to glide insertion.

5.2.2.1. Vowel Epenthesis in MAR: An OT-based Account

As aforementioned, vowel epenthesis occurs in MAR after the prefixes /n,t, j/ are added to verbs that start with a complex cluster consisting of two consonants. Instances include /j-glaʕ/ in which the vowel /ə/ is inserted after the prefix /j/, yielding the output [jəglaʕ]. The illustrative sample of such a process is re-introduced below.

(17)

Input	**Output**	**Gloss**
t-staʕraf	təstaʕraf	'She recognizes'
n-staʕmar	nəstaʕmar	'We colonize'
j-ktum	jəktum	'He keeps a secret'
j-tkassar	jətkassar	'It breaks'

j-gʕod	jəgʕod	'He sits'
n-tfaradʒ	nətfaradʒ	'He watches'
t-bɣini	təbɣini	'You love me'
n-dʒbad	nədʒbad	'I get something out'
t-ħaqu	təsħaqu	'You deserve'
t-tfakkar	tətfakkar	'You remember'
n-krahha	nəkrahha	'I hate her'
t-tmaʃaj	tətmaʃaj	'You (feminine) walk'
j-zbar	jəzbar	'It is expensive'
j-twadaw	jətwadaw	'They do ablution'

The reason behind vowel insertion in the above sample seems to be the fact that complex onsets are not allowed in MAR. Yet, one may notice that the stems contain a complex onset as /gl/ in /j-glaʕ/. Hence, MAR allows complex onsets that consist of two consonants as a maximum so that any onset that consists of more than three consonants is disallowed in MAR. Such requirement is the outcome of a specific version of the markedness constraint *Complex Ons which prohibits complex onsets of any kind. In MAR onsets that consist of two consonants are allowed, thus the markedness constraint that is applied in MAR is *CCC Onset which prohibits more than three consonants to appear in onset position. *CCC Onset dominates the anti-epenthesis faithfulness constraint DEP-IO which requires segments in the output to have correspondents in the input.

However, one may wonder why not deletion, but epenthesis takes place in this case. Two reasons may be provided to explain such a case. The first reason is that epenthesis is less costly in MAR than deletion in this case which implies that the anti-deletion constraint MAX-IO dominates the anti-epenthesis constraint DEP-IO in MAR. Furthermore, deleting one of the consonants in the tri-consonantal cluster would affect the semantic interpretation of the word /jəglaʕ/. Indeed, deleting the prefix is no option since it is added to modify meaning or else add to meaning as it refers to the third person present masculine morpheme. Even deleting one of the consonants /l/ or /ʕ/ would affect the meaning of the word /glaʕ/. The following tableau describes OT account of /ə/ epenthesis in /j-glaʕ/:

Tableau 5.19. OT Account of vowel epenthesis in /j-glaʕ/ in MAR

/j-glaʕ/	*CCC ONS	MAX-IO	DEP-IO
[jglaʕ]	*!		
☞ [jə.glaʕ]			*
[jlaʕ]		*!	
[jgaʕ]		*!	
[glaʕ]	*!	*!	

It appears that the most harmonious and thus optimal candidate is [jəglaʕ] as it satisfies the higher ranked constraint *CCC ONS by including only a di-consonantal onset /lʕ/. Indeed, after /ə/ is added /j/ and /ə/ became part of a separate second syllable /jə/ and /glaʕ/ syllabified as a separate second syllable. The other candidates are excluded as they either violate the higher ranked *CCC ONS as is the case for [glaʕ] or MAX-IO as is the case for [jgaʕ], [jlaʕ] and [glaʕ].

Absence of epenthesis in cases like /n-roːħ/ 'I go' which is realized as [nroːħ], could also be accounted for using the same set of constraints and hierarchy that was used to account for epenthesis in [jə.glaʕ]. Before explaining the absence of /ə/ epenthesis in [nroħ], cases that exhibit the absence of /ə/ epenthesis are re-introduced in the sample below.

(18)

Input	**Output**	**Gloss**
n-roħ	nroħ	'I go'
n-baːt	nbaːt	'I sleep in'
n-ʕawəd	nʕawəd	'I do it again'
n-fuːt	nfuːt	'I pass'
t-luːm	tluːm	'You blame'
t-soːm	tsoːm	'You fast'
t-qarri	tqarri	'You teach'
j-guːl	jguːl	'He says'
j-noːḍuː	jnoːḍuː	'They stand up'
j-roːħuː	jroːħuː	'They go'

The following tableau explains why /ə/ does not take place in cases of the above sample:

Tableau 5.20. OT Account of absence of /ə/ epenthesis in /n-roːħ/ in MAR

/n-roːħ/	*CCC ONS	MAX-IO	DEP-IO
☞ [nroːħ]			
[nə.roːħ]			*
[noːħ]		*!	
[roːħ]		*!	

The optimal candidate for /n-roːħ/ seems to be [nroːħ] as it does not violate any of the constraints that are involved in this case. Indeed, adding the prefix ‘n-’ to /roːħ/ does not result in an offensive onset since the onset of stem /roːħ/ consists of a single consonant. Thus, adding ‘n-’, yields a di-consonantal onset which is allowed and quite common in MAR. The candidate [nroːħ] then does not violate the higher ranked since it does not consist of a tri-consonatal onset, but a di-consonantal one. Furthermore, [nroːħ] satisfies both MAX-IO and DEP-IO as all elements present in the input have correspondents in the output and all elements of the output have counterparts in the input which implies that no segment has been deleted or added. The candidate [nə.roːħ] is excluded by EVAL since it violates DEP-IO unnecessarily as the complex cluster /nr/ is allowed in MAR. Exclusion also applies to the candidates [noːħ] and [roːħ] which violate MAX-IO as they both miss one of the consonants of the cluster /nr/ which is unnecessary since, as stated earlier, /nr/ is a permissible cluster in MAR as it includes less than three consonants, and thus does not violate *CCC ONS. After having accounted for the first type of epenthesis in MAR, we shall now move to the second type of epenthesis in MAR which is glide insertion.

5.2.2.2. Glide Insertion in MAR: An OT-based Account

As demonstrated in the previous chapter, glide insertion takes place in MAR when the word /ana/ 'I' follows a verb or adverb that ends with a vowel. A vowel sequence results as is the case in /jəʃriliː ana/ 'he buys for me' in which the vowels /i:/ and /a/ occur in a sequence. The sample that exemplifies such a process in MAR is reproduced below.

(19)

Input	**Output**	**Gloss**
jəʃriliː ana	jəʃriliː **j**ana	'He buys for me'
jəʕdʒabniː ana	jəʕdʒabni **j**ana	'I like him'
ħawdʒiː ana	ħawdʒiː **j**ana	'Oh my God'
ʕiː ana	ʕiː **j**ana	'Just I'
gattiː ana	gattiː **j**ana	'She said, "I…."
ʕlabaliː ana	ʕlabaliː **j**ana	'I know'
jədiruːliː ana	jədiruːliː **j**ana	'They do to me'
jəxtoːniː ana	jəxtoːniː **j**ana	They leave me alone'
jfutuːniː ana	jfutuːniː **j**ana	'They bail on me'

It appears that the glide /j/ is inserted between the vowels /i:/ and /a/. Such insertion is the result of the markedness constraint Onset which requires syllables to have onsets. Indeed, the syllable /a/ in /ana/ is onsetless which goes against the requirement of Onset. Onset dominates DEP-IO in MAR as mentioned earlier for vowel epenthesis. Moreover, Max-IO dominates DEP-IO in MAR which explains why epenthesis rather than deletion takes place in this case. Glide insertion also occurs in this case as a result of the markendess constraint *Hiatus which militates against vowel sequence. Thus, /j/ is inserted between /i:/ and /a/ in /jəʃriliː ana/, for example, to satisfy *Hiatus. Given that Onset and *Hiatus do not have conflicting requirements, they are left unranked with regard to each other.

The fact that it is /j/ and not any other consonant that is inserted in this case may lead to questioning. The reason for inserting /j/ and not another consonant like /ʔ/ is the fact that /j/ is [+high] and [+front] just like /i:/. Thus, any other consonant is marked after /i:/ (Uffman 2007:465). /ʔ/, for instance, is excluded as it is neither [+high] nor [+front]. Hence, a markedness constraint must require the glide /j/ to be inserted after a high vowel, like /i:/ in our instance, when this high vowel is followed by another vowel as /a/ in /ana/. This constraint is *[+high] [-high] V which considers a [-high] consonant, such as /ʔ/ for example, to be marked after a [+high] vowel, such as /i:/. *[+high] [-high] V does not have conflicting requirement with ONS and *Hiatus and is thus at the same level as ONS and *Hiatus.

Another markedness constraint favours the insertion of /j/ rather than any other consonant. This constraint is based on the intervocalic scale that was introduced by Uffman (2007:465) and reproduced below.

(20) *V-V/ Lar (laryngeal) » *V-V/ Obs (obstruent) » *V-V/ Nas (nasal) » *V-V/ Liq (liquid) » *V-V/ Gli (glide)

As it appears from the above scale, glides are the least marked intervocalic consonants. The constraint that considers glides as the least marked intervocalically could be developed from the above scale so that the extremes of the scale would be included in such a constraint. *V-V/ Lar (laryngeal) » *V-V/ Gli (glide) is such a constraint since the requirement of *V-V/ Lar (laryngeal) » *V-V/ Gli (glide) does not conflict with those of ONS, *Hiatus and *[+high] [-high] V, it is at the same level as these constraints. The following hierarchy represents constraint hierarchy for glide insertion in MAR:

(21) ONS, *Hiatus, *[+high] [-high] V, *V-V/ Lar (laryngeal) » *V-V/ Gli (glide) » Max-IO » DEP-IO

The following tableau describes OT account of glide insertion in MAR for /jəʃriliː ana/:

Tableau 5.21. OT Account of glide insertion in /jəʃriliː ana/

/jəʃriliː ana/	ONS	*Hiatus	*[+high] [-high] V	*V-V/ Lar (laryngeal) » *V-V/ Gli (glide)	MAX-IO	DEP-IO
[jəʃriliː ana]	*!	*!				
[jəʃriliː na]					*!	
☞ [jəʃriliː jana]						*
[jəʃriliː ʔana]			*!	*!		

The candidate [jəʃriliː jana] is the optimal candidate as it satisfies the higher ranked ONS, *Hiatus, *[+high] [-high] V, *V-V/ Lar (laryngeal) » *V-V/ Gli (glide) and MAX-IO. Indeed, [jəʃriliː jana] satisfies ONS as the syllable /a/ acquires an onset in that candidate after /j/ is inserted. On the other hand, the candidate [jəʃriliː ana] violates ONS as it includes an onsetless syllable in /ana/. The optimal candidate [jəʃriliː jana] also satisfies *Hiatus since the vowel hiatus /iː a/ is solved in that candidate by inserting /j/ unlike [jəʃriliː ana] which includes a vowel hiatus, and thus violates *Hiatus. [jəʃriliː jana] also satisfies *[+high] [-high] V as it includes the [+high] /j/ between the [+high] /iː/ and the vowel /a/. Moreover, [jəʃriliː jana] satisfies *V-V/ Lar (laryngeal) » *V-V/ Gli (glide) as it includes the least marked /j/ between the vowels /iː/ and /a/. In retrospect, [jəʃriliː ʔana] violates both *[+high] [-high] V and *V-V/ Lar (laryngeal) » *V-V/ Gli (glide) as it includes the [-high] /ʔ/ which is a laryngeal and is thus marked intervocalically. Finally, [jəʃriliː jana] satisfies MAX-IO as it includes all input segments unlike [jəʃriliː na] in which input /a/ is missing. After epenthesis, it is now worth turning to deletion and attempt to account for it from an OT perspective.

5.2.3. Deletion in MAR: An OT-based Account

As indicated earlier in chapter 4, deletion is of two types in MAR, and both types the vowel /ə/ is deleted, yet different cases of /ə/ deletion are displayed in MAR. We shall start with the first case of /ə/ deletion which occurs after the suffixes /iː/ or /uː/ are added to verbs or to adjectives. Instances of such a case of deletion are presented in the following samples:

(22)

Input	**Output**	**Gloss**
ʕajət-iː	ʕajtiː	'Call (you feminine singular)'
jfarəʃ-uː	jfarʃuː	'They set'

ʕawəd-uː	ʕawduː	'They did it again'
jzajər-uː	jzajruː	'They work hard'
jħaʃəm-uː	jħaʃmuː	'They embarrass'
tradʒəʕ-iː	tradʒʕiː	'You (singular feminine) turn'
tgawəd-iː	tgawdiː	'You (singular feminine) take by the hand'
tħawwəs-iː	tħawwsiː	'You (singular feminine) look for'
jdaxxəl-uː	jdaxxluː	'They make something enter'
nṭajəb-uː	nṭajbuː	'We cook'
jkaməl-uː	jkamluː	'They finnish'
ʕawən-iː	ʕawniː	'Help (you singular feminine)'

(23)

Input	**Output**	**Gloss**
ħaːkəm-iːn	ħaːkmiːn	'Be in control, masculine plural '
rajəħ-a	rajħa	'Going, singular feminine'
raːfəd-a	raːfda	'Carrying, singular feminine'
mʕamər-a	mʕamra	'Full, singular feminine'

waːʒəd-iːn	waːʒdiːn	‘Ready, plural masculine’
gaːbəd-a	gaːbda	‘Grabbing, singular feminine’
raːgəd-a	raːgda	‘Sleeping, singular feminine’
faːhəm-a	faːhma	‘Wise, singular feminine’
ʕaːqəl-a	ʕaːqla	‘Kind, singular feminine’
saːləħ-a	saːlħa	‘Good, singular feminine’

As it appears from the former samples, the vowel /ə/ is deleted in instances like /ʕajəṭ-i:/ and /ħakəm-i:n/. The reason for deletion in such a case is due to the markedness of /ə/ in open syllables. Indeed, /ə/ is a weak syllable that occurs in an open unstressed syllable which is often avoided in Arabic as proposed by Btoosh (2006, p. 201) “weak nuclei cannot stand in open syllables in MARabic varieties”. As a matter of fact, /ə/ is a weak vowel and is thus never stressed which makes its situation in the open syllables /jə/ and /kə/ in /ʕajəṭ-i:/ and /ħakəm-i:n/ in conflict with the requirements of the markedness constraint which militates against the occurrence of weak nuclei in open syllables. Such a constraint is *Weak nucleus (*WN).

It is important to indicate in that case that /jə/ and /kə/ are open syllables since /t/ and /m/ would syllabify as onsets of the following syllables, namely /i:/ and /i:m/ that are created by suffixation. Thus, to satisfy the markedness constraint ONS, /t/ and /m/ syllabify as onsets of the syllables /t:/ and /i:m/, and thus the previous syllables /jə/ and /kə/ become open syllables. Hence, deletion in MAR in cases as /ʕaj**ə**ṭ-i:/ and /ħak**ə**m-i:n/ is the outcome of the domination of *WN and ONS over MAX-IO in MAR. The following tableaus account for the deletion in /ʕajəṭ-iː / and /ħakəm-iːn/ respectively:

Tableau 5.22. OT Account of deletion in /ʕajəṭ-iː/

/ʕajəṭ-iː /	*WN	ONS	MAX-IO	DEP-IO
[ʕa.jə.ṭiː]	*!			
[ʕa.jəṭ.iː]		* !		
☞ [ʕaj.ṭiː]			*!	
? [ʕa.jəb.ṭiː]				*

Tableau 5.23. OT Account of deletion in /ħakəm-iːn/

/ħakəm-iːn/	*WN	ONS	MAX-IO	DEP-IO
[ħa.kəm.iːn]		*!		
[ħa.kə.miːn]	*!			
☞ [ħak.miːn]			*!	
?[ħa.kəb.m-iːn]				*

The tableaus above indicate a problem of description as it appears that candidates other than the ones that appear as the eventual outputs of /ʕajəṭ-iː/ and /ħakəm-iːn/ seem to be more optimal. Indeed, in both tableaus the candidates [ʕa.jəb.ṭiː] and [ħa.kəb.m-iːn] seem to be more optimal than [ʕaj.ṭiː] and [ħak.miːn]. The reason for this problem is the ranking MAX-IO » DEP-IO as it was earlier specified that MAX-IO dominates DEP-IO in MAR. As a matter of fact, the candidate [ʕa.jəb.ṭiː] satisfies MAX-IO while [ʕaj.ṭiː] which violates MAX-IO while it satisfies the lower ranked DEP-IO. In spite of all that, [ʕaj.ṭiː] and not [ʕa.jəb.ṭiː] is the eventual output of /ʕajəṭ-iː/ in MAR and so is the case for [ħak.miːn] in relation to /ħakəm-iːn/. Hence, there must be another constraint that dominates MAX-IO and considers epenthesis in this case as offensive. Such a constraint is a markedness constraint Morpheme Contiguity (M-CONT) which was introduced by Eddington (2001, p. 40) as Morpheme Contiguity (M-CONT) bans inserting segments between elements of a single morpheme as is the case with /ʕajəṭ/ and /ħakəm/ in /ʕajəṭ-iː/ and /ħakəm-iːn/. Inserting /b/ in /ʕajəṭ/ and /ħakəm/ between /jə/ and /t/, and /kə/ and /m/ would violate M-CONT, and thus result in a more fatal violation than that of violating MAX-IO by deleting /ə/. The following tableaus illustrate this point more closely:

Tableau 5.23. Modified OT account of deletion in /ʕajəṭ-iː/

/ʕajəṭ-iː /	*WN	ONS	M-CONT	MAX-IO	DEP-IO
[ʕa.jə.ṭiː]	*!				
[ʕa.jəṭ.iː]		* !			
☞ [ʕaj.ṭiː]				*!	
[ʕa.jəb.ṭiː]			*!		*

Tableau 5.24. Modified OT account of deletion in /ħakəm-iːn/

/ħakəm-iːn/	*WN	ONS	M-CONT	MAX-IO	DEP-IO
[ħa.kəm.iːn]		*!			
☞ [ħa.kə.miːn]	*!				
[ħak.miːn]				*!	
[ħa.kəb.m-iːn]			*!		*

After including M-CONT in the constraint hierarchy, it appears more logical that [ʕaj.ṭi:] and [ħak.miːn] are the eventual outputs of /ʕajəṭ-iː / and /ħakəm-iːn/ respectively. Unlike [ʕa.jəb.ṭi:], [ʕaj.ṭi:] satisfies [ʕaj.ṭi:]M-CONT even though it violates MAX-IO, but such a violation is necessary in order to satisfy M-CONT and the other higher ranked constraints. [ʕaj.ṭi:] also satisfies ONS by syllabifying /ṭ/ as onset to /ṭi:/. Unlike [ʕa/jəṭ./i:] in which /i:/ is onsetless. Furthermore, [ʕaj.ṭi:] satisfies *WN since the weak nucleus /ə/ which was part of an open syllable /jə/ is deleted in that candidate unlike [ʕa.jə.ṭi:] which violates *WN as it includes the weak nucleus /ə/ in the open unstressed syllable /jə/. The same analysis applies to [ħak.miːn].

The absence of deletion in cases as demonstrated below could also be explained through OT.

(24)

Input	Output	Gloss
ʕajət-lah	ʕajətlah	‘He called him’
jfarəʃ-lah	jfarəʃlah	‘He sets for him’
ʕawəd-lah	ʕawədlah	‘He repeated for him’
jzajər-lah	jzajərlah	‘He sets things strict’
jħaʃəm-hum	jħaʃəmhum	‘He embarrasses them’
tradʒəʕ-ha	tradʒəʕha	‘She will turn her’
tgawəd-ha	tgawədha	‘You take her by the hand’
tħawwəs-lah	tħawwəslah	‘She looks for something for him’
jdaxxəl-ha	jdaxxəlha	‘He make her enter’
nṭajəb-ha	nṭajəbha	‘I cook it’
jkaməl-hum	jkaməlhum	‘He finishes them’
ʕawən-ha	ʕawənha	‘He helped her’

The non-applicability of deletion in the former sample is due to the fact that the suffixes that are added, viz ‘-lah’, ‘-hum’ and ‘-ha’, start with a consonant. Hence, no syllable is onsetless in words like /ʕawəd-lah/ ‘he repeated for him’ which implies that the previous syllable /wəd/ has a coda and thus, /ə/ does not stand in an open syllable. The following tableau explains this point more closely:

Tableau 5.25. OT Account of the absence of deletion in /ʕawəd-lah/

/ʕawəd-lah/	*WN	ONS	M-CONT	MAX-IO	DEP-IO
☞ [ʕa.wəd.lah]		* !			
[ʕa.wə.dlah]	*!				
[ʕaw.dlah]				*!	
[ʕa.wəb.dlah]			*!		*

Tableau 5.25 demonstrates that deleting the vowel /ə/ is not necessary in /ʕawəd-lah/ since the syllable that is created by suffixation has an onset /l/ which satisfies ONS. Hence, the candidate [ʕa.wəd.lah] is optimal in this case because it does not violate ONS. In contrast, the candidate [ʕaw.dlah] unnecessarily violates MAX-IO as deleting /ə/ is not required in this since the following syllable /lah/ is onsetful and thus, it is not necessary to re-syllabify /d/of /wəd/ as onset for the following syllable. Furthermore, the candidate [ʕa.wəd.lah] is optimal since it satisfies *WN by including the closed syllable /wəd/ unlike the candidate [ʕa.wə.dlah] which violates *WN unnecessarily since the syllable /lah/ has an onset, and thus syllabifying /d/ as onset for that syllable is unnecessary and also results in the fatal violation of *WN since the syllable /wə/ becomes open. Finally, the candidate [ʕa.wəd.lah] is optimal as it satisfies M-CONT and DEP-

IO unlike the candidate [ʕa.wəb.dlah] which violates both of these constraints since it includes the inserted /b/ which interrupts the contiguity of the morpheme 'ʕawəd-' and is not present in the input /ʕawəd-lah/.

After having accounted for the first case of vowel deletion in MAR, let us now move to the second case of vowel deletion in MAR and attempt an OT account of that case.

The second case of vowel deletion in MAR involves the deletion of a vowel like /ə/ or /i/ or /a/ in case another vowel precedes it at word boundaries. Instances of that case include /ʕla: ismah/ → [ʕla: samh], /kima ana/ → [kima na], /kla: əl/ → [kla: l]. The sample that illustrates such a case of deletion is re-introduced below:

(25)

Input	**Output**	**Gloss**
ʕla: **i**smah	ʕla: smah	'Under his name'
mama **ə**l	mama l	'Mom, the…'
faṭima **ə**ddrari	faṭima ddrari	'Fatima, the kids'
kima **a**na	kima na	'Like me'
kla: **ə**l	kla: l	'He ate the'
ʃra: **ə**ddwa	ʃra: ddwa	'He bought the medicine'
ʕṭa **ə**l	ʕṭinaha l	'He gave'
radʒaʕu: **ə**l	radʒaʕu: l	'They put back the'
zi:du: **ə**ṭṭʕa:m	zi:du: ṭṭʕa:m	'Have more couscous'

Deletion as exemplified in the above sample is the outcome of the requirement of the markendess constraint *Hiatus which bans vowel sequences. Indeed, in /klaː **ə**l/, for instance /a/ builds up vowel hiatus together with /ə/ at word boundaries which goes against the requirements of *Hiatus. As a result, deleting /ə/ resolves the problem. Furthermore, the syllable /əl/ of the monosyllabic word /ə/ is onsetless which violates another markedness constraint, namely ONS. As a result, the constraints ONS and *Hiatus dominate MAX-IO in MAR as mentioned earlier. The following tableau accounts for deletion in /klaː **ə**l/ from an OT perspective:

Tableau 5.26. OT Account of deletion in /klaː əl/

/klaː **ə**l/	ONS	*Hiatus	MAX-IO	DEP-IO
[klaː əl]	* !	*!		
☞ [klaː l]			*	
? [klaː jəl]				*

Tableau 5.26 above demonstrates that another solution could be adopted in order to solve the vowel hiatus /i: ə/ and provide an onset for the onsetless /əl/. Such a solution is provided by inserting the glide /j/ in the candidate [kla: jəl]. The latter seems to be more optimal than [klaː l] as it satisfies the higher ranked MAX-IO while [klaː l] violates it. Yet, it is [klaː l] that surfaces the eventual output of /klaː **ə**l/. The reason for preferring deletion to epenthesis in this case is the markedness constraint *[+high] [-high] which considers /j/ insertion as necessary when a [+high] vowel like /i:/ is the first in the hiatus.

In the case of /klaː **ə**l/, the first vowel /a:/ in the hiatus is not [+high]. Thus, inserting /j/ would not satisfy *[+high] [-high] or else a modified version of that constraint which in that case is *[-high] j V, this constraint considers /j/ as marked after a [-high] vowel. The following tableau includes *[-high] j V in the hierarchy and explains why [klaː l]is the optimal candidate:

Tableau 5.27. OT Account of deletion in /klaː əl/ (modified descritption)

/klaː **ə**l/	ONS	*Hiatus	*[-high] j V	MAX-IO	DEP-IO
[klaː əl]	* !	*!			
☞ [klaː l]				*	
[klaː jəl]			*!		*

Tableau 5.26 determines why [klaː l] is the optimal candidate for /klaː **ə**l/ rather than [klaː jəl]. Indeed, [klaː jəl] violates the higher ranked *[-high] j V by including /j/ after a [-high] vowel /a:/. On the other hand, in [klaː l] such a violation is avoided by deleting /ə/ and solving the problem of vowel hiatus without inserting any offensive segment.

The absence of deletion in cases as demonstrated below can also be accounted for using OT framework. The following sample re-introduces instances of the absence of deletion in MAR:

(26)

Input	Output	Gloss
drapt əddrari	drapt əddrari	'I hit the kids'
ʃrapt əlma	ʃrapt əlma	'I drank water'
naʕraf ismah	naʕraf ismah	'I know his name'
smaʕt əl xbar	smaʕt əl xbar	'Why me?'
kliːt əl dʒaːdʒ	kliːt əl dʒaːdʒ	'I heard the news'
kriːt əl ħanuːt	kriːt əl ħanuːt	'You ate chicken'
ʃriːthum əssbaħ	ʃriːthum əssbaħ	'I rented a shop'
		'I bought them this morning'

The non-application of deletion in the above instances is due to the fact that no hiatus results at the boundary of words such as /drapt/ and /əddrari/ because the first word /drapt/ ends with a consonant unlike /klaː əl/ in the former case in which the first words ends with a vowel. Hence, no offense is committed with regard to the markedness constraints ONS and *Hiatus since the /t/ of /drapt/ syllabifies as the onset of the following syllable /əd/. Furthermore, no vowel hiatus is created by concatenating the words /drapt/ and / əddrari/. Thus, no need for deletion can be observed in this case and tableau 5.28 below explains why deletion is not optimal in /drapt əddrari/.

Tableau 5.28. OT Account of the absence of deletion in /drapt əddrariː/

/drapt əddrariː/	ONS	*Hiatus	*[-high] j V	MAX-IO	DEP-IO
☞ [drapt əddrariː]					
[drapt ddrariː]				*	
[drapt jəddrariː]			*!		*

Tableau 5.28 demonstrates that the optimal output for /drapt əddrariː/ is [drapt əddrariː] as it is the most harmonious with constraint hierarchy. Indeed, [drapt əddrariː] satisfies the higher ranked constraints ONS and *Hiatus since the consonant /t/ of the syllable /drapt/ syllabifies as the onset of the following /əd/. Hence, deleting the vowel /ə/ is not required as is the case in the candidate [drapt ddrariː] which commits an unnecessary violation of MAX-IO as no hiatus resuls at the boundary of the words /drapt/ and /əddrariː/, plus as mentioned earlier the consonant /t/ syllabifies as the onset of the syllable /əd/. Furthermore, inserting the glide /j/ before /əd/ is also not the optimal solution since such an insertion violates the higher ranked *[-high] j V and DEP-IO.

After having accounted for deletion in MAR from an OT perspective, it is now worth moving to the last type of non-assimilatory processes within this study, viz major class change and account for it within an OT framework. The subsequent section provides an OT account of major class change in MAR.

5.2.4. Major Class Change in MAR: An OT-based Account

Two cases of major class change exist in MAR as highlighted in chapter 4. The first case occurs when the suffixes '-u:' and '-i:' are added to verbs that end with the non-high vowels /a:/ and /a/. As a result, /u:/ and /i:/ are turned into the glides /w/ and /j/ respectively. Instances of such a case of major class change include /jəbda-uː/ and /ʔardʒa-i:/ which are respectively realized [jəbdaw] and [ʔardʒaj]. The sample illustrating this case of major class change in MAR is presented below.

(27)

Input	**Output**	**Gloss**
ħjaː-uː	ħjaːw	'They resurrected'
jətwadaː-uː	jətwadaːw	'They do ablution'
jəbdaː-uː	jəbdaːw	'They start'
jətʕaʃaː-uː	jətʕaʃaːw	'They have dinner'
tətlaqaː-uː	tətlaqaːw	'You (plural) meet'
dublaː-uː	dublaːw	'They did not pass'
klaː-uː	klaːw	'They ate'
təpqaː-iː	təpqaːj	'You (feminie) stay'
tənsaː-iː	tənsaːj	'You (feminine) forget'
ʔərdʒaː-iː	ʔərdʒaːj	'Wait (you feminine)'

This case of major class change occurs because of the requirement of the markedness constraint *Hiatus which bans vowel sequence. Indeed, after the suffixes '-u:' or '-i:' have been added to the verbs in sample 27 above, a vowel hiatus results including the verb's final vowels and together with the suffixes '-u:' or '-i:'. Such a hiatus violates the constraint *Hiatus and also ONS since the syllable that is created by '-u:' and 'i:' is onsetless. The solution in this case is to change the major class of the vowel /i:/ and /u:/ from vowels to the glides /j,w/. The fact that there is a change in major class from vowel to glide implies that the major class feature [syllabic] is changed from (+) to (-). Such a change results in the violation of the faithfulness constraint IDENT [syllabic] as the input specifivation of the feature [syllabic] for /u:/ or /i:/ changes in the output. Hence, ONS and *Hiatus dominate IDENT [syllabic]. The following tableau describes and explains major class change in /jəbdaː-uː/:

Tableau 5.29. OT Account of major class change in /jəbdaː-uː/

/jəbdaː-uː/	ONS	*Hiatus	IDENT [syllabic]
[jəb-daː-uː]	*!		
[jəb-daːuː]		*!	
☞ [jəb-daːw]			*

It appears from Tableau 5.29 that [jəb-daːw] is preferred to [jəb-daː-uː] since it satisfies the higher ranked ONS by including no onsetless syllable. Furthermore, [jəb-daːw] is more optimal than [jəb-daːuː] as it does not solve the offensive vowel sequence

/a: u:/. However, a question may be asked in this case regarding the candidates that GEN derives. Indeed, other possibilities for /jəbdaːuː/ exist, namely inserting the glides /w/ instead of turning /u:/ to [w] or deleting one of the vowels. As to inserting a glide, it is not possible in that case since for a glide to be inserted in MAR the first vowel in the hiatus must be [+high] and not the second as required by the markedness constraint *[+high] [-high]. Deletion is also not an option in this case since deleting one of the vowels in that case would affect the semantic aspect of the words since /a:/ and /u:/ both carry inflectional and derivational meanings. Thus, deleting either /a:/ or /u:/ would affect the meaning of the word as a whole. Indeed, /a:/ is a suffix that is used to derive a verb like /kla:/ from a noun, while /u:/ refers to plurality. Hence, the most suitable option in this case is major class change. The following tableau accounts for major class change in MAR including the anti-deletion and anti-insertion constraints MAX-IO and DEP-IO:

Tableau 5.30. OT Account of major class change in /jəbdaː-uː/ (modified account)

/jəbdaː-uː/	ONS	*Hiatus	*[+high] [-high]	MAX	DEP	IDENT [syllabic]
[jəb-daː-uː]	*!	*!				
☞ [jəb-daːw]						*
[jəb-daː-wuː]			*!		*	
[jəb-daː]				*!		
[jəb-duː]				*!		

As it appears from tableau 5.30, [jəb-daːw] is the optimal candidate as it satisfies DEP, unlike [jəb-daː-wuː] which violates it by including /w/ which in turn violates *[+high] [-high]. [jəb-duː] and [jəb-daː] are excluded as they violate MAX-IO in that case by missing either /a:/ or /u:/ unlike [jəb-daːw] which satisfies MAX-IO.

The absence of major class change in cases as demonstrated in the following sample can also be explained in terms of constraint interaction:

(29)

Input	**Output**	**Gloss**
takl-uː	takluː	'You eat, plural'
təlʕb-iː	təlʕbiː	'You play, feminine'
jəfaṭr-uː	jəfaṭruː	'They have lunch'
tbaːt-iː	tbaːtiː	'You stay overnight, feminine'
jmuːt-uː	jmuːtuː	'They die'
təssamʕ-iː	təssamʕi	'You hear, feminine'
tərgd-iː	tərgdiː	'You sleep, feminine'
tnuːm-iː	tnuːmiː	'You dream, feminine'

It appears from the above sample that the addition of the suffixes /i:/ or /u:/ to the verbs of the above sample does not result in an offensive form. Indeed, all verbs in sample 29 end with a consonant and thus no vowel hiatus is created by the addition of the suffixes /i:/ and /u:/. Furthermore, the syllables that are created by /i:/ and /u:/ suffixation are not onsetless since the final consonant of the stems syllabify as the onsets of these syllables. The following tableau explains why major class change is not necessary in the cases of sample 29:

Tableau 5.31. OT Account of the absence of major class change in /taːkl-uː/ (modified account)

/takl-uː/	ONS	*Hiatus	*[+high] [-high]	MAX	DEP	IDENT [syllabic]
☞ [tak-luː]						
[taklw]						*
[takl-wuː]			*!		*	
[takl]				*!		

Tableau 5.31 demonstrates that the optimal candidate in this case is [tak-luː] since it does not commit any violation of the constraints, unlike the candidate [taklw] which violates IDENT [syllabic] unnecessarily since the consonant /l/ syllabifies as the onset of the syllable /u:/, plus no hiatus results from the suffixation of /u:/ since the stem /takl/ does not end with a vowel as /jəbdaː-uː/ above. The candidate [takl-wuː] is excluded as well since it violates the higher ranked

*[+high] [-high] unnecessarily since the sequence /lu:/ is not an offensive sequence in MAR as vowel hiatus is created in this case and thus it is not necessary to insert /w/ between /l/ and /u:/. Finally, the candidate [takl] is elimninated by EVAL since it violates MAX unnecessarily.

After having accounted for the first case of major class change in MAR, let us now turn to the second case in which a glide turns to a vowel. The second case of major class change in MAR occurs, as mentioned earlier in chapter 4, when the glide /w/ which stands for the conjunction ‘and’ in MAR turns to /u/ when connecting words that end and start by consonants. Instances of this case of major class change include /ʃkiːt w gaːluːliː/ ‘I colplained and they told me’ in which /w/ is preceded by a verb that ends with the consonant /t/ and is followed by another verb that starts with a consonant, viz /g/. Instances of this case of major class change in MAR are re-introduced in the following sample:

(30)

Input	**Output**	**Gloss**
ʃkiːt w gaːluːliː	ʃkiːt **u** gaːluːliː	‘I complained and they told me’
gaːl w hija	gaːl **u** hija	‘He said and she’
ʃajṭoːh w bahadloːh	ʃajṭoːh **u** bahadloːh	‘They humiliated him’
klaːt w raːħət	klaːt **u** raːħət	‘She ate and left’
xallast w xraʃt	xallast **u** xraʃt	‘I paid and left’
saːkət w hamuː	saːkət **u** hamuː	‘He is a fake calm’
ktaːb w kaji	ktaːb **u** kaji	‘A book and copybook’
ṭabbakt w daxxalt	ṭabbakt **u** daxxalt	‘Folded the clothes and put them in the closet’

The reason for the change of /w/ to /u/ in the above instances seems to be the outcome of a markedness constraint that considers the sequence CWC as an offensive sequence in MAR. As mentioned earlier in the case of vowel epenthesis, *CCC disallows three consonants to appear in a sequence which is the case of /twg/ in /ʃkiːt w gaːluːliː/. However, *CCC disallows three consonants to occur in a sequence as part of the same onset as in /t-drab/. Yet, in the case of /ʃkiːt w gaːluːliː/, /t/ is coda to the first syllable /ʃkiːt/, while /wg/ is a complex onset of the following syllable /ga:/. Hence, *CCC is not the required constraint in that case. The problem seems to be in the sequence /wg/ more than /twg/. Indeed, syllabifying /w/ as coda with /t/ in /ʃkiːt/ is not an option since no complex codas are allowed in MAR except codas that consist of geminates as in /faʃʃ/ 'he deflated'. Hence, the sequence /wg/ seems to be offensive in MAR.

In general, the sequence /wC/ in the sample seems to be offensive in MAR. The reason lies in the sonority principle for onsets which requires onsets to rise in sonority towards the nucleus. Indeed, the instances within the sample (30) include /w/ followed by consonants that are less sonorant than /w/ which is unavoidable since glides are the most sonorous sounds after vowels (Eddington 2001:40, Alber and Plag 1999:16). Hence, the onset /wg/ violates the markedness constraint SONORITY which requires "the most sonorous elements must be the closest to the nucleus" (Eddington 2001, p.42). In order to satisfy SONORITY, /w/ changes to /u/ builds up a syllable with preceding /t/, yielding the syllabification /ʃkiː-tu- gaː-luː-liː/. Major class change obviously results in the violation of the faithfulness constraint ID [syllabic] as input /u/ changes its specification for the feature syllabic from (-) to (+) in the output.

One may wonder why major class change and not another non-assimilatory process is the best option in this case. Let ius start by considering metathesis, for example, and try to explain why it is not an option in this case. Indeed, since the problem with /wg/ is that it violates SONORITY, the sequence could be inverted and /w/ would be the closest to the nucleus and thus the problem would be solved. However, metathesis of /w/ and /g/ would result in the violation of M-CONT in this case since /w/ and /ga:lu:li:/ are different morpheme and inverting /w/ with /g/ would introduce a foreign consonant to the morpheme /ga:lu:li:/, namely /w/, yielding [gwa:lu:li:].

Another option is to insert a vowel like /ə/ to break such an offensive onset. However, if /ə/ is inserted, it would build up a new syllable with /w/, viz /wə/ which is an open unstressed syllable which violates *WN. Indeed, /ə/ is a weak vowel that occurs in an open unstressed syllable which goes against the requirements of *Weak nucleus as mentioned earlier in this chapter.

Deletion is still another option to this case in MAR as one of the consonants in the offensive onset /wg/ could be deleted and the problem would be solved. Yet, deleting would violate MAX-IO which dominates ID [syll], and thus its violation is more serious than that of ID [syll]. Plus, deleting /w/ or /g/ would affect the semantic aspect of the whole phrase /ʃkiːt w ɡaːluːliː/.

Hence, major class change is the best option in that case. The following tableau accounts for major class change in /ʃkiːt w ɡaːluːliː/:

Tableau 5.32. OT account of major class change in /ʃkiːt w gaːluːliː/

/ʃkiːt w gaːluːliː/	SON	*COMPlEX Coda	*WN	M-CONT	MAX	DEP	IDENT [syllabic]
[ʃkiː.t.wgaː.luː.liː]	*!						
[ʃkiːtw.gaː.luː.liː]		*!				*	
[ʃkiːt.gwaː.luː.liː]				*!	*!		
[ʃkiːt. wə gaː.luː.liː]			*!			*	
[ʃkiːt.gaː.luː.liː]					*!		
[ʃkiːt.waː.luː.liː]					*!		
☞ ʃkiːtu.gaː.luː.liː]							*

It appears that [ʃkiːtu.gaː.luː.liː] is the optimal candidate as it satisfies the higher ranked constraint SON as it solves the offensive onset /wg/ by changing it to the vowel /u/ and syllabifying it as nucleus in the syllable [tuː]. [ʃkiːtu.gaː.luː.liː] also satisfies each of *complex coda, *WN as it includes no weak nucleus in an open syllable. Furthermore, [ʃkiːtu.gaː.luː.liː] also satisfies M-CONT as it includes no foreign segment in any of its morphemes. The optimal [ʃkiːtu.gaː.luː.liː] also satisfies MAX-IO and DEP-IO as all input segments have correspondents in the output and vice versa. Finally, [ʃkiːtu.gaː.luː.liː] violates the lower ranked ID [syll], yet such a violation is necessary as it allows satisfying the higher ranked SON. Plus, violating ID [syll] is less costly than violating MAX and DEP as theses constraints dominate ID [syll].

The absence of major class change in cases as demonstrated in the following sample can also be explained from an OT perspective:

(31)

Input	**Output**	**Gloss**
roːħiː w kuːliː	roːħiː **w** kuːliː	'Go and eat'
suktiː w qraj	suktiː **w** qraj	'Keep quiet and study'
raħuː w dʒa	raħuː **w** dʒa	'They left and came back'
ʃkaː w pkaː	ʃkaː **w** pkaː	'He complained and he cried'
kraː w baːʕ	kraː **w** baːʕ	'He rented and sold'
ʃarbiː w guːliliː	ʃarbiː **w** guːliliː	'Drink and tell me'
hadruː w kamluː	hadruː **w** kamluː	'They are done talking'
balʕuː w xatruː	balʕuː **w** xatruː	'They closed the house and travelled'

It appears from the above sample that major class change does not occur in case w is flapped by a vowel and a consonant. Indeed, in /roːħiː w kuːliː/ the conjunction /w/ is preceded by the vowel /iː/ and followed by the consonant /k/ and thus no offensive cluster of the sort /CwC/ is encountered in this case. The following Tableau explains the absence of major class change in cases like /roːħiː w kuːliː/:

Tableau 5.33. OT account of the absence of major class change in /roːħiː w kuːliː/:

/roːħiː w kuːliː/	SON	*COMPlEX Coda	*WN	M-CONT	MAX	DEP	IDENT [syllabic]
☞ [roː.ħiːw.kuː.liː]							
[roː.ħiː u kuː.liː]							*
[roː.ħiː wuː.liː]					*!		
[roː.ħu. kuː.liː]					*!		
[roː.ħiː wə kuː.liː]			* !			*	
[roː.ħiː kwuː.liː]				*!			

As indicated in tableau 5.33, the candidate [roː.ħiːw.kuː.liː] is the optimal candidate since it is the most harmonious with constraint hierarchy by satisfying all constraints even the lower ranked ones. Indeed, unlike the candidate [roːħiː u kuːliː] which violates IDENT [syllabic] unnecessarily, the optimal [roː.ħiːw.kuː.liː] satisfies it since there is no need for major class change in this case as /w/ syllabifies as the coda of the syllable /ħiː/. Thus, no offensive cluster occurs as coda or onset in this instance as it was the case for /ʃkiːt w gaːluːliː/. The candidates [roːħiː wuːliː] and [roː.ħu. kuː.liː] are excluded as well since they unnecessarily violate MAX-IO as in this case the sequence /wk/ is solved by syllabifying /w/ as coda of the syllable /ħiː/. Besides, [roː.ħiːw.kuː.liː] is optimal since it satisfies all of M-CONT and DEP-IO, unlike the candidates [roː.ħiː kwuː.liː] and [roː.ħiː wə kuː.liː] which respectively violate M-CONT and DEP-IO. Indeed, the candidate [roː.ħiː kwuː.liː] involves a metathesis of /w/ and /k/ which is pointless in this case since, as aforementioned, /w/ syllabifies as the coda of the syllable /ħiː/ and thus no offensive cluster occurs as onset in this case. Furthermore, the epenthesis of /ə/ in this case is also needless since the cluster /wk/ is solved by syllabification of /w/ as coda of the syllable /ħiː/.

Obviously, OT-based account succeeded in providing a satisfactory description and explanation of both assimilatory and non-assimilatory processes that were identified in the study. Indeed, OT account of processes in MAR not only explained why such processes take place, but also succeeded in explaining why a given process and not another occur in a given cas

General Conclusion

As indicated at the beginning of this study, the aim of the present study is to validate the hypothesis that OT provides an exhaustive and explanatory account of MAR's phonological processes. Whether such an account is more reliable than a rule-based account is to be discovered in the subsequent summary of findings. This summary is designed in a comparative manner exposing the findings of both the rule-based and OT accounts in order to prove or disprove the aforementioned hypothesis. We shall start with assimilatory processes, we will, then, move to non-assimilatory ones.

1. Assimilatory Processes (Rule-based vs. OT Accounts)

The first type of assimilation that was tackled in the study at hand was voice assimilation. T wo cases of voice assimilation were observed in the data of the study, namely the case of prefix 't-' assimilation and root obstruents assimilation.

The first case of prefix 't-' voice assimilation was exemplified in forms like /t-do:r/ which is realized as [ddo:r]. The rule-based account of this case of voice assimilation included a distinctive features approach as the distinctive features of the target /t/ as well as those of the conditioning segments were listed. Then, a rule describing and explaining the process was provided and it included the distinctive features listed before in the discussion of the process. In retrospect, OT account involved the identification of the consonant set involved in this case of prefix 't-' assimilation. Then, a hierarchy of such constraints was established and combined with the candidates generated by GEN for the input /t-do:r/ in a tableau which displayed the selection of the optimal candidate by EVAL based on constraint violation and satisfaction. As far as 't-' voice assimilation is concerned, both rule-based and OT accounts seem to have provided satisfactory descriptions and explanations. OT account, nevertheless, remains more explanatory as it not only explains why assimilation occurs, but also why /t/ assimilates and not the adjacent obstruent /d/.

The second case of voice assimilation, root-obstruent voice assimilation, was illustrated by forms like /ħsab-t/ which is realized as [ħsapt]. Rule-based account of such a case of voice assimilation was accomplished through the listing of the distinctive features of root obstruent /b/ together with those of suffix ‘t-’. Then, a rule including those distinctive features described and explained such a process. As to OT account, the constraints relating to this case of voice assimilation were established in a hierarchy, then a tableau described and explained why [ħsapt] is the optimal output of /ħsab-t/. Even though rule-based account of this case of voice assimilation was more explanatory and exhaustive as it explained the reason behind voice assimilation and the reason behind the regressive direction of such an assimilation.

Place assimilation is the second type of assimilation that has been analyzed in the study at hand. Instances like /mən baːlək/ which is realized as [məm baːlək] were object to the rule-based and OT account in this study. Rule-based account identified the distinctive features of target /n/ as well as those of conditioning segments. Then, a phonological rule accounted for such a type of assimilation. In contrast, OT account of place assimilation in cases like /mən baːlək/ involved the setting of the constraint set relevant to this process and the description and explanation of such a process in a tableau. Obviously, OT account was more inclusive and detailed than the rule-based account of place assimilation in MAR since OT not only explained why assimilation takes place, but also why /n/ and not /b/ is the segment that assimilates.

Total assimilation was still another type of assimilation that was tackled in the present study. Instances like /əl-zwa:q/ which is realized as [əz-zwa:q] were provided to exemplify such a process. Rule-based approach to total assimilation was based on distinctive feature formulation so that target /l/ and following conditioning consonants share the place feature coronal but differ in manner or voice and manner. OT account, on the other hand, relied on constraint interaction to describe and explain total assimilation which made of it more detailed and convincing than its rule-based counterpart. Indeed, unlike rule-based account which only explained why assiliation takes place in MAR, OT explained why /l/ and not the adjacent coronals assimilate.

2. Non-assimilatory Processes (Rule-based vs. OT Accounts)

A number of non-assimilatory processes have been identified in the present study for MAR, viz epenthesis, deletion, metathesis, major class change. The accounts provided by rule-based approach and by OT were differently. We shall explore such a difference below.

2.1. Metathesis

Metathesis was observed in forms like /dxal-at/ which is realized as [daxlat]. Rule-based account of metathesis was short of any explanations since no conditioning environment seemed to be available. However, OT explained such a process through the requirements of the higher-ranked markedness constraints ‘stem syllable, and ‘heavy syllable which are both based on syllable structure and requires stress to fall on a heavy stem syllable.

2.2. Epenthesis

Two cases of epenthesis were identified for MAR, namely vowel epenthesis and glide insertion. Vowel epenthesis was exemplified by forms like /jglaʕ/ which is realized as [jəglaʕ]**.** Rule-based account of this case of epenthesis was established in the form of a rule which generally attributed epenthesis to the fact that three consonants occur in a sequence at the beginning of the word, did not explain why such epenthesis is necessary and why in this position it is offensive to have three consonants in a row. OT, however, succeeded in explaining thoroughly why word initial position is disallowed for three consonants. Such an account was based on syllable structure constraints and was more detailed than the rule-based account which was vague and general as it was devoid of reference to syllable structure.

The second case of epenthesis which is glide insertion was exemplified by forms like /jəʃri:li: ana/ which is realized as [jəʃri:li: jana]. Rule-based account of such a process was formulated in a rule that attributed /j/ insertion to its intervocalic occurrence without any further analysis. However, OT account of glide insertion was more explanatory as it attributed such an insertion to the constraints ONS and *Hiatus which are based on syllable structure.

2.3. Deletion

Deletion also displays two cases of vowel deletion. The first case of vowel deletion involves /ə/ deletion in forms like /ʕajt-i:/ which is realized as [ʕaj.ti:]. Rule-based account of such a case of vowel deletion was not satisfactory as it was short of providing any conditioning environment or explanation for /ə/ deletion. However, OT succeeded in explaining /ə/ deletion in MAR by attributing it to the requirement of the markedness syllable-structure constraint *WN which considers weak nuclei as disallowed in open syllables.

The second case of vowel deletion involves forms like /kla: əl/ which is realized as [kla:l]. The rule-based account of this case of vowel deletion was again not quite successful as it only attributed its occurrence to the preceding V in the form of a rule. In contrast, OT account succeeded in exploring such a process relying on the syllable structure constraints ONS and *Hiatus.

2.4. Major Class Change

Major class change was another non-assimilatory process that was analyzed in the present study. Two cases of major class change were introduced in this study, viz vowel to glide change and glide to vowel change. Vowel to glide change was exemplified by forms like /jəbda:-u:/ which is realized as [jəbda:w]. Rule-based account of this case of major class change was based on the feature [syllabic] which is turned from (+) to (-) in the explanation provided by rule-based approach was incomplete and broad only attributing the process to the preceding V in the target /u:/'s vicinity. OT account, on the other hand, was more plausible as it provided as explanation for the process the requirements of the markedness constraints, ONS and *Hiatus which are based on syllable structure.

The second case of major class change was illustrated by forms like /ʃk:t w ga:lu:li:/ which is realized as [ʃki:t u ga:lu:li:]. Rule-based account of this case of major class change was not detailed or explanatory enough as it attributed the change [-syllabic] to [+syllabic] to the fact that the glide /w/ is flapped by C____C. OT account, nevertheless, was more explicit and exhaustive as it was based on the requirements of the markedness constraints SON and * Complex coda which respectively require onsets to rise in sonority towards the nucleus, which bans the syllabification /wg/, and prohibit complex codas, which excludes the syllabification /tw/.

It is obvious from the former comparative summary that an OT-based account is more exhaustive and explanatory than a rule-based account. Such deduction validates the hypothesis that was set at the beginning of the study. Indeed, a number of reasons may be attributed to the adequacy of OT over rule-based phonology in accounting for MAR's phonological processes. One such a reason is the elaborate and sophisticated nature of OT's machinery and theorizing. Another reason is the neglecting of syllable structure in rule-based phonology which is crucial in accounting for non-assimilatory processes.

3. Limitations of the Study

In spite of the researcher's attempt to be exhaustive and to cover all aspects and points that relate to an OT account and a rule-based account of MAR's phonological processes, this work remains, nevertheless, a modest attempt to reduce some of the mystery that surrounds the phonology of MAR. Thus, further works are of necessity in order to add to the findings of the present study.

4. Suggestions and Recommendations

No work is exhaustive and this study does not make an exception as a number of points still need to be covered in future research. Indeed, MAR certainly possesses some phonological processes other than the ones that have been identified in the present study. Moreover, an OT account of suprasegmental features such as stress, rhythm and intonation would be another addition to the identification of MAR's phonology as such research would reveal more about syllable structure constraints and would shed more light on the prosody of MAR. Comparative studies applying OT and other approaches of generative phonology such autosegmental phonology would also help discover the strengths and weaknesses of OT. Furthermore, applying OT to account for phonological processes in other Algerian dialects would reveal more about the phonology of Algerian Arabic. Finally, OT could be used to account for other linguistic angles of Algerian Arabic such as its sociolinguistic variations.

Obviously, the approaches of generative phonology proved to be useful in accounting for MAR's phonological processes. Indeed, in spite of the more exhaustive and explanatory account that OT yielded, rule-based phonology remains, nevertheless, an important approach which paved the ground for the emergence of more sophisticated approaches within the generative tradition. Hence, OT and rule-based phonology are in a complementary relationship rather than a contrastive one so that when one fails to provide an explanation, the one is applied.

References

Aba-Alkh, F. (2007), Optimality theory and the analysis of syllable structure and related complexities in Taifi Arabic. Retrieved November 27th, 2014, from http://www.faculty.ksu.sa.

Abu-Abbas, K., Zuraiq, W. & Abdel-Ghafer, O. (2011), Geminates and Long Consonants in Jordanian Arabic.*International Journal of Linguistics 3*, 1-17.

Alber, B. & Plage, I. (1999), Epenthesis, deletion, and the emergence of the optimal syllable in Creole. *Lingua 111*, 811-840.

Alfozan, I. (1989). *Assimilation in Classical Arabic: A phonological study*. Unpublished PhD dissertation. University of Glasgow, Glasgow, Scotland.

Al-Harbi, A. (2005). English voicing assimilation: Input-to-output [±Voice] and output-to-input [±Voice]. Retrieved December 4th, 2014, from http:// www.roa.rutgers.edu/files/723-0305/723-AL-Hamadi-Al-Harbi 0-0 PDF.

Aljumah, A. (2008), The Syllable Shape of Al-Ahsa Dialect: An OT Perspective. *Poznań Studies in Contemporary Linguistics 44*, 155-177.

Al-Omar, M. (2009), Pharygealization in Syrian Arabic. Retrieved Jun 21st, 2015, from http://www.essex.ac.uk/linguistics/department/events/langue/2008/proceedings/pdfs/Al-Omar%20Morris-LangUE2008.pdf.

Bakovic, E. (2006), Local assimilation and constraint interaction. Retrieved December 4th, 2014 from http://www.idiom.ucsd.edu/˜bakovic/work/bakovic-local-assim.pdf.

Bacovic, E. (2011). Opacity and Ordering. In J. Riggle & A. Yu. *The Handbook of Phonological Theory* (pp. 40-67). Malden: Wiley-Blackwell.

Belhamissi, M. (1982). *Histoire de Mostaganem* (History of Mostaganem). Algiers: SNED.

Bloch, B. (1941). Phonemic overlapping. *American Speech 16*, 278-84.

Borrowsky, T. (2000). Word-faithfulness and the direction of assimilation. *The Linguistic Review 17*, 1-30.

Btoosh, M. (2006), Constraint Phonotactics: An Optimality Theoretic Approach. *Journal of Language and Linguistics 5*, 192-221.

Chachou, I. (2009). Remarques sur le Parler Urbain de Mostganem (Remarks on the Urban Spoken Dialect of Mostaganem). *Sinergies 4*, 69-81.

Chomsky, N. (1965). *Aspects of the Theory of Syntax*. Cambridge: MIT.

Chomsky, N. (1966). *Topics in the Theory of Generative Grammar*. Malden: Mouton.

Chomsky, N. & Halle, M. (1968). *The Sound Pattern of English*. New York: Harper and Row.

Clark, J., Yallop, C. & Fletcher, J. (2007). *An Introduction to Phonetics and Phonology.* Malden: Blackwell Publishing.

Clayton, M. (1979). Topics in phonological theory by Michael Kenstowicz and Charles Kisseberth. *Language* 55, 408-413.

Cruttenden A. (Ed). (2001). *Gimson's Pronunciation of English*. London: Arnold.

Dvorak, V. (2010), Voicing assimilation in Czech. *Rutgers Working Papers in Linguistics 3*, 115-144.

Eddington, D. (2001), Spanish Epenthesis: Formal and Performance Perspectives. *Studies in Linguistics Sciences 31*, 33-54.

Elramli, Y. (2012). Phonological assimilation of the prefix /t-/ in Misrata Lybian Arabic. *Newcastle Working Papers in Linguistics* 18, 38-51.

Fanslow, G, and Féry,C. (2002). Ineffability in Grammar. In Gisbert Fanslow and Caroline Féry (eds), *Resolving Conflicts in Grammars: Optimality Theory in Syntax, Morphology and Phonology* (pp.265-300). Germany: Helmut Buske Verlag.

Féry, C. and De Vijver R. (2003). *The Syllable in Optimality Theory*. Cambridge: Cambridge University Press.

Flynn, D. (2012). *Phonology: The Distinctive Features of Speech Sounds*. Calgary: University of Calgary.

Gala, M. (2004), An OT Approach to Loanwords Adaptation in Cairene Arabic. Kansas Papers in Linguistics *27*, 1-20.

Ghadoua, A. (2000). Consonant clusters in Quranic Arabic. Retrieved December 4th, 2014 from http://clo.canadatogu.com/28/Ghadoua (2000) CL028-61-85.pdf.

Grijzenhout, J. (2000), Voicing and devoicing in English, German and Dutch; evidence for domain-specific identity constraints.*SFB Working Paper 282*, 116, 1-22.

Grijzenhout, J. & Kramer, M. (2000), Final devoicing and voicing assimilation in Dutch derivation and cliticization. Retrieved December 4th, 2014 from http://www.hum.uit.no/a/ Kramer/lif-grijzenh.pdf.

Gonzalez, C. (2008), Assimilation and Dissimilation of Syllable Final /k/ in North-Central Spanish, Selected Proceedings of the 10th Hispanic Linguistics Symposium. *Cascadilla Project10*, Somerville, Massachusetts 19-22 October, 2006, 170-183.

Guerrero, J. (2015). Preliminary Notes on the current Arabic dialect of Oran. Retrieved on October 28th, 2015 from http://araba.lls.unibuc.ro/wp-content/uploads/2014/12/RoAr15-1.pdf

Hall, T. (2011), Vowel Prosthesis in Walsier German. *Linguistics* 49, 945-976.

Hamerlain, S. (2001), A Linguistic Analysis of MAR: A Spoken Dialect of Arabic. Unpublished BA project. University of Mostaganem, Mostaganem.

Jaber, A. (2001), Syllable Structure in Jordanian Arabic as spoken in Irbid. Unpublished MA thesis. Yarmouk University, Irbid.

Jakobson, R. (1962). *Selected Writings 1: Phonological Studies*. The Hague: Mouton.

Kabrah, R. (2011), Regressive voicing assimilation in Cairene Arabic. *Perspectives on Arabic Linguistics: Papers from Annual symposia on Arabic Linguistics* 25, 21-33.

Kager, R. (1999). *Optimality Theory*. Cambridge: Cambridge University Press,.

Kahn, D. (1968). Syllable-based generalizations in English phonology. Unpublished PhD thesis. MIT, Cambridge. USA.

Kang, S. (1996), An optimality theoretic account of nasal assimilation in English. *Language, Information and Computation*, 11, 479-488.

Katamba, F. (1989). *An Introduction to Phonology*. New York: Longman Inc.

Kenstowicz, M. & Kisseberth, C. (1977). *Topics in Phonological Theory*. New York: Academic Press.

Kenstowicz, M. & Kisseberth, C. (1979). *Generative Phonology: Theory and Description*. New York. Acad Press.

Kikuchi, S. (2004). Relativized contiguity and word-final deletion in Catalan.Retrieved December 4th, 2014 from http://www.sal.tohoku.ac.jp/~S-kiku/papers/PF20040901.pdf.

Kisseberth, C. (1970). On the Unity of Phonological Functional Rules. *Linguistic Inquiry* 1(3), 291-306.

Kisseberth, C. (1970). On the Unity of Phonological Functional Rules. *Linguistic Inquiry 1(3)*, 291-306.

Ladefoged, P. & Johnson, K. (2011). *A Course in Phonetic*. Wadsworth: Cengage Learning.

Lee, J. (2001), The systematic patterning of epenthetic vowels with special reference to English loanwords in Korean. *Essex Graduate Student Papers in Language and Linguistics 4*, 1-27.

Lema, J. (1978). An examination of vowel epenthesis in Spanish. Unpublished MA thesis. Simon Fraser University, Bumaby, Canada.

Lombardi, L. (1995), Restrictions on directions of voicing assimilation an OT account. Retrieved December 4th, 2014 from http://www.roa.rutgers.edu/files/246-0298/roa-246-lombardi-2-ps.

Lombardi, L. (1999), Positional faithfulness and voicing assimilation in optimality theory. *Natural Language and Linguistics Theory*, 17, 267-302.

Louriz, N. (2004), Repair strategies in loanword phonology. *Essex Graduate Student Papers in Language and Linguistics* 6, 1-15.

Masacro, J. (2007), External allomorphy and lexical representation. *Linguistic Inquiry 38*, 715-735.

McCarthy, J. (1979), *Formal problems in Semitic phonology and morphology*. Doctoral dissertation. Massachusetts Institute of Technology, Cambridge.

McCarthy, J. and Prince, A. (1995), Faithfulness and reduplicative identity. In Jill Beckman, Laura Walsh Dickey and Suzane Urbanczyk (Eds), *Papers in Optimality Theory*. (pp. 249-384), Amherst: GLSA Publications.

McCarthy, J. & Smith, N. (2003). *Phonological Processes: Assimilation*. Amherst: Linguistics Department Faculty Publication Series.

Miwita, L. (2009), The adaptation of Swahili loanwords froMARabic: A constraint-based analysis. *Journal of Pan African Studies*, 2, 46-61.

Mustafawi, E. (2006), *An optimality theoretic approach to variable consonantal alternations in Qatari Arabic.* Unpublished PhD thesis. University of Ottawa, Ottawa.

Myers, S. (1991), Persistent Rules. *Linguistic Inquiry*, 22, 315-344.

Nevins, A. and Chitoran, I. (2008), Phonological Representations and the Variable Patterning of Glides. *Lingua*, 118, 1979-1997.

Ohala, J. (1990), The Phonetics and Phonology of aspects of assimilation. In John Kingston and Mary Beckman (Eds), *Papers in Laboratory Phonology I: Between the Grammar and Physics of Speech* (pp. 258-275), Cambridge: Cmbridge University Press.

Paradis, C. (1988), On Constraints and Repair Strategies. *Linguistic Review*, 6, 71-97.

Petrova, O., Plapp, R., Ringen, C. and Szentgyorgyi, S. (2006), Voice and aspiration: Evidence from Russian, Hugarian, German, Swedish and Turkish. *Linguistic Review*, 23, 1-35.

Prince, A. & Smolensky, P. (1993). *Optimality Theory: Constraint Interaction in Generative Grammar*. New Brunswick, Rutgers University Center for Cognitive Science Technical Report 2.

Prince, A. & Smolensky, P. (1997). Otimality theory: From neural networks to universal grammar. *Science 275*, 1604-1610.

Prince, A. & Smolensky, P. (2002). OT in Phonology. Retrieved from April 5th, 2015, from http//:ruccs.rutgers.edu/~Prince/grammar/oiel.PDF.P2.

Prince, A. & Smolensky, P (2004), *Optimality Theory*. Retrieved March 3rd, 2015, from http://www.roa.rutgers.edu/files/537-0802-PRINCE-0-0.PDF.

Schane, S. (1973). *Generative Phonology*. Englewood Cliffs: Prentice Hall Inc.

Sobkowiak, W. (1985). On some n-final prefixes, boundaries and nasal assimilation. *Studia Anglica Posnaniensia* 3, 81-99.

Spencer, A. (1996). *Phonology: Theory and Description*. Massachusetts: Blackwell Publishers Ltd.

Steriade, D. (1995), *Positional Neutralization*. Los Angeles. University of California.

Sutomo, J. (2012). English phonological processes: a study of generative phonology theory. *Dinamika Bahasa Dan Budaya* 7(2), 1- 12.

Uffmann, Christian (2007), Intrusive [r] and Optimal Epenthetic Consonants. *Language Sciences* 29, 451-476.

Younes, M. (1994). On emphasis and /r/ IN Arabic. In: M. Eid, V. Cantarino and Keith W. (Eds), *Perspectives on Arabic Linguistics VI* (pp. 215-235). Amsterdam: Benjamin Publishing Company.

Zahrani, A. (1995). Vowel epenthesis in Malay. *Akademika* 47, 15-36.