

Phonological Variation in Mostaganem Arabic: Insights from Optimality Theory**Farida Ouali ; Yacine Moulai Hacene**¹University of Abdelhamid Ibn Badis ,Mostaganem (Algeria), Farida.ouali@univ-mosta.dz²University of Ibn Khaldoun ,Tiaret (Algeria), Yacine.moulaiyacene@univ-tiaret.dz**Summary:**

The study examines phonological processes within Mostaganem Spoken Arabic (MTG) through the framework of Optimality Theory (OT). It investigates the mechanisms influencing phonological modifications in the dialect and evaluates how OT principles account for these patterns. A qualitative approach is employed, relying on recorded speech samples from one hundred native speakers of MTG. The methodology involves analyzing the interaction between markedness and faithfulness constraints in shaping phonological outputs. The findings reveal that place assimilation is the dominant phonological process in MTG, alongside epenthesis, syncope, and major class change. Place assimilation primarily affects the nasal /n/, which adopts the place features of adjacent labial consonants, ensuring phonetic cohesion. The study highlights the significance of these phonological modifications in maintaining natural speech flow and articulatory ease. By applying OT to MTG, this research contributes to a deeper understanding of phonological variation in Algerian Arabic and provides insights into the universality of phonological constraints across languages.

Keywords: Optimality Theory, phonological processes, markedness constraints, faithfulness constraints, epenthesis, Mostaganem

1. INTRODUCTION

Phonological processes play a crucial role in shaping the linguistic structure of spoken varieties of Arabic, including Mostaganem Spoken Arabic (MTG), a dialect spoken in northwestern Algeria. Despite the significant linguistic diversity among Algerian Arabic dialects, MTG has remained largely under-researched, with only a limited number of studies addressing its phonological aspects. The present study aims to fill this research gap by

identifying, classifying, and analyzing the phonological processes occurring in MTG within the framework of Optimality Theory (OT).

Optimality Theory provides a comprehensive approach to examining the dynamics of phonological processes. This research explores how these processes are shaped by the interaction of phonological constraints. In pursuit of this goal, the study aims to answer the following research question:

- How does an occupational therapy-based analysis elucidate the preference for certain phonological processes over others in multi-tasking groups (MTG)?

By addressing these questions, this research aims to determine whether Optimality Theory (OT) effectively accounts for these phonological changes and whether its analytical tools can demonstrate why certain processes occur in preference to others. The findings of this study are anticipated to enhance the broader understanding of phonological variation in Algerian Arabic and provide insights into the universality of phonological constraints across languages.

2. THEORETICAL FOUNDATION ON OPTIMALITY THEORY

Optimality Theory (OT), a model developed by Prince and Smolensky (1993) and refined by McCarthy and Prince (1995), has significantly shaped phonological analysis. OT postulates that phonological structures arise from the interaction of constraints rather than rule-based processes. Constraints in OT are categorized into two main types: markedness constraints, which govern the structural coherence of phonological outputs is governed by markedness constraints, while faithfulness constraints preserve the essential features of input forms in their corresponding outputs. The interplay between markedness and faithfulness constraints governs the realization of various phonological processes, such as epenthesis, deletion, and assimilation. Markedness constraints, in particular, regulate the well-formedness of phonological structures within a language, determining which patterns are preferred or avoided. This study applies OT principles directly to MTG phonological data, investigating the interaction of markedness and faithfulness constraints.

Markedness constraints are characterized as "conditions on the well-formedness of the output" (Prince & Smolensky, 2004, p. 4), while faithfulness constraints are defined as "conditions asking for the exact preservation of the input in the output" (Prince & Smolensky, 2004, p. 4). Optimality Theory accounts for phonological processes such as epenthesis, syncope, and assimilation by analysing the interaction between markedness and faithfulness constraints. The subsequent sections will explore the structural framework of OT grammar and present a detailed examination of its fundamental principles.

2.1 Optimality Theory Architecture

A marked form requires greater effort in production and perception, which contrasts with the principle of least effort. This principle reflects the human tendency toward articulation and perception that requires the least effort. An

unmarked form, on the other hand, promotes ease of articulation and perception.

Faithfulness constraints ensure that the phonological contrast in input forms is maintained in output forms. For instance, phonological contrast may involve differences in voice features, ensuring that an underlyingly voiced sound retains its voicing in the surface representation. Maintaining contrast in the phonological structure of lexical items is essential, as it preserves semantic distinctions. Faithfulness constraints, therefore, ensure that differences in meaning are reflected in phonological contrast (Kager, 1999, p. 10).

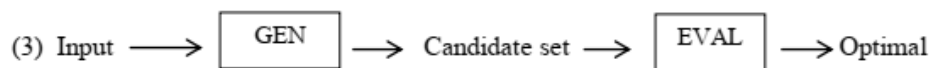
The lexicon (input) represents the underlying form before any phonological process occurs. It includes contrastive phonological features, such as voice features (Kager, 1999, p. 19). These input forms are then subject to the operations performed by the generator (GEN).

The generator (GEN) is the component of OT responsible for deriving possible output forms from a given input (McCarthy, 2007, p. 4). The possible outputs generated by GEN are referred to as candidates. Some candidates satisfy markedness constraints while violating faithfulness constraints, while others do the opposite. In some cases, GEN produces candidates that violate both types of constraints.

The evaluator (EVAL) is the OT component that assesses the candidates generated by GEN and selects the optimal candidate as the final output. EVAL evaluates candidates based on their compatibility with the constraint hierarchy. As noted by McCarthy (2007, p. 4), "EVAL receives the candidate set from GEN, evaluates it using some constraint hierarchy, and selects its most harmonic or optimal member as output of the grammar." The selected optimal output is the candidate that most effectively adheres to the highest-ranked constraints, whether they pertain to markedness or faithfulness, based on the specific constraint hierarchy of the language. Moreover, an optimal candidate may disregard a lower-ranked constraint if such a violation is required to uphold more dominant constraints. (Boersma, Dekkers, & Van de Weijer, 2000, p. 3).

OT's architecture is represented by the following diagram, adapted from Boersma, Dekkers, and Van de Weijer (2000, p. 2):

Figure 1: OT's architecture



To illustrate the functioning of OT grammar, an example from Cairene Arabic is examined. In this dialect, /i/ is inserted between the second and third consonants of a tri-consonantal cluster in English loanwords, such as /banka/ 'banknote', in order to break up complex consonant clusters (Galal, 2004, p. 8).

2.2 Principles of Optimality Theory

Optimality Theory grammar operates according to a set of core principles. Some of these principles relate to the constraint set (CON), others pertain to the input representation, while additional principles govern the roles of the generator

(GEN) and the evaluator (EVAL) in determining optimal phonological outputs.

2.2.1 Universality

Markedness and faithfulness constraints are considered universal and can be observed across languages. However, the ranking of these constraints varies from one language to another, leading to cross-linguistic variation. The universality of markedness constraints is attributed to typological and phonetic factors (Kager, 1999, p. 5).

Typological factors refer to the tendency of languages to favor certain types of sounds and structures over others. For instance, all languages show a preference for oral vowels over nasal vowels and open onsetful syllables over closed and onsetless syllables (Kager, 1999, p. 5). This typological preference underlies markedness constraints, such as:

- ONS (requiring syllables to have onsets),
- NOCODA (favoring open syllables), and
- V-NASAL (which prohibits nasal vowels).

Phonetic factors involve articulation and perception. Certain sounds and sound structures appear universally because they require less articulatory and perceptual effort (Kager, 1999, p. 5). Markedness constraints are therefore universal, as they favor sound types and syllable structures that are easier to produce and perceive.

Similarly, faithfulness constraints are universally present across languages, as they serve to maintain the structural integrity of output forms while preserving essential contrasts from the input. As Kager (1999, p. 10) explains, faithfulness constraints work to “limit the distance between outputs and their basic shapes.” Furthermore, languages universally require the preservation of phonological contrasts from the input to the output, ensuring that lexical distinctions remain semantically clear and unambiguous.

2.2.2 Violability

Violability is a key principle within the constraint set (CON) in Optimality Theory (OT). This principle suggests that both markedness and faithfulness constraints can be violated when necessary. The reason behind this violability is the inherent conflict between these two categories of constraints (Kager, 1999, p. 4). Markedness constraints, for instance, enforce structural well-formedness, which may lead to output forms that differ from input forms, causing violations of faithfulness constraints. Conversely, faithfulness constraints demand that the output mirrors its input counterpart, which can result in marked structures that violate markedness constraints.

In Arabic, the imperative form [ʔismaʕ] ('listen') satisfies the markedness constraint ONS, which requires syllables to have onsets. However, this output differs from its underlying form /ismaʕ/ due to the insertion of the epenthetic /ʔ/, violating the faithfulness constraint DEP-IO, which prohibits epenthesis. As a result, compliance with ONS necessitates a breach of DEP-IO. Conversely, if the

form [ismaʕ] were preserved as the output, it would conform to DEP-IO but violate ONS. This illustrates the inherent trade-off in constraint interaction, where the fulfilment of one constraint often necessitates the violation of another.

2.2.3 Strict Dominance

Strict dominance is a fundamental principle in OT's constraint hierarchy, stipulating that higher-ranked constraints always take precedence over lower-ranked ones (Prince & Smolensky, 2004, p. 2). As a result, any candidate that violates a highly ranked constraint is immediately eliminated by EVAL (the Evaluator).

Furthermore, this principle establishes that adherence to a lower-ranked constraint cannot compensate for breaching a higher-ranked one (Kager, 1999, p. 22). For instance, in the previously discussed Arabic example, the candidate /ismaʕ/ is rejected by EVAL because it violates ONS, a high-ranking constraint in Arabic, even though it satisfies the lower-ranked DEP-IO constraint.

2.2.4 Transitivity of Ranking

This principle asserts that constraint ranking is transitive, meaning that if Constraint C1 outranks Constraint C2, and C2 outranks Constraint C3, then C1 also outranks C3 (Kager, 1999, p. 21). This hierarchical structure ensures consistency in constraint ranking, enabling the prediction of optimal phonological outputs.

2.2.5 Economy

The economy principle in OT dictates that constraint violations should be minimized. As Prince and Smolensky (2004, p. 27) explain, "banned options are available only to avoid violation of higher-ranked constraints and can only be used minimally."

This means that a constraint is violated only when it is necessary to satisfy a higher-ranked constraint, and the extent of the violation should be as limited as possible. For instance, in Arabic /ismaʕ/, a candidate such as [ʔisiʕmaʕ] does not adhere to the principle of economy, as it incurs two violations of DEP-IO due to the unnecessary insertion of the epenthetic /i/. Conversely, the optimal form [ʔismaʕ] violates DEP-IO only once, making it the preferred output. Thus, OT allows constraint violations, but only when strictly necessary to ensure phonological well-formedness (Kager, 1999, p. 21).

2.2.6 Richness of the Base

This principle maintains that constraints do not apply at the input level (Kager, 1999, p. 19). In other words, all phonological structures and features are permissible in the underlying representation, even if they are later restricted by markedness constraints at the output level.

For example, in the case of [ʔismaʕ], the input form remains /ismaʕ/ because the markedness constraint ONS, which prohibits onsetless syllables, does not regulate input forms. Instead, ONS applies only at the output level,

necessitating the insertion of the epenthetic /ʔ/ to comply with the constraint.

Additionally, phonological feature distinctions, such as voicing contrasts, may be present in the input but can be neutralized in the output, depending on the ranking of constraints governing the phonological system.

2.2.7 Freedom of Analysis

This principle asserts that GEN (Generator) is unrestricted in producing all possible output candidates for a given input (Kager, 1999, p. 20). However, the candidates generated by GEN must be linguistically viable, meaning they must consist of “licit elements... of linguistic representation” (Kager, 1999, p. 20). These elements include:

- Distinctive features
- Moras
- Syllables
- Feet (metrical structure)

Beyond these core principles, several sub-theories have emerged within OT, such as Syllable Theory and Faithfulness Theories. These sub-theories further clarify the interaction between markedness and faithfulness constraints, providing insight into how phonological processes such as epenthesis and deletion are governed.

3. CROSS-LINGUISTIC STUDIES ON PHONOLOGICAL PROCESSES IN AN OT FRAMEWORK

The current section discusses the significant impact of Optimality Theory on the analysis of phonological processes since its introduction by Prince and Smolensky in 1993. It highlights OT's effectiveness in explaining various phonological phenomena such as epenthesis, deletion, and assimilation across a diverse range of languages, including English, Spanish, Japanese, and several African and Indo-European languages. The paper emphasizes the theory's ability to account for both universal and language-specific phonological patterns through the interaction and ranking of constraints. In particular, it focuses on the application of OT within Arabic linguistics, where researchers have utilized the framework to investigate phonological processes in various Arabic dialects, including Cairene, Jordanian, Moroccan, and Gulf dialects. The chapter reviews key studies that illustrate how OT captures the systematicity and variation in phonological patterns, thereby reinforcing its relevance and utility in understanding the complexities of phonology across different languages, especially within the context of Arabic dialects.

3.1. OT account of epenthesis and deletion in Arabic Dialects

Galal (2004) was among the first researchers to apply Optimality Theory (OT) to analyze epenthesis in Arabic, specifically in the adaptation of English loanwords in Cairene Arabic (CA). Since the syllable structure of English does not always conform to the phonotactic rules of CA, epenthesis is frequently employed as a repair strategy. According to Galal (2004, p. 6), a vowel is inserted at the

beginning of loanwords such as */stub/* ('stub'), resulting in [istub], to resolve the restriction against complex onsets in CA. Additionally, a glottal stop /ʔ/ is introduced before an onsetless vowel, such as in words beginning with /i/, to prevent a syllable from lacking an onset, which is not permitted in CA.

Louriz (2004) used OT to examine deletion in the adaptation of French loanwords in Moroccan Arabic (MA). When a borrowed word begins with a vowel, as in */agrese/* ('to attack'), MA deletes the initial vowel, producing the output [grisa]. According to Louriz (2004, p. 8), this deletion is driven by the markedness constraint ONSET, which requires syllables to have an onset. Since /ag/ in */agrese/* forms an onsetless syllable, MA repairs the structure by eliminating the initial /a/, thereby satisfying the ONSET constraint.

Btoosh (2006) and Aljumah (2008) applied OT to study epenthesis in Karak Arabic (KA), a Jordanian dialect, and Al-Ahsa Arabic, spoken in Saudi Arabia. Both dialects prohibit onsetless syllables, which leads to the insertion of a glottal stop /ʔ/ to rectify such structures. According to Btoosh (2006, p. 196), this repair process is evident in the name */aħmad/* ('Ahmed'), which surfaces as [ʔaħ.mad] due to the insertion of /ʔ/ before the initial vowel. This phenomenon aligns with the highly ranked ONSET constraint, which mandates the presence of an onset in every syllable. Similarly, Aljumah (2008, p. 166) observed the same pattern in Al-Ahsa Arabic, where the word */isbır/* ('be patient') surfaces as [ʔisbır], illustrating the obligatory insertion of /ʔ/ to resolve the onsetless syllable.

The application of OT to Arabic phonology has enhanced our understanding of both cross-linguistic variation and universal phonological patterns. Different Arabic dialects exhibit distinct rankings of markedness and faithfulness constraints, accounting for variations in epenthesis, deletion, and assimilation processes. These analyses contribute significantly to the study of phonological structure and the interaction of constraints in spoken Arabic varieties.

4. METHODOLOGY

This section outlines the methodological framework employed by the researchers for data collection and analysis. It details the study's setting, the specific dialect under investigation, the target population, and the sample selected for linguistic analysis. Additionally, it offers an overview of the corpus used in the study and concludes by explaining the step-by-step procedures undertaken by the researchers in both data collection and analytical processes.

Therefore, this research employs a qualitative, descriptive, and theoretical methodology to examine the phonological processes of Mostaganem Spoken Arabic (MTG) through the lens of Optimality Theory (OT). The qualitative aspect of this study facilitates a comprehensive linguistic analysis of phonological patterns, independent of numerical or statistical data. Although quantitative methods could complement the study, qualitative analysis is chosen to focus on phonological patterns rather than statistical frequency.

4.1 Data Collection

For this study, data were obtained through audio recordings of spontaneous speech from one hundred native speakers of Mostaganem Spoken Arabic (MTG).. The total recording time amounted to twelve hours, with data collection conducted covertly to preserve the authenticity and naturalness of speech production. The recordings were sourced from diverse social contexts, including family gatherings, informal conversations with relatives and neighbors, as well as everyday interactions in settings such as hair salons and beachside discussions.

4.2 Population of the study

The study's sample comprises one hundred Mostaganem native speakers, all of whom are residents of the city of Mostaganem. No participants were selected from annexed areas such as Acha'acha or Sidi Ali. Only fluent MTG speakers were included, and speech samples were analyzed independently by multiple researchers to ensure transcription accuracy. The sample includes both male and female speakers from various age groups, with differing levels of education—some being formally educated while others are not. However, factors such as gender, age, and educational background were not considered variables in this study, as it follows a descriptive approach. Additionally, all participants are bilingual in French and may engage in code-switching during speech. The sample consists of individuals from the researcher's social network, including family members, relatives, and neighbors, as well as strangers encountered in public spaces such as supermarkets and beaches.

4.3 Data Analysis

After data collection, the recorded speech was transcribed using the International Phonetic Alphabet (IPA). A broad transcription approach was employed, focusing solely on the essential phonological details necessary for identifying phonological processes.

The transcribed data were subsequently analyzed within the framework of Optimality Theory (OT) to describe and interpret the phonological processes observed in Mostaganem Spoken Arabic (MTG). The analysis centered on the interaction between markedness and faithfulness constraints within a hierarchical ranking system, illustrating how these constraints shape phonological variation in MTG and determine the selection of optimal phonological outputs.

4.3.1 Place Assimilation in MTG

This section expands on the phonological processes observed in Mostaganem Spoken Arabic (MTG) with additional examples and analysis. The processes analyzed include place assimilation, epenthesis, syncope, and major class change.

4.3.1.1 Place Assimilation in MTG

The nasal /n/ undergoes assimilation by adopting the place feature of a following labial consonant.

Examples:

/kɑ:n mri:d/ → [kɑ:m mri:d] ('He was ill')

/ʔanbija:ʔ/ → [ʔambija:ʔ] ('The prophets')

/man badjat/ → [mam badjat] ('From the beginning')

/ʃəf nəʃ/ → [ʃəf məʃ] ('He saw people')

/mən fiha/ → [məm fiha] ('From within it')

OT Analysis:

The dominant constraint AGREE [Place] enforces homorganicity between adjacent nasal and labial sounds.

The faithfulness constraint IDENT-IO [Place] is ranked lower, allowing assimilation to occur.

4.3.1.2 Epenthesis in MTG

Epenthesis is used to resolve vowel hiatus or complex consonant clusters.

Examples:

/ʃrɒt lɹæ:n/ → [ʃrɒt əlwæ:n] ('I drank colors')

/ʒɒti sʃid/ → [ʒɒti əsʃid] ('You brought Said')

/ktb smit-ha/ → [ktb əsmit-ha] ('He wrote her name')

/drɒ rʃel/ → [drɒ ərʃel] ('He hit a man')

OT Analysis:

The markedness constraint ONSET prevents vowel-initial syllables, leading to epenthesis.

The faithfulness constraint DEP-IO, which prohibits insertion, is violated to satisfy higher-ranked markedness constraints.

4.3.1.3. Syncope in MTG

Unstressed vowels are omitted to simplify syllable structure.

Examples:

/katab-u/ → [ktab-u] ('They wrote')

/safar-a/ → [sfar-a] ('He traveled')

/θəhəb-a/ → [θhb-a] ('He went')

/ʃamal-u/ → [ʃaml-u] ('They worked')

OT Analysis:

The markedness constraint NOCODA is ranked high, promoting vowel deletion to achieve preferred syllable structures.

Faithfulness constraints preventing deletion are ranked lower, allowing syncope.

4.3.1.4. Major Class Change in MTG

A vowel changes into a glide to prevent hiatus.

Examples:

/sajara/ → [sajra] ('car')

/tawa:rat/ → [tawrat] ('she hid')

OT Analysis:

The markedness constraint HIATUS disfavors vowel-vowel sequences.

The process occurs to satisfy phonological well-formedness while minimally violating IDENT-IO constraints.

5. DISCUSSION OF FINDINGS

The results of this study substantiate the presence of total assimilation in Mostaganem Spoken Arabic (MTG). This process predominantly affects the /l/ in the definite article /ʔal/ ('the'), which fully assimilates to the manner and voicing features of an adjacent coronal consonant, ultimately producing an identical phonetic segment.

The following examples illustrate total assimilation in MTG:

Input	Output	Gloss
tu:qba/	[ʔat-tu:qba]	'the hole'
zwa:q/	[ʔaz-zwa:q]	'the decoration'
dayla/	[ʔad-dayla]	'the entrance'
saħa/	[ʔas-saħa]	'the health'
su:q/	[ʔas-su:q]	'the market'
nu:/	[ʔan-nu:]	'the rain'
ri:ħa/	[ʔar-ri:ħa]	'the smell'

These examples indicate that /l/ undergoes complete assimilation when followed by a coronal consonant, as in /ʔal-saħa/ → [ʔas-saħa]. However, this process does not occur when /l/ precedes a non-coronal consonant, as illustrated in the following cases:

Input	Output	Gloss
ħalqa/	[ħalqa]	'the throat'
/ʔal-	[ʔal-	'the

Input	Output	Gloss
kita:b/	kita:b]	book'
/ʔal-	[ʔal-	'the
ʕa:lam/	ʕa:lam]	world'

From this data, it is evident that total assimilation in MTG applies only when /l/ is followed by a coronal consonant, reinforcing the requirement for place feature agreement between /l/ and the segment it assimilates to. In addition to total assimilation, this study highlights the prominence of place assimilation, epenthesis, and syncope in Mostaganem Arabic, aligning with phonological patterns observed in other Arabic dialects.

Place assimilation emerges as the most prevalent phonological process in MTG, aligning with findings on Algerian Arabic dialects (Benyoucef & Mahadin, 2021). However, unlike Moroccan Arabic, where deletion is more dominant (Lahrouchi, 2018), MTG favors assimilation as a repair strategy. The preference for assimilation, epenthesis, and syncope is dictated by the ranking of markedness and faithfulness constraints in MTG, with **AGREE [Place]** ranked higher than in other Arabic dialects, where faithfulness constraints tend to resist assimilation. Studies on Algerian Arabic suggest that assimilation plays a crucial role in dialect variation (Benyoucef & Mahadin, 2021), and this study supports those findings while providing a detailed OT-based analysis of constraint interaction. In contrast, Moroccan Arabic prioritizes deletion over assimilation due to its Amazigh influence (Lahrouchi, 2018), while Tunisian Arabic exhibits more cases of vowel coalescence rather than syncope (Imani & Ahangar, 2020). These findings highlight the systematic nature of MTG phonology within the framework of OT, demonstrating both universal constraint interactions and dialect-specific variations.

6. CONCLUSION

This study explores the phonological processes in Mostaganem Spoken Arabic (MTG) within the framework of Optimality Theory (OT), focusing on the interaction between markedness and faithfulness constraints. It examines key phonological phenomena, including epenthesis, syncope, assimilation, and major class change, to determine how constraint ranking governs phonological patterns in the dialect, which are governed by specific constraint rankings that prioritize phonological well-formedness while maintaining input preservation. Notably, the analysis of place assimilation demonstrates how MTG speakers achieve phonetic cohesion by ensuring homorganicity between adjacent segments, while total assimilation in the definite article /ʔal/ underscores the influence of coronal consonants on the dialect's phonological patterns. These findings resonate with cross-linguistic research on markedness constraints, revealing both universal principles and dialect-specific variations in constraint ranking. The application of

OT to MTG not only enhances the understanding of this lesser-studied dialect's phonological structure but also contributes to broader discussions in Arabic phonology and phonological typology. The paper suggests that future research could explore the impact of social and stylistic factors on phonological variation in MTG, thereby deepening insights into the relationship between phonological processes and linguistic context.

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