Morphological causatives in Moroccan Arabic: An Optimality-Theoretic account

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Abstract

This study investigates the formation of the morphological causative in Moroccan Arabic within the framework of Optimality Theory. The pivotal process involved in this construction is morphological gemination, where the second consonant of the root is doubled (e.g., *ktəb* ~ *kəttəb*). A perplexing aspect of this process is its consistent targeting of the second consonant, while excluding ill-formed words such as **kktəb* and **ktəbb*. In this study, we argue that the linearization of the causative morpheme in MA is governed by phonological well-formedness interacting with the morphological process of causativization, resulting in infixation. This phenomenon exemplifies the Emergence of the Unmarked (McCarthy & Prince 1994; Alderete et al. 1999), where the otherwise inactive markedness constraint *COMPLEX$_{ONSET}$ in the language assumes explanatory prominence. The strength of the analysis proposed here lies in treating the infixal process as an outcome of simple and universal constraints, primarily motivated by demands on prosodic well-formedness, without recourse to language-specific templatic patterns. This approach highlights the implications of phonological constraints in capturing morphological processes and suggests that templatic patterns may emerge from phonological well-formedness rather than being innate to the language.

Keywords: morphological causatives, Moroccan Arabic, Optimality Theory, positional faithfulness, prosodic morphology

1. Introduction

In Moroccan Arabic (MA henceforth), causatives are formed through the infixation of a featureless consonantal mora to the verbal root (McCarthy 1993; Bennis 1992; Boudlal 2001)[1]. However, the consistent targeting of the second consonant in the gemination

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[1] The data is taken from the urban variety spoken in Rabat-Sale (Coastal East, Central), a variety of which I am a native speaker. See section 2 for more details.

process, while excluding ill-formed words like *kktəb and *ktəbb, poses a puzzling question. The examples provided in (1) illustrate this phenomenon[2].

(1)

Perfective[3]		Causative Form	
ktəb	'he wrote'	*k**ə**ttəb*	'to make someone write'
ħRəb	'he ran away'	*ħə**RR**əb*	'to make someone run away'
ʃRəb	'he drank'	*ʃə**RR**eb*	'to make someone drink'
xrəʒ	'he went out'	*xə**rr**əʒ*	'to make someone go out'
lʕəb	'he played'	*lə**ʕʕ**əb*	'to make someone play'

As illustrated in (1), the phonological elements involved in morphological causatives in MA are exclusively derived from the root, reflecting a base-dependence effect (Kager 1999). Additionally, the structure of the causative morpheme remains consistently invariant across the paradigm, comprising solely a consonantal mora whose phonetic properties vary as the second radical consonant of the root varies. Furthermore, the positioning of the causative morpheme relative to the root consistently skips over the root's first consonant.

This study aims to explain why gemination occurs infixally within the root. While various scholars have described the process of morphological causatives (see Harrell 1962 for instance), the rationale behind why this morpheme targets the second radical consonant of the root has been explained either through unsatisfactory stipulations (McCarthy 1993; Bennis 1992; Boudlal 2001) or by lacking empirical support. Two main viewpoints have emerged in this regard. The first posits the template as a morphological unit (McCarthy 1979, 1981, 1993; Bennis 1992). The second contends that the morphological process is triggered by the privileged status of the root's first radical consonant, which not only avoids phonological processes but also morphological ones (Noamane 2020).

The inadequacies of both the templatic and positional faithfulness approaches become apparent upon closer examination of their empirical grounding. First, while the templatic analysis may align with certain verb patterns, it fails to accurately capture the semantic and syntactic nuances of causatives. Moreover, it neglects the pivotal role of phonological well-formedness in triggering the infixal process, which is a critical factor in understanding the phenomenon (McCarthy 1993; Yu 2007).

Similarly, the positional faithfulness approach encounters challenges when confronted with empirical evidence highlighting other phonological processes that affect the ostensibly privileged position. These processes, such as long-distance consonant harmony and

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[2] For the transcription of data in this paper, the International Phonetic Alphabet is adopted. Emphatic consonants are represented using capital letters, and geminate consonants are denoted by doubling the respective consonant symbol.

[3] MA, like many Arabic dialects, exhibits a distinct phonemic and vocalic inventory. Notably, in MA the presence of schwa [ə] is restricted and typically does not appear in open syllables. For further information on the phonological features and syllable structure of MA, interested readers may refer to works such as Benhallam (1990), Boudlal (2001), and Al Ghadi (2022).

secondary labial assimilation, disrupt the notion of a fixed positional hierarchy (Zellou 2010). Consequently, both approaches fail to provide a comprehensive explanation of morphological causatives in MA.

Hence, we advocate an alternative framework rooted in parallel Optimality Theory (OT), which offers a more robust and empirically grounded account. Within this framework, we demonstrate that the causative morpheme's appearance is constrained by *COMPLEX$_{ONSET}$, explaining its infixation relative to the root. Crucially, the dominance of *COMPLEX$_{ONSET}$ underscores MA's allowance for complex onsets, aligning with OT's concept of the Emergence of the Unmarked (TETU) (McCarthy & Prince 1994; Alderete et al. 1999).

By adopting the principles of OT and emphasizing the interplay between phonological and morphological constraints, our analysis provides a more nuanced understanding of morphological causatives in MA, transcending the limitations of previous approaches.

The remainder of this paper is constructed as follows: Section 2 focuses on the data source. In section 3, we examine the MA syllable structure to understand its influence on morphological processes. Section 4 introduces OT and the concept of TETU, establishing the theoretical foundation. Section 5 reviews previous analyses of MA causatives, including templatic analysis and positional faithfulness approaches, and evaluates their strengths and weaknesses. Section 6 presents the proposed analysis within the OT framework, outlining the constraints and mechanisms governing causative formation and discussing the theoretical implications. Finally, section 7 concludes the study by summarizing the key findings.

2. Data source

This study primarily uses data from the urban MA variety spoken in Rabat-Sale, a region in the Coastal East Central region of Morocco. Broadly, MA is classified as a member of the Hamito-Semitic language family. It is often referred to as Afro-Asiatic, a broader category encompassing languages such as Berber (Amazigh), Semitic, Cushitic, Egyptian, and Chadic. Languages within this family share several linguistic features, notably non-concatenative morphology, where word formation primarily occurs through internal modifications of the root rather than simple morpheme concatenation, as observed in languages like English or Italian (McCarthy 1976, 1981). Other distinctive features include broken plurals in nouns (Al Ghadi 2014), emphatic and glottalized consonants, and intricate verb inflection and derivation processes.

Despite their linguistic relatedness, Standard Arabic and MA exhibit significant differences across lexical, phonological, morphological, and semantic domains (Benhallam and Dahbi 1990; Boudlal 2001). Additionally, MA serves as the primary spoken language in Morocco, lacking codification or standardization, and is exclusively used in oral communication. Because of language contact, MA has absorbed numerous lexical items from Amazigh and foreign languages, exemplifying its dynamic linguistic evolution (Boudlal 2001).

MA encompasses various regional varieties, each of which exhibits intradialectal variations. These include the urban, mountain, bedouin, and Hassani varieties. However,

despite these variations, all MA varieties are believed to share the same morphological process for deriving morphological causatives[4].

3. Moroccan Arabic syllable structure

In the investigation of the MA syllable structure, crucial insights emerge regarding its phonological organization, shedding light on the language's intricate phonotactic patterns. As documented in previous studies (Benhallam 1990; Boudlal 2001; Bensoukas & Boud-lal 2012; Al Ghadi 2022), MA exhibits a vowel inventory consisting of three basic vow-els [i, u, o] along with an epenthetic schwa [ə]. The epenthetic nature of schwa is attrib-uted to its restricted distribution, which is notably absent in open syllables. This phenomenon is evidenced in the data presented, where schwa appears in positions dic-tated by phonotactic constraints, such as between the first two root consonants when the third-person plural affix is added.

(2)

ktəb	'he wrote'	*kətb-u*	'they wrote'
DRəb	'he hit'	*DəRb-u*	'they hit'
gləs	'he sat'	*gəls-u*	'they sat'
ʒbəd	'he pulled'	*ʒəbd-u*	'they pulled'
ħRət	'he plowed'	*ħəRt-u*	'they plowed'
qtəl	'he killed'	*qətl-u*	'they killed'

Furthermore, the MA syllable structure encompasses two primary types: CV and CVC, with additional forms derived from these basic structures (Benhallam 1990).

Of particular significance to the main argument of this paper is the observation that MA permits word-initial consonant clusters, as demonstrated across various linguistic categories such as verbs, adjectives, and nouns. Consider the examples below:

(3)

	Verbs		**Adjectives**		**Nouns**	
ktəb	'he wrote'	*ʕrəʒ*	'lame'	*rʒəl*	'leg'
ʃTəħ	'he danced'	*ħwəl*	'cross-eyed'	*qfəz*	'cage'
DRəb	'he hit'	*kħəl*	'black'	*ʕsəl*	'honey'
gləs	'he sat'	*byəD*	'white'	*nməl*	'ants'

The allowance of complex onsets in MA aligns with the dominance of markedness constraints over constraints prohibiting complex onsets, as elucidated within the OT

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[4] For an analysis of morphologically-derived causatives in Classical Arabic, see Loutfi (2024b). This study examines how morphological strategies like gemination, prefixation, and ablaut are governed by Contextual Allomorphy.

framework. In OT, allowing complex onsets amounts to saying that the constraint militating against complex onsets, namely *COMLEX$_{ONSET}$, is crucially dominated. This is apparent when the constraint interacts with the phonological constraint active in the language[5]. Notably, while the *COMPLEX$_{ONSET}$ constraint may seem inactive due to the language's tolerance of complex onsets, its influence becomes apparent in cases where faithfulness constraints fail to determine optimal surface forms. Unless otherwise indicated, this study adopts Boudlal's (2001) OT treatment of syllable structure in MA:

(4)

a. *Constraints:*

*Min-σ: Minor syllables are prohibited.

MAX$_{IO}$: Every segment present in the input form of a linguistic expression must have a corresponding segment in the output form. This constraint prevents deletion, ensuring that all elements of the input are retained in the output.

DEP$_{IO}$: Every segment present in the output form must have a corresponding segment in the input form. This constraint prevents the addition of epenthetic material, ensuring that no new segments are introduced in the output that were not present in the input.

*COMPLEX$_{ONSET}$: More than one consonant in the onset position is prohibited.

b. *Ranking*:

Input : /bka/		MAX$_{IO}$	*Min-σ	DEP$_{IO}$	*COMPLEX$_{ONS}$
	a. bə.ka			*	
☞	b. bka				*
	c. bk	*!			
	d. b.ka		*!		

The *Min-σ constraint stipulates that minor syllables, defined as those containing fewer than two moras, are prohibited in the output forms of linguistic expressions. This constraint reflects a phonotactic preference against syllables that lack sufficient weight, ensuring that they are adequately structured and phonologically well-formed. Furthermore, MAX$_{IO}$ dictates that every segment present in the input form of a linguistic expression must have a corresponding segment in the output form. This constraint promotes faithfulness to the input, ensuring that all phonetic material present in the input is preserved in the output without deletion or alteration. DEP$_{IO}$, on the other hand, requires that every segment in the output must have a corresponding segment in the input, thereby militating against the addition of epenthetic material. Unlike MAX$_{IO}$, which is concerned with

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[5] This paper refrains from delving deeply into the intricate details of the syllable structure in MA because such discussions would divert attention from the primary focus. Therefore, only the phonological aspects relevant to the current investigation are addressed. For instance, the undominated constraint prohibiting onsetless syllables was omitted, as its exclusion did not significantly impact the analysis. Interested readers seeking further exploration of these topics are encouraged to consult works such as Benhallam (1990), Boudlal (2001), and Al Ghadi (2022) and the references provided therein.

preventing deletion, DEP$_{IO}$ enforces faithfulness to the input by prohibiting epenthesis, ensuring that no new segments are introduced in the output that were not present in the input.

The *COMPLEX$_{CODA}$ constraint prohibits the occurrence of more than one consonant in the coda position of a syllable in the output forms of linguistic expressions. This constraint reflects a phonotactic preference for simple syllable structures, ensuring that codas remain phonologically well-formed and avoiding complexity in syllable-final consonant clusters.

As evident from the tableau in (4-b) above, candidates (a) and (c-d) are dismissed due to violations of the higher-ranked constraints DEP$_{IO}$ and MAX$_{IO}$, respectively. Conversely, candidate (b) remains faithful to the input and avoids contravening any undominated constraints, thereby emerging as the optimal surface form. Notably, *COMPLEX$_{ONSET}$ does not influence the selection or rejection of candidates in this instance because the language permits complex onsets, a situation that arises from *COMPLEX$_{ONSET}$ being low-ranked and dominated by higher-ranked faithfulness constraints. However, this constraint becomes crucial in contexts in which faithfulness constraints are less decisive, demonstrating its role in shaping surface forms. This interaction exemplifies Optimality Theory's concept of TETU (The Emergence of the Unmarked), where a typically inactive constraint can influence the output under specific conditions. This phenomenon is further explored in the following section.

4. OT and TETU

OT (Prince & Smolensky 2004) provides a constraint-based framework for analyzing phonological phenomena. A key concept in OT is TETU, which captures the observation that reduplicants tend to favor unmarked structures over marked structures in a language (McCarthy & Prince 1994). This section explores the theoretical underpinnings of TETU and its explanatory power in the OT context.

In OT, markedness refers to the relative complexity or naturalness of a linguistic structure. Unmarked structures are considered simpler and more universal, adhering to the principles of ease of articulation and learnability. However, marked structures deviate from these tendencies. For instance, single consonants are unmarked compared to consonant clusters, which require more complex articulatory gestures.

OT considers a set of universal constraints to evaluate the candidate outputs generated by GEN. Markedness constraints prioritize unmarked structures, whereas faithfulness constraints favor the preservation of underlying structures. These two types of constraints are often in conflict; in some instances, faithfulness constraints dominate markedness constraints, whereas in other cases, the opposite occurs. The concept of arises from the dynamic interaction between these constraints.

Consider a language in which syllables can generally have consonant codas, which are marked structures. Now, imagine a scenario where a high-ranked markedness constraint against complex codas dominates a lower-ranked faithfulness constraint that enforces identity between the root and the reduplicant in reduplication. In this case, the

high-ranked markedness constraint would prevent the emergence of codas in the redupli-cated form, resulting in simpler, unmarked syllables without codas. TETU explains how the high ranking of the markedness constraint leads to avoidance of the marked structure (coda) in reduplicated words, despite the presence of a lower-ranked faithfulness con-straint.

In fact, TETU holds significant theoretical weight within OT. First, it highlights the power of even low-ranked constraints. Although dominated by faithfulness constraints, markedness constraints can still influence outputs when faithfulness is inapplicable. This suggests that all constraints might be universally present in grammar even if they are not always active.

Overall, the proposed TETU provides a framework to explain how reduplication often simplifies underlying structures. It is the high-ranking markedness constraints, rather than faithfulness constraints, that push the reduplicant towards unmarked structures. This dy-namic offers a powerful tool within OT for understanding why reduplicants tend to avoid marked structures. TETU sheds light on the interplay of universal constraints and their interaction with specific morphological processes like reduplication, contributing to a rich-er understanding of how languages function (Urbanczyk 2007).

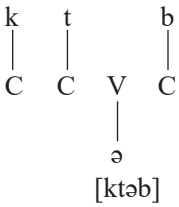## 5. Previous accounts of morphological causatives in MA

5.1. Templatic approach

Earlier approaches to morphologically derived causatives, influenced by McCarthy (1979, 1981), have posited a framework rooted in Autosegmental Phonology, as initially proposed by Goldsmith (1976). McCarthy's model suggests that Arabic verbs are struc-tured across three distinct tiers within the lexical representation. First, the root tier con-tains the core verbal lexeme, which is composed of consonantal roots. Second, the skel-etal tier, known as the prosodic template, establishes the canonical shape associated with specific meanings and grammatical functions, such as causativity, which is often repre-sented by templates like CVCCVC. Finally, the vocalic melody tier encodes grammatical nuances like voice, aspect, and mood.
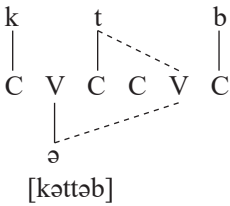
Within this framework, the derivation of causatives hinges on identifying the appro-priate prosodic template and adhering to association conventions to fill vacant slots through consonant and vowel spreading mechanisms. Consequently, the causative forms emerge through a systematic mapping process that ensures a coherent alignment of con-sonant and vowel elements within the established prosodic template. Under this approach, the causatives are derived as follows:

(5)
a. Perfective form

```
k     t           b
|     |           |
C     C     V     C
            |
            ə
      [ktəb]
```

b. Causative form

```
k        t              b
|        ⌐              |
C     V  C     C     V  C
      |
      ə
   [kəttəb]
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In both instances presented in (5), the consonantal root "ktb" and the vocalic melody are systematically associated with their respective slots. This association is governed by the Well-Formedness Constraint, which dictates that association lines must not cross and that, by the end of the derivation, all melody elements must be appropriately associated, with any unassociated materials being erased. The association mechanism follows a left-to-right directionality, ensuring a one-to-one mapping between the three tiers—root, prosodic template, and vocalic melody—without overlap.

As illustrated in (5), the distinction between the forms in (5-a) and (5-b) arises from the addition of a medial consonant slot. This addition triggers medial gemination, which is achieved through the automatic spreading of the medial consonant /t/ to fill the empty slot C. Consequently, the phonological content of the causative morpheme affix is realized by copying the phoneme melody of the root. Proponents of this view, such as Bennis (1992) and Bennis & Lazzi (1995), argue that morphological processes like infixation are driven primarily by the need to satisfy the prosodic template.

However, this approach faces two empirical challenges. First, the assumption that each template corresponds to a distinct meaning is not universally supported, as there exist verbs with template patterns that resemble those of causatives but lack causative properties. Consider the examples in (6):

(6)

fəlləħ	'he farmed'
səlləf	'he lent (money)'
wəlləf	'he accustomed'
Təlləq	'he divorced'
SəRRəf	'he gave change'

Similar to morphological causatives, the verb class described in (6) exhibits the phenomenon of medial gemination and shares the same templatic shape as the causatives outlined in (5). This similarity becomes apparent when we consider the nominal counterparts of these verbs. As demonstrated in (7), their nominal forms are realized with a singleton consonant, mirroring the pattern observed in the causatives:

(7)

Nouns		**Verbs**	
flaħa	'farming'	*fəlləħ*	'he farmed'
səlf	'loan'	*sælləf*	'he lent (money)'
wəlf	'getting used to'	*wælləf*	'he accustomed'
Tlaq	'divorce'	*Tælləq*	'he divorced'
SəRf	'cash change'	*Sərrəf*	'he changed money'

Moreover, as discussed in Benmamoun (1991) and Loutfi (2014, 2017, 2020, 2024a), one property of the causative morpheme in MA is that it functions as a valency-increasing morpheme that adds an agent argument to the clause. By way of illustration, consider the following examples:

(8)
a.   *ʒamal   xrəʒ*
     Jamal   go.out.PST[3M.SG]
     'Jamal went out.'

b.   *ʒamal   xərrəʒ   d-drari*
     Jamal   go.out\CAUS.PST[3M.SG]   DEF-children
     'Jamal made the children go out.'

c.   *d-dərri   lʕəb   l-kuRa*
     DEF-boy   play.PST[3M.SG]   DEF-ball
     'The boy played football'

d.   *ʒamal   ləʕʕəb   d-dərri   l-kuRa*
     Jamal   play\CAUS.PST [3M.SG]   DEF-boy   DEF-ball
     'Jamal made the boy play football.'

However, this is not the case for the class of verbs in (7) because these verbs do not alternate, as evidenced by the ambiguous and ungrammatical sentences in (9):

(9)
a.   **Hiʃam   sælləf   (*ʒamal)*
     Hicham   lend.PST[3M.SG]   (*Jamal)
     'Hicham lent Jamal money'

b. *Hiʃam   SəRRəf   (*l-flus)
    Hicham give.change.PST[3M.SG] (*the-money)
    'Hicham gave change'

The second issue with the templatic approach pertains to the element associated with the V-slots. According to the original argument, the V-slots encode grammatical categories such as tense, aspect, and mood (see Bahloul 2008 for example). However, MA has undergone the loss of stem vowels. This becomes apparent when we compare the same class of verbs in both Standard Arabic (SA) and MA:

(10)

	SA	**MA**	
	katab	ktəb	'he wrote'
	xaraʒ	xrəʒ	'he went out'
	raħal	rħəl	'he moved out'
	ħarab	ħrəb	'he ran away'
	ʃarib	ʃRəb	'he drank'

In all MA verbs, the vowels encoding the active voice, namely /a…a/, are lost (Benhallam 1990; Al Ghadi 2022; Boudlal 2001). Associating schwas with V slots, as in (5), would treat them on a par with full vowels. This move is problematic because the restricted nature of the insertion of schwa in MA renders its status as purely epenthetic, breaking up clusters of consonants that the language does not tolerate. Therefore, the existence of forms whose derivations resemble those of morphologically derived causatives and the loss of stem vowels suggests that the prosodic template is not sufficient to identify morphologically derived causatives.

Theoretically, the templatic account overlooks the interaction between phonology and morphology in deriving the process of morphological gemination (Ussishkin 2000, 2007). For instance, the absence of ill-formed words such as *lləʕb and *lʕəbb in the system is stipulated, rather arbitrarily, by the left-to-right association. However, we demonstrate that the process is derived through a joint consideration of both the phonological constraints active in the language, such as its syllable structure and the morphological process per se.

Constructing the process of morphological causatives as an instance of TETU, we illustrate that this process fundamentally arises from universal constraints, highlighting how phonological well-formedness influences morphological processes. Before we elaborate on our analysis, we review and argue against another account couched within the theory of OT.

5.2. Positional faithfulness

The positional faithfulness theory is based on three fundamental assumptions. First, privileged positions permit a wide range of marked segments, unlike unprivileged posi-

tions. This phenomenon is evident in languages with a rich consonantal system, where only a limited, ostensibly unmarked subset of segments/features are allowed in the featural content of affixes. Second, privileged positions trigger phonological processes, and third, they resist otherwise regular processes in the language (Yip 1991; McCarthy & Prince 1999; Beckman 1998, 2004; Alderete 2001; Lombardi 2004, among others). In MA, numerous contexts exhibit positional faithfulness. For example, the definite article affix /l/ regressively assimilates into the immediately adjacent coronal sound of the first radical consonant of the root (11-a). Otherwise, the /l/ morpheme is realized. The data below illustrate this general process:

(11)
UR
a. */l-DaR/*   *DDaR*   'the house'
    /l-Suq/   *SSuq*   'the market'
    /l-tuma/   *ttuma*   'the garlic'
    /l-ʒlbana/   *ʒʒəlbana*   'the green peas'
    /l-ʃms/   *ʃʃəms*   'the sun'
    /l-ngʷir/   *nngʷir*   'the nagging'
    /l-Rajb/   *RRajəb*   'the churned milk'
b. */l-bab/*   *lbab*   'the door'
    /l-flfla/   *lfəlfla*   'the peppers'
    /l-qRfa/   *lqəRfa*   'the cinnamon'
    /l-klma/   *lkəlma*   'the word'
    /l-ʕRaDa/   *ləʕRaDa*   'the invitation'
    /l-ħmm/   *lħəmm*   'the worry'

As indicated by the data above, elements in the root, particularly the initial consonants, exhibit behaviors that trigger and resist the assimilatory process. These privileged behaviors are derived from the following ranking schema for positional phonological asymmetries:

(12)
IDENT-Position (F) >> C >> IDENT (F)
                        (Beckman 1998: 9)

Here, "C" represents the intervening markedness constraints. By dominating the non-privileged position faithfulness constraint IDENT (F), C implies neutralizing of contrast in this context. According to OT, assimilation is generally viewed as an instance of the markedness constraint AGREE (Lombardi 2004). In this case, the intervening markedness constraint is AGREE-Coronal, which competes with the positional constraints IDENT-ROOT (F) and IDENT-IO (F).

(13)
a. *Constraints:*
AGREE-CORONAL: Coronal clusters should agree in place.
IDENT-IO (F): Underlying featural specifications should remain the same.
IDENT-ROOT (F): The underlying feature specifications of the root must be the identical.

b. *Ranking:*
IDENT-ROOT (F) >> AGREE-CORONAL >> IDENT-IO (F)

At the core of this framework is the IDENT-ROOT (F) constraint, which prioritizes the preservation of the underlying feature specifications of the root. This constraint underscores the importance of maintaining the integrity of the root structure throughout the derivation process. Placing IDENT-ROOT (F) at the top of the ranking schema highlights its pivotal role in ensuring that the phonological properties of the root are faithfully preserved in the derived form.

In contrast, the AGREE-CORONAL constraint addresses the need for coronal clusters to agree in place. While crucial for maintaining phonological harmony within the word structure, AGREE-CORONAL is positioned below IDENT-ROOT (F) in the ranking schema. This placement suggests that while coronal agreement is important, it is subordinate to preserving the featural specifications of the root. Consequently, the analysis prioritizes the integrity of the root's phonological structure over coronal cluster agreement.

Finally, the IDENT-IO (F) constraint focuses on maintaining consistency in the underlying featural specifications across different morphemes. Positioned last in the ranking schema, IDENT-IO (F) underscores the importance of preserving featural content but indicates that this consideration is secondary to ensuring agreement in coronal features as dictated by AGREE-CORONAL. By placing IDENT-IO (F) below AGREE-CORONAL, the analysis suggests that while consistency in featural specifications is relevant, it is less crucial than achieving coronal feature agreement across segments.

(14)
     IDENT-ROOT (F), AGREE-CORONAL >> IDENT-IO (F)

Input: /l-DaR/	IDENT-ROOT (F)	AGREE-CORONAL	IDENT-IO (F)
a. l-DaR		*!	
b. l-laR	*!		
☞ c. D-DaR			*

The application of positional faithfulness constraints in the analysis of phonological processes yields insights into the systematic nature of phonological asymmetries. In the presented example, the constraint AGREE-CORONAL plays a pivotal role in determining the optimal candidate by enforcing agreement within coronal clusters. Candidate (a) is deemed unviable due to its violation of AGREE-CORONAL, illustrating the constraint's influence on phonological decision-making. Meanwhile, candidate (b) satisfies AGREE-CORONAL but is ultimately ruled out by a higher-ranked positional constraint, highlighting the hierarchical nature of the constraint interaction. Candidate (c) emerges as the optimal choice, aligning with the dominating constraints and exemplifying the effectiveness of positional faithfulness in phonological analysis.

Moreover, the phenomenon of glide formation in MA provides additional evidence for the relevance of positional faithfulness. The realization of the third person plural in the perfective aspect as the suffix {-u}, as exemplified in (15), reflects a systematic pattern

governed by positional constraints. This pattern underscores the consistent application of positional faithfulness principles across various phonological processes in MA. By analyzing such phenomena through the lens of positional faithfulness, scholars can gain deeper insights into the underlying phonological mechanisms that shape linguistic structures and forms.

(15)

xərʒ-u	'they left'
ʃəTħ-u	'they danced'
baʕ-u	'they sold'
ləʕb-u	'they played'

The phenomenon of glide formation in MA presents a compelling case for applying positional faithfulness constraints in phonological analysis. Specifically, when the root ends in a vowel, the suffix {-u} undergoes a transformation into the glide /w/. This process resolves hiatus structures, a phonological challenge in MA, by introducing a consonantal element to improve syllable structure and satisfy the markedness constraint ONSET, which prohibits onsetless syllables (V). Interestingly, positional faithfulness predicts that the affix, rather than the root vowel, undergoes modification in this process. This observation highlights the systematic nature of positional faithfulness in governing phonological repairs and optimizing syllable structures in MA.

(16)

ʒa-w	**ʒa-u*	'they came'
mʃa-w	**mʃa-u*	'they went'
bka-w	**bka-u*	'they cried'
ʕTa-w	**ʕTa-u*	'they gave'
ʃka-w	**ʃka-u*	'they complained'

In view of these facts, Noamane (2020) extended the framework of positional faithfulness to elucidate the morphological causatives in MA. Central to his proposal is the notion that the first radical consonant of the root occupies a privileged position in MA, resisting phonological and morphological processes. To formalize this observation, Noamane introduces the positional constraint IDENT-RtC1 (Weight), where "Rt" represents the root and "C1" denotes the root-initial consonant[6]. This constraint asserts that the

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[6] While Noamane's proposal introduces a constraint specifically tailored to the Semitic linguistic context, we find it necessary to critically assess its universality within the OT framework. Our contention arises from the observation that certain languages, such as English, do not adhere to the notion of word formation revolving around a central root, which is commonly conceived in Semitic languages. Instead, Beckman's (2004) constraint IDENT-σ1 appears to capture a similar generalization with broader applicability across languages, suggesting a more universal perspective. Despite this, for the sake of exposition and consistency with prior analyses, we opt to adopt Noamane's constraint, albeit acknowledging its limitations in capturing cross-linguistic phenomena.

underlying feature specifications of the root-initial consonant must remain unchanged. The proposed constraints and their ranking are as follows:

(17)
a. *Constraints:*
RM: Some phonological exponent must appear in the output form.⌞SEP⌟
IDENT-IO (Weight): Output segments and Input segments must be featurally identical for weight.
ALIGN-(μ_c, Left, Root, Left): The left edge of the causative morpheme must coincide with the left edge of the root.
IDENT-RtC$_1$ (Weight): The featural specification for the weight of the root's first radical element must be preserved in the input/output mapping.

b. Ranking:
RM >> IDENT-IO (Weight) and IDENT-RtC$_1$ (Weight) >>ALIGN-L (μ_C, Rt)

Noamane's (2020) analysis of morphological causatives in MA faces two significant challenges, both theoretical and empirical. The theoretical issue revolves around the proposed Root-Affix Metaconstraint, which fails to align with Beckman's (1998) established ranking schema for positional asymmetries within OT. As shown in (13), a markedness constraint should typically intervene between privileged and non-privileged positions, with the former remaining undominated. However, Noamane's schema deviates from this principle because it lacks the expected configuration in which markedness constraints mediate between privileged and non-privileged positions (Noamane 2020).

Empirically, the Root-Affix Metaconstraint encounters problems when confronted with observed phonological phenomena in MA. Specifically, two phonological processes, namely secondary labial assimilation and long-distance consonant harmony, cast doubt on the assumption that morphological causatives strictly adhere to positional faithfulness effects. The data in (18) and (19) below are a case in point:

(18) *Labial assimilation*
a. UR

/xrʒ/	x^wruʒ	'go out'
/ʃrb/	$ʃ^w$rub	'drink'
/ħrb/	$ħ^w$rub	'run away'
/qtl/	q^wtul	'kill'
/ʃf/	$ʃ^w$uf	'see'

b.

/DRb/	DRəb	'hit'
/ʃTħ/	ʃTəħ	'dance'
/ħyyd/	ħəyyəd	'move'
/ʒwb/	ʒawəb	'answer'
/ktb/	Ktəb	'write'

(19) *Long-distance consonant harmony*
a. UR

/zwaʒ/	ʒwaʒ	'marriage'
/zlʒlan/	ʒəlʒlan	'sesame seeds'
/zuʒ/	ʒuʒ	'two'
/sRʒm/	ʃəRʒəm	'window'
/sfnʒ/	ʃfənʒ	'doughnut'
/zlliʒ/	ʒəlliʒ	'tiles'

In the context of MA, both labial assimilation and consonant harmony phenomena challenge the positional faithfulness hypothesis. Labial assimilation entails the initial consonant undergoing labialization due to the influence of an adjacent high-round vowel when present in the root. Similarly, consonant harmony involves the regressive assimilation of the palatal consonant, resulting in a change of place for the initial consonant to post-alveolar positions (Zellou 2010). Intriguingly, in both cases, the initial consonant undergoes modification, contrary to the predictions of positional faithfulness. These observations suggest that the first radical consonant of the root does not occupy a privileged position, undermining the core premise of positional faithfulness.

Another criticism arises concerning the postulation of the "Realize Morpheme" (RM) constraint, raising doubts about its theoretical necessity and empirical efficacy (van Oostendorp 2005; Trommer 2008). Critics argue that its inclusion may not significantly enhance explanatory power beyond existing constraints like DEP-IO. Given that DEP-IO already addresses the presence of morphemes in the input, the addition of RM appears redundant in many instances. Moreover, the RM constraint lacks clear criteria for distinguishing between phonologically realized and unrealized morphemes, leading to ambiguity and inconsistency in its application. This ambiguity raises concerns regarding the constraint's universality and generalizability, potentially violating typological principles by rigidly requiring the full phonological realization of morphemes (van Oostendorp 2005).

To recapitulate, previous analyses of geminated causatives in MA have explored templatic frameworks and positional faithfulness hypotheses. However, these approaches encounter limitations. The templatic analysis alone failed to adequately capture morphological causatives, whereas empirical evidence undermines the validity of positional faithfulness. Given these shortcomings, this paper shifts its focus toward presenting an alternative analysis. We will delve into the specifics of MA's syllable structure, arguing that it serves as the primary driver for the infixal process, ultimately leading to the observed phenomenon of TETU.

6. Proposed analysis

TETU, an important phenomenon within OT (McCarthy & Prince 1994; Alderete et al. 1999), manifests when a constraint typically inactive in a language becomes active in specific contexts where higher-ranked constraints fail to select the optimal candidate. This

phenomenon is often observed in reduplication, where reduplicants prefer unmarked structures, even if they violate the language's phonotactics (Kennedy 2008). The ranking schema for reduplicative TETU, as proposed by Alderete et al. (1999), highlights the complex interaction between faithfulness and markedness constraints. Specifically, it demonstrates the dominance of $Faith_{IO}$ over markedness constraints, while markedness constraints, in turn, dominate $Faith_{BR}$. The ranking schema that captures this fact is given in (20):

(20)
Ranking schema for reduplicative TETU (Alderete *et al.* 1999: 330):
$Faith_{IO} \gg M \gg Faith_{BR}$

Drawing parallels with reduplication, we argue that the causative morpheme, denoted as AffixCAUSEμ, exhibits a similar unmarked preference, leading to its emergence as an infix. This emergence is driven by the otherwise inactive constraint $*COMPLEX_{ONSET}$. Assuming that the causative morpheme functions as a consonantal mora aligns with the cross-linguistic observation that geminates are underlyingly moraic (Davis 1999; Davis & Torretta 1998; Noamane 2019). The proposed constraints for deriving causatives and their ranking are crucial for understanding this process.

(21)
a. *Constraints:*
ALIGN-Root-C2: Align the second consonant of the root with the corresponding position in the output.

ALING (Affix$_{CAUSE}$, L, Root, L): Align the left edge of the Affix$_{CAUSE}$ with theleft edge of the root = every Affix$_{CAUSE}$ is a prefix in the Root.
*Min-σ: Minor syllables are prohibited.
MAX_{IO}: Every segment of the input has a correspondent in the output.
DEP_{IO}: Every segment of the input has a correspondent in the output.
$*COMPLEX_{CODA}$: More than one consonant in the coda position is prohibited.
$*COMPLEX_{ONSET}$: More than one consonant in the onset position is prohibited.

b. *Ranking:*
MAX_{IO}, $COMPLEX_{CODA}$, *Min-σ $\gg$ DEP_{IO} $\gg$ $*COMPLEX_{ONS}$ $\gg$ ALING- Affix$_{CAUSE}$μ-L.

The constraints proposed for the analysis of causative formation in this framework offer a comprehensive account of the phonological and morphological processes involved. ALIGN-Root-C2 plays a crucial role in ensuring that the second consonant of the root aligns properly in the output, reflecting the typical position where causative morphemes are inserted. This constraint captures a fundamental aspect of causative formation and contributes to the systematicity of morphological processes. Similarly, ALIGN (Affix-CAUSE, L, Root, L) highlights the consistent morphosyntactic behavior observed in causative constructions, where the causative affix typically appears as a prefix within the

root. By enforcing this alignment, the constraint reflects cross-linguistic tendencies in morpheme positioning.

The *Min-σ constraint serves to maintain the phonotactic well-formedness of derived forms by prohibiting the formation of minor syllables, which contain fewer than two moras. This ensures that syllable structures adhere to the phonological constraints of the language and contribute to the overall prosodic harmony of the derived causatives. In addition, MAX$_{IO}$ ensures that every segment present in the input is preserved in the output, preventing any deletion of phonetic material. DEP$_{IO}$, on the other hand, prevents the addition of new segments in the output that were not present in the input, thereby prohibiting epenthesis. Together, these constraints maintain both phonological transparency and morphological integrity in the derivation of causatives, ensuring that the output accurately reflects the phonological and morphological properties of the input roots.

In terms of ranking, MAX$_{IO}$ and *Min-σ are given higher priority, reflecting the importance of preserving input segments and adhering to phonotactic constraints. DEP$_{IO}$ follows, emphasizing the need for faithful preservation of input segments. Finally, *COMPLEX$_{CODA}$ and *COMPLEX$_{ONSET}$ constrain the complexity of coda and onset consonant clusters, respectively, ensuring that the derived forms adhere to the language's phonotactic patterns. ALING-AffixCAUSE-L is positioned last, reflecting its role in maintaining the morphosyntactic structure of causative constructions. Overall, these constraints provide a comprehensive framework for analyzing causative formation, capturing both phonological and morphological aspects of the process. An example of how these constraints interact is given in (22), where candidate (c) incurs the least violation; hence, it is selected as optimal:

(22)

Input : / Affix$_{CAUSE}$μ-ktb/	MAX$_{IO}$	*COMP$_{CODA}$	*Min-σ	DEP$_{IO}$	*COMP$_{ONS}$	ALING
a. ktb			*			
b. kkətəb				*!*	*	
☞ c. kəttəb				*!*		*
d. ktəb.b			*	*		
e. ktət.b			*	*		*
f. ktəbb		*		*	*	*
g. ktətb		*		*	*	*

In the evaluation of candidate forms for causative formation, constraints play a crucial role in determining the optimal output. Candidate (a) is immediately ruled out because it violates the higher-ranked constraint, which requires the realization of the AffixCAUSEμ. This underscores the importance of prioritizing constraints that ensure the faithful realization of morphological elements in the derived forms. Similarly, candidates (d) and (e) are eliminated due to their violation of *Min-σ, which prohibits the formation of minor syllables. This constraint reflects a phonotactic requirement to maintain the structural integrity of syllables in the language.

Candidates (f) and (g) face disqualification for violating the top-ranked constraint *COMPLEX$_{CODA}$, which restricts the presence of multiple consonants in coda positions. This constraint reflects a phonological restriction on syllable structures, ensuring that the derived forms adhere to the language's phonotactic patterns. The remaining candidates demonstrate a tie in violation of the active constraints, highlighting the need for a mechanism to resolve such conflicts.

Of particular interest is the tie between the two remaining candidates regarding their violation of the faithfulness constraint DEP$_{IO}$. Both candidates incur the same number of violations of this constraint, which emphasizes the importance of maintaining faithfulness to the input segments in the derived forms. Excluding the constraints where no violations occur, the evaluation process narrows down to prioritize constraints that ensure phonotactic well-formedness and faithful preservation of input segments, leading to the selection of the optimal candidate.

(23)

Input: /Affix$_{CAUSE}$µ-ktb/	DEP$_{IO}$	*COMP$_{ONS}$	ALING
b. kkətəb	*!*	*	
☞ c. kət.təb	*!*		*

In the final stage of candidate evaluation, the resolution of ties is crucial for determining the optimal output. Adopting Prince and Smolensky's *Method of Mark Cancellation* provides a systematic approach to address such ties by canceling out the same number of violation marks shared by competing candidates. In the case at hand, candidates (d) and (c) violate the faithfulness constraint DEP$_{IO}$, leading to their cancellation. Consequently, candidate (b) is ruled out due to its violation of *COMPLEX$_{ONSET}$, despite the irrelevance of this constraint in the language's phonological context. This outcome underscores the operation of TETU, where otherwise inactive constraints become active under specific conditions, thus shaping the derivation of morphological forms.

The emergence of morphologically derived causatives in MA as instances of TETU offers insights into the interaction between morphological and phonological constraints. The fact that *COMPLEX$_{ONSET}$ dominates the alignment constraint highlights the influence of phonotactic considerations on the morphological process. This observation aligns with cross-linguistic findings suggesting that dominant prosodic demands may override morphological requirements, as evidenced by the data on causative formation.

Despite the selection of the optimal candidate, potential forms such as *kəbtəb and *kəktəb appear to comply with the language's phonotactic constraints. However, these candidates are ruled out by invoking the constraint NO-CROSSING, which prohibits the long-distance spreading of consonants. This constraint serves to maintain the structural integrity of syllables and prevents violations of phonotactic patterns. Thus, the NO-CROSSING analysis provides a principled account for the exclusion of these potential candidates, further bolstering the analysis of morphological causatives in MA.

(24)

*C V C C V C

k   t   b
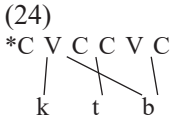
Since these two candidates do not surface, this constraint must be higher ranked, as shown in the following tableau:

(25)

Input: /RED-ktb/	NO-CROSSING	MAX$_{IO}$	*COMP$_{CODA}$	*Min-σ	DEP$_{IO}$	*COMP$_{ONS}$	ALING
a. ktb				*			
b. kkətəb					* !*		
☞ c. kəttəb					* !*		*
d. ktəb.b				*	*		
e. ktət.b				*	*		*
f. ktəbb			*		*	*	*
g. ktətb			*		*	*	*
h. kəbtəb	* !						
i. kəktəb	* !						

The strength of the present analysis lies in its ability to provide a unified and theoretically grounded account of morphological causatives in MA. Unlike the templatic analysis and positional faithfulness approaches, which have been previously proposed but have encountered theoretical and empirical challenges, the analysis presented in this paper offers a more robust and empirically supported framework.

First, the present analysis, which is based on OT, allows for a more principled explanation of morphological causatives in MA by integrating both phonological and morphological constraints. By using constraints such as ALIGN-Root-C2, ALING (AffixCAUSE, L, Root, L), *Min-σ, MAX$_{IO}$, DEP$_{IO}$, *COMPLEX$_{CODA}$, and *COMPLEX$_{ONSET}$, the analysis captures the intricate interplay between phonological and morphological factors in the formation of causative verbs.

Second, the present analysis demonstrates its superiority over templatic approaches by moving away from the rigid template-based morphology and instead adopting a constraint-based approach that can account for both regular and exceptional patterns observed in MA. Unlike templatic analyses, which often struggle to accommodate exceptions or irregularities, the OT framework allows for a more flexible and adaptive analysis that capture the full range of data without resorting to ad hoc stipulations.

Similarly, the analysis presented in this paper surpasses the positional faithfulness approach by offering a more nuanced and empirically supported account of morphological causatives in MA. While positional faithfulness has been proposed to explain certain phonological patterns in morphological processes, its application to MA causatives faces challenges due to the presence of other phonological processes that seem to override

positional constraints. The OT-based analysis, on the other hand, can accommodate these competing constraints and provide a more comprehensive explanation of the data.

Equally importantly, our analysis of TETU in MA causatives has broader implications for understanding other linguistic phenomena. For instance, the tendency for reduplicated forms to exhibit unmarked structures aligns with our findings. Reduplication, a prevalent morphological process in many languages, often involves the repetition of a morpheme or part of a morpheme. In many cases, the reduplicant appears with an unmarked structure, mirroring the patterns observed in MA causatives (McCarthy & Prince 1994). This parallelism suggests that the Emergence of the Unmarked may be a more widespread phenomenon, with implications beyond the specific context of MA causatives (Pecker & Potts 2011).

7. Conclusion

In conclusion, this study has undertaken a comprehensive investigation into the derivation of morphologically derived causatives in MA, employing OT as the theoretical framework. Through a critical examination of previous analyses, including templatic approaches and positional faithfulness accounts, we identified theoretical and empirical shortcomings that underscore the need for a more nuanced explanation. Building upon these insights, our analysis offers a novel perspective that integrates phonological and morphological constraints to elucidate the process of infixation in MA causatives.

The application of TETU has emerged as a central tenet in our analysis, shedding light on the dynamic interaction between phonological and morphological constraints in language. By demonstrating how otherwise inactive constraints can become operational under specific conditions, we highlighted the intricate interplay between phonotactic considerations and morphological processes. This has led to a deeper understanding of how dominant phonological demands may override morphological requirements, as evidenced by the emergence of infixation in MA causatives.

Moreover, our analysis addressed empirical challenges posed by phonological processes such as labial assimilation and consonant harmony, which question the validity of positional faithfulness effects in MA. By highlighting how these phenomena are better accounted for within the framework of TETU, we underscore the robustness and explanatory power of our proposed approach.

In summary, our study advances our understanding of morphological causatives in MA by offering a principled analysis grounded in OT principles. By integrating phonological and morphological constraints within a unified framework, we provide a more nuanced and empirically grounded account of infixation processes in MA. This not only contributes to our theoretical understanding of language structure and derivation but also underscores the importance of considering the intricate interplay between phonology and morphology in linguistic analyses.

Abbreviations

M	Mora	IO	Input-Output
Σ	Syllable	MAX	Maximality
☞	Optimal candidate	Min	Minor
*	Violation mark	Ms	Masculine
*!	Fatal violation	OT	Optimality Theory
3	Third person	RM	Realize Morpheme
ALIGN-L	Left Alignment	RtC$_1$	First radical segment
C	Consonant	SA	Standard Arabic
DEP	Dependency	TETU	The Emergence of the Unmarked
F	Faithfulness	UR	Underlying Representation
IDENT	Identity	V	Vowel
MA	Moroccan Arabic		

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