

Deriving Morphological Causatives in Moroccan Arabic *

Ayoub Loutfi **

(Hassan II University of Casablanca, Morocco)

Abstract: This paper explores the nature of the post-syntactic operations responsible for the representations of the linear order of terminal nodes. In particular, it argues in favor of a unified model of the morphosyntax and morphophonology, wherein the theory of Distributed Morphology and Optimality Theory operate in a single module. The testing ground is an investigation of the formation of morphological causatives in Moroccan Arabic. Herein, the process of realizing causatives is morphological gemination, whereby the second consonant of the root is doubled. Investigating the question of what triggers the infixal process, I argue against the linearization algorithm suggested in Embick & Noyer (2001), Embick & Marantz (2008), and Embick (2006, 2010). Instead, the claim I defend here is that the onus of the linearization process falls on the prosody in Arabic, the central assumption being that the morphosyntactic structure, the output of the syntactic derivation, is the input to OT morphophonological constraints. These constraints are responsible for the linearization of the terminal nodes of the syntactic derivation. I show that adopting one theory over others misses important generalizations about the language.

Keywords: causatives, Arabic, Moroccan Arabic, non-concatenative morphology, linearization

1. Introduction

The issue of linearization, especially the problem of how morphemes are linearized with respect to the root, is a central issue in Distributed Morphology (DM). Central to DM is the assumption that phonological exponents are conceived of as the outcome of syntactic derivation, the output of which is morphosyntactic representations. The empirical question herein is how the generated phonological exponents are linearized. To explore this issue,

* This paper was presented at the First Purdue Languages and Cultures Conference, Purdue University, USA, March 4-6, 2016, and at the Illinois Language and Linguistics Society 8th Annual Conference, University of Illinois at Urbana-Champaign, April 21-24, 2016. I would like to thank the audience at these events for their comments and questions. The usual disclaimer applies.

** Dr. Ayoub Loutfi: Assistant Professor, Department of English Studies, Hassan II University of Casablanca, Morocco. His research interests are Syntax and Morphology. Email: a.loutfi@flbenmsik.ma, ayoubloutfi1@gmail.com.

this paper is a contribution to this line of research, with the basic claim being that by not appealing to phonological well-formedness, DM appears to miss essential generalizations and makes wrong predictions. This problem stems from the fact that the theory invokes complex syntax-like machinery that is susceptible to criticism as far as nonconcatenative morphology is concerned. It reduces a number of operations to the detriment of creating more technical complexities. Unquestionably, this narrows down its descriptive as well as explanatory power.

I support this claim by investigating the formation of morphologically-derived causatives in Moroccan Arabic (MA). The process involved in realizing causatives is morphological gemination, where the second consonant of the root is doubled. The paradigm in (1) illustrates this process^①:

(1) Perfective	Causative Forms
<i>ktəb</i> ‘to write’	<i>kəttəb</i> ‘to make someone write’
<i>hRəb</i> ‘to run away’	<i>həRRəb</i> ‘to smuggle’
<i>ʃRəb</i> ‘to drink’	<i>ʃəRRəb</i> ‘to make someone drink water’
<i>xrəʒ</i> ‘to go out’	<i>xərrəʒ</i> ‘to take someone out’
<i>lʕəb</i> ‘to play’	<i>ləʕʕəb</i> ‘to make someone play’

As it stands, causativization is uniformly formed via geminating the second consonant of the base. The problem here is why the causative morpheme, being an infix, always skips the first consonant of the root, copying the phonological features of the second consonant. In this paper, we will see how this issue is analyzed in two frameworks, namely DM (Halle & Marantz, 1993, 1994) and Optimality Theory (OT) (Prince & Smolensky, 1993; McCarthy & Prince, 1994, 1999). In particular, I will argue that the linearization algorithm suggested in DM has missed interesting generalizations and made wrong predictions. As an alternative, the model I suggest is a grammar in which DM and OT interact, drawing from insights laid down in the literature (Trommer, 2001; Haugen, 2011; Tucker, 2010). The central assumption advanced herein is that the morphosyntactic structure, the output of the syntactic derivation, is the input to morphophonological constraints. These constraints are responsible for the linearization of the terminal nodes of the syntactic derivation. The advantage of this model is that it does not only show that a theory where DM and OT interact in a single module fares better in accounting for a wide array of data, as one of the advantages of OT grammar is that it not only predicts that morphology and prosody interact in a single hierarchy, but it also circumvents the problems that DM generates.

This paper is structured as follows. Section 2 presents the morphosyntactic properties of

^① Transcription: The IPA transcription is used. Emphatic consonants are represented using a corresponding capital letter. Gemination is transcribed by doubling the consonant.

Deriving Morphological Causatives in Moroccan Arabic

morphological causatives in MA, and how they are built in the clausal syntax. In section 3, I show how the causative morpheme is linearized using Local Dislocation. This section also shows the inadequacy of this linearization algorithm. Section 4 presents the suggested model, fleshing out the basic analysis. Finally, section 5 concludes with showing the advantages of combining both DM and OT in a single system.

2. The morphosyntax of morphological causatives

This section presents how morphologically-derived causatives are built in the clausal syntax. A characteristic of morphological causatives in MA is that the causative morpheme functions as a transitivizer for intransitive verbs (2a) and a ditransitivizer for transitive verbs (2c), for the evident reason that it adds an argument to the verbal argument structure, hence its status as a valency-increasing morpheme^①. The following examples are a case in point:

- (2) a. *Ayoub xrəʒ.*
Ayoub went out-3S
'Ayoub went out.'
- b. *Ayoub xərrəʒ ddrari.*
Ayoub CAUSE-went-out-3S the-children
'Ayoub made the children go out.'
- c. *d-dərri lʕəb l-kura.*
the-boy played-3S the-ball
'The boy played football.'
- d. *ʒamal ləʕʕəb d-dərri l-kura.*
Jamal CAUSE-played-3S the-boy the-ball
'Jamal made the boy play football.'

In this study, I adopt the morphosyntactic assumptions assumed in the framework of DM. As a syntactic approach, DM alongside approaches is referred to in the literature as the Constructionist approaches^② which assume that verbal argument structure is largely determined by the syntactic structure in which a verb appears (Loutfi, 2017). For this reason, in this study I follow Loutfi (2017) in assuming that causative verbs in Arabic instantiate a bipartite structure in which the traditional VP bifurcates into two functional heads. These heads are VoiceP and ν P^③. From this view, external and internal arguments

^① For a morphosyntax treatment of causatives in MA, see Benmamoun (1991) and Loutfi (2017, 2020).

^② See Marantz (2013) for a discussion of the Projectionist-Constructionist debate.

^③ The status of $\sqrt{\text{ROOT}}$ as a head is not as clear, for the evident reason that it contains no category information; so there is no way they can serve as syntactic labels, capable of licensing/ theta-assigning theta-roles. Whether $\sqrt{\text{ROOT}}$ is computed as a pure syntactic head or as a modifier of their categorizer is in essence an empirical issue (Harley, 2014; Acquaviva, 2009; Embick, 2010; Lohndal, 2014).

are severed from the verb (Borer, 2005; Ramchand, 2008; Marantz, 2013; Lohndal, 2014; Loutfi, 2014, 2015, 2017, amongst others). Here, the causative morpheme is represented as the Affix_{CAUSEμ}. This suggests that the causative morpheme is a bare mora affix whose phonological materials are copied from the second radical consonant of the root (see Loutfi (2016) for details). This explains why the phonological material of this affix varies as the second consonant of the root varies (see data in (1) above). The suggested syntactic trees are in Figure 1 and Figure 2 below. This tree is sent over to Spell-Out for Vocabulary Insertion.

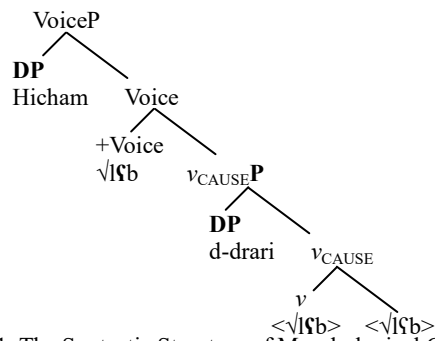


Figure 1. The Syntactic Structure of Morphological Causatives in Arabic

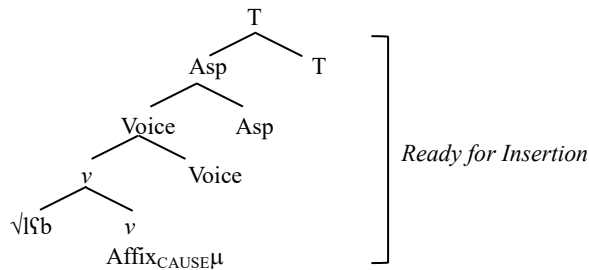


Figure 2. Output Hierarchical Representation

As shown in Figure 2, the suggested syntactic heads, i.e. Voice and light *v*, along with the $\sqrt{\text{Root}}$ get together into a single complex head via the process of head movement, in which the $\sqrt{\text{Root}}$ moves in a successive cyclic fashion via light *v* and Voice, and possibly to Aspect and Tense^①. What is puzzling is how these heads are linearized with respect to each other to derive the correct linear order, excluding forms such as **lʃab*, **lʃabb*. This issue is discussed in the following section.

3. Local dislocation and linearization

With generative lexicon absent, DM admits the existence of several post-syntactic

^① See Rahhali & Souali, 1997; Benmamoun, 2000; and Aoun *et al.*, 2010 for some aspects of verb movement in Arabic.

Deriving Morphological Causatives in Moroccan Arabic

operations that can modify terminal nodes.^① These operations are triggered by language-particular requirements that minimally modify the output of the syntactic structure. Of these processes, there are impoverishment, fusion and fission. Of interest to the present study is the issue of how the linearization of phonological exponents takes place. Following proposals in the literature of DM (Embick & Noyer, 2001; Embick & Marantz, 2008; Embick, 2006, 2010), linearization is the result of the morphological operation Local Dislocation. This process is a type of Morphological Merger, which is defined in Marantz (1981:261), adopted from Embick & Noyer (2001:561), as:

At any level of syntactic analysis (D-Structure, S-Structure, phonological structure), a relation between X and Y may be replaced (expressed by) the affixation of the lexical head of X to the lexical head of Y.

Succinctly stated, Morphological Merger is a type of a post-syntactic head movement process whose task is to move heads from one structural position to another for language-specific reasons. This type of Merger^② applies after Vocabulary Insertion. Along the same basic lines, Embick & Noyer (2001) make a distinction between two morphological objects, principally morphosyntactic words (MWd) and subwords (SWd), each of which displays distinct behavior and complies with distinct locality effects. The two are defined as follows:

(3) MWd: A node X^0 is (by definition) a morphosyntactic word (MWd) iff X^0 is the highest segment of an X^0 not contained in another X^0 .

SWd: A node X^0 is a subword (SWd) if X^0 is a terminal node and not an MWd.

(Embick & Noyer, 2001:574)

A SWd represents the terminal nodes, so it immediately dominates a single feature bundle and nothing else, while a MWd is the highest segment which is neither contained nor dominated by any other segment. These morphological objects are viewed as the basic atoms of post-syntactic movement operations. Roughly speaking, the distinction between MWd and SWd corresponds to the distinction between heads and phrases, respectively. Furthermore, both of these objects are moved by Local Dislocation. However, a restriction is imposed on the application of Local Dislocation in that MWd adjoins only to an adjacent

^① Lexicalist Approaches assume a particular architectural grammar, wherein there are two generative engines responsible for the derivation and the formation of basic linguistic units, each of which with its own distinct mechanisms and primitives. This assumption is abandoned in DM. Instead, all derivation of complex objects, be they words, phrases or sentences, are expected to be derived via the rules of syntax (Merge and Move). Under such a view, morphology, as is traditionally conceptualized, operates over multiple points in the derivation. Its characteristics in this sense are distributed, taking place at several stages in the grammar, hence the term distributed.

^② Another type of Merger is Lowering. This operation is required to join two syntactic terminals that are phonologically spelled out together but not joined in syntax (Embick & Noyer, 2001:561).

MWd, and the same applies to SWd, a structure preservation effect. The principle capturing this fact is referred to as Typed Linearization, stated as follows:

- (4) TYPING ASSUMPTION ON LD: M-Words only dislocate with adjacent M-Words, and Subwords with Subwords. (Embick, 2006:4)

To see how the LD mechanism works, consider the derivation of the following sentence:

- (5) a. *Hicham ləʕʕəb d-drari.*
 Hicham CAUSE-played-3MS the-boys
 ‘Hicham made the boys play.’
 b. {[T+past, +NOM], [Asp+Perfective], [D+3rd Singular Masculine, u-Case], [Voice] [V_{CAUSE}], +ACC], [D 3rd Plural, u-Case, √{b}]}

The syntax merges and moves all the feature bundles in the Numeration to create the syntactic tree in Figure 1 above, in which all uninterpretable features have been properly checked. As the structure in Figure 1 above suggests, the subject in this derived syntactic tree precedes the verb, which, in turn, precedes its complement. By the same reasoning, the definite article in the DP internal arguments precedes the nominal expression. In DM, the linear order is taken to be a PF process. In Embick & Noyer (2007) and Embick (2006, 2010), the linear order is a binary operator, formally represented by ‘*’ read as “it is left-adjacent to”. Another binary operator is suggested, whose task is to encode immediate precedence and concatenate terminal nodes. This binary operator is indicated by ‘-’. Affixation, namely SWd affixation, is represented by \oplus . The last operator is the one that chains the concatenated elements into a linear representation. For the sentence above, the following linear representation is generated:

- (6) a. Linear relations by *: (DP*V), (V*DP), (D*NP)
 b. Linear relations by -: D-V, V-D, D-N
 c. Chained: D-V-D-N

Assuming that these procedures that linearize MWd are correct, Local Dislocation that linearizes SWd is problematic. Data of nonconcatenative morphology constitute a vexing analytical challenge to any theory that assumes linear, one-to-one, operations. This state of affairs stems from the fact that Arabic is a language where a great portion of its morphology is not the result of the concatenation of adjacent morphemes, i.e. morphemes of immediate precedence in the sense of Embick (2006, 2010). Instead, the language also appears to make use of discontinuous morphemes. By way of illustration, the so-called passive participles in MA are derived from both prefixation of the morpheme {*m-*} and sporadically involve the infixation of the vowel {-*u-*}, as seen in (7) below:

- (7) *məqtul* ‘killed’
məktub ‘written’
məhlul ‘open’

Deriving Morphological Causatives in Moroccan Arabic

məDrub ‘hit’

As it stands, this discontinuous morpheme /*m...u*/ is attached to the same morpho-syntactic head. In a similar vein, Arabic realizes the feature of tense, aspect, and voice by the same morpheme, i.e. in the vocalic melody (see e.g. McCarthy, 1979; Tucker, 2010). Following the formalism that accounts for linearization presented above, the problem that arises is how consonants and vowels are placed in the correct linear order. For the formation of morphological causatives in MA, this linearization would proceed as follows:

- (8) a. [$\sqrt{ʕb} \oplus v_{\text{CAUSE}} \oplus \text{Asp}^0$] (Complex head- Output of Syntax)
 b. [$\sqrt{ʕb} \oplus \text{Affix}_{\text{CAUSE}\mu} \oplus \emptyset$] (Insertion of Vocabulary Items)
 c. [$[-\text{Affix}_{\text{CAUSE}\mu} -ʕb^+ \emptyset]$] (Local dislocation of $\text{Affix}_{\text{CAUSE}}$ and \sqrt{dab})
 d. [$[\partialʕʕ\partial b]$] (Phonological content of $\text{Affix}_{\text{CAUSE}}$ computed by copying from the base)

Although the correct surface form of forms like these is derived, the theory seems to miss a number of generalizations and phonological regularities in the language. The analysis of the causative data reveals that DM does get the position of the causative morpheme with respect to the root via Local Dislocation, but it still leaves unanswered the question why the morpheme appears next to the second consonant of the root.

Another complication arises when we consider more data from Arabic. As has been pointed out, Arabic verbs are structured around a discontinuous root consisting of consonants only. The problem arises when we consider the possibility that, as argued in Bahloul (2008:31), each vowel carries its own semantic features. According to Bahloul, the first vowel in the perfective forms in (9) encodes the aspect-tense properties. The second vowel describes the verb’s valance. As shown in (9), the vowel /*a*/ appears with transitive verbs, /*u*/ appears with passive verbs, and /*i*/ occurs with psychological predicates.

- (9) a. *DaRab-a* ‘hit’
 kassar-a ‘break’
 katab-a ‘write’
 b. *kabur-a* ‘to become big’
 qaSur-a ‘to become short’
 karum-a ‘to be noble’
 c. *farih-a* ‘to become happy’
 Dahik-a ‘to laugh’
 karih-a ‘to hate’

Finally, the vowel that always appears as a suffix is considered to be an agreement morpheme. This is illustrated in the following examples:

- (10) a. *katab-a*
 wrote-3MS

- b. *katab-u*
wrote-3MP
- c. *katab-na*
wrote-1P

As Tucker (2010) points out, the linearization algorithm, which the process of Local Dislocation incarnates, suffers from overgeneration in that there are several possibilities that the system would generate. Considering the linearization of vowels alone, this would give us at least the following possible linearizations^①:

- (11) V1 V2 V3
- V2 V1 V3
- V3 V2 V1
- V1 V3 V2
- V2 V3 V1

To constrain the phonological shape of the different forms in Arabic and circumvent the problems described in (11) above, templates have been proposed (McCarthy, 1979, 1981; McCarthy & Prince, 1994). In the cases at hand, these templates stipulate the position of vowels and consonants. Arad (2003, 2005), for example, argues that the properties that have traditionally been associated with templates are the result of the combination of syntactic functional heads. However, there is evidence from Arabic and MA that casts doubt on the existence of templates. First, since different verbs correspond to different templates, these templates seem to encode information on a verb's argument structure. This said, however, the template pattern alone does not suffice to identify morphological causatives in MA, as there are verbs whose templates resemble that of causatives as in (12), but they do not exhibit the properties that morphologically-derived causatives do. This is evident as this class of verbs does not alternate, as in (13).

- (12) *fəlləh* 'to agriculture'
- səlləf* 'to lend'
- wəlləf* 'get used to'
- TəLLəq* 'to divorce'
- SəRRəf* 'to give change'

- (13) a. **Hicham səlləf*.
Hicham lent-3MS
'Hicham lent.'

^① A possible analysis is to argue that these heads may observe the Mirror Principle. The bulk of the data in Arabic shows evidence to the contrary. See Loutfi (2017) for a discussion along these lines.

Deriving Morphological Causatives in Moroccan Arabic

b. **Hicham sərrəf*.

Hichan gave-change-3MS

‘Hicham gave change.’

As shown in the examples in (2) presented earlier, the causative morpheme functions as a valency-increasing morpheme. For the present purposes, this amounts to saying that the causative template CVCCVC augments the argument structure of the verb. This assumption is not borne out, however, as the examples in (13) demonstrate. Note also that it is hard to motivate the claim that there is underlying gemination in these words, for the evident reason that their nominal counterparts seem to be realized with a singleton, as the forms below show:

(14) Nouns	Verbs
<i>flaha</i> ‘agriculture’	<i>fəlləh</i> ‘to cultivate’
<i>səlf</i> ‘lending’	<i>səlləf</i> ‘to lend’
<i>wəlf</i> ‘habituation’	<i>wəlləf</i> ‘to get used to’
<i>Tlaq</i> ‘divorce’	<i>Təlləq</i> ‘to divorce’
<i>SəRf</i> ‘exchange’	<i>SəRRəf</i> ‘to give change’

The second problem comes from MA, in which the postulation of templates means that schwas would be associated with V-slots. This would treat schwas on a par with full vowels, contrary to the fact. In MA, schwas are epenthesized within an unsyllabified CC sequence (Benhallam, 1990; Boudlal, 2001).

Summarizing thus far, I have provided evidence that casts doubt on the process of Local Dislocation. In particular, I have argued that the process overgeneralizes the phenomenon as far as nonconcatenative morphology is concerned. I have also shown that templates fare no better. The bulk of evidence coming from causative-like verbs and the status of schwa in MA supports this.

4. Towards a DM-OT model

In view of these facts, the present study argues that linearization is driven in essence by phonological requirements. For this reason, the following sections argue for a blended model of DM, where syntax feeds OT. I argue that this move is motivated by both empirical and conceptual grounds. Much of the impetus of this state of affairs stems from the fact that the affixal process makes reference to the prosodic structure of the language under investigation, i.e. syllable structure, in the linearization of the causative morpheme. This cannot be ignored as it misses essential generalizations. This analysis has the phonological effect of the Emergence of the Unmarked (TETU, henceforth) (McCarthy & Prince, 1994), where the markedness constraint *COMPLEX_{ONS} bears the burden of the explanation, a state of affairs that DM cannot predict. The grammar that the present study

adopts is as follows:

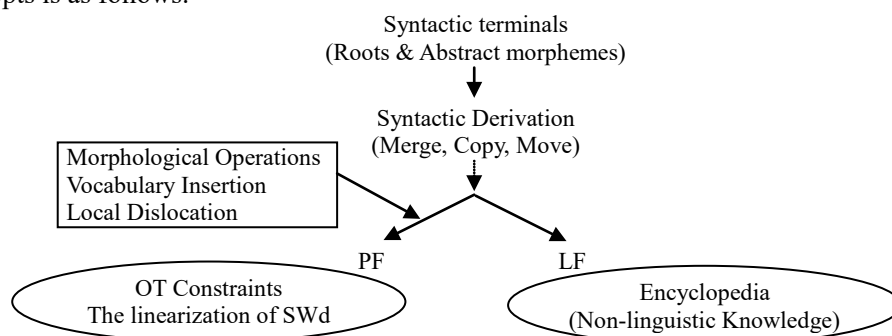


Figure 3. DM Grammar Organization

With this background in mind, I will show how the OT analysis of the formation of causatives accounts for the linearization process in a systematic way, one that follows the prosodic considerations active in the language. The next section provides the relevant theoretical background of OT alongside the basic assumptions I fall back on in the analysis. This is coupled with a discussion of some facts about the syllable structure in MA, facts that adduce support to the claims advanced here.

4.1 Basics of OT

The central claim advanced in OT is that surface forms are the outcome of conflicts between universal constraints. From such a view, the task of individual grammars is to resolve the conflicts by ranking the constraints on a language-particular basis. The OT grammar of a language is made up of three main components: Input, Generator (GEN) and Evaluator (EVAL). GEN is seen as a universal candidate generator whose role is to take an input and emit a set of infinite number of candidates $\{Cand_1, Cand_2 \dots Cand_n\}$ ^①. EVAL is the central component of OT whose role is to evaluate the candidates against the language-particular constraint ranking as well as to assign violation marks whenever a given candidate incurs one. Then, it locates the most harmonic candidate which ultimately qualifies as the optimal one, the surface form. In fact, such a view of grammar dispenses with the serially ordered rule application adopted in earlier approaches of grammar.

In OT, the ranking of constraints is conventionally demonstrated in the constraint tableau method. In Table 1, candidates generated by GEN appear underneath INPUT. Constraints are listed horizontally in front of INPUT. In this analysis, Constraint A and Constraint B disagree on these two candidates. Since Candidate 2 obeys Constraint A and as it appears, it is the optimal one, Constraint A must dominate Constraint B; thus, the ranking is indicated by a solid line. If a constraint incurs a violation of a given constraint it receives a violation

^① This property is referred to as *Freedom of Analysis*.

Deriving Morphological Causatives in Moroccan Arabic

mark indicated by (*). Fatal and gratuitous violation is indicated by (*!). The optimal candidate is called by a pointing hand.

Table 1. A ranking argument, Constraint A >> Constraint B ^①

INPUT	Constraint A	Constraint B
Candidate 1	*!	
☞ Candidate 2		*

Additionally, OT distinguishes between different types of constraints, the most important of which are markedness constraints and faithfulness constraints. Markedness constraints, on the one hand, demand unmarked configurations. Examples of these constraints are ONSET, a constraint militating against onsetless syllables and NOCODA that requires that syllables must be open (CV). Faithfulness constraints, on the other hand, require correspondence between the input and the output, or, put simply, the input and the output must be identical. If markedness constraints dominate faithfulness constraint, M >> F, the language achieves outputs that are minimally marked. The opposite ranking, F >> M, however, yields faithful mappings. Faithfulness constraints are a mandatory requirement in the grammar, as they preserve underlying contrast. Assuming a grammar without faithfulness constraints all underlying contrast will be neutralized, and all inputs will favor unmarked configurations, undesired effects. As should be obvious, these constraints are always in conflict with markedness constraints, for the two interact to derive the optimal form, and hence the term constrains interaction.

One corollary of OT grammar is a phenomenon referred to as the Emergence of the Unmarked. It is a case where a markedness constraint, which is generally dominated/inactive in a language, emerges as decisive in cases when faithfulness constraints fail to select the optimal candidate. This phenomenon is generally attested in cases of reduplication where the reduplicant is observed to opt for unmarked phonological structures, contrary to the base that seems to abide by the phonotactic constraints of the language. More often than not, this tendency violates the phonotactic structure of the language in question.

As the discussion unfolds, it appears that in MA, the Affix_{CAUSE}μ does not tolerate appearing in positions where *COMPLEX_{ONS} is violated. This accounts for why the causative morpheme appears infixes with respect to the root, a TETU effect. The effect of the TETU is captured by the ranking schema below:

^① Interestingly, if the ranking above Constraint A >> Constraint B is the opposite, i.e. Constraint B >> Constraint A, a different grammar emerges, in which case candidate 1 wins out. This essential property of OT is referred to as *Factorial Typology*. As its core, factorial typology predicts that from reranking the universal constraint of one language, another grammar is obtained.

(15) Ranking schema for reduplicative TETU (Alderete, et al. 1999:330): Faith_{IO} >> M >> Faith_{BR}

4.2 Moroccan Arabic syllable structure

MA distinguishes between two types of syllables: CV and CVC. The rest of the forms (CCVC and CVCC) are derived by rules (Benhallam, 1990). As opposed to full vowels, the distribution of schwa is highly restricted in MA as it is disallowed in open syllables. As argued in Benhallam (1990), schwa is epenthesized between an unsyllabified CC sequence^①. Of interest to the present analysis, MA allows complex onsets. As shown in (16), these contexts include verbs, adjectives and nouns.

(16) Verbs	Adjectives	Nouns
<i>ktāb</i> ‘to write’	<i>ʕrāʕ</i> ‘lame’	<i>rʕāl</i> ‘leg’
<i>ʕtāh</i> ‘to dance’	<i>ħwāl</i> ‘cross-eyed’	<i>qfāz</i> ‘cage’
<i>DRāb</i> ‘to hit’	<i>khāl</i> ‘black’	<i>ʕsāl</i> ‘honey’
<i>glās</i> ‘to sit’	<i>byāD</i> ‘white’	<i>nmāl</i> ‘ants’

Using the logic of OT, one can safely say that *COMPLEX_{ONS} is crucially dominated; hence, it is inactive and irrelevant in such contexts. Following Boudlal (2001)^②, the constraints that are operative in deriving the syllable structure in MA are ONSET, *Min-σ, DEP_{IO}, MAX_{IO}, *COMPLEX_{CODA}, and *COMPLEX_{ONS}. The definition of these constraints and their roles are as follows:

- (17) a. *Min-σ: Minor syllables are prohibited
- b. MAX_{IO}: Every segment of the input has a correspondent in the output (No phonological deletion).
- c. DEP_{IO}: Every segment of the input has a correspondent in the output (No epenthesis)
- d. *COMPLEX_{CODA}: More than one consonant in the coda position is prohibited.
- e. *COMPLEX_{ONS}: More than one consonant in the onset position is prohibited.

As should be obvious, the interaction of these constraints is what derives the correct optimal candidates, the surface forms in the language. To illustrate with a pertinent example, the ranking of these constraints is illustrated in Table 2.

Incurring no violation of the higher-ranked constraints, the fully faithful candidate (b) is selected as the optimal one despite its violation of the lower-ranked markedness constraints *COMPLEX_{ONS}. The violation is justified by the presence of two consonants in the onset

^① Syllable structure in MA is so complex a phenomenon that an attempt to present an adequate analysis is beyond the scope of the present study. Recall that the ultimate goal of this paper is to showcase the necessity to make reference to phonological well-formedness in the linearization of the output of syntactic derivation. Accordingly, only the phonological aspects pertaining to the present discussion are reviewed. The interested reader may consult Benhallam (1990) and Boudlal (2001) and references cited therein.

^② In this discussion, ONSET is not relevant. Undeniably, this constraint is active in the language as it rules out all instances of onsetless syllables. It is thus undominated with respect to the constraints suggested above.

Deriving Morphological Causatives in Moroccan Arabic

position. This is indicative of the fact that this constraint is inactive and almost irrelevant. Candidate (a) is ruled out by virtue of its violation of the higher-ranked *Min-σ. Candidate (d) is similar to the surface form, but the first consonant of the root /b/ constitutes a minor syllable. Interestingly, the main explanatory burden in this case falls on the faithfulness constraints to choose the optimal candidate^①.

Table 2. MA syllable structure

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

Summarizing thus far, the paper has presented some of the basic phonological constraints active in the phonology of MA, as these constraints will prove crucial in the sections that follow. It has been shown that MA tolerates the presence of complex onsets, as the constraint *COMPLEX_{ONS} is totally irrelevant. The section that immediately follows will show how the linearization of the causative morpheme is affected by phonological well-formedness, and how the process is an instance of the TETU.

4.3 Proposed analysis

The constraints proposed in this study along with their relative ranking are as follows:

- (18) REALIZE-MORPH, MAX_{IO}, *COMPLEX_{CODA}, *Min-σ >> DEP_{IO} >> *COMPLEX_{ONS} >> ALING-Affix_{CAUSE}μ-L.

For expository reasons, the definition and the role of the newly introduced constraints are as follows:

- (19) a. REALIZE-MORPHEME_{Causative} (RM): An input causative morpheme has a correspondent in the output. (Kurusu, 2001)
 b. ALING (Affix_{CAUSE}, L, Root, L): Align the left edge of the Affix_{CAUSE} with the left edge of the root = every Affix_{CAUSE} is a prefix in the Root.

The hierarchy proposed in Table 3 is what derives the correct surface forms of causatives in MA. For the root input /ktb/, GEN provides many candidates, each of which represents a possible surface form. It is the task of the language-particular ranking to choose the most harmonic one, the one which will ultimately be spelt out as the surface form. This is illustrated in Table 3.

^① In Table 2, there is no provable direct ranking holding between the faithfulness constraints DEP_{IO} and MAX_{IO}.

Table 3. Constraint interaction for causatives in MA

Input: /Affix _{CAUSE} μ-ktb/	RM	MAX _{IO}	*COMP _{CODA}	*Min-σ	DEP _{IO}	*COMP _{ONS}	ALING
a. <i>ktb</i>	*!			*			
b. <i>kkatāb</i>					*!*	*	
☞ c. <i>kattāb</i>					*!*		*
d. <i>ktāb.b</i>				*	*		
e. <i>ktāt.b</i>				*	*		*
f. <i>ktābb</i>			*		*	*	*
g. <i>ktātb</i>			*		*	*	*

Candidate (a) fatally fails as the morpheme that encodes causativity is not morphologically realized.

This is captured by its violation of RM. Candidates (d) and (e) are ruled out as the two violate the constraint *Min-σ. Candidates (f) and (g) satisfy the top-ranked constraint RM and MAX_{IO} but fail to satisfy *COMPLEX_{CODA}. Of interest to the present discussion are the two remaining candidates (b) and (c). These candidates tie as to surface well-formedness, in the sense that the two satisfy the higher ranked constraints and incur the same violation of DEP_{IO}. A question of considerable interest in this regard is how the tie is resolved. This can be made clear in Table 4 where the irrelevant constraints and candidates are not included:

Table 4. Applying method of mark cancellation

Input: /Affix _{CAUSE} μ-ktb/	DEP _{IO}	*COMP _{ONS}	ALING	MAX _{BR}
b. <i>kkatāb</i>	**	*		**
☞ c. <i>kat.tāb</i>	**		*	

If we cancel the violation marks that the two candidates incur, in compliance with the Method of Mark Cancellation^① (Prince & Smolensky, 1993), the faithfulness constraint DEP_{IO} becomes totally irrelevant. It naturally follows that the markedness constraint *COMPLEX_{ONS} is what decides on the optimality of the competing candidates in this case. As has been demonstrated earlier, this constraint is crucially dominated in the language. Note also that obedience to *COMPLEX_{ONS} is obtained at the cost of ill-alignment, the resulting affixal process being infixation. This captures the fact that phonological well-formedness, the banning of complex onsets in the case under study, overrides morphological requirements. This accounts for why the well-aligned candidate (b) is not

^① The gist of this principle is that the violation marks that two candidates share are cancelled/ignored, provided that these violation marks have no direct bearing on the competition (McCarthy, 2002:6).

Deriving Morphological Causatives in Moroccan Arabic

the actual output. This example is a highly predicted one of TETU.

5. Concluding remarks and implications

This paper has attempted to show how the process of infixal gemination is realized in the formation of morphological causatives in MA. To this end, it has compared the technical machinery of two frameworks, namely DM and OT. In particular, I have shown that as far as morphophonology is concerned, OT proves more superior than DM. Incorporating DM has its advantages as well. First, assuming that the root is the input to phonological constraints in standard OT leads to the problem of grammatical categorization^①. What is puzzling in this regard is how the root acquires its morphological category in a systematic and principled way. In the model presented here, this process takes place in the syntax, in compliance with DM assumptions (see Loutfi, 2017). Another advantage is that this model explains why lexical causatives are not morphologically marked. As demonstrated in (20b) and (21b), these verbs, although encoding causativity, cannot be marked morphologically. This observation is attested in both MA and Moroccan Amazigh (Alalou & Farrell, 1993). This is also problematic for standard OT.

(20) a. *Jamal qtəl Khalid.* (MA)

Jamal killed-3MS Khalid

‘Jamal caused Khalid to die.’

b. **Jamal qattəl Khalid.*

Jamal CAUS-killed Khalid

‘Jamal caused Khalid to die.’

(21) a. *y-wt wrba iydi.* (Amazigh)

3MS-hit boy dog

‘The boy hit the dog.’

b. **y-ss-wt-as wrayz iydi I wrba*

3MS-CAUS-hit-DAT man dog to boy

‘The man made the boy hit the dog.’

The ungrammaticality of these constructions can be explained only on the basis of the encyclopedic nature associated with each root^②. Causative morphology is possible only when the root to which the causative morpheme is attached is not specified as externally caused root. It would therefore appear that roots that derive lexical causatives are all specified as $\sqrt{\text{externally caused root}}$. Therefore, the morphological marking on the

^① See Loutfi (2017, 2020) for arguments against a word-based approach to word formation.

^② In DM, roots are classified according to their encyclopedic semantics. More precisely, the verbal root is assumed to function as an event modifier introducing the idiosyncratic aspect of the verb’s meaning. See Alexiadou *et al.* (2006).

√externally caused root renders the sentences ungrammatical (See Louf, 2017) for a detailed discussion), an observation that is hard to capture in a standard OT model.

Abbreviations and Symbols

<p>* (1) a binary operator read as “it is left-adjacent to” (2) a violation mark</p> <p>*! fatal and gratuitous violation</p> <p>— encode immediate precedence and concatenate terminal nodes</p> <p>⊕ SWd affixation</p> <p>1/2/3 first/second/third person</p> <p>μ mora</p> <p>ACC accusative case</p> <p>Cand candidates</p> <p>D determiner</p> <p>DM distributed morphology</p> <p>DP determiner phrase</p> <p>Eval OT evaluator</p> <p>F (1) feminine; (2) faithfulness constraint</p> <p>GEN (1) genitive case; (2) OT generator</p> <p>LD local dislocation</p> <p>M (1) masculine (2) markedness constraints</p>	<p>MA Moroccan Arabic</p> <p>MWd morphosyntactic words</p> <p>NEG negation</p> <p>N noun</p> <p>NOM nominative case</p> <p>OT optimality theory</p> <p>P plural</p> <p>PF phonetic form</p> <p>S singular</p> <p>SWd subwords</p> <p>TETU the emergence of the unmarked</p> <p>u unvalued/uninterpretable feature</p> <p>V (1) lexical verb; (2) vowel</p> <p>v light verb</p> <p>VoiceP voice phrase</p> <p>VP verb phrase</p> <p>vP light verb phrase</p>
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