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# On the Integrity of Geminates in Moroccan Arabic: An Optimality-Theoretic Account[1]

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*Abstract*

*This paper investigates the phonological behavior of geminate consonants in Moroccan Arabic. In particular, we focus on the issue of geminate integrity in the context of schwa epenthesis and word formation. We show that, despite the many apparent exceptions, the variable nature of geminate integrity in MA can be successfully accounted for along the lines of the Geminate Law (Benhallam, 1980) if the latter is reinterpreted in the Optimality Theory framework. In this regard, this paper promises the following contributions: (i) It provides a unified analysis of geminate integrity in MA (ii) It accounts for the variability of geminate integrity through constraint interactions á la Optimality Theory (iii) It reconciles the exceptional patterns of geminate integrity with the regular ones.*

*Keywords***:** geminate behavior, geminate integrity, schwa epenthesis, word formation, phonology, Moroccan Arabic, optimality theory

## 0. Introduction

A geminate can be defined as a "long or doubled consonant that contrasts phonemically with its shorter or singleton counterpart" (Davis, 2011). However, providing a formal phonological definition of geminates requires a theoretical framework of analysis. In linear phonology, a

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geminate is regarded either as a single segment specified for the feature [+long] (Chomsky & Halle, 1968) or as a sequence of two identical consonants (Kenstowicz & Pyle, 1973; Saib, 1977). In non-linear phonology, a geminate is defined in terms of prosodic association to two skeletal positions (McCarthy, 1979, 1981; Leben, 1980) or a mora (Hayes, 1989; McCarthy and Prince, 1986; Davis, 1994, 1999a-b, 2003; Davis and Ragheb, 2014; Davis and Topintzi, 2017). Phonetically speaking, the difference between a geminate and a singleton is described in terms of tenseness, with the former being [+tense]. This means that geminates are articulated with longer constriction in the vocal tract compared to 'normal' consonants (see Hankamer & Lahiri, 1988; Ladefoged & Maddieson, 1996; Thurgood, 1993; Ridouane, 2010; Khattab & Al-Tamimi, 2014; Kubozono, 2017 for more on the phonetic properties of geminates).

A significant cross-linguistic characteristic concerning the phonological behavior of geminates is that they sometimes exhibit properties of cluster structures as well as singleton structures. In other words, within the same language, geminates may simultaneously pattern with consonant clusters with respect to certain rules and with short consonants with regard to other rules. In MA, the phonological behavior of geminates is characterized by resisting rules of epenthesis (i.e. *$C_x$ə$C_x$) which normally affect clusters of unlike consonants (i.e. $C_x$ə$C_y$) (Kenstowicz & Pyle, 1973; Guerssel, 1977; Benhallam, 1980). This generalization is commonly referred to in the literature as geminate 'integrity' or 'inseparability'. However, as far as full vowels are concerned, the integrity of geminates in MA has been found to be regularly subject to breaking (i.e. $C_xVC_x$).

In this paper, we will examine the issue of geminate integrity in MA in connection with schwa and full vowel placement, using the constraint-based framework of Optimality Theory (Prince & Smolensky, 1993/2004). More specifically, we will explore the inconsistent behavior displayed by geminates vis-á-vis normal consonant clusters. Geminates in MA have been shown to be typically immune to vocalic splitting by means of schwa epenthesis (e.g. ħəll 'to open' as opposed to zṛəb 'to hurry'). However, it has been reported that, occasionally, geminates may succumb to schwa epenthesis (e.g. də**ff**a vs. d**fəf** 'doors'). In this regard, we will attempt to discern the possible constraint interactions that make geminates behave the way they do with respect to schwa epenthesis. In connection to this, we also intend to address the behavior of geminates in relation to full vowels, which have been found to split geminates and clusters alike without any notable irregularities (e.g. sə**dd** vs. məs**d**u**d** 'closed').

The structure of this paper is mapped out as follows. Section 1 provides a brief background on the issue of geminate integrity in the non-OT literature. Section 2 characterizes the phonology of schwa in MA and introduces our proposed analysis to capture the effect of the GL in the framework of OT. Section 3 examines some persisting issues to our account and offers some solutions. Section 4 concludes the paper.

## 1. Geminate Integrity: A Review

### *1.1 Benhallam (1980): Rule types and geminate integrity*

Cross-linguistically, the characterization of geminate behavior has been a recalcitrant issue for phonologists. In previous works (Kenstowicz & Pyle, 1973; Saib, 1977; Guerssel, 1977; Leben, 1980), it has been elaborately demonstrated that, within a single language, geminates may display a dual behavior by combining qualities of both cluster structures and unit structures. In this paper, we focus on the issue of geminate integrity in the context of MA data.

Early works on the issue of geminate behavior have predominantly conceived of geminates as cluster structures that pattern with sequences of unlike consonants. However, upon further investigation, it has been observed that geminates prefer to keep the adjacency of their constituent members intact, exhibiting some degree of integrity that normal consonant sequences lack. One manifestation of this preference is their resistance to rules of epenthesis. To account for this anomaly, the Integrity Hypothesis (IH) (Kenstowicz & Pyle, 1973) and the Adjacency Identity Constraint (AIC) (Guerssel, 1977) have been proposed.

(1) The IH (Kenstowicz & Pyle, 1973)

> All other things being equal, a rule which splits up a geminate cluster is less highly valued than a rule which must be constrained from doing so.

(2) The AIC (Guerssel, 1977)

> Given two segments A1A2 where A1=A2, a phonological rule can alter the adjacency of A1A2 if and only if it alters the identity of A1 or A2.

These took the form of general constraints on rules. Their function, then, consisted in excluding geminates from the effect of rules that apply to other clusters. The IH and AIC have been pronounced in an inflexible manner by predicting that the unbroken state of geminates is the most natural state of affairs, in contradiction to the facts shown by the data from a number of languages.

On this note, it was not long after Benhallam (1980) stated that, contrary to the predictions made by the IH and the AIC, the adjacency of geminate clusters can sometimes be predictively altered. Benhallam (1980)

suggested that not all rules are equal in relation to the adjacency of geminates. On this basis, a modification to the theory of geminate integrity was advanced, taking into account the nature of the rules in question. The author argued that geminates tend to have different reactions to different types of rules, such that they can be split by morphological rules but not by phonological ones. To capture this generalization, Benhallam (1980) formulated a constraint on rules dubbed the Geminate Law (GL):

(3) The Geminate Law (Benhallam, 1980, p. 141)[2]

> Geminates can be split up by morphological (or morpholexical) rules but not by phonological rules.

The GL is based on a close examination of data from Palestinian Arabic (PA), Standard Arabic (SA) as well as MA. Consider the following cases from PA:

(4) PA[3]

| | | | |
|---|---|---|---|
| a. sad | 'to close' | sad**i**d | 'closed' |
| b. ħal | 'to open' | ħal**i**l | 'open' |
| c. xad | 'cheek' | xd**u**d | 'cheeks' |

According to Benhallam, an analysis that does not recognize a distinction between phonological rules and morphological ones would have to posit ad hoc solutions to the problem of the inconsistency of geminate integrity. For example, in an attempt to make the IH reign supreme over all rules equally, Guerssel (1977) claimed that the geminates in the first two items from PA are underlyingly split by the vowel /i/. Benhallam criticized this by introducing the datum in (4c), also from PA, which is problematic for Guerssel's view since it entails that the plural [xdud] is the underlying form, from which the singular form is derived by means of vowel deletion, degemination and vowel insertion. For Benhallam (1980), this seems very unlikely, simply because such a claim would lead to a lot of confusion and inconsistency elsewhere. For elaboration, Benhallam presented the following data from SA to highlight the problem:

[2] A reservation about this terminology is in order. The term 'law' gives the impression that the relevant hypothesis is universal and unchallenged. The author himself admits that this is not meant to be a universal, but only a tendency of geminate behavior. A better name could be the Rule-type condition on geminate integrity.

[3] A rule of final degemination applies here.

(5) SA

| | | | |
|---|---|---|---|
| a. ʃubba:k | ‘window’ | ʃab**a:**bi:k | ‘windows’ |
| b. sadd | ‘dam’ | sud**u:**d | ‘dams’ |
| c. ħabi:b | ‘lover’ | ʔaħibba | ‘lovers’ |

The point here is that if the integrity of geminates becomes a criterion for deciding on underlying forms, one would have to list the plural forms as underlying in the cases of (5a) and (5b), while listing the singular form as underlying in the case of (5c). Furthermore, in the case of the derivatives in (6), it would be unclear if one should posit the singular form of the adjective or its plural form as underlying since both occur with split geminates.

(6)

| | |
|---|---|
| ʒadi:d | ‘new (sg.)’ |
| ʒudud | ‘new (pl.)’ |
| ʔaʒadd | ‘newer’ |

Analogously, when inflected for person and tense, some geminated verbs give rise to paradigms whose members vary in terms of the integrity of their geminates. Some forms appear with unbroken geminates, while others have broken geminates. This is exemplified in (7) with the past tense paradigm for the verb ʃaqq ‘to crack’. Given Guerssel’s proposal to posit forms with split geminates as underlying, the question that Benhallam raises here is: what form in the paradigm below, among those with split geminates, should be the underlying form? Note that the paradigm includes more than one form where the geminate is split. Evidently, it would be very implausible to suggest positing more than one form as underlying.

(7) The paradigm problem:

| | |
|---|---|
| ʃaqqa | ‘he cracked’ |
| ʃaqqu: | ‘they cracked’ |
| ʃaqaqtu | ‘I cracked’ |
| ʃaqaqta | ‘you cracked’ |
| ʃaqaqtum | ‘you (pl.) cracked’ |

With these serious problems in the picture, Benhallam confidently suggested that the GL provides better insights into the issue of geminate integrity. Instead of meddling with underlying representations, the GL predicts that geminates get split under the effect of morphological processes. This is supported by the above-discussed data where splitting geminates correlates with the formation of new word forms. Phonological processes, on the other hand, fail to split geminates as has been evidenced by some of the data presented in Kenstowicz and Pyle (1973) and Guerssel (1977).

On a later note, Benhallam cautioned that there exit some notable contradictions to his GL, calling for a revised version that takes into account the new facts represented by the following set of data:

(8) Derived geminates split by phonology:

| | | |
|---|---|---|
| /m-mdd/ | məmdud | 'stretch' |
| /m-mlk/ | məmluk | 'own' |
| /m-mnʕ/ | məmnuʕ | 'forbid' |

The contradiction showcased by this data has to do with what appears to be the splitting of some geminates by means of a phonological rule. The relevant items above are all past participle forms whose geminates arise through affixing the past participle morpheme /m-u/ to base forms that happen to begin with the sound /m/. The result is a derived geminate whose integrity is later compromised by schwa epenthesis, in contradiction with the prediction of the GL. Therefore, to conform to the new facts a revision proved necessary.

(9) The Geminate Law Revised (Benhallam, 1980, p. 145)

> Underlying geminate clusters can be split up by morphological or phonolexical rules but not by phonological rules. Derived geminate clusters can be split up by phonological rules.

The revised version of the GL draws a further distinction between underlying geminates and derived geminates. Only the adjacency of underlying geminates is resistant to phonological rules under the new version. Derived geminates, however, are assumed to be prone to the effect of phonology.

Benhallam briefly pointed out to the fact that the new version of the GL does not say whether, like underlying geminates, derived geminates can be split by morphological rules or not. This is due to the absence of data that can support such a claim. In this regard, we suppose that the GL implicitly predicts that morphological rules should be able to split derived geminates, given their ability to split underlying ones. Coming up with data that could back up this prediction is difficult since it would require two morphological processes interfering with each other. For example, such a case would ideally involve a morphological material which splits a geminate derived through the concatenation of two morphological forms.

Later, it will be shown that the GL does not require any revision to account for this data. We will also show that the dictate of the GL can simply emerge from constraint interaction á la OT. Moreover, we will demonstrate that a distinction between phonological rules and

morphological ones suffices to explain all cases of geminate breaking in MA, including those that were deemed as exceptions in Benhallam (1991).

In view of the GL, the alterable integrity of geminates in MA becomes justified. The items on the left in (10) show that schwa, which is phonologically motivated, is unable to break up the relevant geminates. In the items on the right, however, geminates are split by full vowels that are morphologically or lexically motivated.

(10) Geminate integrity and schwa epenthesis

| | | | | |
|---|---|---|---|---|
| a. | *Verb* | | *PP* | |
| | sədd | *sdəd | məs.d**u**d | 'close' |
| | ħəll | *ħləl | məħ.l**u**l | 'open' |
| | ʃədd | *ʃdəd | məʃ.d**u**d | 'catch' |
| | dəqq | *dqəq | məd.q**u**q | 'knock' |
| b. | *Comparative* | | *Adjective* | |
| | ṛəqq | *rqəq | ṛq**i**q | 'thin' |
| | xəff | *xfəf | xf**i**f | 'light' |
| | bənn | *bnən | bn**i**n | 'tasty |
| | ṣəħħ | *ṣħəħ | ṣ**i**ħ | 'strong' |

### *1.2 Benhallam (1991): Limitations of the GL*

As a follow-up to his earlier work on geminates in 1991, Benhallam published a new article wherein he revisited the issue of geminate integrity in light of new data. In this work, the GL was criticized for being unable to account for all cases of geminate breaking in MA. Specifically, the following items were cited as problematic counterexamples to the GL:

(11)

| | |
|---|---|
| sləl | 'baskets' |
| gfəf | 'bags' |
| rẓəẓ | 'turbans' |
| bərgəg | 'to spy' |

In these items, schwa epenthesis splits underlying geminates, in conflict with the prediction that all geminates should resist breaking by means of phonological rules. In accounting for this problematic data, Benhallam (1991) dispensed entirely with the idea of the GL and proposed a new account where geminates are treated as sequences of normal consonants with no integrity whatsoever. As a result, cases where geminates exhibit resistance to schwa epenthesis are now considered exceptions to the normal application of schwa insertion.

The new state of affairs looks as follows. Given every triliteral root, a schwa is inserted between $C_2$ and $C_3$. Therefore, as far as this general rule of epenthesis is concerned, the broken plural forms in (11) become the norm. Every form that deviates from this rule should then be treated as an exception. For example, words like sədd 'to close' and bənt 'girl' are considered as equally problematic, thus the concept of geminate integrity is no longer necessary. Benhallam needed two rules to explain this pattern. The first one is a lexical rule that inserts a V position after $C_1$ of some lexical categories and subcategories. The rule is reproduced below, where X and Y stand for any number of segments and lexical categories, respectively:

(12) $\varnothing \Rightarrow V / \#C\_X]_Y$


He also proposed a second rule which applies postlexically to fill in the V position. The rule inserts a schwa in the empty nucleus, deriving the structure CəCC. This can be illustrated as follows:

(13) $\varnothing \Rightarrow$ ə / $\underline{V}$


This new way of looking at the issue comes at a cost, however. As has been mentioned before, the concept of geminate integrity becomes irrelevant in this analysis. This alienates the geminate patterns of MA from their crosslinguistic context since it has been shown that geminates do exhibit some degree of integrity across many languages. Thus, we end up having an analysis that works just for MA. Also, the treatment of schwa epenthesis, in forms like gfəf 'bags', as a merely phonological process leaves some unanswered questions. At worst, it seems like the morphology of such forms is left out; at best, it implies that the roots from which these plurals are derived are underlyingly marked for plurality without supporting such a claim.

## 2. An OT account of geminate integrity

In what follows, we will try to show that the inconsistent integrity of geminates in MA is best captured through constraint interactions. More specifically, we will argue for a fixed ranking of geminate integrity between morphology and phonology, such that morphology dominates geminate integrity, which in turn dominates phonology. By doing so, we

will maintain that the broken plural exceptions mentioned in Benhallam (1991) are in fact morphologically relevant, hence put in the morphology side along with the case of the past participle derivation. As for schwa epenthesis, it will be shown that when schwa fails to break a geminate, it is because of its low-ranking status as a phonological process. However, when schwa splits geminates elsewhere, it is probably because the geminates in question are fake. Therefore, we will name our proposed account for geminate integrity in MA: The Fixed Integrity Ranking.

### *2.1 The OT apparatus*

The analysis in this paper is entertained within the framework of Optimality Theory (Prince & Smolensky, 1993/2004; McCarthy & Prince, 1993), which is an output-oriented and constraint-based theory for modelling and formalizing human linguistic knowledge. Central to OT is the assumption that surface language structures are the outcome of interactions between conflicting universal, yet violable, constraints. The universality of constraints in OT offers a way of characterizing the cross-linguistic similarities that correspond to universal grammar (UG). Violability, on the other hand, makes it possible to account for the attested cross-language variations. In OT, constraints are ranked differently from one language to another with priority being given to some constraints over others. A surface form is qualified as being optimal, as compared to other competing candidates, if it incurs the least serious violations of the relevant constraint set, taking into account their hierarchical ranking.

The OT grammar consists of four main components, namely the lexicon, the generator (GEN), the constraint set (CON) and the evaluator (EVAL). First, the lexicon is thought of as a general repertoire containing the underlying forms of morphemes. This component is responsible for supplying the grammar with the essential lexical representations which then function as input forms. The latter are handed to GEN which produces an unlimited number of logically possible output candidates from every input. Third, CON is claimed to be universally shared by the grammars of all individual languages. Finally, EVAL ranks constraints on a language specific basis and selects the optimal output from the relevant candidate set via the parallel assessment of the candidates under scrutiny.

In the remainder of this paper, we will demonstrate that the OT framework allows for an elegant and unified analysis of geminate integrity in MA, which eschews the pitfalls of previous analyses.

### *2.2 Schwa epenthesis in MA*

Understanding the behavior of schwa is very central to our investigation of geminate behavior in Moroccan Arabic. Therefore, before we delve into the intricacies of our account of geminate integrity and its interaction with schwa epenthesis, we will first delineate the general role of schwa in the phonology of MA.

The nature and behavior of schwa are among the most studied phonological aspects of MA (see Benhallam, 1980, 1989/1990, 1991; Benkirane, 1982; Benkaddour, 1982; Al Ghadi 1990/2014, 1994; Boudlal 2001, 2006/2007; Bensoukas & Boudlal, 2012a-b to name but a few). In this body of research within the generative paradigm, it has been mostly claimed that schwa in MA is a purely phonetic vowel, epenthesized in order to break up impermissible sequences of consonant clusters.[4] The epenthetic status of schwa can be determined through comparing morphologically related words, whereby shifting between categories causes schwa to disappear or otherwise change position. To illustrate, we provide the following examples:

(14) The epenthetic nature of schwa in MA

a. Disappearing schwas

| | | | |
|---|---|---|---|
| ktəb | 'to write' | ktuba | 'books' |
| ktəf | 'a shoulder' | ktaf | 'shoulders' |
| sləx | 'slay' | slix | 'slaying' |
| təɾʒəm | 'to translate' | ṭəɾ̣ʒmu | 'they translated' |
| ʃəɾʒəm | 'a window' | ʃɾ̣aʒəm | 'windows' |

b. Moving schwas

| | | | |
|---|---|---|---|
| ʃɾ̣əb | 'to drink' | ʃəɾbat | 'she drunk' |
| ɦɾ̣əb | 'to escape' | ɦəɾ̣bu | 'they escaped' |
| wdən | 'an ear' | wədnin | 'ears' |
| ṣbəʕ | 'a finger' | ṣəbʕu | 'his finger' |
| srəħ | 'to shepherd' | sərħa | 'shepherding' |

In an OT analysis, the process of schwa epenthesis outlined above is captured by the interaction of two basic constraints: PARSE-Segment and DEP-ə. The former requires all consonants to be parsed into syllables, whereas the latter demands that every schwa in the output have a correspondent in the input, prohibiting the insertion of schwa. Being the

[4] Benkirane (1982) and Benkaddour (1982) maintain that schwa is underlying in nouns and epenthetic in verbs only. These works adhere to a diachronic account of schwa in nouns whereby vowel reduction of Classical Arabic (CA) full vowels is what gave rise to underlying schwas in MA.

dominant constraint in this case, PARSE-Seg triggers the epenthesis of schwa at the expense of DEP-ə.[5]

(15) PARSE-Seg >> DEP-ə

| /CCC/ | PARSE-Seg | DEP-ə |
|---|---|---|
| ☞a- CCəC | | * |
| b- CCC | ***! | |

This tableau evaluates candidates for a tri-consonantal input, where the faithful candidate CCC loses for having no syllable structure. Candidate (15a) becomes the winner by satisfying PARSE-Seg through schwa epenthesis. Note that at this stage the justification for the position of schwa is not discussed yet. Any candidate with an additional schwa (e.g. CəCəC) not only would incur multiple and gratuitous violations of DEP-ə but would also violate the undominated constraint against schwa in open syllables, i.e. *μ/ə.

(16) ***μ/ə:** moraic schwas are prohibited (Bensoukas & Boudlal, 2012a, p. 23)

In MA, complex syllable margins are not permitted in MA, in accordance with the stipulation of *COMPLEX. As a result, in order for the latter to be satisfied, a syllabic consonant is created in violation of the constraint against moraic head consonants, i.e. *$\mu_{head}$/C.

(17) ***$\mu_{head}$/C**: moraic head consonants are prohibited.

The interaction between *COMPLEX and *$\mu_h$/C also helps create a bimoraic/disyllabic word that meets the word minimality condition of MA:

(18) *COMPLEX >> *$\mu_h$/C

| /CCəC/ | *COMPLEX | *$\mu_h$/C |
|---|---|---|
| ☞a- C.CəC | | * |
| b- CCəC | *! | |

Thus, the candidate that avoids complex onset via creating a syllabic consonant emerges as the most harmonic form.

[5] Schwa is the default epenthetic vowel in MA. This can be explained by the ranking: Dep-V >> Dep-ə (where V stands for any full vowel). Schwa epenthesis in MA has been described as an oddity of the language, given that other Arabic dialects lack schwa epenthesis; instead they rely on full vowels for epenthesis (see Bensoukas and Boudlal (2012a-b) and references therein for more on this). Bensoukas and Boudlal (2012a-b) describe this oddity as an Amazigh substratum in MA since schwa epenthesis in Amazigh is more fundamental and occurs across many Amazigh dialects.

The epenthetic site of schwa in MA is marked by variability. In triliteral roots, a schwa could fall either between the last two consonants (i.e. CCəC) or the first two ones (i.e. CəCC). In nouns in particular, schwa insertion is subject to the sonority level of the relevant consonants. Al Ghadi (1990/2014, p. 85) maintains that schwa is placed before the most sonorous consonant among the last two or otherwise between the last two consonants if they have the same sonority index:[6]

(19) Schwa epenthesis in triliteral nouns

| a. CəCC | | b. CCəC | |
|---|---|---|---|
| fərx | 'bird' | qbəṛ | 'grave' |
| qəṛd | 'monkey' | kfən | 'shroud' |
| wəld | 'boy' | ʒbəl | 'mountain' |
| qənt | 'corner' | smən | 'salty butter' |

This sonority condition on schwa epenthesis in triliteral nouns is formulated as follows:

(20) The sonority condition (Al Ghadi, 1990/2014):[7]

a. $C_1əC_2C_3$: If $C_2$ is more sonorous than $C_3$
b. $C_1C_2əC_3$: If $C_3$ is more sonorous than $C_2$ or equal to it

Such a condition can be stated in the form of a violable constraint á la OT. Therefore, through its interaction with the previously established constraints, the constraint SON-Cond would define the epenthetic position of the schwa in triliteral nouns in the following way:

(21) SON-Cond, PARSE-Seg, *COMPLEX >> *$\mu_h$/C, DEP-ə

| /frx/$_N$ | SON-Cond | PARSE-Seg | *COMPLEX | $\mu_h$/C | DEP-ə |
|---|---|---|---|---|---|
| ☞a. fər.x | | | | * | * |
| b. f.rəx | *! | | | * | * |
| c. .fərx. | | | *! | | * |
| d. frx | | ***! | | | |

This tableau illustrates the effect of the first part of the sonority condition. In the optimal candidate, schwa is inserted before the liquid /r/ since it is more sonorous than the fricative /x/. Candidate (21b) is ruled out for violating the sonority condition by placing the schwa before the less sonorous consonant of the $C_2C_3$ cluster. Candidate (21c) respects the

[6] The sonority of $C_1$ is kept out of the equation probably for the simple reason that placing a schwa before $C_1$ would be costlier than all the other possible options in terms of syllable well-formedness, resulting in an onsetless syllable which the language prohibits.

[7] The vast majority of nouns obey the sonority condition. However, there are a bunch of nouns that stray away, for example: ħnəʃ 'snake' and ħəbs 'jail'.

sonority condition in the same way the optimal form does, but it is excluded for violating *COMPLEX. Candidate (21d) is rejected simply for having no syllable structure, going against the will of PARSE-Seg.

The following tableau shows the optimal position of schwa when $C_3$ is more sonorous than $C_{2:}$

(22) SON-Cond, PARSE-Seg, *COMPLEX >> *$\mu_h$/C, DEP-ə

| /ʒbl/$_N$ | SON-Cond | PARSE-Seg | *COMPLEX | $\mu_h$/C | DEP-ə |
|---|---|---|---|---|---|
| ☞a. ʒ.bəl | | | | * | * |
| b. .ʒbəl. | | | *! | | * |
| c. ʒəb.l | *! | | | * | * |
| d. ʒbl | | ***! | | | |

In this tableau, however, it is the second part of the sonority condition that gets to define the place of the schwa. The optimal candidate has its schwa epenthesized right before the lateral /l/, for it is more sonorous than the bilabial /b/. *COMPLEX disqualifies candidate (22b) due to its complex onset. Candidate (22c) wrongly places the schwa before the less sonorous consonant, and hence loses in the competition. Candidate (22d) fails as it does not conform to the stipulation of the high-ranking PARSE-Seg.

Now, let us consider the case of schwa epenthesis in triliteral verbs and adjectives. Unlike in nouns, the sonority of the individual consonants in verbs and adjectives has no impact on the placement of schwa. The latter, however, is invariably epenthesized between the last two consonants. Consider the following examples:

(23) Schwa epenthesis in triliteral verbs and adjectives

| *a. Verbs* | | *b. Adjectives (comparative)* | |
|---|---|---|---|
| ɦiṛəb | ‘escape’ | tqəl | ‘heavy’ |
| tləf | ‘disappear’ | ṭwəl | ‘tall’ |
| ʃṛəb | ‘drink’ | ɣləḍ | ‘fat’ |
| kbər | ‘grow’ | sɦəl | ‘easy’ |

In the face of this situation, an alignment constraint has been devised by Boudlal (2001) to explain the invariability that characterizes schwa epenthesis in triliteral verbs and adjectives (also see Bensoukas & Boudlal (2012a-b)). The constraint proposed requires that the verb/adjective stem and the main syllable should be aligned at the right periphery, formally written as ALIGN-R-Maj-σ.

(24) ALIGN-R-Maj-σ:

> The right edge of the verb/adjective stem should align with the right edge of the major syllable.

If we think of SON-Cond as a constraint that is applicable only to nouns, then ALIGN-R would not need to dominate it. This means that their effects would be in complementary distribution, with each one operating on different lexical categories. However, if SON-Cond is thought of as a general constraint that is blind to the lexical category of words, then ALIGN-R would have to dominate it to keep verbs and adjectives out of its reach. For us, SON-Cond is a general constraint that should be dominated by ALIGN-R as shown by the following tableau:

(25) ALIGN-R >> SON-Cond, PARSE-Seg, *COMPLEX >> *$\mu_h$/C, DEP-ə

| /tlf/$_V$ | ALIGN-R | SON-Cond | PARSE-Seg | *COMPLEX | $\mu_h$/C | DEP-ə |
|---|---|---|---|---|---|---|
| ☞a. t.ləf | | * | | | * | * |
| b. .tləf. | | * | | *! | | * |
| c. təl.f | *! | | | | * | * |
| d. tlf | | | ***! | | | |

What is explained by this tableau is why the schwa of the optimal candidate is inserted before the fricative /f/ rather than the more sonorous lateral /l/. On the basis of the ranking ALIGN-R >> SON-Cond, verbs and adjectives break free from the stipulation of SON-Cond in order to satisfy ALIGN-R. On the other hand, the sonority-respecting candidate is ruled out for failing to satisfy the more important right alignment. Candidates (25b) and (25d) are suboptimal for violating *COMPLEX and PARSE-Seg, respectively.

With this out of the way, we are now in a good position to introduce our analysis of the issue of geminate integrity in relation to schwa epenthesis and word formation in MA.

### *2.3 Schwa epenthesis in the context of geminate integrity*

The GL, as argued for in Benhallam (1980), belongs to the pre-OT literature. It is formulated in the form of a general constraint on rewrite rules. It permits morphological rules to split up geminates while prohibiting phonological rules from doing so. In that framework, the GL can be criticized for being an extra cost on the grammar of the language, intuitively stated and allegedly inviolable. In OT, the effect of the GL can be achieved simply through the interaction of universal and violable constraints. To this end, a constraint named GEM-Integ (short for Geminate Integrity) is posited to represent the resistance to breaking exhibited by geminates:

(26) GEM-Integrity: a geminate consonant cannot be split

We have previously shown that schwa epenthesis in triliteral verbs and adjectives is subject to an alignment constraint that demands the main

syllable to align with the word stem at the right periphery. However, lexically geminated verbs and adjectives appear to violate this requirement. Here comes the role of GEM-Integ. By dominating ALIGN-R, GEM-Integ prohibits the schwa from splitting the designated geminates. Rather, schwa epenthesis takes place between $C_1$ and G. The interaction between GEM-Integ and ALIGN-R is illustrated by the following tableau:

(27) GEM-Integ >> ALIGN-R

| /$CC_xC_x$/$_{V/adj}$ | GEM-Integ | ALIGN-R |
|---|---|---|
| ☞a. C$\partial C_xC_x$ | | * |
| c. C.$C_x\partial C_x$ | *! | |

This tableau shows that candidate (27c) is penalized by the high-ranking GEM-Integ due to its broken geminate. Hence, it loses to the optimal candidate, which succeeds in maintaining the integrity of its geminate.

The tableau in (28) below presents other competing candidates and interacting constraints. Specifically, the markedness constraints *COMPLEX and *$\mu_h$/C are introduced to distinguish between the candidates *səd.d* and *sədd.* *COMPLEX disfavors candidates with a complex coda whereas *$\mu_h$/C prohibits consonantal syllabic heads:[8]

(28) GEM-Integ, *COMPLEX, PARSE-Seg >> ALIGN-R, *$\mu_h$/C, DEP-ə

| /sdd/ | GEM-Integ | *COMPLEX | PARSE-Seg | ALIGN-R | $\mu_h$/C | DEP-ə |
|---|---|---|---|---|---|---|
| ☞a. səd.d | | | | * | * | * |
| c. s.dəd | *! | | | | | * |
| d. .sədd. | | *! | | * | | * |
| e. sdd | | | **! | | | |

In this tableau, both the optimum and candidate (28d) respect geminate integrity. However, candidate (28d) is inferior to the optimum in that it has a complex coda. In the optimal candidate, the first half of the geminate syllabifies into a coda whereas the second half projects a syllable of its own in satisfaction of the high-ranking *COMPLEX, militating against complex margins. Candidate (28e) stands no chance in the competition since none of its segments is parsed.

### *2.4 Broken plurals*

In this section, we provide a fresh look at the issue of geminate integrity in MA. We show that, by rushing to undermine the generalization of the GL, Benhallam (1991) overlooks some important details about the issue. We argue that a distinction between phonological processes and

[8] See Noamane (Forthcoming) for a different and more elaborate take on the representation and syllabification of geminates.

morphological processes can be the basis of an adequate account of all the patterns of geminate integrity in MA. To achieve this goal, our analysis will be entertained under the rubric of OT.

It is true that the Fixed Integrity Ranking predicts that all underlying geminates should resist schwa epenthesis. Therefore, the items in (29) seemingly stand as counterexamples to this prediction. However, it could very well be that the status of geminates in these items follows from the provision of the Fixed Integrity Ranking itself if a careful look is taken. Recall that the Fixed Integrity Ranking also predicts that morphological processes can break geminates. Therefore, is not this a case of a morphologically motivated geminate breaking?

(29) Broken geminates

| *Sg.* | *Pl.* | |
|---|---|---|
| səlla | sləl | 'basket' |
| gəffa | gfəf | 'bag' |
| rəẓẓa | rẓəẓ | 'turban' |
| səkka | skək | 'rail' |
| dərra | drər | 'veil' |
| dəffa | dfəf | 'door' |
| sədda | sdəd | 'mezzanine' |
| ʕəʃʃ | ʕʃəʃ | 'nest' |
| ħukk | ħkək | 'can' |

In this set of data, the broken plurals on the right consist of a consonantal root, which they share with their singular counterparts, plus schwa that splits their geminates. Other broken plurals have full vowels, instead. Consider the following examples for illustration:

(30)

| *Sg.* | *Pl.* | |
|---|---|---|
| muxx | mxax | 'brain' |
| kumm | kmam | 'sleeve' |
| muʃʃ | mʃaʃ | 'cat' |
| ʕəmm | ʕmam | 'uncle' |
| ʒədd | ʒdud | 'grandfather' |
| xədd | xdud | 'cheek' |
| qəṭṭ | qṭuṭ | 'cat' |
| kəff | kfuf | 'palm' |
| ṛəff | ṛfuf | 'shelf' |
| ʒənn | ʒnun | 'ghost' |
| xəṭṭ | xṭuṭ | 'line' |

In particular, the geminates in the broken plurals in (30) are split either by the vowel /a/ or /u/. The nature of the vowel that each plural happens

to have seems to be unpredictable.[9] We believe that an analysis which recognizes the morphological equivalence between the broken plurals in (29) and those in (30) is preferable. Also, such an analysis appears to require fewer assumptions about the phonology of schwa. Additionally, this will also help us maintain an analysis that could be extended to the items below:

(31)

| | | | |
|---|---|---|---|
| a. | *Comparative* | *Adjective* | |
| | ṛəqq | ṛqiq | 'thin' |
| | xəff | xfif | 'light' |
| | bənn | bnin | 'tasty' |
| | ṣəħħ | ṣħiħ | 'strong' |
| b. | *Verb* | *Past participle* | |
| | sədd | məsdud | 'close' |
| | ħəll | məħlul | 'open' |
| | ʕəḍḍ | məʕḍuḍ | 'bite' |
| | ʃəqq | məʃquq | 'crack' |
| | ʃədd | məʃdud | 'catch' |
| | ħədd | məħdud | 'limit' |

By doing this, we will be able to maintain that all cases of geminate breaking ensue from morphological demands.

To this end, two hypotheses will be considered. The first hypothesis that intuitively comes to mind would be to assume that the schwa of the broken plurals in (29) is a morphological marker, in the same way the full vowels in (30) through (31) are, arguably, morphologically induced. In this case, the schwa in (29) should be distinguished from the schwa used to break consonant clusters for purely phonological purposes. This way, we could account for our data in total agreement with the stipulation of the Fixed Integrity Ranking. However, this proposal seems unfavorable for two reasons. For one, granting a morphemic status to the schwa is not supported by other data in the language, unlike full vowels whose morphological use recurs on more than one occasion. For another, by distinguishing a morphological schwa and a phonological one, we sacrifice the phonological generalization of schwa epenthesis, meaning that not all schwas would have to be phonologically predictable.

For these reasons, an alternative treatment is suggested. We argue that the geminates in (29) are not broken by schwa epenthesis per se. Rather, they

[9] The unpredictability of the vowels in these plurals could be explained by a subcategorization mechanism, whereby different nouns can be lexically related to one vowel or the other.

are split by means of morphological activity. To be more specific, we believe that the optimum is marked for plurality by means of neutralizing the geminate integrity of the input, meaning that the position between the parts of the geminate becomes available for schwa epenthesis. Schwa in this case has no morphological status by itself.[10] To make our account more concrete, we posit the following constraints:

(32)

a. PARSE-Segment: assign one violation to every unsyllabified segment.
b. DEP-ə: every element in the output must have a correspondent in the input (no insertion).
c. RM-Plural: the plural morpheme must have some phonological exponence in the output form, whereby the latter should be unfaithful to the root.
d. GEM-Integrity: a geminate consonant cannot be split.

The interaction between the constraints PARSE-Seg and DEP-ə is conventionally responsible for schwa epenthesis for purely phonological reasons, namely breaking consonant clusters. The RM-Pl constraint in (32c) requires some degree of unfaithfulness between the input and the output for the sake of realizing the plural morpheme. The constraint in (32d) demands the maintenance of the integrity of geminates. Through the ranking of RM-Pl over GEM-Integrity, some degree of unfaithfulness can be achieved. In this case, the integrity of the underlying geminate in the input can be broken as a very subtle way to realize the plural morpheme. This is reflected by schwa epenthesis, which then interprets the relevant geminate as a sequence of two consonants.

(33) PARSE-Seg, RM-Pl >> GEM-Integrity, DEP-ə

| √sll | PARSE-Seg | RM-Plural | GEM-Integrity | DEP-ə |
|---|---|---|---|---|
| a. sll | W*! | W* | L | L |
| b. səll | | W*! | L | * |
| ☞c. sləl | | | * | * |

The inserted schwa in candidate (33b) cannot accomplish any morphological function. In fact, in this context, schwa epenthesis is a mere syllabification auxiliary. Thus, candidate (33b) fails to realize the plural morpheme by remaining faithful to the input. Arguably, such a candidate does not have any morphological exponence that could represent the plural morpheme. The optimal candidate (33c) satisfies

[10] Our account for this data assumes a root-based approach to word derivation in MA. See Noamane (2014, 2018) for arguments in favor of the morphological status of the root in MA.

RM-Pl at the expense of Gem-integrity, thereby allowing the schwa to occur between the parts of the split geminate.

### *2.5 The past participle*

This section will be devoted to investigating the morphological effect of the past participle (PP) derivation on geminate integrity. We look at those PPs derived from roots with final geminates. To illustrate, consider (34) below:

(34) məC.$C_i$u$C_i$:

| *Verb* | *PP* | |
|---|---|---|
| sədd | məsdud | 'close' |
| ħəll | məħlul | 'open' |
| ʕəḍḍ | məʕḍuḍ | 'bite' |
| ʃəqq | məʃquq | 'crack' |
| ʃədd | məʃdud | 'catch' |
| ħədd | məħdud | 'limit' |

Note that the same geminates that resist schwa epenthesis in the verb forms in (34) tend to be split by the vowel /u/ in the corresponding PP forms. In compliance with the line of reasoning that we have been pursuing in this paper, our analysis of this case of geminate breaking is also underlain by the basic assumption that geminates can only be split by morphological rules but not by phonological ones. Like in the case of the broken plural, we demonstrate that such assumption is supported by constraint interaction á la OT.

In this regard, the other assumption that follows is that the PP affix is represented by the discontinuous morpheme /m-u/. This means that the /u/ is part of the PP morpheme. Such an assumption is motivated by two main factors. First, we believe that assuming that the vowel /u/ is able to split geminates thanks to its morphological status resonates well with the postulations of the Fixed Integrity Ranking. Claiming otherwise would undermine the latter's generalization. Second, the vowel /u/ establishes morphological contrast between a large set of nouns and their PP counterparts, working as a meaning carrier morpheme. For the sake of illustration, some examples are listed below:

(35)

| *PP* | *Noun* | |
|---|---|---|
| məktub | məktəb | ‘write’ |
| məlʕub | məlʕəb | ‘play’ |
| məḍrub | məḍrəb | ‘hit’ |
| mədfun | mədfən | ‘bury’ |
| mərbuṭ | mərbəṭ | ‘tie’ |
| məxzun | məxzən | ‘store’ |
| məʃṛub | məʃṛeb | ‘drink’ |
| mədluk | mədlək | ‘flat’ |
| məlbus | məlbəs | ‘wear’ |

Alternatively, one could attribute the morphological contrast between the nouns and PPs in (35) to their templates (see Boudlal, 2001). Under this view, the nature of the epenthetic vowel follows from the templatic properties of each form. However, the morphemic status of the /u/ is further supported by the fact that no nouns of the shape [məC.$C_i$əC$_i$] are found in MA -where the last two consonants can be the result of geminate breaking. If both the vowel /u/ and the schwa were equally epenthetic vowels that are used to satisfy some templatic requirement, then nouns like the ones in (36) should also be possible. Said differently, for templatic reasons, one would also expect the schwa to break the geminates in the potential, yet nonexistent, nominals in (36). Nonetheless, the vowel /u/ is exclusively entitled to split geminates.

(36)

| | |
|---|---|
| sədd | *məs.dəd |
| ħəll | *məħ.ləl |
| ʃədd | *məʃ.dəd |
| ʕəḍḍ | *məʕ.ḍəḍ |
| ʃəqq | *məʃ.qəq |

Therefore, the fact that no such lexical items are attested could be interpreted as an indication of the inadequacy of templatic effects in predicting the nature of epenthetic vowels in MA. Accordingly, it is more convincing to treat the /u/ as part of the PP morpheme (Joe Pater, personal communication).

In OT, morphemes have no intrinsic affixal status. Their locations are defined by a category of constraints dubbed anchor or alignment constraints. Anchor constraints are one of Prince and Smolensky’s (1993/2004) earliest contributions in OT. Building on that, McCarthy and Prince (1993) proposed a general family of constraints to capture the various constituent-edge effects in both morphology and phonology. Linguistic theory provides the grammar with a wide range of prosodic

(PCat) and grammatical (GCat) categories. Thus, "a GA requirement demands that a designated edge of each prosodic or morphological constituent of type Cat1 coincide with a designated edge of some other prosodic or morphological constituent Cat2." (See McCarthy & Prince, 1993, p. 2) The general schema of this constraint family comes as follows:

(37)

Generalized Alignment: (McCarthy & Prince, 1993)
Align (Cat1, Edge1, Cat2, Edge2) =def
∀ Cat1 ∃ Cat2 such that Edge1 of Cat1 and Edge2 of Cat2 coincide
Where
Cat1, Cat2 ∈ PCat ∪ GCat
Edge1, Edge2 ∈ {Right, Left}

Though alignment constraints are equally violated, their violation should be kept minimal. The designated affix should be as close as possible to the designated edge. Therefore, alignment constraints need to be gradiently assessed for violations, whereby the degree or multiplicity of violation is measured in terms of distance from the designated edge. The formal constraint which represents this general constraint family is ALIGN, which can be then specified for the targeted edges and the relevant categories.

One of the major functions of ALIGN constraints is the formation of new words by affixing morphemes to the left or the right of a stem. GA conceives of affixation as an edge-oriented phenomenon. Under this model, the prefixhood or suffixhood of morphemes is dictated by alignment constraints. In this context, prefixation and suffixation occur when ALIGN constraints refer to the left edge and the right edge, respectively.

Under this conception, the constraint that is responsible for the morphological distribution of the PP morpheme in our OT analysis is the following alignment constraint:

(38) ALIGN (m, L, u, R)

The right edge of /m-/ is aligned to the left edge of the stem, the left edge of /-u/ is aligned to the right edge of the stem.

This constraint characterizes the PP morpheme as a circumfix, in that the [m] of the affix is aligned to the left edge of the root while the [u]

is aligned to the right edge of the root. However, while the [m] is consistently left aligned, the [u] of the morpheme always appears inside the derived forms, contrary to the stipulation of the posited alignment constraint. In order to account for the misalignment of the /u/, we postulate another alignment constraint, which we define as follows:

(39) **ALIGN- (Rt, R, PrWd, R)**

> The right edge of the root should coincide with the right edge of the prosodic word.

The type of demand made by this alignment constraint is that the right edge of the root should match the right edge of the derived PP form. By being in a dominant position, this constraint pushes the [u] of the PP morpheme inside the prosodic word. The interaction between these two alignment constraints is illustrated by the following tableau:

(40) ALIGN- (Rt, R, PrWd, R) >> ALIGN (m, L, u, R)[11]

| √sdd /m, u/ | ALIGN- (Rt, R, PrWd, R) | ALIGN-affix-$_{pp}$ |
|---|---|---|
| ☞a. məs.dud | | * |
| b. məs.d.du | *! | |

Evidently, candidate (40b) loses in the competition for failing to bring the right edges of the root and the prosodic word together. In satisfaction of the dominating constraint, the winning candidate infixes the suffixal part of the PP morpheme, allowing the right edge of the root and that of the prosodic word to match. This brings us back to the issue of geminate integrity. In this concern, when the /u/ of the PP morpheme moves inside the derived form, it splits the relevant geminates in the process. This means that the alignment constraint regulating the edges of the root and the prosodic word has to outrank the constraint GEM-Integrity as well.

[11] This analysis can be extended to account for all the other PP classes. See Noamane (In preparation) for a comprehensive analysis of the PP formation in MA. In this work, it is claimed that the /u/ of the PP morpheme may get deleted under phonological pressure, like in *məkri* 'rented', hence the ranking Phonology >> MAX-Affix$_{pp}$. In particular, we argue that the /u/ is deleted under the pressure of the conjoined markedness constraint *High$^2_{word}$, militating against the co-occurrence of the feature [+high] in the domain of the word.

(41) ALIGN- (Rt, R, Pwrd, R) >> GEM-Integrity

| √sdd /m, u/ | ALIGN- (Rt, R, Pwrd, R) | GEM-Integrity |
|---|---|---|
| ☞a. məs.dud | | * |
| b. məs.d.du | *! | |

What disqualifies candidate (41b) is its persistence to observe the integrity of the geminate by keeping the /u/ of the PP morpheme at the right edge, hence violating the high-ranking alignment constraint. The winner, however, gives up the integrity of the geminate in question by allowing the right edges of the root and the prosodic word to match. A summary tableau is provided below:

(42) ALIGN- (Rt, R, Pwrd, R) >> ALIGN (m, L, u, R), GEM-Integrity

| √sdd /m, u/ | ALIGN- (Rt, R, Pwrd, R) | ALIGN (m, L, u, R) | GEM-Integrity |
|---|---|---|---|
| ☞a. məs.dud | | * | * |
| b. məs.d.du | *!W | L | L |
| c. m.sudd | | **! | |

Recall that, in the theory of GA, affixation is edge-oriented. Therefore, affixes should be as close to their designated edges as possible. This means that moving the /u/ of the PP morpheme further inside the prosodic word would be costlier, causing multiple violations of ALIGN-Affix. This situation is represented by candidate (42c) which is excluded exactly for this reason.

To recapitulate, we have been trying to prove that the variable nature of geminate integrity in MA follows from constraint interaction á la OT. Particularly, it has been shown that, on the one hand, the phonological process of schwa epenthesis fails to break geminates due to the ranking of Gem-Integrity above ALIGN- (Major-σ, R). On the other hand, it has been demonstrated that geminate integrity can be compromised only under morphological pressure like in the cases of the broken plural and the past participle, whereby the constraint Gem-integrity is outranked by RM-Pl and ALIGN (Rt, R, PWrd, R), respectively. In summary, the patterning of geminate integrity in MA can be captured by the general ranking of GEM-Integrity between morphology and phonology in the following way: Morphology >> GEM-Integrity >> Phonology.

## 3. Some persisting issues

For the sake of exhaustiveness, there are other interesting portions of the data that remain to be captured under our analysis. First, there is this set of items which does not comply with the stipulation of RM-Pl. In the plurals listed in (43) below, the plural morpheme is not realized by neutralizing the integrity of the relevant geminates as is the case in (29)

above. Instead, the inserted schwa happens to obey geminate integrity. This could undermine the analysis we have been trying to construct. Consider the following examples:

(43)

| *Sg.* | *Pl.* | |
|---|---|---|
| bəqqa | bəqq | ‘bug’ |
| ħəbba | ħəbb | ‘grain’ |
| bəẓẓa | bəẓẓ | ‘brat’ |
| qəʃʃa | qəʃʃ | ‘junk’ |

The question we ask now is: why does the schwa in these plurals not split the geminates? To answer this question, we argue that the roots of these plurals are inherently marked for plurality. A simple diagnosis to confirm the plurality of the designated roots is to put them after the quantifying phrase ‘bəzzaf djal’, translated into ‘plenty of’. Only plural nouns can come after such a phrase:

| | |
|---|---|
| Bəzzaf djal l- | bəqq |
| | bəẓẓ |
| | ħəbb |
| | qəʃʃ |

The underlying assumption here is that the singular form of these nouns is derived from the mass plural forms stated above. However, it is worth noting that these nouns can also have count plurals, which are plurals that refer to discrete entities, derived through normal concatenation. This can be exemplified as follows:

(44)

| *Mass Pl.* | *Sg.* | *Count Pl.* | |
|---|---|---|---|
| bəqq | bəqqa | bəqqat | ‘bug’ |
| ħəbb | ħəbba | ħəbbat | ‘grain’ |
| bəẓẓ | bəẓẓa | bəẓẓat | ‘brat’ |
| qəʃʃ | qəʃʃa | qəʃʃat | ‘jun-k’ |

Therefore, since RM-Pl is inherently satisfied by the root of these nouns, there is no morphological motivation for schwa epenthesis to break the integrity of the geminates for the sake of deriving the plural form. Therefore, in the absence of the morphological incentive to split the geminates of the forms in (43), the latter would preserve the integrity of their geminates. Any gratuitous change of the integrity of the relevant geminates would be penalized by the constraint GEM-Integrity.

(45) PARSE-Seg >> RM-Plural >> GEM-Integrity, DEP-ə

| √bqq (pl) | PARSE-Seg | RM-Plural | GEM-Integrity | DEP-ə |
|---|---|---|---|---|
| a. b.qəq | | | *! | * |
| b. bqq | *! | | | |
| ☞c. bəq.q | | | | * |

Since the root is inherently marked for plurality, there is no need for candidate (45a) to give up the integrity of its geminate. Thus, candidate (45a) is ruled out due to its violation of GEM-Integrity. Candidate (45b) is excluded by PARSE-Seg for failing to parse its segments. Candidate (45c) emerges as the winner for keeping the integrity of its geminate intact.

There is another set of data that needs to be handled so that our analysis can stand firm. This time we are considering instances of underlying geminates that are spilt by schwa epenthesis without being morphologically licensed. Some examples are shown below:

(46)

| *3p sg.* | *2p sg.* | *3p pl.* | |
|---|---|---|---|
| bərgəg | bərgəgti | bərggu | 'spy' |
| fərtət | fərtətti | fərttu | 'crumb' |
| ħənẓəẓ | ħənẓəẓti | ħənẓẓu | 'stare' |

So far, we have been trying to substantiate the idea that geminates can break only when morphology compels them to do so. However, the items in (46) seemingly contradict this line of reasoning. There are two ways out. One way is to consider these cases as exceptions. The other way is to dig deeper and see if we are really dealing with geminates. By asking this question, we proceed to make a comparison between the verbs in (46) and those in (47). We notice that the 'geminates' in (46) do not exhibit any of the geminate qualities that we have come to know and are illustrated by the examples in (48). The latter show that geminates are characterized by resisting schwa epenthesis and triggering [i]-epenthesis in verb inflection. Rather, the 'geminates' in (46) seem to behave in the same way as any two unlike consonants, as shown by (47).

(47)

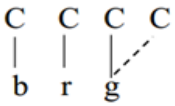
| | | | |
|---|---|---|---|
| ṭərʒəm | ṭərʒəmti | ṭərʒmu | 'translate' |
| kərkəb | kərkəbti | kərkbu | 'roll' |
| dərdek | dərdəkti | dərdbu | 'roll over' |

(48)

| | | | |
|---|---|---|---|
| sədd | sədditi | səddu | 'close' |
| ħəll | ħəlliti | ħəllu | 'open' |
| ʕəḍḍ | ʕəḍḍiti | ʕəḍḍu | 'bite' |

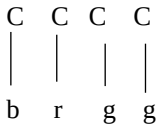
Therefore, the apparent geminates in (46) are but mere sequences of two identical singletons. Hence, this should explain why there is a schwa between them. Prior to the advent of OT, the OCP (McCarthy, 1986) could not allow the occurrence of two identical adjacent elements at the same melodic level. As a result, the items in (46) could only have geminates that are derived through rightward spreading of the last root consonant, creating a structure that would prevent vowel epenthesis in respect of the non-crossing association lines constraint.

(49) The pre-OT OCP prohibits identical melodic elements




In OT, however, there are no restrictions on underlying structures, in the sense that any type of input can be posited. This is referred to as 'richness of the base' (Prince & Smolensky, 1993/2004). Under this view, we can think of the items in (46) as being derived from inputs with sequences of two identical consonants.

(50) Identical melodic elements are possible in OT




Also, special to OT is the idea that all constraints are violable as long as they can be outranked by other constraints. On this basis, the OCP becomes violable under the pressure of higher-ranking constraints. For a structure of two identical consonants to surface, we suggest that the OCP should be dominated by a faithfulness constraint demanding the preservation of the featural identity of the input root nodes, hence IDENT-RN.

(51) IDENT-RN >> OCP

| /brgg/ | IDENT-RN | OCP |
|---|---|---|
| ☞a. bərgəg | | * |
| b. bərgə$C_X$ | *! | |

Candidate (51b) represents any possible candidate where the last consonant changes its featural identity to become different from the adjacent identical consonant. Any candidate of this form would be ruled out by IDENT-RN. The winning candidate under this ranking would always be the one where the identity of all root nodes is preserved.

Another explanation that we can give to this case of schwa epenthesis is to think of the alleged geminates, in the quadriliteral verbs above, as fake geminates, occurring across morpheme boundaries. For this to be possible, we will have to postulate that the second member of the fake geminate is a reduplicant morpheme whose role is to derive what we can call repetitive verbs (i.e. verbs that express repetition of the action). This way, schwa epenthesis in these verbs becomes justifiable, in the sense that it does not break a true geminate, but a fake one.

(52) The reduplicative approach

| *Root* | *Root+RED* | *Derived verbs* |
|---|---|---|
| brg | brg+C | bərgəg |
| frt | frt+C | fərtət |
| ħnẓ | ħnẓ+C | ħənẓəẓ |

Reduplication in MA is not unheard of since there are a number of verbs characterized by the repetition of their first syllable (see Imouzaz, 2002). Some examples are provided below:

(53)

| *Base verb* | *Derived verbs* | |
|---|---|---|
| ʃəmm | ʃəm.ʃəm | 'to smell' |
| ʒəɾɾ | ʒəɾ.ʒəɾ | 'to pull' |
| dəqq | dəq.dəq | 'to knock' |

Next, we proceed to consider more cases of apparent exceptions to the generalization put forward by the Fixed Integrity Ranking. This time we deal with another case of schwa epenthesis which, supposedly, breaks geminate consonants. Note that the relevant 'geminates' in (54) are created through morpheme concatenation. They can only occur when the base form of the derived past participles arbitrarily begins with the consonant /m/, matching that of the past participle affix, believed here to be the discontinuous morpheme /m-u/.

(54) Fake geminates

| | | | |
|---|---|---|---|
| məmdud | hypercorrected as | mmdud | 'stretched' |
| məmnuʕ | | mmnuʕ | 'forbidden' |
| məmluk | | mmluk | 'owned' |
| məmʃuṭ | | mmʃuṭ | 'combed' |

Previously, we mentioned that this data has led Benhallam (1980) to revise the initial version of the GL, thus distinguishing between underlying geminates and derived geminates. In the revised version, derived geminates were allowed to be split by schwa. We weigh in on this issue by claiming that the revised version of the GL is based on a false assumption and could have been avoided. Particularly, we believe that the 'geminates' in (54) ought to be classified as false (or fake) geminates. These are structures that occur across morpheme or phrase boundaries and exhibit none of the properties of true geminates. The latter could be of two types: underlying or derived. Derived geminates can be phonological, created through assimilation, or morphological, created through mora affixation (e.g. √ktb >> kə**tt**əb. Be they underlying or derived, true geminates are expected to behave the same way vis-á-vis schwa epenthesis. This claim is substantiated by the following data:

(55) Derived geminates resist schwa epenthesis:

| | | | | |
|---|---|---|---|---|
| a. | /l-sma/ | ssma | *səsma | 'the sky' |
| | /l-ḍra/ | ḍḍṛa | *ḍəḍṛa | 'the corn' |
| b. | /ktra/ | kətra | | 'plenty' |
| | /ħʃma/ | ħəʃma | | 'shyness' |

Schwa epenthesis is an effective diagnosis to tell fake and true geminates apart in MA. True geminates normally block schwa epenthesis while fake ones allow it. This fact can be attributed to the different phonological representations that underlie each one. In autosegmental CV phonology (Goldsmith, 1976; McCarthy, 1979), true geminates are represented as one melodic element associated to two slots in the skeletal tier. Hence, given the non-crossing association lines constraint that regulates autosegmental representations, epenthesis is not permitted. (56) below provides a visual illustration. On the other hand, fake geminates are represented as two independent melodic elements linked to distinct positions. Under this representation, schwa epenthesis can take place without violating the non-crossing association lines constraint. This is exemplified by (57).

(56) True geminates block epenthesis

(57) Fake geminates allow epenthesis


As a result, when two identical heteromorphic consonants occur side-by-side by sheer coincidence, they ought to be distinguished from geminate consonants derived by assimilation.

As shown in (55), geminates derived through total assimilation between the definite article morpheme and the first root consonant display geminate integrity. Thus, it is not true that derived geminates can be split by schwa epenthesis as the revised version of the GL claims. In fact, the case of schwa epenthesis in (54) should not be of much concern to studies dealing with geminates. They are mere sequences of identical segments occurring across morpheme boundaries. Hence, Schwa epenthesis treats them like any other consonant sequences. The fake geminates in (54) are sometimes misleadingly hyper-corrected as unbroken geminates, giving the impression that they are true geminates. This hypercorrection process could be seen as a reflection of native speakers' knowledge of the nature of true geminates in relation to schwa epenthesis. Yet, the forms with schwa epenthesis in (54) are in fact the default structures and not vice versa.

## 4. Conclusion

This paper has been devoted to the investigation of geminate integrity in MA. We have entertained an analysis that builds on Benhallam (1980), which claims that geminates in MA can be split by morphological rules but not by phonological ones. Cast in the constraint-based framework of OT, our account has been underlain by the basic idea that geminate integrity is a constraint that is not inviolable. As far as the effect of geminates on schwa epenthesis is concerned, we argued that the constraint on geminate integrity dominate the constraint responsible for word-to-syllable alignment: Gem-integrity >> Align-R. Under this ranking, schwa epenthesis gets blocked by geminates.

We have come to realize that schwa can split geminates on some occasions. We specifically treated the case of a class of broken plurals whose underlying geminates were shown to be prone to schwa epenthesis (e.g. slәl 'baskets'). In this regard, we have argued that there is a high-ranked plural Realize Morpheme (RM) constraint that dominates Gem-integrity: $RM_{pl}$ >> Gem-integrity. It has been shown that thanks to this ranking geminate integrity gets compromised for morphological purposes, namely the realization of the plural morpheme. Comparably, it

was also demonstrated that when the full vowel [u] of the PP splits underlying geminates (e.g. ħəll vs. məħlul 'open'), they do so under morphological pressure, which consists in bringing together the right edges of the root and the prosodic word. This was captured by the ranking of the alignment constraint ALIGN-R (Rt, PWrd) over Gem-integrity.

## References


Al Ghadi, A. (1990/2014). *Moroccan Arabic plurals and the organization of the lexicon*. D.E.S. Thesis. Mohammed V University, Rabat.

Al Ghadi, A. (1994). An OT account of Moroccan Arabic prosody. Ms. Delaware University, and Mohammed V University, Rabat.

Benhallam, A. (1980). *Syllable structure and rule types in Arabic*. Ph.D. Dissertation. Gainesville: University of Florida.

Benhallam, A. (1989/1990). Moroccan Arabic syllable structure. *Langues et Littératures, 8,* 177-191.

Benhallam, A. (1991). On geminates in Moroccan Arabic. *Linguistica Communicatio*, 28-40.

Benkaddour, A. (1982). A nonlinear analysis of some aspects of the phonology and nonconcatenative morphology of Arabic. Ph.D. Dissertation. London: School of Oriental and African Studies.

Benkirane, T. (1982). *Etude phonétique et fonction de la syllabe en Arabe Marocain*. Thèse de 3ème cycle. Université de Provence.

Bensoukas, K. & Boudlal, A. (2012a). The prosody of Moroccan Amazigh and Moroccan Arabic: Similarities in the phonology of schwa. In T. Borowsky, S. Kawahara, T. Shinya, & M. Sugahara (Eds.), *Prosody Matters: Essays in Honor of Lisa Selkirk* (pp. 3-42). London: Equinox.

Bensoukas, K. & Boudlal, A. (2012b). An Amazigh substratum in Moroccan Arabic: The prosody of schwa. *Langues et Littératures, 22,* 179-221.

Boudlal, A. (1993). *Moroccan Arabic glides: A lexical approach*. D.E.S. Thesis. Rabat: Faculté des Lettres.

Boudlal, A. (2001). *Constraint interaction in the phonology and morphology of Casablanca Moroccan Arabic*. Doctorat d'Etat thesis. Rabat: Mohammed V University.

Chomsky, N. & M. Halle. (1968). *The sound pattern of English.* New York: Harper and Row.

Davis, S. (1994). Geminate consonants in moraic phonology. *West Coast Conference on Formal Linguistics, 13,* 32-45.

Davis, S. (1999a). On the moraic representation of underlying geminates: Evidence from prosodic morphology. In R. Kager, H. Van der Hulst, & W. Zonneveld (Eds.), *The prosody-morphology interface* (pp.39–61). Cambridge: Cambridge University Press.

Davis, S. (1999b). On the representation of initial geminates. *Phonology, 16,* 93-104.

Davis, S. (2003). The controversy over geminates and syllable weight. In C. Féry & R. Van de Vijver (Eds.), *The syllable in Optimality Theory* (pp. 77–98). Cambridge: Cambridge University Press.
Davis, S. (2011). Geminates. In M. van Oostendorp, C. J. Ewen, E. Hume & K. Rice (Eds.), *The Blackwell companion to phonology* (Vol. 2) (pp. 837-859). Malden, MA & Oxford: Wiley-Blackwell.
Davis, S. & Ragheb, M. (2014). Geminate representation in Arabic. *Perspectives on Arabic linguistics XXIV-XXV*. Philadelphia/Amsterdam: John Benjamins Co, 3-19.
Davis, S. & Topintzi, N. (2017). On the weight of edge geminates. In Kubonozo, H. (Ed.), *The phonetics and phonology of geminate consonants* (pp. 260-282). Oxford: Oxford University Press.
Goldsmith, J. (1976). Autosegmental phonology. Ph.D. dissertation. Cambridge, MA: MIT Press.
Guerssel, M. (1977). Constraints on phonological rules. *Linguistic Analysis, 3(3)*, 267-305.
Hankamer, J., & Lahiri, A. (1988). The timing of geminate consonants. *Journal of Phonetics 16*, 327-338.
Hayes, B. (1989). Compensatory lengthening in moraic phonology. *Linguistic Inquiry 20*: 2, 253-306.
Imouzaz, S. (2002). Interaction des contraintes dans la morphologie non-Gabaritique de l'Arabe Marocain de Casablanca. Doctoral dissertation. Casablanca: Université Hassan II.
Kenstowicz, M. & C. Pyle. (1973). On the phonological integrity of geminate clusters. In M. Kenstowicz & C. Kisseberth (Eds.), *Issues in Linguistic Theory* (pp. 27-43). The Hague: Mouton.
Khattab, G., & Al-Tamimi, J. (2014). Geminate timing in Lebanese Arabic: The relationship between phonetic timing and phonological structure. *Laboratory Phonology*, 5(2), 231-269.
Kubozono, H. (Ed.). (2017). The phonetics and phonology of geminate consonants. Oxford: Oxford University Press.
Kurisu, K. (2001). *The phonology of morpheme realization*. Ph.D. dissertation. Santa Cruz: University of California.
Ladefoged, P. & I. Maddieson. (1996). *Sounds of the world's languages*. Oxford: Blackwell.
Leben, W. R. (1980). A metrical analysis of length. *Linguistic Inquiry*, 11(3), 497-509.
McCarthy, J. (1979). *Formal problems in Semitic phonology and morphology*. Ph.D. dissertation. Cambridge, MA: MIT Press.
McCarthy, J. (1981). A prosodic theory of nonconcatenative morphology. *Linguistic Inquiry*, 12(3), 373-418.
McCarthy, J. J. (1986). OCP effects: Gemination and antigemination. *Linguistic Inquiry*, 17(2), 207-263.

McCarthy, J. & A. Prince. (1986). *Prosodic morphology*. Ms. University of Massachusetts, Amherst and Brandeis University.
McCarthy, J. & A. Prince. (1993). Generalized alignment. In G. Booij & J. van Marle. (eds.), *Yearbook of Morphology* (pp. 79-153). Dordrecht: Kluwer.
Noamane, A. (2014). *Aspects of the morpho-phonology of causative verbs in Moroccan Arabic: An Optimality-theoretic approach*. Lambert Academic Publishing.
Noamane, A. (2018). Morphological causatives in Moroccan Arabic: Root-based or word-based? *ASINAG 13, La racine dans les kangues chamito-sémitique: nature et fonction*. Rabat: IRCAM.
Noamane, A. (Forthcoming). *Patterns of gemination in Moroccan Arabic: Issues in phonology and morphology*. Doctoral dissertation. Rabat: Mohammed V University.
Noamane, A. (In preparation). The formation of the past participle in Moroccan Arabic: A non-templatic approach.
Prince, A. & P. Smolensky. (1993/2004). *Optimality theory: Constraint interaction in generative grammar*. Malden, MA: Blackwell.
Ridouane, R. (2010). Geminates at the junction of phonetics and phonology. *Laboratory Phonology*, 10, 61-90.
Saib, J. (1977). The treatment of geminates: Evidence from Berber. *Studies in African Linguistics*, 8(3), 299-316.
Thurgood, G. (1993). Geminates: a cross-linguistic examination. Papers in honor of Frederick H. Brengelman on the occasion of the twenty-fifth anniversary of the Department of Linguistics, CSU Fresno, 129-139.