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A Root-and-prosody Approach to Templatic Morphology and Morphological Gemination in Moroccan Arabic[1]

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ملخص

تهدف هذه الورقة البحثية إلى استجلاء طبيعة البناء الصرفي والصوتي لأفعال السبب وأسماء الأفعال وأسماء الآلة المشتقة في العربية المغربية. وتتميز هذه الكلمات بالتضعيف الصرفي لحروفها الوسطى. وبالرغم من بساطة بنائها الصرفي، فإنه من غير السهل تحديد طبيعة اللاصق المسؤول عن اشتقاق هذه الكلمات وكذلك الأسباب وراء تضعيف حروفها الوسطى بالتحديد. انطلاقا من هذا الإشكال، تسعى هذه الدراسة إلى تحقيق ثلاث أهداف رئيسية. أولا، تحديد طبيعة الاشتقاق في هذه الكلمات. ثانيا، تحديد الدوافع وراء التضعيف الاشتقاقي للحروف الوسطى تحديدا. ثالثا، استنتاج القيود المسؤولة عن هذا النوع من الاشتقاق وكذا سلمها التراتبي.

Abstract

Morphological geminationconsists of the systematic gemination of a segment associated with the systematic change in meaning of the affected base. In Moroccan Arabic, morphological gemination characterizes the derivation of causative verbs, agent nouns and instrument nouns. It involves the lengthening of the second segment of some base root to express the intended morphological function (e.g. √ktb ‘to write’>>kə**tt**əb ‘to make write’). In the case of the agent and the instrument nouns, lengthening the second segment is espoused with the presence of some vocalic material, namely the vowel /a/ (e.g. fə**lla**ħ ‘farmer’ and sə**mma**ʕ**a** ‘headset’). This paper will try to answer the following questions: (i) What is the morphological process responsible for morphological gemination in Moroccan Arabic? (ii) What is the morphological exponence of the causative, agent and instrument morphemes? (iii) How does the templatic shape of each form come to be? In answering these questions, it will be shown that the linearization of the causative, agent and instrument morphemes as well as the construction of the templates of the forms in question are dictated by the syllable well-formedness of Moroccan Arabic.

Keywords: templatic morphology; morphological gemination; causative verbs; agent nouns; instrument nouns; Optimality Theory; Moroccan Arabic

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1. Introduction

Often, the process of lengthening is described as a case of stem modification, whereby an operation applies to a base form and changes it without adding any segmental material. Morphologists see stem modification as difficult to accommodate in a concatenation-based model (Anderson, 1992). This paper, however, seeks to argue in favor of a morpheme-based approach to deriving morphological gemination (MG) in Moroccan Arabic (MA). The ultimate goal is to extend the range of concatenative patterns to include instances of stem modification (lengthening as a case in point), and hence emphasize the claim that concatenation is an inherent property of the morphological system despite the apparent exceptions (Trommer and Zimmermann, 2014; Zimmermann, 2017).

To this end, we are proposing a constraint-based analysis of morphological gemination in MA cast within the framework of Optimality Theory (OT) (Prince and Smolensky, 1993/2004; McCarthy and Prince, 1993a, 1995, 1999). We show that OT offers an appropriate analytical device which successfully eschews problems that can be encountered elsewhere. In particular, this paper addresses the substantial relevance of three OT offshoots, notably the theories of Generalized Alignment (McCarthy and Prince, 1993b), Correspondence Theory (McCarthy and Prince, 1995, 1999) and Generalized Template Theory (McCarthy and Prince, 1993a). Precisely, it will be demonstrated that an alignment constraint affixes a consonantal mora to the right edge of the root. The realization of the morphological mora is ensured by the interaction between the faithfulness constraints Max-Affix and IDENT-Root-Weight. The mora is then infixed due to some phonological requirement on output well-formedness, namely syllabic well-formedness. The final result is the occurrence of an infixal geminate in the relevant forms, namely causative verbs, agent nouns and instrument nouns (for more on infixation and infixal patterns, see Ultan (1975); Moravcsik (1977); Urbanczyk (1993) and Yu (2007)).

The organization of this paper is mapped out as follows. Section 2 describes and compares the data of morphological causatives, agent nouns and instrument nouns in MA. Section 3 outlines our proposal to answer how morphological gemination is derived in MA through the interaction of constraints à la Optimality Theory. In Section 3.1, the theoretical background of our analysis will be delineated. Section 3.2 specifies and identifies the constraints involved in deriving the patterns in question. In Section 3.3, we show the constraint interactions responsible for yielding the derived forms. The subsequent section summarizes previous accounts of morphological gemination in MA. Section 5 concludes.

2. Data description and basic assumptions

2.1 Morphological causatives

In MA, morphological causatives are characterized by being morphologically marked, hence the name.[2] They are built on some base form and interpreted as verbs with an extended meaning. The first meaning is that of the base and the second meaning is contributed by the causative affix attached to it. Here, the causative affix is realized by means of lengthening the second segment of the base. The examples in (1) are illustrativeof morphological causatives in MA:

(1) Causatives in MA[3]

	Base form		Causative Form
a.	ktb	'to write'	kəttəb
	ɦṛb	'to run away'	ɦəṛṛəb
	ʃṛb	'to drink'	ʃəṛṛəb
	xrʒ	'to go out'	xərrəʒ
	dxl	'to get in'	dəxxəl
b.	kmi	'to smoke'	kəmmi
	xwi	'to empty'	xəwwi
	mʃi	'to leave'	məʃʃi
	bki	'cry'	bəkki

[2] Two other types of causative constructions have been discerned in the literature, namely lexical causatives and analytical causatives (Comrie, 1981). Lexical causatives are not morphologically marked, and hence inherently express the meaning of causativity. Analytical causatives, on the other hand, express causativity periphrastically.

[3]For the most part, the transcription symbols used here have the conventional IPA values, with the exception of emphatic consonants which are indicated with a dot under the consonant in question. The transcription of geminates as a sequence of two identical consonants in IPA is purely conventional, and hence has no theoretical bearing on the segmental and prosodic nature of geminates. In (18) and (19) below, we maintain the transcription symbols of the original works, which correspond to the APA values.

c.	fiq	'to wake up'	fəjjəq[4]
	ṭiħ	'fall down'	ṭəjjəħ
	gul	'to say'	gəwwəl
	ʕum	'swim'	ʕəwwəm

For example, the causative verb [kəttəb] consists of two different morphemes. First, the base morpheme [ktb] has the form of a trisegmental root and indicates the meaning of writing. Second, the causative morpheme contributes the meaning of causativity and is encoded in the form of a geminate [-tt-]. The geminate of every causative must match the featural specifications of the second segment of its corresponding base form.In this context, we do not consider the high vowel/glide alternation a case of featural mismatch since such alternation is often prosodically motivated.

In MA, each and every morphological causative verb falls into one of the following patterns: CəCCəC or CəCCV -where C and V indicate a consonant and a full vowel, respectively, as shown in (2):

(2) Causative patterns:

a. $CəC_iC_iəC$		b. $CəC_iC_iV$	
bəjjəḍ	'to whiten'	ləwwi	'to twist'
məṛṛəḍ	'to sicken'	qəṛṛi	'to teach'
zərrəb	'to speed up'	dəffi	'to warm'
fəjjəq	'to waken up'	nəqqi	'to clean'
məlləs	'to smooth'	wərri	'to show'

The difference between the items in (2a) and those in (2b) stems from the fact that they are derived from distinct base shapes. Pattern (b) includes those causative verbs that are based on final weak tri-literal verbs, where a full vowel appears at the end of the verb. Pattern (a), however, incorporates causative verbs that are derived from the other types of base forms. Hence, the pattern CəCCəC is more productive and subsumes the majority of causative verbs in MA.

The existence of two morphological templates for causative verbs poses a challenge for

[4]Other works on MA transcribe these forms with a full vowel instead of schwa before the glide (e.g. *fijjəq* and *ʕuwwəm*). However, we contend that since the high vowels of the base forms in question turn to corresponding geminate glides, the existence of a high vowel and a glide in the relevant causatives would be anomalous (see Noamane (2013/2014) for more on this).

traditional templatic theory, whereby templates have a morphological status. Later in this paper, we will show that templates are not base-generated but follow from independently motivated demands on output well-formedness.

2.2 Agent nouns

An agent noun is usually described as a deverbal noun (i.e. derived from a verb) that refers to the doer of the action expressed by the base verb. In English, for example, agent nouns are derived through the suffixation of -er to verbs (e.g. driver, fighter, etc.). Deverbal nouns tend to lose all the verbal characteristics of their corresponding verbs. Thus, they should be distinguished from verbal nouns (e.g. gerunds in English), which maintain some of the verbal characteristics of their corresponding verbs. The grammatical process of deriving nouns from verbs is called nominalization. Based on a sample of 42 languages, Bauer (2002) determined that agent nouns are one of the most-frequent derivational nominal categories, second only to action nouns.

Just like MCs, agent nouns in MA are marked off by medial gemination; but, in addition, they incorporate a pre-final vowel [a]. Agent nouns in MA can be derived from tri-consonantal verbs, middle weak verbs as well as final weak verbs. Examples from every class are provided below:

(3) Agent nouns in MA

a.	fləħ	'to farm'	fəllaħ	'farmer'
	ʃfəṛ	'to steal'	ʃəffaṛ	'thief'
	nʒəṛ	'to sharpen'	nəʒʒaṛ	'carpenter'
	gzər	'to butcher'	gəzzar	'butcher'
	ṣbəɣ	'to paint'	ṣəbbaɣ	'painter'
	sṛəṭ	'swallow'	səṛṛaṭ	'a glutton'
	nʕəs	'to sleep'	nəʕʕas	'someone who sleeps a lot'
	mrəḍ	'get sick'	mərraḍ	'someone who gets sick a lot'
	gəbṣ	'plaster'	gəbbaṣ	'plaster craftsman'
	qtəl	'to kill'	qəttal	'serial killer'
	nqəʃ	'to engrave'	nəqqaʃ	'engraving artist'

b.	ħḍi	'to watch over'	ħəḍḍaj	'nosey person'
	ʃri	'to buy'	ʃərraj	'a buyer'
	kri	'to rent'	kərraj	'a renter'
	bni	'to build'	bənnaj	'mason'
	bki	'to cry'	bəkkaj	'someone who cries a lot'
	ʒri	'to run'	ʒərraj	'someone who runs fast'
	kmi	'to smoke'	kəmmaj	'heavy smoker'
c.	ʃuf	'to foretell'	ʃəwwaf	'fortune-teller'
	biʕ	'to sell'	bəjjaʕ	'a seller'
	bul	'to urinate'	bəwwal	'someone who urinates a lot'
	gul	'to say'	gəwwal	'someone who gossips a lot'
	fiq	'to wake up'	fəjjaq	'someone who gets up a lot'
	xuf	'to get scared'	xəwwaf	'someone who has phobia'

All the agent nouns in MA share the pattern $C\text{ə}C_iC_i\text{a}C$. The vowels of tri-literal weak verbs turn into glides (see (3b) and (3c)). The ANs derived from final weak verbs consistently end with the glide [j], which corresponds to the unround high vowel [i]. Those ANs derived from medial weak verbs also occur with a medial glide [ww] or [jj], depending on the corresponding high vowel of the base.

2.3 Instrument nouns

Analogously, instrument nouns are also derived from verbs to indicate an inanimate doer of the action expressed by the corresponding verb. For instance, English instrument nouns are formed from verbs via the affixation of the suffix '-er' (e.g. cooker, dryer etc.), which means that the agent and instrument suffixes in English are homonymous, or otherwise the suffix -er is polysemous.[5]Instrument nouns rank number six in Bauer (2002)'s list of the most frequent derivational nominal categories.

Again, as is the case with MCs and ANs, INs in MA are also characterized by internal gemination. On a different note, INs can only come in the feminine form. They share the pattern

[5] See Luschützky & Rainer (2011) for more on the relation between the agent and instrument morpheme in Indo-European languages.

CəC_iC_iaCa, which contains an internal vowel [a] and a final one. Some examples are shown below:

(4) Instrument nouns in MA

a.	ɣsəl	‘to wash’	ɣəssala	‘washer’
	nʃəf	‘to dry’	nəʃʃafa	‘dryer’
	sməʕ	‘to listen’	səmmaʕa	‘phone handset’
	skət	‘to be quite’	səkkata	‘pacifier’
	rḍəʕ	‘to suck milk’	rəḍḍaʕa	‘nurser’
	təlʒ	‘ice’	təllaʒa	‘fridge’
	frək	‘to scrub’	fərraka	‘washing board’
	ʕləf	‘to feed on’	ʕəllafa	‘horse feeder’
b.	kwi	‘to weld’	kəwwaja	‘welding machine’
	ʃwi	‘to grill’	ʃəwwaja	‘grill’
	ṭfi	‘to put out’	ṭəffaja	‘ashtray’
	mʃi	‘to walk’	məʃʃaja	‘baby walker’
	sqi	‘to water’	səqqaja	‘water supplier’
c.	ɣuṣ	‘to scuba-dive’	ɣəwwaṣa	‘submarine’
	nil	‘grind’	nəjjala	‘grinder’

Just like in the case of ANs, the INs derived from final weak verbs end up containing a glide that corresponds to the final vowel of the base. The only notable difference is that the glide in INs appears intervocalically.

2.4 Basic assumptions

2.4.1 Extending the root-based approach

There are several ANs and INs that would have to be derived from morphologically complex base verbs if a word-based approach to derivation is maintained (Ratcliffe, 1997, 1998, 2013; Benmamoun, 1999, 2003). This would create a conflict between the morphological make-up of the base and that of the agent and instrument forms. In particular, given the fact that the designated base verbs of this class of agent and instrument nouns are already geminated, lengthening the second segment of the base becomes redundant and unnecessary. For illustration, consider the following examples:

(5) Agent nouns from morphologically complex bases

kəssəl	'to stretch'	kəssal	'masseur'
xərrəz	'to cobble'	xərraz	'cobbler'
bərrəħ	'to publicize'	bərraħ	'publicizer'
dəlləl	'to auction'	dəllal	'auctioneer'
fəṛṛəʃ	'to furnish'	fəṛṛaʃ	'street vendor'
xəmməs	'to slave away'	xəmmas	'overtime worker'

(6) Instrument nouns from morphologically complex bases

ṣəlli	'to pray'	ṣəllaja	'praying rug'
ṣəffi	'to strain'	ṣəffaja	'strainer'
ɣəṭṭi	'to cover'	ɣəṭṭaja	'cap'
ʃəṭṭəb	'to sweep'	ʃəṭṭaba	'broom'
kərrəṭ	'to wipe'	kərraṭa	'wiper'
ḍəwwi	'to light'	ḍəwwaja	'glass roof'
ʕəlləq	'to hang'	ʕəllaqa	'clothes hanger'

In previous works (see Noamane, 2018b-c), we have motivated a root-based approach to deriving MCs and comparatives, given the correspondence problems it resolves (Cantineau, 1950; McCarthy, 1971, 1989). Generalizing a root-based approach to deriving ANs and INs would mean that every AN or IN should be derived from a minimal root underspecified for its grammatical category. This way, all ANs and INs would be equally derived from bases with the same amount of morphological complexity (i.e. roots). To prove that the geminates in the base forms above are not basic, we can simply refer to some other semantically related word-forms with singletons instead of geminates, like in the case of *bərrəħ* 'to announce' vs. *tbriħa* 'announcement' and *ɣəṭṭi* 'to cover' vs. *ɣṭa* 'cover'. This could well be understood as another argument in favor of a root-based approach to MA morphology. Consequently, the ANs and INs shown in (5) and (6), respectively, would have to be derived from the following corresponding roots:

(7) A root-based derivation of agent nouns

√ksl	'stretch'	kəssal	'masseur'
√xrz	'cobble'	xərraz	'cobbler'
√brħ	'announce'	bərraħ	'announcer'
√dll	'auction'	dəllal	'auctioneer'
√fṛʃ	'furnish'	fəṛṛaʃ	'street vendor'
√xms	'slave away'	xəmmas	'overtime worker'

(8) A root-based derivation of instrument nouns

√ṣli	'to pray'	ṣəllaja	'praying rug'
√ṣfi	'to strain'	ṣəffaja	'strainer'
√ɣṭi	'to cover'	ɣəṭṭaja	'cap'
√ʃṭb	'to sweep'	ʃəṭṭaba	'broom'
√kṛṭ	'to wipe'	kəṛṛaṭa	'wiper'
√ḍu	'to light'	ḍəwwaja	'glass roof'
√ʕlq	'to hang'	ʕəllaqa	'clothes hanger'

Contrary to the traditional view that sees roots in Semitic as purely consonantal (Cantineau, 1950; McCarthy, 1979), it is claimed that roots in MA could be made up of consonants and vowels alike. This can be based on the observation that certain vowels are consistently and systematically carried over by derived forms sharing the same root (see Noamane (2018b) for more details).

2.4.2 The templatic morphology of the causative, the agent and the instrument

By comparing and contrasting MCs, ANs and INs, one easily notices that they all undergo morphological gemination. In every case, consonantal lengthening affects the second segment of the base, be it a consonant or a vowel. When the second segment is a vowel, it changes to a corresponding geminate glide (see (1c) and (3c) for examples).[6]In the causative case, gemination

[6] It is being assumed that the mora used to derive causatives and instrument nouns is inherently consonantal, in the sense that it can turn a high vowel into a corresponding glide. An easier conception could be to assume that the medial vowels in (1c) and (3c) are glides underlyingly. However, it is better to opt for a vocalic account elsewhere. For example, Noamane (2018b) argues for the underlying status of vowels in MA roots since they get carried over in different derived forms. Particularly, it is argued that high vowels in roots are idiosyncratic and that they can

by itself is the sole morphological marker of the derivation in question. In the agent and instrument cases, gemination is supplemented by other morphological markers, namely an internal vowel [a] that is reminiscent of the [a] in non-derived nominals. Some examples are shown below:

(9) Non-derived nominals in MA

dəft**a**ṛ	'notebook'
sərw**a**l	'trousers'
qal**a**m	'pencil'
ṣəbb**a**ṭ	'shoe'
sṭ**a**ħ	'roof'
ʕəwd**a**n	'horse'

In addition, INs are also characterized by a final vowel [a] which is indicative of their feminine form. The final vowel [a] is a typical feminine marker in many non-derived nouns as well. Consider the examples below:

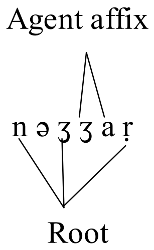
(10) Non-derived feminine nouns:

ħadiq**a**	'zoo'
luʕb**a**	'game'
wəṛq**a**	'paper'
ʒuml**a**	'sentence'
luħ**a**	'board'
misṭar**a**	'ruler'

In this paper, it will be assumed that the agent morpheme in MA is represented by the gemination of the second segment as well as the infixation of an internal [a]. This represents a case of a hybrid morpheme, whereby one part is vocalic and the other is prosodic (i.e. a mora).

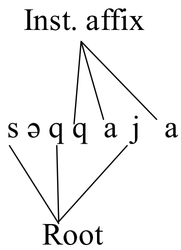
alternate with glides for various reasons (e.g. resolving hiatus, satisfying ONSET…). Noamane (2018b) shows that the underlying status of high vowels in roots is corroborated by the fact that the imperfective form of verbs with medial high vowels is simply derived through turning those vowels into the low vowel [a].

(11) The morphological content of agent nouns in MA



Likewise, the instrument morpheme is assumed to be expressed by the gemination of the second segment of the base in addition to the affixation of an internal [a] and a final one. This also means that the agent morpheme and the instrument morpheme are expressed by multiple exponence, whereby a single morphological feature is realized by more than one phonological form (see Caballero (2011) and Harris (2017) for more on multiple exponence patterns across languages).

(12) The morphological content of instrument nouns in MA



Such an assumption resonates well with the premises of Generalized Template Theory (McCarthy and Prince, 1993a), which will work as our background approach to describing the templatic morphology of MA. At the center of this approach is the idea that templates (e.g. the agent and instrument templates) are emergent structures that have no basic morphological status. This means that the internal [a], that characterizes the derivation of both ANs and INs, and the final [a], which is specific to INs, should have a basic morphological status, instead of being prosodically motivated by some template.

Despite the deceptive templatic morphological similarities between the causative, the agent and instrument templates, we will be assuming that there is no direct morphological connection between them, except that they can be derived from the same root type. That is, ANs are not nominalized causatives, and instrument nouns are not feminized ANs. Rather, each is derived directly from a root base by referring to an independent morpheme. This also means that the gemination in these forms performs a different morphological function in every case:

(i) It represents the causative morpheme in MCs

(ii) It forms the agent morpheme together with the internal [a] in ANs

(iii) It realizes the instrument morpheme jointly with the internal [a] and the final [a] in INs.

On a different matter, every agent noun can be inflected for the feminine form, by suffixing the feminine marker vowel [a], without turning into an instrument noun. Feminine ANs have the same exact phonological shape of INs, except that the latter are feminine by default.

(13)

Masc. ANs		*Fem. ANs*
fəllaħ	'farmer'	fəllaħa
ʃəffaṛ	'thief'	ʃəffaṛa
nəʒʒaṛ	'carpenter'	nəʒʒaṛa
gəzzar	'butcher'	gəzzara
ʃəwwaf	'fortune-teller'	ʃəwwafa

This fact proves two points. First, it shows that INs are not derived from ANs since the latter already have their independent feminine forms. Second, it demonstrates that the feminine quality of INs is not optional, meaning that they can only be feminine. That is, in the event of removing the final [a] of the instrument, the meaning will be incomplete (e.g. *təllaʒ, *səmmaʕ, *səkkat etc.). This is exactly why this marker has been assigned to the lexical representation of the instrument affix.

This seems as an interesting case of overlap between inflection and derivation, such that the [a] in question serves as an exponent of both deriving the instrument forms and marking their feminine quality. Put simply, despite the apparent inflectional feminine quality of the final [a] of INs, it actually does more than being an inflectional marker.In fact, it is also derivationally relevant (John McCarthy, personal communication).

2.4.3 The moraic two-root node representation in the context of MG

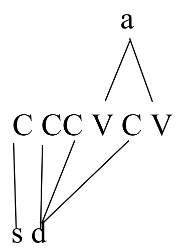
Now, let's wind up this section by commenting on the class of INs whose base roots include an underlying final geminate. We will proceed to call this the 'overgemination' problem as it seems to involve the gemination of what is already an underlying geminate. Some illustrative examples are shown below:

(14)

√sdd	'shut'	səddada	'cover'
√ħkk	'scratch'	ħəkkaka	'mince'
√ṛʃʃ	'spray'	ṛəʃʃaʃa	'sprayer'

The question here is: how does this structure get derived? One answer could be that a geminate is simply a cluster of two identical consonants. Therefore, this can be seen as a case of morphological doubling of one member of the cluster. Such an answer echoes the SPE conception of geminates as sequences of identical segments (Kenstowicz and Pyle, 1973; Guerssel, 1977; Saib, 1977). Another possibility might be to explain this in terms of melodic spreading to a skeletal tier á la autosegmental phonology (McCarthy, 1979, 1981). This would mean that a single melodic element would have to be multiply associated to three slots on the skeletal tier as a result of mapping a bi-consonantal root to the instrument template (i.e. CCCVCV).

(15) The autosegmental account



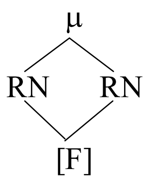
[səddada] 'cover'

Despite the fact that both the non-linear and the autosegmental approaches to consonantal length appear to provide a simplified answer to this case of 'overgemination', we believe that the shortcomings and inadequacies of these approaches elsewhere have been well noted (see Hayes (1989) for a detailed discussion of some of these shortcomings).

However, considering a moraic approach to gemination (Hayes, 1989; Davis, 1994, 1999, 2003, 2011), such as the one we entertain in this paper, it seems more challenging to account for this data. In particular, this is so because the geminates of the base roots in question behave like two-part segments, whereby only one part is reproduced. Thus, even if we could assume that an underlying geminate can be further geminated for morphological purposes by means of moraic affixation, it would be hard to explain why only 'half' of the geminate is replicated and not all of it (e.g. *ṛəʃʃaʃʃa). This would be an embarrassment especially to a moraic one-root node theory.

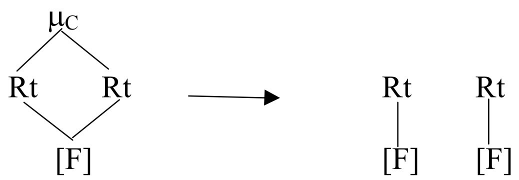
In the face of this situation, the two-root node aspect that we propose to inject into our model of representing geminates comes into good service (Selkirk, 1990), in the sense that it allows morphological gemination to target only one root node.

(16) A moraic two-root node model (Noamane, 2018c)



What happens is that when the mora of the instrument morpheme attaches to the first root node of the underlying geminate, the latter's structure collapses into a sequence of two independent segments. This is akin to the structure created via geminate breaking by means of morphological processes (Noamane, 2018a).

(17) The representation of split geminates



Now that the first root node is an independent segment, it can geminate to encode the moraic part of the instrument morpheme, creating a geminate structure similar to that of underlying geminates. The second root node of the underlying geminate maintains its independence, behaving like any normal short consonant.

3. Analysis

3.1 The Unified Theory of Morphological Gemination

Our proposal to account for morphological gemination by dint of mora affixation finds further support in previous analyses, namely Lombardi and McCarthy (1991), Samek-Lodovici (1992) and Bensoukas (2001).[7]

[7] For more recent moraic accounts of morphological gemination see Davis and Ueda (2002; 2006), Grimes (2002), Trommer and Zimmerman (2014) and Zimmermann (2017).

Lombardi and McCarthy (1991) argues that the formation of completive verbs in Choctaw, a Muskogean language, draws on, among other things, the prefixation of a mora to a circumscribed base à la prosodic circumscription. The affixed mora copies the featural content of the adjacent consonant by a rule of spreading, hence geminating the affected consonant. Next, the derived geminate occurs word-medially after concatenating the extraprosodic constituent. A portion of the data dealt with in Lombardi and McCarthy (1991) is reproduced below for easy reference:

(18) Morphological gemination in Choctaw

Base	*Completive verb*	
talakči	ta**ll**akči	'to be tied'
falama	fa**ll**aama	'to return'
takči	ta**yy**akči	'to tie'
pisa	pi**yy**iisa	'to see'
oktabli	okta**yy**abli	'to dam up'
toksali	toksa**yy**aali	'to work'

To take an example, the completive verb *tallakči* is derived from the base *talakči,* whose first mora (i.e. *ta*) is rendered extraprosodic by a rule of prosodic circumscription. A mora is then prefixed to that base, causing the lengthening of the adjacent segment. Later, when the circumscribed mora is reinstated, the gemination appears internally.

Samek-Lodovici (1993) capitalizes on Lombardi and McCarthy (1991) and extends the analysis to provide a unified account of cross-linguistic morphological gemination, using the constraint-based framework of OT. The essence of the analysis established in this work is that MG in Keley-i and Alabama arises from edge-oriented mora affixation. The optimal output is then decided on by the syllable well-formedness constraints of each language. The data set of MG in Keley-i and Alabama looks fascinating. For convenience, some portions of the data are repeated below:

(19) Morphological gemination in Keley-i

Base	pi.li	du.yag	ʔag.tu	dun.tuk
	'to choose'	'to pour'	'to carry on'	'to punch'

Subject focus

Input	um.pi.li	um.du.yag	man.ʔag.tu	um.dun.tuk
Output	um.pi**l**.**l**i	um.du**y**.**y**ag	man.ʔag. tu	um.dun.tuk

Object focus

Input	pi.li	du.yag	ʔag.tu	dun.tuk
Output	pi**l**.**l**i	du**y**.**y**ag	ʔag.tu	dun.tuk

Access. focus

Input	ʔi.pi.li	ʔi.du.yag	ʔi.ʔag. tu	ʔi.dun.tuk
Output	ʔi**p**.**p**i.li	ʔi**d**.**d**u.yag	ʔi**ʔ**.**ʔ**ag. tu	ʔi**d**.**d**un.tuk

(20) Morphological gemination in Alabama

a. Words with open antepenultimates always geminate the following onset

a.ta.kaa-li	a.tá**k**.**k**aa.li	'hang one object'
a.caa.-pa	á**c**.**c**aa.pa	'object to vocally'
a.fi.nap-li	a.fí**n**.**n**ap.li	'lock up'
a.tak.-li	á**t**.**t**ak.li	'hang more than one object'
ho-co.ba	hó**c**.**c**o.ba	'big (pl)'
a.taa.nap.-li	a.tá**n**.**n**ap.li	'rancid'

b. Bisyllables and light penultimate geminate vocalic nucleus

co.ba	c**óo**.ba	'big (sing)'
i.s-i	**íi**.si	'take, catch'
cam.po.-li	cam.p**óo**.li	'taste good'
i.bak.pi.la	i.bak.p**íi**.la	'turn upside down'
ho-f.na	h**óo**f.na	'smell'
is.-ko	**íi**s.ko	'drink'

In both Keley-i and Alabama, MG marks the imperfective aspect of verbs. The data above illustrates how the process of MG works in tandem with the syllabification process to produce structures that best comply with the well-formedness constraints of each language. In the case of Keley-i, MG cannot get realized if it would create superheavy syllables. (e.g. see 'ʔag.tu' and 'dun.tuk' above). The keley-i data also shows that tautosyllabic geminates are not allowed, which explains why vowels are never geminated. As for Alabama, final syllables are skipped by MG due to their extrametrical nature. In Alabama, however, tautosyllabic gemination is possible (e.g. c**óo**.ba).

Along the same lines, Bensoukas (2001) also accounts for Tashlhit imperfective morphological gemination in terms of the affixation of a mora to a base root. Specifically, despite the complex nature of the imperfective derivation in Tashlhit, the moraic conception of morphological gemination proved to be uselful in developing a unified analysis for the different classes of the imperfective. For easy illustration, only the portion of the data where MG straightforwardly affects one of the root segments is cited below:[8]

(21) Morphological gemination in Tashlhit

a. Geminating the first radical element

krz	**kk**rz	'plow'
frd	**ff**rd	'graze'
ħrt	**ħħ**rt	'go ashore'
krf	**kk**rf	'tie'

b. Geminating the second radical element

kla	k**ll**a	'spend the day'
ftu	f**tt**u	'go'
mgr	m**gg**r	'harvest'
rgl	r**gg**l	'lock'

In analyzing the imperfective gemination in Tashlhit, Bensoukas (2001) posits an abstract prosodic affix that consists of a consonantal mora. The latter is freely attached to the base root to derive the imperfective form. The landing position of the affix, which decides what segment to geminate, is then determined through the interaction of well-formedness constraints on syllable and prosodic structure.

According to Samek-Lodovici (1992), any account of MG should be able to address the following two questions: (a) how does morphological gemination occur? And (b) where does

[8] There is a third class of imperfectives where the mora is realized outside of the root material in the form of a prefixed geminated [tt] e.g. ttkka 'pass', ttumu 'contain' and ttfrtal 'escape'.

gemination happen (i.e. which segment geminates)? To answer these questions, it was suggested that MG should be broken down into two main modules:[9]

(22)

a. *Affixation module*: freely add the moraic morpheme to the base by altering the base's underlying prosodic configuration

b. *Selection module*: select the derivation whose phonological structure optimally satisfies the constraints of the language

The labor of MG is divided between these two components in the following way. The first module represents the part of MG that is common between the various languages where MG is attested. It simply consists of affixing a moraic morpheme that performs the intended morphological function. If successfully realized, the designated affix changes the prosodic as well as the segmental configuration of the base. The second module, however, relies on the framework of OT to account for the cross-linguistic variations concerning the landing position of the moraic affix. This module is composed of universal constraints on syllabic well-formedness, which are independently motivated by the phonology of the relevant languages. Since the ranking of these constraints varies from one language to another, distinct patterns of morphological gemination are produced.

3.2 Generalized Template Theory: A Root-and-Prosody Approach

As has been pointed out earlier, MCs, ANs and INs are all characterized by an invariant templatic shape. The template of MCs consists of two light syllables (i.e. LL), which could have the form [CəC.CəC] or [CəC.CV], depending on the nature of the base root. ANs also come in the form of a disyllabic template, except that one syllable is light and the other is heavy (i.e. LH): [CəC.CaC]. Finally, the template of INs is composed of three light syllables (i.e. LLL): [CəC.Ca.Ca].[10]

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[9] It is worth noting that analyzing morphological gemination as consisting of two modules does not necessarily entail serial derivation. Instead, this only suggests a categorization of the constraints that are typically involved in a moraic approach to morphological gemination. Therefore, the two modules are believed to interact in a parallel fashion in compliance with the tenets of Parallel OT.

[10] Despite being closed, CəC syllables are considered to be light in MA. The reason is because schwa is nonmoraic in the language. This is corroborated by the fact that schwa can never appear in an open syllable or be the head of a monosyllabic word (Al Ghadi, 1990/2014; Boudlal, 2001; Bensoukas and Boudlal (2012a-b)).

To account for the templatic morphology of the forms under study, we adhere to the premises of Generalized Template Theory (GTT; McCarthy and Prince, 1994)), whereby templates are believed to derive from the interaction of independently motivated constraints on the well-formedness of output prosody. GTT represents a departure from earlier templatic theories, namely CV-theory (McCarthy, 1979, 1981) and Prosodic theory (McCarthy and Prince, 1993a), in which templates are assumed to be listed in the lexicon as morphological entities. Within OT, the existence of constraints which explicitly dictate the prosodic shape of templates was found to result in predicting grammars that are, in fact, nonexistent.[11]

In the framework of GTT, the Fixed Prosody (FP) approach (Ussishkin, 1999, 2000, 2005) has been proposed to handle the templatic effects in Semitic without the need for templatic specific constraints. In this approach, roots have no specific morphological status. Instead, word formation is believed to be word-based, in that new word forms are derived from other output forms through melodic overwriting. According to the FP approach, templates are emergent structures that follow from general constraints of prosody, namely constraints of prosodic minimality and maximality.

In this paper, a different approach towards templatic effects will be adopted. The approach is referred to as the Root-and-Prosody (RP) approach (Kramer, 2007; Tucker, 2010, 2011). Like the FP approach, the RP approach assumes that templates arise from the interaction between independently needed constraints. However, the RP approach differs from the FP one in terms of being root-based. This makes the RP approach more aligned with our root-based approach to word formation in MA. The main underpinnings of this approach are summarized as follows:

(23) Central claims of the Root-and-Prosody approach (Tucker, 2010)

a. *Roots and vowels are morphemes*: the input to nonconcatenative templatic morphology (NTM) forms consists of the consonantalroot and a vowel affix.

b. *Templates are given by prosody*: Templates are emergent properties of words in NTM languages which surface from the necessary satisfaction of high-ranking prosodic markedness constraints.

[11] This is dubbed the Kager-Hamilton problem. See McCarthy and Prince (1999) and Ussishkin (2000) for more on arguments against templatic constraints.

According to the RP approach the nonconcatenative templatic morphology of Semitic stems from the low-ranking status of contiguity faithfulness, hence the constraint CONTIGUITY, in relation to prosodic well-formedness: Prosodic Markedness >> CONTIGUITY. This means that the discontinuous linearization of the root and the affixal material is obtained simply through constraint interaction. The RP approach requires only the following types of constraints to derive all template shapes and sizes:

(24) Constraints in an RP approach

a. *Prosodic/Syllabic Constraints*: Constraints on prosody/syllable structure independently needed in the language (FtBin, *Complex, Onset, etc.).

b. *Morphological Constraints*: Constraints which align morphemes in linear prosodic structure (Align-L (n, ω), Align-L (-t-, ω), etc.).

c. *Faithfulness Constraints*: Faithfulness constraints of the usual family (Ident[F], Dep-Root, Max, Contiguity, Linearity etc.).

So far, the RP approach has been used to account for the templatic morphology of verbal forms in Coptic (Kramer, 2007) and Iraqi Arabic (Tucker, 2010). In this paper, we look toward extending the premises of the RP approach to other lexical categories in MA, namely MA agent nouns and instrument nouns.

3.3 Identifying the constraints and their interactions

3.3.1 Affixation module

To account for the various patterns of MG in MA, we follow Lombardi and McCarthy(1991), Samek-Lodovici (1992) and Bensoukas (2001) in assuming that a prosodic mora can be used by morphology to play the role of an affix. Therefore, we believe thatMCs, ANs, and INsin MA are derived, fully or partially, by the affixation of a consonantal mora which is not associated with any melodic material underlyingly.Besides its morphological role as an affix, the posited mora changes the phonological make-up of the base form by lengthening the medial segment of the root. Accordingly, the postulated mora in this analysis has the following properties:

a. Morphologically, it is an affix material thatplays the role of a morphological marker.
b. Phonologically, it is a prosodic constituent that changes the prosodic weight and segmental length of the root.

With this in hand, we proceed to show that the affixation module in our analysis calls for the service of two constraints. First, the faithfulness constraint MAX-Affix is responsible for the realization of the moraic affix in the output form. Particularly, this constraint is posited to guarantee that the mora is both prosodically parsed and segmentally filled. To obtain this result, the MAX-Affix constraint has to dominate the faithfulness constraint IDENT-Root-Weight, which resists any change of the weight configuration of the input root. In this sense, IDENT-Root-W should be violated so that the moraic affix can be realized in the output. In the case of ANs and INs, the scope of Max-affix is extended to ensure the realization of the vowels characterizing their derivation. In other words, the deletion of the internal [a] of the AN and the IN or even the final [a] of the IN would too incur a violation of MAX-Affix.

Second, the analysis also involves an alignment constraint that specifies the edge targeted by the moraic affix. Recall that affixes in OT are either left-aligned or right-aligned. The infixation of a morpheme is normally the result of phonological pressure. That is, before a morpheme gets infixed, it starts at some edge. Defining the canonical edge of the moraic affix in our analysis is no easy task since all forms realize the mora word medially. There are no forms where the mora is realized on its canonical edge. Also, since the infixed mora is equally close to both edges, there is no way to tell where the mora has originated based on its closeness to one of the edges. As a consequence, we would just assume that the affix is right-aligned since suffixation represents the least marked form of affixation. In the case of MCs, where the mora fully represents the causative morpheme, the alignment constraint is defined as follows:

(25) **ALIGN-R (μ)**

The moraic causative affix should be right-aligned

This constraint requires that the right edge of the moraic affix coincide with the right edge of the base root, resulting in the suffixation of the causative morpheme. Regardless of where the mora is realized, the preliminary outcome of this process is the derivation of causative verbs. For instance, given a root form like /tlʒ/ 'snow', ALIGN-R (μ) places a mora at its right edge for the sake of deriving the causative verb [təlləʒ] 'to make snow', as depicted in (26), where brackets refer to the edges of each constituent.

(26)

Root	Affix	Alignment (Root +Affix)
[tlʒ]	[μ]	[[tlʒ]μ]

Otherwise, if the purported affix is aligned to an edge other than the right edge, say the left one, this constraint would be violated, as displayed in the incomplete tableau below:

(27)

Input: √tlʒ	ALIGN-R (μ, Root)
a. [μ_c [tlʒ]]	Violated
b. [tlʒ[μ_c]]	Satisfied

One last fact is that infixation itself is an edge-oriented phenomenon, whereby the affix occurs as close as possible to the designated edge. The more misaligned the affix, the more punished by the alignment constraint in a gradient fashion, as is shown in the following incomplete tableau:

(28)

Input: √nʕs	ALIGN-R (μ, Root)
a. **nn**ʕəs	**!
b. nə**ʕʕ**əs	*
c. nʕə**ss**	Satisfied

As for ANs and INs, the alignment constraint involved in their derivation should be specified for the whole affixal material. This means that when considering the agent and instrument morphemes, which are partly moraic and partly vocalic, their versions of the alignment constraint will have the following form and specifications:

(29)

a. **ALIGN-R(μ-a)**

The agent affix must be right-aligned.

b. **ALIGN-R (μ-a-a)**

The instrument affix must be right-aligned.

Next, we will see how the ultimate position of the affix material of each morpheme is selected. That is, we will be looking at the factors that lead the designated affixes to miss the right alignment and occur inside the base.

3.3.2 Selection module

Since MCs, ANs and INs all consistently come with medial geminates, it is obvious that the moraic affix is invariably realized on the second segment. This means that the moraic affix gets misaligned (i.e. infixed). The question now is what causes the moraic affix to be realized in a position other than the right edge?

As has been previously mentioned, the canonical position of the causative morpheme is determined by the constraint ALIGN-R (μ), demanding that the right edge of the affix coincides with the right edge of the root. However, it is argued that the infixation of the mora is enforced by some phonological restrictions on output forms. We believe that the insertion site and filling segment of the mora are decided on by the need to conform to the prosodic and syllabic well-formedness of MA. In particular, it is suggested that what forces infixation in the relevant forms is the quest for the least marked possible syllabification of the input material, in accordance with the syllabic well-formedness constraints of MA. This is captured by the constraintσWF (i.e. syllabic well-formedness). As a result, being high-ranked, σWFbans the moraic affix from being realized on the edge as it is going to lead to a marked structure. This can be expressed as follows:

(30) Syllable well-formedness forces violation of alignment:

σWF>> ALIGN-R (μ, Rt)

The σWF (i.e. syllable well-formedness) constraint is an umbrella constraint that subsumes a variety of specific constraints on syllable structure. These include:

(31)

a. **ONSET**: syllables must have onsets

b. **$*\mu/C_h$**: a consonant should not be the head of a syllable

c. ***Empty-headedσ**: a syllable must have a nucleus

d. ***μ/ə**: schwas are nonmoraic

For example, the right alignment of the moraic affix in the case of MCs would lead to the creation of a word-final geminate, which, in turn, would project an empty-headed syllable to avoid being fully contained in the coda (Noamane, 2018c; In preparation). Thus, in order to avoid this scenario, the mora should be realized in a position other than the right edge. Here comes the role of infixation as a way out. Another example concerns the vowels of the instrument noun, where the first /a/ is infixed alongside the mora. If both vowels are kept side by side on the right edge, the ONSET constraint will be violated. Hence, under the pressure of the ONSET constraint, the first /a/ moves inside the root to look for an onset, leaving its canonical onset to the final /a/.

After having presented the relevant constraints in an incremental and detailed way, we intend to show, in the subsequent section, how these constraints together with their ranking lead to the formation of MCs, ANs and INs.

3.3.3 Constraint interaction

The central idea that underlies our OT analysis is that there are five major constraints responsible for the derivation of morphologically geminated forms in MA. First, MAX-Affix is a faithfulness constraint which stipulates that the input affixal material must be fully manifested in the output form for the sake of realizing the designated morpheme. This constraint militates against the nonrealization of the affix material in the output. Therefore, for this constraint to be satisfied, gemination should take place.

The Second constraint, IDENT-Root-Weight, is a faithfulness constraint which requires corresponding output and input root segments to be identical in terms of weight. As a result, this constraint disallows input segments from gaining or losing phonological weight. Third, ALIGN-R is an alignment constraint that demands coincidence between the right edge of the affix in question (i.e. the consonantal mora) and the right edge of the root. Given this demand, ALIGN-R (μ, Rt) is violated whenever the edges of the specified constituents fail to coincide. Fourth, σWF is a constraint on prosodic well-formedness which subsumes the main constraints on syllable structure. Fifth, CONTIGUITY is a faithfulness constraint that demands the contiguity of input segments to be preserved in the output. These are summarized below:

(32) Constraints responsible for deriving morphological causatives in MA:

a. **ALIGN-R (μ, Root)**: The right edge of the moraic affix must coincide with the right edge of the root.
b. **MAX-Affix**: The input affixal material should be preserved in the output form.
c. **IDENT-Root (Weight)**: The weight specification of the root must be preserved in the output.

d. **σWF**: The output form should satisfy the following markedness constraints onsyllable well-formedness:

- **ONSET**: syllables must have onsets
- ***μ/C$_h$**: a consonant should not be the head of a syllable
- ***Empty-headedσ**: a syllable must have a nucleus
- ***μ/ə**: schwas are nonmoraic

e. **CONTIGUITY**: The contiguity of input material should be preserved in the output.

We proceed by putting forward the appropriate rankings that would yield the expected output forms. In particular, we highlight the existing ranking arguments between the constraints at play. Ranking arguments will provide us with evidence for ranking certain constraints over others or leaving them unranked.

First, tableau (33) compares the winning candidate [kəttəb] 'to make write' with the losing candidate *[ktəb],whereby the former satisfies MAX-Affix and violates IDENT-Root-W, and the latter violates MAX-Affix and satisfies IDENT-Root-W. This shows that these constraints do really have conflicting demands. Consequently, MAX-Affix is ranked high because it favors the winning candidate while IDENT-Root-W is ranked low as it favors the loser.

(33) Ranking argument (1): MAX-Affix >> IDENT-IO (Weight)

Input: μ√ktb	MAX-Affix	IDENT-IO (Weight)
☞a. kəttəb		*
b.ktəb	W*!	L

Second, tableau (34) displays a conflict between σWF and ALIGN-R (μ) as they disagree on the assessment of both the winner and the loser. Since σWF appears to favor the winning candidate, it ranks high in the hierarchy above ALIGN-R (μ).

(34) Ranking argument (2): σWF>> ALIGN-R (μ)

Input: μ√ktb	σWF	ALIGN-R (μ)
☞a. kəttəb		*
b. k.təb.b	W*!	L

Third, tableaux (35) and (36) show us that the relevant constraints agree on the assessment of at least one candidate, which means that they do not conflict or dominate each other. As a result, these constraints will be left unranked with respect to each other.

(35) No ranking argument: Max-affix and ALIGN-R (μ) have no effect on each other

Input: μ√ktb	MAX-Affix	ALIGN-R (μ)
a. kəttəb		*
b. k.k.təb		

(36) No ranking argument: σWF and IDENT-Rt-W have no effect on each other

Input: μ√ktb	σWF	IDENT-IO (Weight)
a. kəttəb		*
b. k.təb.b	*	*

What these rankings tell us is that there is no one absolute and total ordering between every pair of our constraints. Rather, the constraint set consists of two independent ranked sets in the same hierarchy whereby output forms are evaluated by each in a parallel fashion. This can be vividly illustrated by the following Hasse diagram:

(37) Ranking summary for causatives in MA

MAX-Affix | σWF

IDENT-Rt-W | ALIGN-R (μ)

An important fact about OT is that no ranking should be enforced between two constraints where there is no evidence to that. Also, it is not necessary to provide a total ordering of the relevant constraints. A constraint may stay unranked in relation to some other constraint, or it may have no ordering relation at all with another constraint, as far as they agree on the assessment of the winning candidate. As noted by McCarthy (2008:43), "it's perfectly OK if the process of analysis leads to a partial ordering: CONST1 and CONST3 both dominate CONST2, but the ranking between CONST1 and CONST2 is unknown." In this case, only the crucial constraint rankings that are important for the analysis should be determined and highlighted.

In support of our constraint ranking, we demonstrate the possible repercussions that can emerge if the ranking suggested is altered. The re-ranking of IDENT-Root-Weight over MAX-

Affix in (38) yields forms with no gemination, while the re-ranking of alignment over syllabic well-formedness in (39) gives rise to forms with edge geminates at the right periphery. In each case, the winning candidates are not attested in MA. Conventionally, the symbol "💣" indicates this fact.

(38) IDENT-Root (Weight) >> Max-affix

Input: μ√ktb	IDENT-IO (Weight)	Max-affix
a. kəttəb		*
💣b.ktəb	*!	

(39) ALIGN-R (μ) >>σWF

Input: μ√ktb	ALIGN-R (μ)	σWF
a. kəttəb		*
💣b. k.təb.b	*!	

3.3.4 Output selection: the causative

Bearing in mind the constraints and the ranking arguments presented above,we proceed to illustrate the overall interactions of those constraints and their role in the selection of the optimal structures. To begin with, let's look at how the causative *kəttəb*'to make write' emerges as the winner in its competition with other candidates.

(40) MAX-Affix>> IDENT-Root (Weight); σWF >> ALIGN-R (μ, Rt)

Input: μ√ktb	MAX-Affix	σWF	IDENT-Root-W	ALIGN-R (μ)
☞a. kəttəb			*	*
b. ktəb	*!			
c. k.kət.b		*!	*	**
d. k.təb.b		*!	*	

This tableau demonstrates how the optimal template of MCs emerges. For example, given the input /μ/ √ktb, the optimal form is [kəttəb]. This form realizes the moraic causative affix by geminating the second segment of the root for the sake of achieving the least marked syllable structure possible. The other competing candidates shown in the tableau represent cases of candidates that either fail to parse/fill the moraic affix (i.e. 40b) or geminate the peripheral consonants of the root, creating marked syllable structures (i.e. 40c and 40d), hence violating the high-ranking constraints MAX-Affix and σWF, respectively. For example, candidate (40d) is ruled out because of the empty-headed syllable projected by its final geminate. Note that candidate (40c) is harmonically bounded to the optimal form since it is suboptimal for other reasons, namely the multiple violation of Align-R (μ). This clearly shows that prosody is responsible for the linearization of the input material and the construction of invariant templates.

3.3.5 Output selection: the agent noun

The idea of how prosody could affect input linearization and template derivation would be clearer as we consider the cases of the AN and IN. Particularly, in the context of ANs and INs, the low-ranking status of CONTIGUITY gets more highlighted since the root material gets interrupted by some of the affixal material. We have mentioned before that the contiguity of the input elements gets neutralized under the pressure of constraints on prosodic well-formedness. The following tableau illustrates how the interaction between prosodic well-formedness and contiguity faithfulness leads to the formation of the AN template:

(41)

√nʒr̩ /μ-a/	σWF	CONTIGUITY
a. nəʒ.ʒ.r̩a	*!	
☞b. nəʒ.ʒar̩		*

This tableau reveals that neutralizing the contiguity of the root, by means of infixing the vowel /a/ of the agent affix, is necessary to avoid a syllable structure like the one derived in candidate (41a), whereby the medial geminate projects an empty-headed syllable. Therefore, infixing the vowel /a/ is driven by the need to provide a nucleus for that syllable. The other constraint interactions involved in the derivation of ANs are shown in the tableau below:

(42) Deriving the agent noun from tri-consonantal roots

Input: √nʒṛ /μ-a/	MAX-Affix	σWF	IDENT-Root (Weight)	ALIGN-R (μ-a)	CONTIGUITY
☞a. nəʒ.ʒaṛ			*	*	*
b. n.ʒaṛ	*!	*		*	*
c. n.nəʒ.ṛa		*!	*	**	
c. n.nə.ʒaṛ		*!	*	**	*
d. n.n.ʒaṛ		*!	*	**	*
e. nəʒ.ʒ.ṛa		*!	*	*	
f. nəʒ.ʒəṛ.a		*!	*	*	
g. nəʒ.ṛ.ṛa		*!	*		

This tableau evaluates the most plausible candidates that could be generated from the preliminary input: √nʒṛ-/μ-a/. Candidate (42b) is ruled out by MAX-Affix for failing to realize the moraic part of the agent morpheme. Candidates (42c) through (42g) represent different permutations of input linearization. All these candidates violate some specific aspect of syllabic well-formedness. In particular, (42c) violates *μ/$C_h$and *μ/ə, (42d) violates both *μ/C_h and *EMPTY-headedσ, (42e) violates *EMPTY-headedσ, (42f) violates ONSET and (42g) also violates *μ/C_h. The only linearization that succeeds in avoiding the violation of the high-ranked constraints of prosodic markedness is the one that gives us the optimal form in (42a).

3.3.6 Output selection: the instrument noun

In the same vein, the templatic shape of INs also follows from the interaction between σWF and CONTIGUITY, such that σWF dominates CONTIGUITY. This way, the vocalic material of the instrument morpheme is licensed by prosodic well-formedness to disrupt the contiguity of the root material.

(43)

√tlʒ /μ-a-a/	σWF	CONTIGUITY
a. təl.l.ʒ.a.a	*!	
☞b. təl.la.ʒa		*

The candidate in (43a) above incurs numerous violations of different well-formedness constraints, preferring to keep the contiguity of its root material intact. The winning candidate in (43b), however, neutralizes the contiguity of its constituents in order to conform to the syllabic well-formedness of the language.

In the tableau below, it will be shown that the same constraint hierarchy involved in the derivation of MCs and ANs can account for the derivation of INs as well. In particular, the following tableau shows how the IN *təllaʒa* 'refrigerator' is derived from the input: √tlʒ/μ, a, a/.

(44) Deriving the instrument noun[12]

Input: √tlʒ/μ, a, a/	MAX-Affix	σWF	IDENT-Root (Weight)	ALIGN-R(μ-a-a)	CONTIGUITY
☞a. təl.la.ʒa			*	**	*
b. t.ləʒ.ʒa.a		*!			
c. t.t.la.ʒa		*!	*	**	*
d. t.təl.ʒa.a		*!	*	**	
e. t.la.ʒa	*!	*		*	*
f. təl.l.ʒa	*!	*		*	
g. təl.laʒ	*!		*	*	*

This tableau demonstrates that the way the optimal form in (44a) linearizes the input material does not violate any of the syllabic well-formedness constraints. On the contrary, candidates (44b) through (44f) are ruled out for violating some of the well-formedness constraints. For example, the candidate in (44b) specifically violates ONSET and $*\mu/C_h$. Candidates (44e) and (44f) are sub-optimal for other reasons as well, namely the violation of MAX-Affix. In both candidates, the affix material is not realized in its entirety. Particularly, candidate (44e) does not realize the prosodic part of the instrument morpheme, i.e. mora, while

[12]The final /a/ of the instrument morpheme cannot be driven inside the root for the simple reason that this will lead to some violation of the syllable well-formedness constraint (i.e. σWF). For example, a candidate like *təl.la.aʒ* would violate ONSET. Also, despite the discontinuity characterizing the instrument morpheme, we believe that it is important to assume that the linearity of its constituents is significant and should maintained in the absence of any reasons to change it (i.e. AFFIX-LINEARITY). This means that the internal /a/ and the final /a/ should not be able to randomly swap positions. This is also true for root linearity (i.e. ROOT-LINEARITY).

candidate (44f) fails to realize the nominal /a/ of the affix. Candidate (44g) is excluded for similar reasons, specifically the non-realization of the feminine /a/ of the instrument morpheme.

Another way of looking at INs could be to argue that they form one class with ANs (Karim Bensoukas, personal communication). This means that they would have to be viewed as sharing the semantic affinity expressed by the morpheme /μ-a/. The difference, however, lies in the grammatical specificity brought by the final /a/ of the instrument form. Such an approach to deriving INs suggests a case of output-based derivation. We previously pointed out to the fact that the final /a/ of the instrument form serves a derivational function as well as an inflectional one. Concerning this point, an output approach to instrument formation further asserts this fact since the /a/ occurring at the end of the instrument form becomes the major characteristic of its derivation. Therefore, feminizing ANs becomes the main way to express the instrument meaning. Nevertheless, it should be noted that such an account does not comply with our view of maximizing a root-based perspective to word derivation in MA. Besides, this account would create many forms which morphologically qualify as potential ANs, but they are, in fact, semantically unattested (e.g. *təllaʒ, *səmmaʕ, *səkkat etc.).

4. Earlier accounts of morphological gemination in MA

It is worth noting that the analysis that was developed in the course of this paper has built on previous works that have dealt specifically with morphological gemination in causatives. To the best of our knowledge, no accounts have been devoted to investigating the morphology of ANs and INs in MA. The treatments to be reviewed and discussed here primarily include the pre-OT circumscription analysis of Bennis (1992), the pre-OT autosegmental analysis of Bennis and Iazzi (1995) and the OT partial reduplication analysis of Boudlal (2001).

4.1 The prosodic circumscription analysis

To start with, Bennis (1992) maintains that the causative in MA is derived from word forms (i.e. nouns, verbs and adjectives) through the affixation of a heavy syllable (i.e. bimoraic) to a circumscribed prosodic constituent that can be of the shape -CəC or CV. For instance, the causative [ləʕʕəb] ‘to make play’ is derived from the verb [lʕəb] by prefixing the heavy syllable [σμμ] to the prosodic domain [-ʕəb]. The idea is that one mora generates a geminate while the other mora triggers schwa epenthesis.

(45) The prosodic circumscription analysis

Aff Caus: lʕəb = σμμ- ʕəb * l

= -əʕʕəb * l

= ləʕʕəb

There are two aspects for which this analysis can be criticized. First, it rests heavily on the notion of extraprosodicity, in that it assumes that a segment remains inert and stays out of the derivational procedure, while the morphological process of affixation targets a well-defined prosodic constituent. Extraprosodicity is needed to explain the occurring infixation phenomenon in causatives. In our analysis, however, the infixation of the causative morpheme could be attained simply via the interaction of universal constraints.

Second, the causative affix is believed to be a heavy syllable (i.e. σμμ) which consists of two moras, one to motivate schwa epenthesis and the other to trigger consonant gemination. Nonetheless, it has been shown elsewhere (Bensoukas and Boudlal, 2012a-b) that schwa in MA is nonmoraic. Instead, the nucleus schwa and the following coda consonant share one single branching mora. Grounded on this fact, our analysis limits the prosodic shape of the causative morpheme to one mora responsible for consonant lengethening. Schwa, on the other hand, is independently motivated and is more general, in that it is epenthesised to break up any impermissible consoant clusters.

4.2 The skeletal analysis

Bennis and Iazzi (1995) accounts for the derivation of causatives in MA using the representational premises of autosegmental phonology. The basic claim of this work is that the causative template has the shape XXXX, where X refers to an underspecified position in the segmental tier. This template is then associated to a lexical entry as follows. First, the second radical element is pre-associated to the third position in the template. Second, the other segments spread to associate with the remaining corresponding positions in the template. Finally, the rules of syllabification apply. Below is an example of deriving the causative [dəxxəl] 'to make enter':

(46) The autosegmental analysis

Lexical entry	*Pre-association*	*Spreading*	*Syllabification*
	X X X X	X X X X	
√dxl	d x l	d x l	[dəxxəl]

A major shortcoming of this analysis is that it resorts to an ad-hoc solution to explain the internal gemination that has come to characterize the causative verb in MA. Neither right-to-left nor left-to-right spreading could yield the right forms. It is only through the mechanism of pre-association that the correct forms can be produced. Again, our analysis can explain internal gemination by means of interaction between universally attested constraints.

4.3 The reduplication analysis

Boudlal (2001) analyzes the causative pattern by means of constraint interaction à la OT. At the heart of this analysis is the claim that the causative affix is a reduplicative one. To be more specific, it was maintained that causatives are derived through partially reduplicating the base form (e.g. RED, ktb). The reduplicant takes the form of an underspecified segment that copies the features of the segment it gets to duplicate. After being infixed,the RED affix copies the features of the second consonant of every root it is affixed to.

According to Boudlal (2001), the causative form is derived through the interaction of four main constraints. First, there is an alignment constraint, ANCHOR (Base, L, RED, L), which requires the reduplicant to be left aligned to the base. To account for the medial position of the geminate in the optimal form, this constraint must be dominated by *GEM-σ_1, a markedness constraint banning the occurrence of geminates in initial syllables.

Also, there is another alignment constraint, ALIGN-E (Root, PWd), which demands a complete match between the edges of the root and the prosodic word. The role of this constraint consists in preventing the total reduplication of the base by dominating the faithfulness constraint MAX-Rt-BR. The violation of ALIGN-E (Root, PWd) and ANCHOR (Base, L, RED, L) is assessed gradiently, in the sense that the degree or multiplicity of violation in terms of distance from the designated edge is what makes a candidate pass or fail. The following tableau provides a visual demonstration of these constraint interactions:

(47)

/RED, ktb/	*GEM-σ1	ALIGN-E (Root, PWd)	ANCHOR (Base, L, RED, L)	MAX-Rt-BR
☞a. kə**t**.təb			*	**
b. **k**ək.təb	*!	**		**
c. kə**k**.təb	*!			**
d. kət.**b**əb			**!	**
e. kə**b**.təb			**!	**
f. **k.təb**. k.təb		****!		

This tableau shows that candidate (47a) is the optimal output as it satisfies the structural demands of the higher-ranked constraints: *GEM-σ1 and ALIGN-E (Root, PWd). Candidates (47b) and (47c) are immediately ruled out by the undominated constraint *GEM-σ_1. Furthermore, candidate (47b) incurs multiple violations of ALIGN-E (Root, PWd) since the left edge of the prosodic word no longer corresponds to the left edge of the root. The latter constraint also excludes candidate (47f), which represents a case of total reduplication. As for candidates (47d) and (47e), they seem to tie with the optimal candidate at the level of *GEM-σ1 and ALIGN-E (Root, PWd). The constraint ANCHOR (Base, L, RED, L) becomes the deciding factor in this case. Here, it unties what seems to be a deadlock through gradient assessment, where candidates (47f) and (47e) fare worse on this constraint; hence, [kət.təb] wins out at the end.

The reduplication analysis of morphological gemination in MA seems to be unrestricted, in the sense that the reduplicant is not specified in terms of a well-defined phonological entity. Within current prosodic morphology, namely templatic morphology (McCarthy and Prince, 1986/1996, 1990a, 1990b), restrictions on the size and shape of reduplicants were found to be cross-linguistically defined in prosodic terms, viz. phonological word, foot or syllable. On this view, the analysis of morphological gemination as a case of segment reduplication appears to be inconsistent with this generalization since it does not refer to a constituent of the prosodic hierarchy. In other words, it is not possible to consider morphological gemination a result of segment duplication since a segment is obviously not a prosodic constituent.

5. Conclusion

In this paper, we have argued that morphological gemination in MA is achieved via the affixation of a moraic affix to a root, which later translates into a word-medial geminate. More specifically, we have made the claim that the designated mora is initially suffixed to a base root. The infixation of the mora, however, happens under the pressure of certain phonological requirements, namely requirements pertaining to syllable well-formedness. We have postulated that there is an alignment constraint which stipulates that a mora should be right-aligned to the edge of the root, hence ALIGN-R (μ). The realization of the mora in the output is ensured by the faithfulness constraint MAX-Affix, militating against the non-parsing/non-filling of the moraic affix in the input. The alignment constraint is believed to be outranked by a markedness constraint on prosodic well-formedness, σWF. This very specific ranking forces the aligned mora to be prohibited from attaching to the right edge or any edge for that matter because it will always cause some violation of prosodic markedness.

Prosodic well-formedness was also shown to be responsible for the emergence of the invariant shape templates of the forms under study. This effect is obtained through the ranking of σWF over CONTIGUITY. In particular, it has been demonstrated that the linearization of the roots and affixes involved in the derivation of MCs, ANs and Ins is tuned to comply with the prosodic well-formedness of MA, leading to the construction of the templates characterizing the forms in question. With this done, we have been able to motivate a root-and-prosody approach to templatic morphology in MA, whereby templates are emergent structures.

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