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Gemination within English loanwords in Ammani Arabic: An Optimality-theoretic analysis[1]

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Adopting an Optimality-theoretic approach, this paper examines gemination in English loanwords in Ammani Arabic (AA). Data come from a corpus of 1200 loanwords as produced by 12 AA monolingual native speakers. Results show that gemination, which is not attested in the source input, is induced to satisfy AA structural constraints and to render the output better well-formed. Of particular interest, results show that the introduction of English loanwords into AA highlights the activity of a constraint that requires prosodic words in AA, and probably many Arabic dialects, to be left-aligned with a foot. This constraint enhances our understanding of many aspects of Arabic phonology such as stress assignment and foot formation. The study has important implications for Arabic phonology, loanword phonology and second language acquisition.

KEYWORDS: Arabic, gemination, loanword phonology, Optimality Theory

1. INTRODUCTION

The study of the phonological adaptation of loanwords is an invaluable tool that sheds light on the working phonology of borrowing languages by revealing the activity of constraints that would remain latent in the borrowing language (Davis 1994, LaCharité & Paradis 2005, Calabrese & Wetzels 2009, Crawford 2009, Paradis & LaCharité 2011, among many others).

Gemination within loanwords, which is a common process in many languages, e.g. Japanese (Kubozono, Ito & Mester 2008), Italian (Repetti 2009), Finnish (Kroll 2014), has not received due attention in Arabic dialects. Many loanwords undergo an intriguing process of gemination in Ammani Arabic (henceforth AA), as in *bal.loon* ‘balloon’ and *bik.kii.ni* ‘bikini’.[2] This phenomenon looks unnecessary because it is not attested in the source English input. The very few earlier studies that hinted at gemination in Jordanian Arabic (e.g. Suleiman 1985)

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[2] Following the mainstream practice in Arabic studies, I use double letters to represent long vowels and one letter to represent short vowels in AA. A dot demarcates syllable boundaries.

attributed gemination to source spelling. However, the fact that gemination within loanwords is attested in loanwords that are not spelled with double orthographic consonants and no gemination is attested in many loanwords that are spelled with double orthographic consonants indicates that spelling cannot account for gemination or lack of gemination in loanwords in AA, as will be demonstrated in Section 6.

Studies of gemination in other Arabic dialects are also scarce. Accounting for prosodic adaptation of English loanwords in Egyptian Arabic, Reynolds (2012) reports that Egyptian Arabic resorts to gemination to repair underweight source English words (e.g. 'watt' > *waṭṭ*). He attributes this to borrowing language grammar constraints that militate against monomoraic prosodic words. This type of gemination is also attested in AA, as will be shown in Section 4.1.

Although the study of gemination in Arabic in general and Jordanian Arabic in particular has been almost neglected, it has received considerable attention in other languages, e.g. Japanese, Italian and Korean. Typologically, loanword gemination can be attributed to two main factors: input-oriented and output-oriented factors. Input-oriented factors relate to source language features while output-oriented factors involve borrowing language constraints, usually markedness ones. It will be demonstrated in this paper that gemination in loanwords in AA is mainly output-oriented.

Input-oriented factors are usually faithfulness factors that attempt to preserve source features in the adapted loanwords including phonetic, prosodic, morphophonemic, and orthographic factors. For example, in Japanese, English loanwords such as 'hit' undergo gemination to preserve the moraicity of the source coda of the stop /t/ yielding *hit.to* rather than **hi.to* as the latter form, although well-formed in Japanese phonology, syllabifies the source coda as an onset in the adapted form (Ito, Kubozono & Mester 2017). Another input-oriented factor is a morphophonemic alignment constraint that requires a loanword (which is interpreted as a stem) to be aligned with a syllable in the adapted form (Shinohara 2004 for Japanese; Repetti 2009 for American Italian). For example, in American Italian, the English loanword 'book' is mapped onto *buk.ka* to align the right edge of the stem which ends in the stop /k/, with the right edge of the syllable.

Other input-oriented factors are source phonetic factors. Fine acoustic details in the input can be interpreted as a geminate (Vendelin & Peperkamp 2004 for Korean; Repetti 2009 for American Italian; Ito et al. 2017 for Japanese). To give an example, in Japanese, the higher pitch and the longer duration of obstruents word-finally help to trigger gemination while obstruents in medial position (with lower pitch and shorter duration) do not (Ito et al. 2017). A final input-oriented factor is source orthography where double letters in the source spelling are interpreted as a geminate (Morandini 2007 for Italian; Ito et al. 2017 for Japanese). For example, the English loanword 'shopping' is realized as *ˈʃɔp.piŋ* in Italian because of the double 'p' grapheme in the source spelling (Morandini 2007).

On the other hand, output-oriented factors involve constraints in the borrowing language that improve the prosodic form of the output. A very common constraint

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is a minimality constraint that militates against monomoraic prosodic words in the borrowing language (Reynolds 2012, for Egyptian Arabic, see Section 4.1 for more details on how this constraint invokes gemination in AA). Another constraint is a markedness constraint that favors stressed syllables to be heavy (namely STRESS-TO-WEIGHT PRINCIPLE, see Section 4.2), as in English loanwords in Italian (Morandini 2007, Repetti 2009).

Other output-oriented factors are attested in loanwords in Japanese. Ito et al. (2017) report two cases of gemination in English loanwords. In the first case, gemination is triggered to avoid a word-final head foot (when more than one foot is constructed), as in 'frog' which is realized as *fu*(ˈ*rog)gu*) with accent on the second syllable in order to avoid accent on a foot that is aligned with the right edge of the word (compare **fu*(ˈ*rugu*)). In the second case gemination is invoked to construct a foot word-initially, as in the English loanword 'cookie' that is mapped onto *kuk.kii* with a bimoraic initial foot (Ito et al. 2017: 308–309). To sum up, from a typological perspective, gemination in loanwords can be mainly driven to satisfy faithfulness constraints (input-oriented) or to improve markedness constraints (output-oriented).

Couched within an Optimality-theoretic approach (Prince & Smolensky 1993/2004, Kager 1999), this study aims at accounting for gemination in English loanwords in AA – the dialect spoken in the capital of Jordan[3] from a phonological perspective shedding light on a rather neglected area in Arabic phonology in general and AA in particular (see Davis & Ragheb 2014). This will ultimately contribute to a better understanding of many phonological aspects in Arabic phonology such as stress assignment constraints, foot structure as well as the intriguing gemination of the applicative morpheme *-l* in native words, which is still open to debate. It will be demonstrated that gemination in AA is mainly an output-oriented phonological process that is triggered to satisfy AA structural constraints, chief among which is a high-ranked neglected constraint that demands AA prosodic words to be left-aligned with a bimoraic foot.

The remainder of this paper is organized as follows. Section 2 provides background information on gemination and metrical structure in native AA phonology, and Section 3 describes the methodology used to collect and analyze the data. Section 4 discusses gemination within loanwords where three patterns of gemination are identified. In Section 5 an OT account for each pattern of gemination is presented. Section 6 demonstrates that the role of orthography in gemination is minimal and Section 7 concludes the paper discussing broader implications.

[3] AA is a Levantine dialect that is very close to Palestinian Arabic (see Abu Guba 2016, Al-Wer 2007 for more details on this dialect).

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2. Background

In this section I provide brief information on relevant AA phonological aspects as well as the controversial issue regarding the representation of geminates. Specifically, I give an overview of geminates and syllable structure in native words. Next I give an overview of foot structure and stress assignment and conclude with a review of the phonological representation of geminates.

2.1 *Geminates in native AA phonology*

A geminate is a long or 'doubled' consonant that contrasts phonemically with its shorter or 'singleton' counterpart (Davis 2011: 873). Not only does AA have surface geminates word-medially and finally, as in most Arabic dialects, but it also has geminates word-initially as the examples in (1) below illustrate (see Al-Tamimi, Abu-Abbas & Tarawnah 2010, Amer, Adaileh & Abu-Rakhieh 2011, Davis & Ragheb 2014).

(1) (a) *Initial gemination*

i. /l+ʃams/ > ˈʃʃa.mis[4] 'the sun'
ii. /t+diʕʕ/ > ddiʕʕ 'you.M.S push'
iii. /bi+baal+na/ > ˈbbaal.na 'in our mind'
iv. /mumawwadʒ/ > ˈmmaw.wadʒ 'wavy.M.S'

(b) Medial gemination

i. ˈkas.sar 'broke M.S over and over' (compare ˈka.sar 'broke.M.S')
ii. kas.ˈsaa.ra 'quarry'
iii. rag.ˈgaaṣ 'gifted dancer'
iv. /ma+katab+t+hin+ʃ/ > ma.ka.ta.bit.ˈhin.niʃ 'I did not write them.F'
v. /katab+t+l+u/ > ka.tab.ˈtil.lu 'I wrote for him'
vi. ˈsaw.wa 'he made' (compare ˈsa.wa 'together')
vii. dab.ˈbuur 'wasp'

(c) *Final gemination*

i. ʔa.ˈmall 'more boring' vs. ˈʔa.mal 'hope'
ii. ʔa.ˈmarr 'more bitter' vs. ˈʔa.mar 'he ordered'
iii. ʕamm 'paternal uncle'(compare ˈʕam.mak 'your.M.S paternal uncle')

The examples in (1a) show that initial geminates are derived and thus can be considered as fake geminates, i.e. merged sequences of identical consonants

[4] The raised mark ˈ precedes a stressed syllable.

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resulting from morpheme concatenation or high vowel deletion. They result from the assimilation of the definite article, as in *ʃʃa.mis*, the concatenation of a proclitic to a stem-initial consonant, as in *bbaal.na* or from syncope of short high vowels, as in *mmaw.wadʒ*.[5] Medial geminates appear in causative verbs, as in *kas.sar* and their corresponding instrumental nouns, as in *kas.saa.ra*. They are also attested in intensive nouns and participles as in *rag.gaaṣ*. Furthermore, medial geminates appear before the negative suffix /ʃ/ when affixed to the plural affixes /hum/ and /hin/, as in *ma.ka.ta.bit.hin.niʃ*, as well as in the applicative morpheme *-l*, as in *ka.tab.til.lu*. Medial geminates are also attested in some lexical words, as in *ˈsaw.wa* and *dab ˈbuur*. Finally, the examples in (1c) relate to geminates in absolute final position where stress is attracted to the final heavy syllable. This provides evidence that word-final geminates are attested in AA. However, whether a distinction between a geminate and its singleton counterpart word-finally is maintained is debated in Arabic phonology. This will be further examined acoustically in Section 4.1.1.

2.2 *Syllable structure in AA*

AA displays syllable structure characteristics that are found in other Levantine dialects. The minimal syllable structure in AA is CV (where C stands for consonant and V for vowel). That is, an onset and a vocalic nucleus are obligatory in AA. In other words, onsetless syllables are categorically banned in AA, as in other Arabic dialects (see Watson 2002: 65). The optimal onset is a simplex one; two-consonant onsets result from syncope of short high vowels in unstressed syllables, as in /bilaad/ > *blaad* ‘countries’ and /musammam/ > *msam.mam* ‘poisoned’ or from the concatenation of prefixes, as in /t-kaatal/ > *tkaatal* ‘he fought with someone’ where the detransitivizing prefix *t-* is affixed to a consonant-initial verb. The nucleus can be short or long, as in *sadd* ‘dam’ and *saad* ‘he prevailed’, respectively. There are no restrictions on simplex codas while two-consonant codas are attested in three cases only: true geminates, optional sonorant-obstruent codas and optional obstruent–obstruent sequences. Note that not all obstruent–obstruent sequences are permitted in AA. Only tautomorphemic codas that agree in voicing are allowed (see Abu Guba 2016).

2.3 *Foot structure and stress assignment in AA*

This subsection reviews foot structure and stress assignment in AA in the light of previous studies on Jordanian and Palestinian dialects. Bimoraic feet are constructed from left-to-right while degenerate feet, monomoraic feet, are absolutely forbidden (see McCarthy 1979, Hayes 1995, Watson 2011). Following

[5] Initial geminates are optionally attested with an anaptyctic vowel that is very often deleted in Arabic dialects (see Mitchell 1993: 93–94).

moraic theory (Hyman 1985, McCarthy & Prince 1986, Hayes 1989), a short vowel is monomoraic while a long vowel is bimoraic. Coda consonants receive a mora through the constraint WEIGHT-BY-POSITION unless they are in absolute final position where they are extrametrical.[6] Feet can be composed of a heavy (H) syllable or two light (L) syllables. HH or uneven trochees (i.e. HL), are not allowed.

Based on previous literature on stress assignment in Jordanian and Palestinian dialects (e.g. Brame 1974, Abu-Salim 1982, Hayes 1995, Abu-Abbas 2003, Al-Mohanna 2004, Abu-Rakhieh 2009, Watson 2011), stress assignment in AA would proceed as follows: stress falls on the rightmost heavy syllable and if there is no heavy syllable in the word, stress falls on the first syllable with an antepenultimate limit. Thus, stress falls on the heavy ultimate syllables in *ba*$_{\mu}$(ˈ*naa*$_{\mu\mu}$)[7] <*t*> 'girls', (*ba*$_{\mu}$*ra*$_{\mu}$)(ˈ*wii*$_{\mu\mu}$)<*z*> 'frames' and (*mi*$_{\mu}$*s*$_{\mu}$)*ta*$_{\mu}$(*ʕi*$_{\mu}$*dʒ*$_{\mu}$)(ˈ*lii*$_{\mu\mu}$)<*n*> 'they.M are in a hurry' and on the heavy penult (last but one syllable) in (*sa*$_{\mu}$*y*$_{\mu}$)(ˈ*yaa*$_{\mu\mu}$)*ra*$_{\mu}$ 'car', *ma*$_{\mu}$(*zaa*$_{\mu\mu}$)(ˈ*ri*$_{\mu}$*ʕ*$_{\mu}$)*hu*$_{\mu}$<*m*> 'their.M farms' and (*mak*)(*tab*)*ti* 'my bookshelf'; otherwise stress falls on the antepenult be it heavy or light as in (ˈ*ma*$_{\mu}$*d*$_{\mu}$)*ra*$_{\mu}$*se*$_{\mu}$ 'school', (ˈ*ʃa*$_{\mu}$*dʒa*$_{\mu}$)*ra*$_{\mu}$ 'tree' and (*mu*$_{\mu}$*ħ*$_{\mu}$)(ˈ*ta*$_{\mu}$, *ra*$_{\mu}$)*me*$_{\mu}$ 'respected.F.S'.

However, previous analyses of stress in Jordanian and Palestinian Arabic face two problems. First, they fail to account for monomoraic trapped syllables at the left edge of prosodic words, as in *ba*$_{\mu}$.(*naa*$_{\mu\mu}$)<*t*>. A prosodically trapped syllable is a light syllable that is unfooted as it is adjacent to a heavy syllable or word edges (see Mester 1994: 29). Although previous analyses mention that footing proceeds from left-to-right, they ignore cases where the second syllable is heavy and the initial syllable is light. For example, in *ba*(*naa*)<*t*>, the second syllable makes up a foot on its own therefore the first syllable remains unfooted. Gemination within English loanwords here shows that these light syllables have a crucial status and need to be footed, as will be demonstrated in Section 4.3.

The second problem relates to final foot extrametricality, which was assumed to account for stress on the antepenult in HLL forms, as in (ˈ*mad*)*rase*. Adopting foot extrametricality makes it difficult to account for stress on superheavy syllables, as in (*mis*)*ta*(*ʕidʒ*)(ˈ*lii*)*n* above and heavy syllables ending in long vowels, as in (*sa*$_{\mu}$*w*$_{\mu}$)*wi*$_{\mu}$ (ˈ*naa*$_{\mu\mu}$) 'we did it.M'. Following McCarthy (1979: 453), earlier analyses assume that these syllables are not in final position. They argue that an extrametrical final consonant intervenes between the right edge and the word (compare (*mis*)*ta*(*ʕidʒ*)(ˈ*lii*)<*n*>) and that words ending in long vowels in open syllables such as (*saw*)*wi*(ˈ*naa*) are underlyingly superheavy as they are closed by

[6] Consonant extrametricality, which is indicated by placing the consonant between two < > brackets, is motivated on the grounds that a final CVC syllable is light and revokes stress word-finally whereas a word-internal CVC syllable acts as heavy and attracts stress (Hayes 1995: 57; Watson 2011: 2999 among others).

[7] The symbol μ indicates a mora and parentheses demarcate feet. Recall that feet in LA are assigned from left-to-right, as will be demonstrated in Section 4.3.

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an extrametrical consonant (naa<h>) that is deleted on the surface. However, the introduction of many loanwords such as 'tattoo' (*tat*)(ˈ*tuu*) where stress falls on a heavy ultimate syllable with no extrametrical consonant poses a great challenge to earlier analyses. Moreover, loanwords that comprise four light syllables, as in (*munu*)(ˈ*buli*) 'monopoly' (see Section 5.3), pose another serious challenge to these analyses. The data here suggest that an analysis that requires the prosodic word to start with a foot and that adopts only final light syllable extrametricality would be better able to account for stress assignment in Levantine Arabic (for a complete discussion of stress in AA see Abu Guba 2018).

2.4 *Representation of geminates*

In this subsection, I review the most important views of geminate representation and maintain that a composite model that combines a moraic and segmental view is better able than segmental- or moraic-only representations to account for geminate behavior. I also touch on the difference between true and derived geminates, which could have different representations.

2.4.1 *The prosodic length and moraic representations*

The representation of geminates has been a debated issue in phonology (Davis 2011: 873–876). The two major views of geminate representation are the prosodic length analysis, which postulates that a geminate is linked to two timing slots and the moraic view, which posits that a geminate is underlyingly moraic (Davis & Ragheb 2014: 5). A third possible view is a composite model that combines insights from the above two views and simultaneously attempts to address their shortcomings (see Hume, Muller & van Engelenhoven 1997, Curtis 2003).

Under the prosodic length representation, a geminate has one set of features on the melodic tier but two slots on the skeletal tier, be it a CV-tier, or X-tier, with slots representing prosodic length (Ringen & Vago 2010, Davis 2011). This representation cannot differentiate between geminates and two-consonant clusters and thus predicts that a geminate should appear in positions where CC-clusters also appear. Consequently, the appearance of a geminate in any position where a CC-cluster cannot appear constitutes counterevidence against this representation.

On the other hand, the moraic representation assumes that geminates are underlyingly moraic, and the prosodic tier is moraic rather than segmental. This representation predicts that a geminate does not need to pattern with CC-clusters and a geminate could behave differently from singleton (coda) consonants in weight-sensitive processes (Davis 2011). Observations of the behavior of geminates in AA are compatible with a moraic representation of geminates. First, a geminate can appear in coda position medially and word-finally but consonant clusters are more restricted and the few clusters that appear in AA are optional. For example, CC-clusters word-finally usually trigger vowel epenthesis, but a geminate normally does not (e.g. /bint/ > *binit* 'girl' but /sitt/ > *sitt* 'grandmother'). Furthermore, word-medial geminates (Gs) following long vowels (CVVG) trigger vowel epenthesis in AA while CVVC syllables do not. So, in /saadd-hin/ > *saa.did.hin* 'blocking them.F', vowel epenthesis breaks up the geminate (violating geminate integrity, though) while no vowel epenthesis is attested in /ʃaaf-hin/ > *ʃaaf.hin* 'he saw them.F'. Vowel epenthesis here suggests that the geminate behaves differently from the coda singleton in terms of weight.[8] (See also Curtis 2003 and Davis 2011 for the overwhelming evidence in support of the moraic representation of geminates in other languages.)[9]

However, a moraic analysis of geminates in AA has one problem: it cannot account for contained geminates in CVG] syllables (where] represents a contained geminate) word-internally in native AA words, as in *sitt.na* 'our grandmother' (compare *bit.na* 'we stayed overnight'). A contained geminate is a geminate that wholly syllabifies as a coda within a syllable, i.e. its second leg does not syllabify as an onset of the following syllable. A moraic-only representation would not be able to differentiate between the geminate in *sitt.na*, which is completely syllabified in the coda of the first syllable, and the simple *moraic* coda in the first syllable in *bit.na*. Therefore, we need a way to indicate segmental length and bipositionality of geminates. In this study, following Curtis (2003), I adopt a composite model that assumes a moraic and segmental representation of geminates: the two-root node composite model.

2.4.2 *The two-root node composite model*

As discussed above, neither a purely segmental view nor a purely moraic view of geminates can account successfully for geminate representation. A two-root node composite model that combines both is needed: a model that adopts different units to distinguish syllable weight from segmental length (Curtis 2003). In this model, segmental length is represented independently of prosodic weight and therefore geminates maintain their moraic representation but they are linked to two-root nodes. This representation can account for contained geminates and differentiate them from CVC syllables word-medially: CVG] syllables would equal CVC syllables in terms of weight but they are longer as they are associated with two-root nodes.[10]

The two-root node model for geminates was motivated by phonological phenomena such as the development of pre-aspirated consonants from historical geminates in Icelandic whereby only one member of the geminate is affected

[8] Epenthesis can be explained as a strategy to avoid trimoraic syllables. In *ʃaaf.hin* a shared mora analysis accounts for the bimoraicity of the syllable while in *saadd.hin* mora sharing seems to be blocked presumably due to the inherent moraicity of the geminate (see Section 5 for a shared mora analysis of CVVC syllables). Further investigation is required.

[9] The moraic theory is particularly successful in accounting for the moraic trochee where a heavy syllable or two light syllables make up a trochaic foot.

[10] The root node indicates the major class features of a sound (McCarthy 1988) and it dominates the rest of the specified features.

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(Selkirk 1990). For example, the Icelandic word /mappa/ 'folder' is realized as [mah.pa] where only the first root node is affected and the mora is preserved. Similarly, this model can readily account for possible degemination in some cases in AA where delinking would affect only one root node and the mora is preserved. Note that a two-root node analysis rather than a two X-slots analysis of geminates is preferable because syllabification and weight patterns are sensitive to the segmental features of codas in a number of languages as reported by Zec (1988) and Gordon (1999).

A problem with this composite model relates to the existence of weightless geminates in some languages, e.g. the Uralic language Selkup (as reported by Ringen & Vago 2010). However, it is still possible to account for these weightless geminates under the two-root node analysis within an OT framework. Davis (2011: 890) argues that weightless geminates can be licensed by language-specific high-ranked constraints that militate against moraic geminates (e.g. a constraint that restricts moras to vowels only). That is, although a geminate can be inherently moraic, it loses its moraicity due to a constraint that ranks higher than a constraint that retains its mora (see Davis 2011 for more details).

It is worth noting that gemination within loanwords in AA is consistent with a moraic representation of geminates, as will be seen in this paper, and a moraic only representation can be maintained in this study (as pointed out by an anonymous reviewer). However, this study adopts the two-root node composite model for three main reasons. This model is better able to account for contained geminates in AA as shown above. Furthermore, this model is more consistent with observations of the behavior of geminates cross-linguistically (see Curtis 2003 for more details) and thus it would be better to adopt a unified model to account for geminates cross-linguistically. Additionally, and more importantly, the findings of this study do not contradict the composite model, which also incorporates a moraic representation.

A word on fake/derived geminates is in order here. Fake/derived geminates do not always pattern with true/underlying geminates. First, derived geminates undergo vowel epenthesis while true geminates usually resist epenthesis. For example, /sakat-t/ 'I kept silent' is realized with an epenthetic vowel in AA (*sa.ˈka.tit*) with stress on the second light syllable. This shows that epenthesis is a postlexical process that is invoked to avoid a consonant cluster word-finally. However, in *sitt*, with a true geminate, epenthesis does not apply.

Word-initial geminates, which are always derived, behave differently from medial or final geminates. Initial geminates, which appear with an optional epenthetic vowel, as in /l+ʃams/ > *ʃʃamis* ∼ *ʔiʃ.ʃamis* 'the sun' are moraless in AA. Evidence for the non-moraicity of initial geminates comes from stress assignment, as in *iʃˈʃamis* where stress falls on the light syllable /ʃa/. This means that the initial geminate is not moraic; otherwise, the first syllable would receive stress as per AA stress constraints (see Section 2.3 above). The status of initial geminates seems to be identical to the status of complex onsets in AA. Abu Guba (2016: 170) demonstrates that the first member in complex onsets in AA is licensed as a semisyllable that is affiliated directly to the prosodic word. (A semisyllable is an unsyllabified mora that is linked directly to the prosodic word rather than a foot or a syllable, so it does not contribute to syllable weight – Kiparsky 2003.) Likewise, an initial geminate can be analyzed as a moraic semisyllable that is not linked to a syllable or a foot and therefore it is weightless on the surface.

Adopting this semisyllable analysis of initial geminates means that initial geminates are represented differently from medial and final geminates. Although this is plausible (as derived geminates are reported to behave differently from true geminates and thus could be represented differently (see Topintzi & Davis 2017), it weakens a unified analysis of geminates cross-linguistically. A likely solution is to maintain the two-root composite model with one stipulation: the initial geminate loses its mora on the surface due to a high-ranked constraint that bans initial geminates from maintaining their mora on the surface (see also Davis 2011).

To summarize this subsection, a purely segmental analysis of geminates cannot account for geminate representation and the insights of the moraic analysis can be incorporated into a composite model that can correctly account for contained geminates. Furthermore, although gemination within loanwords in AA can be accounted for adopting a moraic analysis only, I adopt the two-root node analysis for comprehensiveness and parsimony. Maintaining a unified analysis that is more compatible with findings cross-linguistically is better in terms of descriptive and explanatory adequacy.

3. Method

Data for this research come from a corpus of 1200 well-established English loanwords in AA. This corpus was compiled by the researcher and verified by three AA linguists as a part of a large-scale research project (see Abu Guba 2016). Of the 1200 loanwords, 88 words have gemination in their adapted AA forms while gemination does not obtain in the other words as almost all of them are well-formed according to AA phonological constraints (see Section 4).[11] The researcher asked twelve monolingual native AA speakers (six males and six females) whose ages range from 30 to 60 to pronounce the words three times using a carrier sentence.[12] The researcher transcribed all the words and more than

[11] Note that some words have cognates in other languages especially European languages. However, I assume that these loanwords came from or via English. Note further that even if some words could have come from a language that has gemination in the source (e.g. Italian *rondella* 'roundel'), the analysis is still valid as it accounts for the other words, which have definitely come from English, e.g. 'collection' 'okay' and 'tattoo'.

[12] First, the participants pronounced a corpus of 420 loanwords as part of an earlier project (48 of them have geminates) and then the participants pronounced another list of 40 words with geminates.

a third of them were further verified by an American native speaker and trained phonetician.

To avoid the undesirable effect of spelling, the researcher elicited the words through pictures displayed on a screen. Once a participant identified the loanword, he/she pronounced the word three times in a carrier sentence (*ʔiʃtara/baguul* ____ *mbaariħ/marra θaanye* ‘he bought/I say ___ yesterday/once again’). This was recorded using a professional voice recorder at a 48 kHz sample rate (16 bit resolution) and saved in wav. format for further acoustic analysis using PRAAT version 1.4.9 (Boersma & Weenink 2015). Note that the participants were asked to say the words three times for consistency and no intraspeaker variation was attested in the three realizations of the loanwords; however, a little inter-speaker variation was attested among the twelve speakers in the realization of a few loanwords (variation is indicated in the Appendix).

4. Three patterns of gemination in English loanwords

In this section, I present three patterns of gemination within AA loanwords. The 88 loanwords with gemination (see Appendix) will be classified into three main types according to the reasons that trigger gemination. The first type relates to prosodic word minimal form; the second to stress, right-edge alignment and avoidance of parsing a final light syllable; and the third to left-alignment of the prosodic word with a foot. In general, gemination or lack of gemination within loanwords seems to be an output-oriented process that is induced to optimize the phonological structure of adapted loanwords.

4.1 *Gemination for minimality*

In this subsection, I argue that gemination is induced to satisfy the undominated constraint in AA, and probably most Arabic dialects, that requires a prosodic word to be minimally bimoraic (see e.g. Broselow 1992, Watson 2002, Abu-Abbas 2003, Reynolds 2012). Examples are given in (2).

(2) *Gemination for minimality*

	Source word	AA pronunciation
(a)	boss	buṣṣ (bu$_\mu$ṣ$_\mu$)<ṣ>
	dish	diʃʃ (di$_\mu$ʃ$_\mu$)<ʃ>
	full	full (fu$_\mu$l$_\mu$<l>
	net	nitt (ni$_\mu$t$_\mu$)<t>
	watt	waṭṭ (wa$_\mu$ṭ$_\mu$)<ṭ>
(b)	airbus	ˈʔeer ˈbaṣṣ (ˈʔee$_{\mu\mu}$) <r> (ˈba$_\mu$ṣ$_\mu$)<ṣ>
	coffee shop	ˈkufi ˈʃubb (ˈku$_\mu$fi$_\mu$) (ˈʃu$_\mu$b$_\mu$)<b>
	double kick	ˈdabil ˈkikk (ˈda$_\mu$bi$_\mu$)<l> (ˈki$_\mu$k$_\mu$)<k>
	full option	ˈfull ˈʔubʃin (ˈfu$_\mu$l$_\mu$)<l> (ˈʔu$_\mu$b$_\mu$)ʃi$_\mu$<n>

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The words in (2) are of two types. The first type, in (2a), is attested in source monosyllabic words whose vowel is monomoraic with a simple coda. Because word-final consonants in Arabic are weightless and a short vowel is monomoraic, the word would be monomoraic, which does not satisfy minimal word weight requirements in AA. For example, the English word ‘net’ /net/ has a short source vowel that is mapped onto an AA short vowel. This is followed by one consonant, which is moraless in AA (due to final consonant extrametricality). That being the case, AA resorts to geminating the final consonant, which adds another mora rendering the word bimoraic. Note that not all source words have a short vowel: five (out of 34) words such as ‘jeep’ /dʒiːp/ and ‘roll’ /rəʊl/ have a long vowel that is realized as a short vowel in AA resulting in an illicit monomoraic word, hence gemination of the word-final coda.[13]

The second type, in (2b), is attested in source polysyllabic words. Apparently, gemination here seems to be invoked unnecessarily as these words already satisfy minimality. However, all these compounds are treated as two separate words in AA where each word needs to satisfy minimal word requirements on its own; hence gemination. Evidence for this contention comes from the adaptation of words such as ‘full option’, which is realized as *full.ʔub.ʃin* in AA with a lateral geminate in the first syllable. I argue here that the lateral is geminated to satisfy minimality as the first word in the source compound word is treated as an independent word. Glottal stop insertion is invoked in the second word to provide an onset to the second syllable. If such words were treated as one word, there would be no need for gemination or glottal stop insertion as the word would already satisfy minimality in AA and the lateral /l/ would be resyllabified as an onset of the second syllable, as is the norm in native words (see Watson 2002). One might argue that gemination is invoked in such words due to source spelling. However, it will be shown in Section 6 that source spelling is not behind gemination.

4.1.1 *Evidence for final gemination*

It has been sometimes observed that geminates in some Arabic dialects tend to degeminate word-finally and the distinction between a geminate and its singleton counterpart is neutralized in this environment (see Abu-Salim 1982 for Palestinian Arabic; Watson 2002 for other Arabic dialects). For example, the length of final geminates in words such as *rabb* ‘Lord’ would be considerably reduced in many Arabic dialects (see Mitchell 1990: 88). This observation would cast doubt on our impressionistic judgments regarding final geminates. Therefore, in this subsection I provide acoustic evidence that shows that final geminates are significantly longer than their singleton counterparts. Note that although there are other differences between a geminate and its singleton counterpart such as F0, the duration of

[13] The reasons why these unfaithful realizations occur are beyond the scope of this paper (see Abu Guba 2016).

the preceding vowel, intensity and voicing degree (Al-Tamimi & Khattab 2011: 214–215 for Lebanese Arabic), this paper focuses only on duration.

4.1.2 *Duration of word-final singletons and geminates*

Phonetically, the difference between a geminate and its singleton counterpart lies in the hold phase of their production, other things being equal (Catford 1977). Although the ratio of a geminate to its singleton counterpart can vary greatly, it is normally about twice the length of a singleton (Ham 2001: 206; Embarki 2013: 36).

Word-finally, the status of geminates is quite different from geminates word-medially. Word-final geminates are usually shorter than intervocalic geminates (Thurgood 1993, Pająk 2009), leading to an overlap with their singleton counterparts and making the distinction between a word-final singleton and its geminate counterpart hard to detect (Watson 2002). However, whether the distinction between word-final geminates and their singleton counterparts is maintained is debatable. Abu-Salim (1982) claims that the distinction does not hold on the surface as geminates tend to degeminate word-finally. His contention is based on impressionistic judgments with no acoustic evidence. On the other hand, other researchers argue that word-final singletons and geminates are distinctive in Levantine Arabic. For example, Al-Tamimi et al. (2010: 118) found out that word-final geminates in Jordanian Arabic were 50% longer than their singleton counterparts. Ham (2001: 129–131) reached similar conclusions on the basis of the productions of two Jordanians and one Palestinian and reported that final geminates were significantly longer than their singleton counterparts.

On the basis of impressionistic judgments, I argue that final geminates are longer than their singleton counterparts so the distinction is not neutralized word-finally. (This does not mean that final geminates contrast with their singleton counterparts in AA as there are no minimal pairs that involve only a final geminate and its singleton counterpart). To test this acoustically, I compare a set of four pairs of geminates and their singleton counterparts in similar phonetic environments, given in (3).[14] All the words were recorded in the same carrier sentence used to elicit the pronunciation of loanwords (see Section 3 for information on participants). The researcher took standard measures to control for external variables such as consonant position, consonant clusters, and flanking vowels. The researcher asked the participants to speak as they would speak in everyday conversations and to keep a fixed distance between the microphone and their mouth. Two sibilants and two voiceless stops were selected because these sounds can be easily identified on the spectrogram, which makes measurements more reliable: stops have clear closure onset and offset points and sibilants have high frequency noise spectrum.

[14] Due to lack of minimal pairs, results here should be interpreted with caution.

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Final consonant durations were measured in milliseconds (ms) using PRAAT version 1.4.9 (Boersma & Weenink 2015). For stops, the hold phase (from the end of glottal pulses to the burst) was measured and for sibilants, the duration of the noise was measured. Table 1 compares the average duration of geminates and their singleton counterparts as produced by ten participants (five males and five females). The readings of each consonant were tabulated into Excel and fed into SPSS for further comparisons.

Geminates	Average duration in ms	Singletons	Average duration in ms	Ratio of singleton to geminate
ṣṣ (buṣṣ)	155	ṣ (baaṣ)	102	1 : 1.52
ʃʃ (diʃʃ)	169	ʃ (ˈraabiʃ)	102	1 : 1.66
kk (dʒakk)	125	k (ˈkuntak)	59	1 : 2.12
tt (nitt)	125	t (ˈrikit)	60	1 : 2.08
Geminate	143.5	Singleton	80.8	1 : 1.78

Table 1
Average duration of geminates and their singleton counterparts.

From Table 1, we can clearly see that geminates are longer than their singleton counterparts with an average ratio of 1 : 1.8. The difference is higher for stops (1 : 2.10), than for sibilants (1 : 1.59). Overall, the difference is higher than the 20 ms threshold for the perceptual distinction between a geminate and its singleton counterpart (see Obrecht 1965).

To find out whether the differences are statistically significant, a two-tailed *t*-test was conducted and it was found that the differences between word-final geminates and their singleton counterparts are statistically significant at a .01 significance level ($t = (1, 39) = 19.697$, $p = .000$). These findings confirm that such loanwords are geminated in AA, which is in conformity with earlier findings (e.g. Ham 2001, Al-Tamimi et al. 2010).

One might argue that the difference in duration between geminates and their singleton counterparts is due to stress as the geminate is found in the stressed syllable while the singletons in the last three pairs in Table 1 are in unstressed syllables. Therefore, I measured the duration of the consonants in question in stressed syllables as produced by the same ten participants in six more words, namely *kaaʃ* 'cash' and *flaaʃ* 'flash' for /ʃ/, *hatʃˈbaak* 'hatchback' and *keek* 'cake' for /k/, and *ʃaat* 'chat' and *dʒurˈdʒeet* 'georgette' for /t/. It was found that the average duration of /ʃ/ was 108; of /k/, 62; and of /t/, 58. These figures are very close to the duration of the singletons in Table 1. This gives further evidence that geminates in word-final position are considerably longer than their singleton counterparts, hence a distinction with singletons still holds.

4.2 *Gemination for stress, right-edge alignment and not parsing a final light syllable*

We have seen in the previous subsection that gemination is invoked to meet the minimal word requirements in Arabic. In this subsection, I examine a second

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pattern of gemination that results in a less marked output at the suprasegmental level. Gemination here is not only triggered to render a heavy stressed syllable in the adapted loanword, (whether the source syllable is stressed or not), but also to render the output optimal by aligning the stressed syllable with the right edge of the prosodic word to the extent possible without parsing a final light syllable. These factors conspire together to yield a prosodically less marked output in AA. Some illustrative examples are presented in (3) below.

(3) *Pattern two gemination*[15]

SOURCE WORD	AA PRONUNCIATION
ˈblock	ˈblukke (ˈblu$_{\mu}$k$_{\mu}$)ke$_{\mu}$
ˈflannel	faaˈnilla ~ faa ˈneella (faa$_{\mu\mu}$)(ˈni$_{\mu}$l$_{\mu}$)la$_{\mu}$
ˈmillimeter	ˈmilli ~ ˈmiili (ˈmi$_{\mu}$l$_{\mu}$)li$_{\mu}$
spaˈghetti	sbaaˈgitti (sbaa$_{\mu\mu}$)(ˈgi$_{\mu}$t$_{\mu}$)ti$_{\mu}$
vaˈnilla	vaaˈnilla ~ vaa ˈneella (vaa$_{\mu\mu}$)(ˈni$_{\mu}$l$_{\mu}$)la$_{\mu}$

The examples in (3) show that source stress is not the decisive factor behind gemination. Rather, it is stress in the adapted form that is crucial as gemination is attested in the syllable that carries stress in AA. Source stress falls on the same syllable that has gemination in 14 out of 27 cases. In these 14 cases, gemination is expected as borrowers would attempt to retain the stress position of the source loanword. However, this cannot account for the other 13 cases where source stress does not fall on the syllable with gemination, as in ‘ˈflannel’ /ˈflænəl/ > *(faa$_{\mu\mu}$)(ˈni$_{\mu}$l$_{\mu}$)la$_{\mu}$*.

Given that gemination cannot be related to source stress in these 13 cases, why should AA resort to gemination here? Although one might argue that this could be motivated by a markedness constraint that prefers stressed syllables (in the adapted form) to be heavy, this constraint alone cannot account for gemination, as will be demonstrated below.

All pattern two words have one thing in common. They all have a heavy stressed penult that is followed by a final light syllable. This shows that AA attempts to place stress on a heavy syllable that is as close as possible to the right edge of the word without parsing a final light syllable. Consider the word ‘ˈflannel’ where source stress is on the initial syllable. We would expect AA borrowers to keep the source stress position intact especially because the initial syllable in the adapted form is also heavy yielding **(ˈfaa)ni.la*. However, this would assign stress to the antepenult and leave two syllables unparsed. The first heavy syllable (faa) is bimoraic and would make up a foot by itself. It would receive stress, as it is a heavy syllable within the three-syllable window according to AA phonology. The penult (ni) and the ultimate syllable (la) are light and thus they would not be able to construct a bimoraic foot as this would shift stress to the light penult skipping

[15] This pattern is also attested in many proper nouns such as *suu ˈzukki* ‘Suzuki’.

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the heavy antepenult, besides parsing a final light syllable (see also Section 5 for the interaction of these requirements). Therefore, AA resorts to gemination to render the penult heavy making up a bimoraic foot on its own without parsing the final light syllable. That is, gemination results in a better-formed output that has a stressed syllable that is not only heavy but also closer to the right edge of the prosodic word. Note that AA does not keep source stress on the heavy initial syllable and it shifts it to the penult, which further shows that source stress is not the leading factor in this type of gemination.

To further demonstrate how these requirements result in gemination, consider the word 'vanilla' /vəˈnɪlə/, which is realized as $(vaa_{\mu\mu})(ˈni_{\mu}l_{\mu})la_{\mu}$ with a geminate /l/. Gemination renders the penult, which is also stressed in the source, heavy making up a foot by itself and therefore there would be no need to parse the final light syllable. A more faithful mapping at the segmental level, i.e. $*(va_{\mu}.ni_{\mu})la_{\mu}$ would shift stress to a light antepenult according to AA phonology, which seems marked as it has stress on a light syllable that is further away from the right edge. Also, another possible parse would be $*(ˈvaa_{\mu\mu})ni_{\mu}.la_{\mu}$ with a heavy, stressed antepenultimate syllable, but this still looks marked in AA as it has stress on the antepenult with two syllables unparsed.

The same arguments apply to the word 'block' /blɒk/, which is mapped onto $(ˈblu_{\mu}k_{\mu}).ke_{\mu}$. It is assigned feminine gender and thus needs to bear the feminine marker in AA. Affixing the feminine marker yields $*(blu_{\mu}.ke_{\mu})$, which seems to be marked not only because it has a light stressed syllable but also because it parses a final light syllable. Gemination of the velar stop /k/ renders the initial syllable heavy so it constructs a bimoraic foot that receives stress without parsing the final light syllable.[16] Recall that it is not possible to render the initial syllable heavy by syllabifying the velar consonant as a coda because this will render the final syllable onsetless, which is categorically forbidden.

Some evidence for this type of gemination comes from free variation in some loanwords, as in 'millimeter', which is realized either as $(ˈmii_{\mu\mu})li$, with a long vowel in the first syllable without gemination, or as $(ˈmi_{\mu}l_{\mu})li$, with gemination of the lateral /l/. In the former, the penult is already heavy so there is no need for gemination while in the latter the penult is light and gemination renders it heavy and thus there would be no need to parse the final light syllable.

More evidence for the unmarked status of geminated syllables at the suprasegmental level comes from both universal and AA phonological tendencies. Cross-linguistically, a heavy stressed syllable is less marked than a light stressed syllable (see Kubozono 1999, Gussenhoven 2000). And it is very common among many languages that have phonemic geminates to resort to gemination to render stressed syllables heavy (see Repetti 2009: 226). Moreover, leaving two consecutive syllables unparsed is marked cross-linguistically (Halle & Vergnaud

[16] Gemination here can also be analyzed as an effect of word minimality, as pointed out by an anonymous reviewer. That is, 'block' could have been adapted as *blukk* to satisfy minimality and the feminine suffix was affixed later.

1987, Kager 1999). In the same vein, evidence for final syllable extrametricality comes from cross-linguistic tendencies where final syllables are invisible to metrical constraints unless the stress domain is exhausted (see Hayes 1995; Hyde 2011: 1028). Note further that some languages resort to trochaic lengthening to satisfy final-syllable extrametricality (Hyde 2003: 38). For example, in Chimalapa Zoque, a language spoken in Oaxaca, Mexico, /hukuti/ 'fire' is realized as *huːkuːti* with primary stress on the penult (Hyde 2003: 42).

Evidence from AA phonology that pattern two gemination results in preferred well-formed outputs comes from tendencies in both native and loan words. AA, which is weight-sensitive, tends to stress a heavy syllable that is aligned with the right edge of the word to the extent possible. About 94% (in a corpus of 420 English loanwords in AA) of stressed syllables are heavy and 85% of the 500 most common polysyllabic native words have a heavy stressed syllable (Abu Guba 2016). In terms of position, stress in AA falls on a heavy penultimate or ultimate syllable in 96% of the 420 loanwords and of the 500 most common native words (Abu Guba 2016). This is in line with findings in other Arabic dialects where stress tends to fall on the penult (see Altmann 2006: 97–98).[17]

Note that AA has native words that have similar prosodic structures to the loanwords that undergo gemination. For example, AA has HLL forms such as (ˈ$ma_{\mu}d_{\mu}$)$ra_{\mu}.se_{\mu}$[18] 'school', with a heavy stressed antepenult that is followed by two unfooted light syllables and LL forms such as (ˈ$sa_{\mu}.ne_{\mu}$) 'year', where stress falls on a light syllable and a final light syllable is parsed. However, the existence of such forms does not mean that they are not marked. Rather, they seem to be marked but they are licensed by higher-ranked faithfulness constraints. However, in loanwords, where faithfulness appears to be less demanding (Ito & Mester 1995), lower-ranked markedness constraints force the violation of faithfulness constraints giving rise to less marked outputs. That is, gemination (albeit a marked option at the segmental level) is called for to yield an output that is better well-formed at the suprasegmental level. To summarize this subsection, this second pattern of gemination is invoked to render a stressed syllable heavy and aligned with the right edge of the word to the extent possible without footing a final light syllable.

These findings are important to Arabic phonology as they shed light on an intriguing case of gemination in AA and other Levantine dialects. This relates to the applicative morpheme *-l* 'to/for', as in /katab-t-l-u/ 'I wrote to him' where the applicative morpheme undergoes gemination yielding $ka_{\mu}.ta_{\mu}b_{\mu}$ˈ$ti_{\mu}l_{\mu}.lu_{\mu}$. Without gemination, stress would fall on the heavy antepenult (tab) and the last two syllables (ti.lu) would be left unparsed yielding *$ka_{\mu}.$ˈ$ta_{\mu}b_{\mu}.ti_{\mu}.lu_{\mu}$. Earlier

[17] As pointed out by an anonymous reviewer, the tendency to have stress on the penult is stronger in some dialects, e.g. Cairene, where stress in HLL words such as *madrasa* 'school' falls on the penult rather than the antepenult as in Levantine Arabic.

[18] The syllabification here is in line with AA constraints where the optimal onset and coda are simplex (see Abu Guba 2016 for more details).

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studies (e.g. Farwaneh 1995: 116), attributed gemination to a moraic status of the applicative morpheme. Farwaneh claimed that this morpheme is moraic and therefore it needs to retain its moraic status on suffixation and so the lateral needs to be syllabified as a coda in the output. However, this cannot successfully account for gemination here nor can it account for a similar case of gemination before the negative morpheme /ʃ/, as in /ma-ʃuf-t-hin-ʃ/ > *ma*$_{\mu}$.*ʃu*$_{\mu}$.*ʃi*$_{\mu}$*t*$_{\mu}$ˈ*hi*$_{\mu}$*n*$_{\mu}$.*ni*$_{\mu}$ <*ʃ*> 'I did not see them.F'. This means that gemination is neither restricted to the applicative morpheme /l/ nor related to the phonological properties of the lateral sound. Rather, it applies to yield a better well-formed output at the prosodic level. To illustrate, *ka.tab.* ˈ*til.lu* is better formed than **ka.* ˈ*tab.ti.lu* as the former has a stressed heavy syllable that is closer to the right edge leaving a light final syllable unfooted while the latter has a stressed heavy syllable that is further away from the right edge leaving two syllables unparsed.[19]

4.3 *Gemination for left-alignment*

A third pattern of gemination, illustrated in (4), is invoked to align the left edge of the prosodic word with a bimoraic foot.

(4) *Gemination for left-alignment*

SOURCE WORD	AA PRONUNCIATION
balloon	balˈloon (ba$_{\mu}$l$_{\mu}$)(ˈloo$_{\mu\mu}$)<n>
bikini	bikˈkiini (bi$_{\mu}$k$_{\mu}$)(ˈkii$_{\mu\mu}$)ni$_{\mu}$
collage	kulˈlaadʒ (ku$_{\mu}$l$_{\mu}$)(ˈlaa$_{\mu\mu}$)<dʒ>
dozen	dazˈziine (da$_{\mu}$z$_{\mu}$)(ˈzii$_{\mu\mu}$)ne$_{\mu}$
tattoo	tatˈtuu (ta$_{\mu}$t$_{\mu}$)(ˈtuu$_{\mu\mu}$)

As can be seen in (4), all the words here are realized in AA with an apparent unexpected gemination after the first vowel of the word. To explain why gemination is adopted here, consider the word 'balloon' /bəˈluːn/, which is mapped onto (*bal*)(ˈ*loo*)<*n*>. Without gemination, the word would be made up of a light syllable that is followed by a heavy syllable. According to AA stress rules/constraints, stress would fall on the second heavy syllable. The initial syllable would be left unfooted: it cannot join the second heavy syllable, as this would result in an ill-formed foot (*LH), and it cannot make up a foot by itself as degenerate feet are absolutely forbidden in AA. Gemination of the lateral /l/ renders the light syllable heavy and left-aligned with the prosodic word.

[19] Note that gemination is not attested in a few loanwords that are composed of two light syllables such as (ˈ*badi*) 'body', (ˈ*gala*)<*n*> 'gallon' and (ˈ*tina*)<*r*> 'thinner'. According to my arguments above, gemination should be expected here. However, these words are recent borrowings that seem to resist adaptation due to other sociolinguistic factors, which are beyond the scope of this study (see Paradis & LaCharité 1997, 2011; Blevins 2004).

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This analysis is in conformity with AA phonology where footing is rightward. However, as has been shown above in Section 2.3, although previous studies stipulated that footing proceeds from left-to-right, they could not account for trapped syllables at the left edge. For example, Abu-Salim (1982: 85) proposed that such light syllables are directly linked to the prosodic word as weak elements. However, findings here show that these syllables undergo gemination to become heavy so that they can make a foot by themselves. Below, I give more details on this requirement and show how polymorphemic words harmonically violate this requirement.

Note that the source initial syllable in this type of gemination is heavy in two out of 10 cases, namely 'massage' /ˈmæsɑːʒ/[20] and 'okay' /əʊˈkeɪ/. To explain, the first syllable in 'okay' in English has a diphthong, which is bimoraic; nevertheless, it is realized as a short vowel in AA and therefore gemination is called for to render the first syllable heavy. This shows that it is the adapted form that determines whether gemination will be triggered or not. If the initial syllable in the loanword is realized with a short vowel, gemination is induced to augment the light syllable.

4.3.1 *Evidence for left-alignment*

As we have seen above, AA resorts to gemination to eliminate trapped syllables at the left edge of the word. The question is why AA should avoid such trapped syllables in loanwords while some native words have such trapped syllables. Based on observations in both loanwords and native words, I argue that this requirement reveals the activity of a constraint, not always active in AA native words, that requires prosodic words to begin with a bimoraic foot. Below I provide some evidence in support of this argument.

The first piece of evidence comes from acoustic measurements. Acoustically, initial syllables to the left of stressed heavy syllables usually have relatively comparable F0 values to stressed syllables suggesting that such syllables might carry secondary stress (Abu Guba 2016). More evidence comes from frequency effects. The overwhelming majority of adapted loanwords start with a bimoraic foot and only a few seem to begin with a monomoraic syllable. On closer inspection, we notice that the majority of the words that seem to start with a trapped syllable actually start with a heavy syllable.[21] These words have an underlying long vowel that is shortened at the surface level and they are produced with either a long vowel or a short vowel, as shown in (5).

[20] The vowel /æ/ is almost always mapped onto a long vowel in AA unless the output would violate foot-binarity. Also, AA learners of English produce it as a long vowel in their interlanguage. As pointed out by an anonymous reviewer, this vowel, though it behaves phonologically as a short vowel, is phonetically longer than the other short vowels in British English. The reasons behind this mapping are beyond the scope of this study.

[21] Only six words, e.g. *ʔaˈṣanṣ* 'essence' and *baˈlanti* 'penalty' violate this and the vowel in the first syllable is the low short vowel, which has a special status, as will be demonstrated in the following subsection.

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(5) maˈtoor ~ maaˈtoor ‘motor’
baˈneel ~ baaˈneel ‘panel’
bruˈtiin ~ bruuˈtiin ‘protein’
riˈmoot ~ riiˈmoot ‘remote’

Further support for the bimoraic status of these vowels at the underlying level comes from the fact that these words are spelled with a long vowel in the first syllable in Arabic. This further shows that the short vowels that appear in these words result from a process of phonetic dissimilation that shortens long vowels before stressed syllables (see Abu-Salim 1982: 114; Watson 2002). Note that this also occurs in native words where a long vowel shortens before a stressed syllable, as in *da.reen* ‘two houses’ (compare *daar* ‘house’). This points out that these vowels are underlyingly bimoraic.

Frequency effects are also attested in native words. Of the 500 most common polysyllabic words in AA, 85% of them start with a bimoraic foot. They start with either a bimoraic syllable or a monomoraic syllable that is followed by another monomoraic syllable with which it forms a bimoraic trochee. Statistics from both loan and native words suggest that the tendency to avoid trapped syllables in loanwords can be enhanced by frequency effects. This is not unusual as frequency effects do play a role in language processing and patterning (Frisch 2011: 2160).

More evidence for left-alignment comes from syncope of short high vowels in AA native words. As in most Arabic dialects that allow for word-initial consonant clusters, AA syncopates short high front vowels when they appear in unstressed open non-final syllables, as in /bilaad/ > *blaad* and /mumawwadʒ/ > *mmawwadʒ* in (1) in Section 2.1 (see Broselow 1992, Farwaneh 2009). Although this has been attributed to a tendency to optimize syllable weight by rendering syllables bimoraic, I argue that this can also be related to ruling out trapped syllables. Eliminating monomoraic syllables at the left edge renders the output less marked.[22] Recall that prosodic words that start with two light syllables such as *gibil* ‘he accepted’ do not violate left-alignment because the first syllable is not a trapped syllable as it is the first member of a trochaic foot; hence deletion is blocked.

[22] Note that this requirement also manifests itself in first and second language acquisition in AA. The researcher observed that four-year-old AA children acquiring Arabic tend to geminate medial consonants in forms such as (*ʔal*)(ˈ*laa*)<*ʔ*> for *ʔa*(ˈ*laa*)<*ʔ*> ‘a female name’ and (*ʕal*)(ˈ*laa*)<*ʔ*> for *ʕa*(ˈ*laa*)<*ʔ*> ‘a male name’. This tendency is confirmed by Khattab & Al-Tamimi (2013), who report that Lebanese Arab children produce more disyllables with geminates than any other word shapes. Also, Arab learners of English tend to opt for gemination in forms with trapped syllables, as in ‘correct’ > (*kur*)(ˈ*rik*)*t* and even in words that are not spelled with double orthographic consonants as in ‘select’ > (*sil*)(ˈ*lik*)*t*. Also, this can be linked to what is known as the ‘abracadabra effect’ (see Hulst 2014: Chapter 1). Hulst (2014: 31–32) points out that in right-edge primary stress languages, the first syllable tends to be prominent suggesting that it has a secondary stress. Furthermore, this can be related to the ‘hammock’ or ‘dual’ stress systems as reported by Gordon 2011, where word edges align with foot edges in many world languages (see Gordon 2011 for more details).

Note that native words that do not meet this requirement are all derived words such as *banaat* 'girls' and *ʃabaab* 'young people', and proper names such as *sihaam* 'a female name' and *bilaal* 'a male name'.[23] The fact that trapped syllables are attested in derived words rather than non-derived words can be related to derived environment effects (see Burzio 2011: 2089). That is, trapped syllables are restricted to morphologically derived environments. These morphologically derived words are templatic and they need to fit into one of the morphological templates in Arabic morphology. That is, plural nouns such as *ba.naat* have an iambic foot template (CV.CVV) (see McCarthy & Prince 1990) and the presence of the trapped syllable seems to be licensed by a high-ranked constraint that requires templatic satisfaction. Put differently, the plural form needs to satisfy a constraint, say FAITH-AFFIX, that requires the plural affix to be faithfully realized in the output. Polymorphemic words would harmonically violate this requirement if FAITH-AFFIX was ranked above a constraint that requires a prosodic word to begin with a bimoraic foot.

Note further that trapped syllables tend to be avoided even in derived words if the short vowel is not the low vowel /a/, as in /nusuur/ > *nsuur* 'eagles'. This suggests that there could be a high-ranked constraint in AA that bans non-low short vowels in all contexts. This constraint should rank higher than a constraint that requires templatic satisfaction. A future study that further investigates the status of these trapped syllables in native words is highly recommended.

The fact that the overwhelming majority of AA native words that start with trapped syllables have the low short vowel /a/ in their first syllable shows that this vowel has a special status in AA, which makes it behave differently from the other two short vowels. First, in terms of duration, the short low vowel is longer than the other short vowels (see Kirchner 1996, cited in Adra 1999: 51). Second, in terms of sonority, low vowels (being the most sonorous sounds in language) are more sonorous than high vowels (Parker 2011: 1171). The properties of the short low vowel motivated Kirchner (1996, cited in Adra 1999: 51) to posit that a short low vowel is more prominent than high vowels and therefore it is assigned two gridmarks on a prominence scale while a high vowel is assigned one gridmark. That said, it is not strange that the phonetic and acoustic prominence of short low vowels makes them different phonologically, hence their appearance in trapped syllables.[24]

To summarize, the avoidance of trapped syllables at the left edge of prosodic words results in a better well-formed output at the prosodic level. This is in

[23] Proper nouns most probably represent cases of code-mixing from Standard Arabic because AA speech community is characterized by a diglossic situation where AA speakers have access to two forms: Standard Arabic and their vernacular (AA) (Suleiman 1985, Amer et al. 2011). These forms are common in Standard Arabic and they are well-formed according to Standard Arabic phonology.

[24] In this regard, the researcher noticed that some AA native speakers report that such words have two stresses. This is left for further research.

conformity with Hayes' observation that cross-linguistically unparsed syllables tend to be located at the right edge of a prosodic word (Hayes 1995: 57).

4.3.2 *Morphologically-induced gemination*

Gemination is invoked in a few cases for morphological reasons. That is, a morphological process results in a marked phonological structure that calls for gemination to repair the ill-formed output. For example, gemination is invoked following the affixation of a noun with the feminine suffix -*a*(*t*), as in 'party' > $(ba_{\mu}r_{\mu})(\text{ˈ}ti_{\mu}y_{\mu})ye_{\mu}$. Assigning the feminine suffix to the word 'party' yields **bar.ti.a*. This is ill-formed due to hiatus. Glide formation obtains to eliminate hiatus yielding **bar.ti.ye*, which still seems to be ill-formed in AA. Gemination of the glide renders it better well-formed with a heavy stressed penult. Another morphological case relates to verb formation, as in $(\text{ˈ}ʃa_{\mu}y_{\mu})ya_{\mu}$<*t*> 'to chat'. Gemination here is invoked to provide a melody to the verb to make it fit into AA verb templates (see McCarthy 2007: 300–301).

5. OT ANALYSIS

The previous section has outlined three patterns of gemination in English loanwords in AA. In this section, I present an Optimality-theoretic analysis of these three patterns. First, I introduce two undominated constraints in AA phonology: ONSET and FOOT-BINARITY. ONSET, given in (6), requires a syllable to begin with a consonant. AA, like almost all Arabic dialects (see Watson 2002, 2011), resorts to epenthesis of the default glottal stop to provide an onset to otherwise onsetless syllables.

(6) ONSET: Syllables must have onsets.
(Prince & Smolensky 1993/2004: 93)

FOOT-BINARITY, presented in (7), is an established undominated constraint in probably most Arabic dialects (see Hayes 1995: Chapter 4; Watson 2002: Chapter 5, 2011).

(7) FOOT-BINARITY (henceforth FTBIN): Feet are binary under syllabic or moraic analysis.
(Hayes 1995: Chapter 4; Prince & Smolensky 1993/2004: 50)

This constraint rules out trimoraic feet and monomoraic feet. Note that FTBIN applies at a moraic level in AA. Whether FTBIN at a syllabic level is attested in AA requires further investigation. One might argue that some forms such as *treel.la* and *run.deel.la* violate FTBIN where the initial syllable in the former and the penult in the latter have three moras. However, Broselow, Chen & Huffman (1997: 67–68), and Watson (2007: 349) argue that these forms are still bimoraic thanks to mora sharing where a mora is shared between the second leg of the vowel and the following consonant. Broselow et al. (1997: 59) provide acoustic

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evidence that shows that long vowels in open syllables are significantly longer than long vowels closed by a coda (161 ms vs. 131.6 ms) and that the coda consonant in CVVC syllables is significantly shorter than the coda in CVC syllables (67.6 ms vs. 88.4 ms).

These two undominated constraints will not be shown in tableaux and their satisfaction will be taken for granted. In the rest of this section, I analyze gemination due to minimality in Section 5.1; gemination due to stress, right-edge alignment and not parsing a final light syllable in Section 5.2; and finally gemination for left-edge alignment in Section 5.3.

5.1 *Gemination for minimality*

Recall that the first pattern of gemination is invoked to satisfy minimality. In OT terms, I adopt the constraint MINIMAL WORD given in (8), which requires a prosodic word to be minimally bimoraic.

(8) MINIMAL WORD (henceforth MINWD): A prosodic word is minimally bimoraic.

(see Prince & Smolensky 1993/2004: 112)

To see how gemination satisfies MINWD, consider the word ‘stock’ which is realized as (*stu*$_\mu$*k*$_\mu$)<*k*>. The source vowel is short and mapped onto a short vowel in AA. A coda consonant receives a mora through the constraint WEIGHT-BY-POSITION, given in (9) below. However, coda consonants in absolute final position are non-moraic (e.g. Hayes 1995, Kager 1999) by virtue of the undominated constraint *FINAL-C-μ, presented in (10).

(9) WEIGHT-BY-POSITION (henceforth WBP): Coda consonants are moraic.

(Hayes 1989: 258)

(10) *FINAL-C-μ: A word-final consonant is weightless.

(Prince & Smolensky 1993/2004: Chapter 4; Kager 1999: Chapter 4)

To illustrate, a faithful mapping of ‘stock’ would violate MINWD; it has a short vowel that is monomoraic and the coda is non-moraic according to *FINAL-C-μ. To repair this ill-formed structure, vowel lengthening or gemination can be resorted to, among other, more marked options. Vowel lengthening would violate the constraint DEP-μ (Vowel), presented in (11) while geminating the final consonant violates the constraint DEP-μ (Consonant), given in (12).

(11) DEP-μ (Vowel) (henceforth DEP-μ(V): A mora associated with a vowel in the output has a correspondent in the input.

(McCarthy & Prince 1995: 264)

(12) DEP-μ (Consonant) (henceforth DEP-μ(C): A mora associated with a consonant in the output has a correspondent in the input.

(McCarthy & Prince 1995: 264)

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Since AA generally opts for gemination, it can be concluded that DEP-μ(V) outranks DEP-μ(C).[25] The interaction of all these constraints is depicted in the tableau in (13).

(13) MINWD, *FINAL-C-μ >> WBP >> DEP-μ(V) >> DEP-μ(C)

Input: stock /stɒk/[26]	MINWD	*FINAL-C-μ	WBP	DEP-μ(V)	DEP-μ(C)
a. ☞ (stu$_{\mu}$k$_{\mu}$)<k>[27]			*		*
b. (stu$_{\mu}$k$_{\mu}$)		*!			
c. (stu$_{\mu}$)<k>	*!		*		
d. (stuu$_{\mu\mu}$)<k>			*	*!	

As can be seen from the tableau above, candidate (b) is eliminated as it fatally violates the undominated constraint *FINAL-C-μ. Candidate (c) satisfies *FINAL-C-μ but incurs a fatal violation of the undominated constraint MINWD. The optimal candidate in (a) satisfies the two undominated constraints by geminating the final consonant violating DEP-μ(C) and WBP by not assigning a mora to the second member of the geminate. Candidate (d) violates DEP-μ(V) and thus loses out to candidate (a), confirming that DEP-μ(V) outranks DEP-μ(C). Note that although no ranking relationship can be established between WBP and DEP-μ(V) here, I assume that WBP dominates DEP-μ(V) because WBP is only violated in AA to satisfy *FINAL-C-μ while DEP-μ(V) is violated in other contexts in AA (see details below).

Note that the above ranking does not predict that all word-final consonants would geminate because any output that violates DEP-μ(C) unnecessarily (not to satisfy higher ranked constraints) would be suboptimal as it would violate faithfulness constraints unnecessarily and hence ruled out. Note further that FTBIN alone would not be sufficient to account for gemination here. This is because FTBIN would be satisfied if no foot is constructed at all. That is, a null parse would not violate FTBIN but it would fatally violate minimality, hence the need for MINWD (see Prince & Smolensky 1993/2004: 51).

[25] Although AA generally resorts to gemination to augment syllable weight, vowel lengthening is attested in a few cases. Nevertheless, I assume here that DEP-μ(V) outranks DEP-μ(C). In order to account for the cases where vowel lengthening is attested, a weighted-constraint approach whereby the constraint DEP-μ(V) would have more weight than DEP-μ(C) can be adopted (for details on weighted constraints see Pater 2009).

[26] I assume that the majority of loanwords come from British English as the educational system adopts British-based curricula in teaching English besides the fact that Jordan was under the British mandate between 1917 and 1946. Whether the input is based on spelling or pronunciation cannot be known with greater certainty as the borrowing process is complicated and involves many linguistic and non-linguistic factors. The transcriptions are based on British pronunciation as found in the *Oxford English Dictionary Online* (Proffitt 2015).

[27] This can also be realized as *ʔistukk* with initial epenthesis of the glottal stop and the short high vowel /i/. The fact that gemination obtains even after epenthesis shows that epenthesis occurs at the surface level, i.e. the prosodic word must satisfy minimality at the underlying level.

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Thus far, the following initial ranking can be established:

(14) MINWD, *FINAL-C-μ >> WBP >> DEP-μ(V) >> DEP-μ(C)

Returning to the compound words in (2b) above, the same constraints apply to these words but each member of the source compound needs to satisfy minimality on its own. To explain, consider the word ‘coffee shop’ /ˈkɒfi ʃɒp/ > (ˈ*ku*$_{\mu}$.*fi*$_{\mu}$)(ˈ*ʃu*$_{\mu}$*b*$_{\mu}$)<*b*> where the bilabial stop in the second word geminates rendering it bimoraic. The following tableau in (15) shows the interaction of these constraints to yield the optimal output (ˈ*ku*$_{\mu}$.*fi*$_{\mu}$)(ˈ*ʃu*$_{\mu}$*b*$_{\mu}$)<*b*> where MINWD rules out candidate (b) providing evidence that these source compound words are treated as two independent prosodic words in AA.

(15) MINWD, *FINAL-C-μ >> WBP >> DEP-μ(V) >> DEP-μ(C)

Input: ‘coffee shop’ /ˈkɒfi ʃɒp/	MINWD	*FINAL-C-μ	WBP	DEP-μ(V)	DEP-μ(C)
a. ☞ (ˈku$_{\mu}$.fi$_{\mu}$) (ˈʃu$_{\mu}$b$_{\mu}$)<b>			*		*
b. (ˈku$_{\mu}$.fi$_{\mu}$) (ˈʃu$_{\mu}$)<b>	*!		*		
c. (ˈku$_{\mu}$.fi$_{\mu}$) (ˈʃuu$_{\mu\mu}$)<b>			*	*!	
d. (ˈku$_{\mu}$.fi$_{\mu}$) (ˈʃu$_{\mu}$b$_{\mu}$)		*!			

To summarize, the first pattern of gemination is called for to satisfy the undominated MINWD constraint at the expense of the low ranked DEP-μ(C) constraint. Gemination is blocked if the adapted form already satisfies minimality constraints (see Section 6 below for cases where gemination is blocked).

5.2 *Gemination for stress, right-edge alignment and not parsing a final light syllable*

In this subsection, I account for the second pattern of gemination, which is invoked to augment a stressed penultimate syllable resulting in a better well-formed output where stress falls on a heavy syllable that is closer to the right edge without footing a final light syllable. In OT terms, the interaction of STRESS-TO-WEIGHT PRINCIPLE, NONFINALITY-σ, ALIGN-HEAD-RIGHT and PARSE-σ constraints, given in (16)–(19), yields the optimal output.

(16) STRESS-TO-WEIGHT PRINCIPLE (henceforth SWP): Stressed syllables are heavy.

(Gussenhoven 2000: 4)

(17) NONFINALITY-σ (henceforth NONFIN): A final light syllable of a word is unparsed.

(see Hyde 2003: 2)

(18) ALIGN-HEAD-RIGHT (henceforth ALIGN-H-R): A peak of prominence lies at the right edge of the word

(Gordon 2011: 147)

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(19) PARSE-σ: All syllables must be parsed into feet.
(Prince & Smolensky 1993/2004: Chapter 4)

NONFIN here applies to final light syllables only. It does not apply to heavy or superheavy syllables (which are stressed in AA) for these syllables have dual status: they constitute syllables and feet at the same time as they are bimoraic syllables that make up a foot by themselves (see Zec 2011: 1351). NONFIN should outrank PARSE-σ because AA prefers to leave final light syllables unparsed unless FTBIN is violated.

ALIGN-H-R requires stress to be as close as possible to the right edge and violations of this constraint are counted in syllables. Accordingly, if stress falls on the antepenult, ALIGN-H-R will be violated twice and if it falls on the penult, it will be violated once. It is satisfied only if stress falls on the ultimate syllable. Moreover, when more than one foot is constructed in a word, ALIGN-H-R will assign stress to the rightmost foot. This constraint echoes Hayes' (1995) End Rule Right (ERR), which prefers main stress to fall as close as possible to the right edge of the word. This constraint should be ranked below NONFIN because it does not force footing a final light syllable, as in *(mu$_\mu$ħ$_\mu$)(ˈta$_\mu$ra$_\mu$)me$_\mu$* 'respected.F', which would surface as **(muħ)ta(ˈrame)* if ALIGN-H-R were ranked higher than NONFIN. The tableau in (20) establishes the ranking relationship between NONFIN and ALIGN-H-R.

(20) NONFIN >> ALIGN-H-R, PARSE-σ

Input: /muħtaram/+/a/	NONFIN	ALIGN-H-R	PARSE-σ
a. ☞ (mu$_\mu$ħ$_\mu$)(ˈta$_\mu$ra$_\mu$)me$_\mu$		**	*
b. (mu$_\mu$ħ$_\mu$) ta$_\mu$(ˈra$_\mu$me)$_\mu$	*!	*	*

The tableau in (20) shows that the optimal candidate satisfies NONFIN but violates ALIGN-H-R twice while the suboptimal candidate in (b) fares better than the winner on ALIGN-H-R but it is ruled out as it fatally violates NONFN. If ALIGN-H-R were ranked higher than NONFIN, candidate (b) would be the winner, thus it can be safely established that NONFIN dominates ALIGN-H-R.

Having established that NONFIN dominates ALIGN-H-R, let us consider how the constraints in (16)–(19) interact with the faithfulness constraint DEP-μ(C) in (12) (which bans gemination) to yield *(faa$_{\mu\mu}$)(ˈni$_\mu$l$_\mu$)la$_\mu$* 'ˈflannel'. Without gemination, it would be realized as *ˈ*faanila*. Footing proceeds from left-to-right forming a bimoraic trochee over the first heavy syllable *(faa$_{\mu\mu}$)ni$_\mu$.la$_\mu$*. Two syllables would be left unparsed. It will not be possible to group the last two syllables into one foot as this would result in a marked output in AA because it would assign stress to a light penult skipping a heavy antepenult. Moreover, the light penult cannot make up a foot on its own due to FTBIN, so gemination is induced to augment the penult and therefore there would be no need to parse the final light syllable. ALIGN-H-R ensures that stress does not retract to the heavy antepenult. The interaction of these constraints is illustrated in (21) below. (Only relevant constraints will be shown in tableaux.)

(21) SWP, NONFIN >> ALIGN-H-R, PARSE-σ>> DEP-μ(C)

Input: ‘ˈflannel’ /ˈflænəl/+ /a/	SWP	NONFIN	ALIGN-H-R	PARSE-σ	DEP-μ(C)
a. ☞ (faa$_{\mu\mu}$)(ˈni$_{\mu}$l$_{\mu}$)la$_{\mu}$			*	*	*
b. (faa$_{\mu\mu}$)(ˈni$_{\mu}$la$_{\mu}$)	*!	*!	*		
c. (ˈfaa$_{\mu\mu}$)ni$_{\mu}$.la$_{\mu}$			**!	**!	
d. (ˈfaa$_{\mu\mu}$)(ni$_{\mu}$l$_{\mu}$)la$_{\mu}$			**!	*	*
e. (ˈfa$_{\mu}$ni$_{\mu}$)la$_{\mu}$	*!		**!	*	

The tableau in (21) shows that candidate (a) is optimal as it bests all other candidates by satisfying SWP and NONFIN, violating only the other three lower-ranked constraints once. Candidate (b) is suboptimal as it fares worse on SWP and NONFIN. Candidate (c) satisfies SWP and NONFIN but loses out to candidate (a) since it has stress on the antepenult and leaves two syllables unparsed. Candidate (d) is very close to the winner but it incurs two violations of ALIGN-H-R and therefore eliminated. Candidate (e) satisfies NONFIN but fatally violates both SWP and ALIGN-H-R as well as PARSE-σ.

The same ranking accounts for longer words. For example, in the proper noun ‘Piccadilly’, which is realized as (*bi*$_{\mu}$.*ka*$_{\mu}$)(ˈ*di*$_{\mu}$*l*$_{\mu}$)*li*$_{\mu}$ not only in AA but probably in most Arabic dialects, gemination of the lateral /l/ results in an optimal output that has a heavy stressed penult that is aligned with the right edge to the extent possible without parsing a final light syllable.

5.2.1 *A note on SWP*

A closer look at the tableau in (21) above shows that SWP can be eliminated without affecting the competition. Candidate (b) can be eliminated as it violates NONFIN and candidate (e) will be ruled out as it fares worse than the optimal candidate on ALIGN-H-R, so without SWP, these two candidates would be still excluded. That said, it would be better and more economical to do without SWP.

Although the adaptation of loanwords seems to suggest that SWP plays a role in gemination, loanwords do not provide us with compelling evidence to determine the right ranking of this constraint, so we need to look for further evidence from native words. Data from AA native words indicate that SWP is not high-ranked in AA phonology and it is violated in many forms. For example, in (ˈ*ʃa*$_{\mu}$*dʒa*$_{\mu}$)<*ra*$_{\mu}$> ‘tree’, stress is assigned to the light antepenult that makes up a bimoraic foot with the penult leaving the last syllable unparsed, which satisfies NONFIN but violates ALIGN-H-R twice. Additionally, in (ˈ*sa*$_{\mu}$*ne*$_{\mu}$) ‘year’, the stressed initial syllable is light and neither lengthening nor gemination is invoked to render it heavy. Put differently, because loanwords do not provide us with conclusive evidence for the ranking of SWP and its effect is achieved by other constraints and because native words seem to provide contrary evidence, the exact

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ranking of SWP cannot be worked out with certainty here and it is thus left for future research.

5.3 *Gemination for left-alignment*

Recall from Section 4.3 that the third pattern of gemination is called for to ensure that a prosodic word begins with a foot, as in $(ba_{\mu}l_{\mu})(\text{ˈ}loo_{\mu\mu})$<*n*> 'balloon', and $(bi_{\mu}k_{\mu})(\text{ˈ}kii_{\mu\mu})ni_{\mu}$ 'bikini' where gemination is invoked to augment the first syllable to render it aligned with the left edge of the prosodic word. In OT terms, I adopt the constraint ALIGN-LEFT (Prwd, F), presented in (22), which requires every prosodic word to start with a foot.

(22) ALIGN-LEFT (Prwd, F) (henceforth ALIGN-L): Every prosodic word begins with a foot.

(Kager 1999: 169; Gordon 2011: 150–152)[28]

This constraint is only satisfied if the first syllable is footed. If the first syllable is bimoraic, it makes up a foot on its own. However, if it is light it needs to join another light syllable to construct a bimoraic foot, as degenerate feet violate the undominated constraint FTBIN (presented earlier in (7)). A problem arises if the initial light syllable is followed by a bimoraic heavy syllable. It cannot group up with this heavy syllable because it would again violate FTBIN (as well as an undominated constraint in AA that requires the first member of a foot to bear the stress, i.e. TROCHAIC; see Abu Guba 2016 for more details). Leaving this light syllable unfooted would violate ALIGN-L, so gemination is invoked to augment syllable weight rendering the syllable bimoraic and consequently footed and left-aligned. The interaction of ALIGN-L and DEP-μ(C) is illustrated in the following tableau for the word 'balloon':

(23) ALIGN-L >> DEP-μ(C)

Input: balloon /bəˈluːn/	ALIGN-L	DEP-μ(C)
a. ☞ $(ba_{\mu}l_{\mu})(\text{ˈ}loo_{\mu\mu})$<n>		*
b. $ba_{\mu}(\text{ˈ}loo_{\mu\mu})$<n>	*!	

As is clear in (23), the optimal candidate in (a) wins the competition as it satisfies the higher ranked constraint ALIGN-L while candidate (b) incurs a fatal violation of ALIGN-L. Recall that the first syllable cannot form a foot on its own due to the undominated FTBIN constraint and the lateral /l/ cannot be syllabified as a coda of the first syllable to satisfy FTBIN, as this would render the second syllable onsetless violating the undominated ONSET constraint.

[28] This constraint is similar to the INITIAL-FOOT constraint suggested by Ito et al. (2017) to account for gemination in Japanese. However, Align-L was independently developed by the researcher in an earlier version of this paper (Abu Guba 2016).

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The implications of ALIGN-L are crucial to AA phonology. The introduction of this constraint can correctly account for the unusual stress on a light penult in AA (e.g. *munuˈbuli* ‘monopoly’),[29] which is wrongly predicted to fall on the antepenult yielding **mu*(ˈ*nubu*)*li* according to previous accounts of stress in Levantine Arabic (see Section 2.3 above). ALIGN-L forces the first two light syllables to make up a bimoraic foot. Two syllables are left unparsed resulting in a marked output that also has stress on the preantepenult, which is impossible as stress in most Arabic dialects never goes beyond the antepenult. Thus, the last two syllables make up a bimoraic foot (violating NONFIN) and stress is assigned to the penult according to ALIGN-H-R. The tableau in (24) illustrates the interaction of these OT constraints to yield *munuˈbuli*.

(24) ALIGN-L >> NONFIN >> ALIGN-H-R, PARSE-σ

Input: ‘monopoly’ /məˈnɒpəli/	ALIGN-L	NONFIN	ALIGN-H-R	PARSE-σ
a. ☞ (mu$_{\mu}$nu$_{\mu}$)(ˈbu$_{\mu}$li$_{\mu}$)		*	*	
b. mu$_{\mu}$(ˈnu$_{\mu}$bu$_{\mu}$)li$_{\mu}$	*!		**	**
c. mu$_{\mu}$nu$_{\mu}$(ˈbu$_{\mu}$li$_{\mu}$)	*!	*	*	**
d. (ˈmu$_{\mu}$nu$_{\mu}$)bu$_{\mu}$li$_{\mu}$			***!	**
e. (ˈmu$_{\mu}$nu$_{\mu}$)(bu$_{\mu}$li$_{\mu}$)		*	***!	

The winning candidate in (a) violates both NONFIN and ALIGN-H-R once but it satisfies ALIGN-L. Candidate (b) is ruled out as it incurs a fatal violation of ALIGN-L although it satisfies NONFIN, which establishes that ALIGN-L dominates NONFIN. Recall that NONFIN dominates both ALIGN-H-R and PARSE-σ (see the tableaux in (20) and (21) above). Again, candidate (c), although it fares equally well as the winner on NONFIN and ALIGN-H-R, fails to align the left edge with a bimoraic foot and hence ruled out. Although candidates (d) and (e) satisfy ALIGN-L, they lose out to the winner as they violate the low-ranked ALIGN-H-R three times. The role and further implications of ALIGN-L in Arabic phonology await further research.

Before closing this section, I first incorporate all the constraints that account for the three patterns of gemination in (25) below and then summarize the data forms that justify the rankings.

(25) ONSET, FTBIN, MINWD, *FINAL-C-μ, ALIGN-L>> WBP, NONFIN >> ALIGN-H-R, PARSE-σ, DEP-μ(V)>> DEP-μ(C)

Following OT practice, I assume that a constraint is top-ranked in the hierarchy unless there is evidence to the contrary, i.e. it is violated to satisfy another top-ranked constraint. Therefore, all constraints that are not violated here will be

[29] This word can also be realized with a heavy penult (following gemination) and the same ranking can account for this. Recall that there are no native words of this pattern i.e. four consecutive light syllables.

assumed not to be crucially dominated. (This applies to the five undominated constraints in (25).) In addition, I assume that if a constraint is violated to satisfy one of the high-ranked constraints, it will be demoted by transitivity below all the constraints that are equally ranked with the constraint that forced the violation. For example, although there is no interaction between *FINAL-C-μ and NONFIN, NONFIN will be ranked below *FINAL-C-μ as NONFIN is violated to satisfy other constraints (e.g. FTBIN) that are equally ranked with *FINAL-C-μ.[30]

The following ranking relationships could be established:

- *FINAL-C-μ must dominate WBP: (*stu*$_{\mu}$*k*$_{\mu}$)<*k*> is a better parse than (*stu*$_{\mu}$*k*$_{\mu}$) (Section 5.1).
- MINWD/FTBIN must dominate NONFIN: (ˈ*ba*$_{\mu}$*di*$_{\mu}$) is a better parse than (*ba*$_{\mu}$)*di*$_{\mu}$ (Section 4.3).
- FTBIN must dominate PARSE-σ: (*sa*$_{\mu}$*w*$_{\mu}$)*wi*$_{\mu}$(*naa*$_{\mu\mu}$) is a better parse than (*sa*$_{\mu}$*w*$_{\mu}$)(*wi*$_{\mu}$)(*naa*$_{\mu\mu}$) (Section 2.3).
- ALIGN-L must dominate NONFIN: (*mu*$_{\mu}$*nu*$_{\mu}$)(ˈ*bu*$_{\mu}$*li*$_{\mu}$) is a better parse than *mu*$_{\mu}$(ˈ*nu*$_{\mu}$*bu*$_{\mu}$)*li*$_{\mu}$ (Section 5.3).
- ALIGN-L must dominate DEP-μ(V): (*vaa*$_{\mu\mu}$)(ˈ*ni*$_{\mu}$*l*$_{\mu}$)*la*$_{\mu}$ is a better parse than *va*$_{\mu}$(ˈ*ni*$_{\mu}$*l*$_{\mu}$)*la*$_{\mu}$ (Section 4.2).
- ALIGN-L must dominate DEP-μ(C): (*ba*$_{\mu}$*l*$_{\mu}$)(*loo*$_{\mu\mu}$)<*n*> is a better parse than *ba*$_{\mu}$(*loo*$_{\mu\mu}$)<*n*> (Section 5.3).
- NONFIN must dominate ALIGN-H-R: (*mu*$_{\mu}$*ħ*$_{\mu}$)(ˈ*ta*$_{\mu}$*ra*$_{\mu}$)*me* is a better parse than (*mu*$_{\mu}$*ħ*$_{\mu}$)*ta*$_{\mu}$ (ˈ*ra*$_{\mu}$*me*$_{\mu}$) (Section 5.2).
- NONFIN must dominate PARSE-σ: (*faa*$_{\mu\mu}$)(ˈ*ni*$_{\mu}$*l*$_{\mu}$)*la*$_{\mu}$ is a better parse than (*faa*$_{\mu\mu}$)(ˈ*ni*$_{\mu}$*la*$_{\mu}$) (Section 5.2).
- NONFIN must dominate DEP-μ(V): (*mii*$_{\mu\mu}$)*li*$_{\mu}$ is a better parse than (*mi*$_{\mu}$*li*$_{\mu}$) (Section 4.2).
- DEP-μ(V) must dominate DEP-μ(C): (*stu*$_{\mu}$*k*$_{\mu}$)<*k*> is a better parse than (*stuu*$_{\mu\mu}$)<*k*> (Section 5.1).

Note that the ranking of the so-far-equally ranked constraints still requires further research. For example, DEP-μ(V) cannot be ranked with respect to ALIGN-H-R and PARSE-σ as they do not interact with each other here.

6. Role of orthography

One might be tempted to attribute gemination to source spelling (e.g. Suleiman 1985). That is, the existence of a double orthographic consonant in the English spelling might lead borrowers to mistakenly assume that a double orthographic consonant represents a geminate, as Arabic orthography is mostly phonemic

[30] Recall that ALIGN-L could be violated to satisfy morphological templates (see Section 4.3.1 above). However, this is beyond the scope of this paper.

with a close correspondence between graphemes and phonemes (Holes 2004: 89). Although this might happen in few cases, I show in this section that the role of orthography is minimal and it cannot account for gemination or lack of gemination in the adaptation process.

Evidence for the minimal role of orthography comes from two sources. First, not all loanwords that are realized with a geminate have a double orthographic consonant in the source. About 53% of the loanwords that are realized with gemination are not spelled with a double orthographic consonant. Some examples are given in (26).

(26)	ˈbubbu	‘baby’
	bikˈkiini	‘bikini’
	brikk	‘brake’
	ˈʔukkee	‘okay’

More evidence comes from the fact that 68 English loanwords (out of 1200) are spelled with double consonants; nevertheless, they are realized with a singleton in AA, as illustrated in (27).

(27)	balˈyoon	‘billion’
	karaˈdoor	‘corridor’
	ʔitiˈkeet	‘etiquette’
	mool	‘mall’
	brufuˈsoor	‘professor’
	ˈraali	‘rally’

I argue here that if gemination were triggered by source spelling then one needs to explain why spelling does not elicit gemination in these cases. In fact, gemination is not invoked here as the adapted output already satisfies AA phonological constraints. For example, in words such as ‘corridor’ /ˈkɒrɪdɔː(r)/, which is adapted as $(ka_{\mu}ra_{\mu})(\text{ˈ}doo_{\mu\mu})<r>$, gemination does not obtain although the word is spelled with double ‘r’. The first two syllables are light so they make up a bimoraic foot that is left-aligned and the third syllable is bimoraic with an extrametrical final consonant. This output satisfies AA markedness constraints and gemination would render it ill-formed.

Consider also words such as ‘rally’ /ˈræli/, which is realized as $(\text{ˈ}raa_{\mu\mu})li_{\mu}$. Again, the output satisfies AA markedness constraints and thus there is no need for gemination. The vowel in the first syllable is mapped onto a bimoraic vowel in AA making up a bimoraic foot on its own and thus aligned with the left edge of the prosodic word. Therefore, there is no need to parse the second syllable, which satisfies NONFIN. The second syllable itself satisfies ONSET.

Finally, gemination is not attested in monosyllabic words such as ‘pass’ > $(baa_{\mu\mu})<\text{ṣ}>$, as they already satisfy minimality constraints. Their source vowel is faithfully mapped onto an AA long vowel. This satisfies MINWD without parsing

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the last consonant, which satisfies *FINAL-C-μ. Gemination would be blocked even if spelling would tempt borrowers to geminate the consonant, as the output is already bimoraic.

7. Conclusion and implications

This paper has shown that gemination within English loanwords in AA is an output-oriented process that improves the prosodic structure of the adapted form. The adaptation process is mainly a phonological process that is invoked by AA grammar. From a typological perspective, gemination in AA is similar to gemination in loanwords in Japanese (Ito et al. 2017), i.e. it is mainly triggered by output-oriented constraints that improve the surface forms of the borrowed words.

Three patterns of gemination have been identified. In the first pattern, gemination is triggered to satisfy minimality constraints whereby a prosodic word must be minimally bimoraic. In the second pattern, it is induced to yield a heavy stressed syllable that is aligned with the right edge of the prosodic word to the extent possible without parsing a final light syllable. In the third pattern, gemination is called for to ensure that a prosodic word begins with a bimoraic foot.

Of particular interest, this study has revealed the activity of the constraint ALIGN-L that accounts for the unexpected gemination in a number of loanwords that would otherwise begin with a trapped initial light syllable. Since the constraint ALIGN-L can be violated in AA native words (and in other Arabic dialects) by a high ranked templatic constraint (as in broken plural, see Section 4.3.1), it can be argued that this type of gemination shows a case of the emergence of the unmarked effect.[31] The recognition of the role of this constraint is of great importance to Arabic phonology in terms of explanatory and descriptive adequacy as it renders the phonology simpler and more parsimonious. This constraint sheds light on many thorny issues in Arabic phonology such as stress assignment and foot construction as demonstrated in Section 5.3. The role of this constraint in other Arabic dialects awaits further research.

Results also shed light on the status of SWP, ALIGN-H-R and NONFIN in Arabic phonology. Findings suggest that Arabic dialects would prefer stressed syllables to be heavy and close to the right edge but avoid footing final light syllables. These constraints could explain the intriguing gemination of the applicative morpheme in AA and other Arabic dialects, as discussed in Section 4.2. Incorporating a constraint that renders final light syllables extrametrical into Levantine constraint rankings would result in a more elegant analysis.

The findings of this research lend support to a moraic representation of geminates. Maintaining a moraic analysis of geminates is required as it is consistent

[31] Note that the emergence of the unmarked is a phonological situation whereby a marked structure is usually permitted in a language (e.g. a trapped syllable), while it is not allowed in certain contexts where faithfulness constraints are not very crucial.

with the fact that AA resorts to gemination as a repair strategy to augment syllable weight, as explained in Section 4 (see Davis & Ragheb 2014). However, a moraic only representation would not be able to account for contained geminates (Section 2.4). Therefore, a composite model that maintains both the moraic status and the bipositionality of geminates is needed, as shown in Section 2.4.

In the same vein, given that the source words do not have geminates, it follows that a geminate is moraic be it underlying or derived and both must have the same representation (except for initial geminates). That is, a surface geminate in AA will contribute a mora whether it has an underlying base or not, as explained in Section 5. This is in line with OT principles, which are surface-oriented.

The findings also bear on the role of orthography in loanword adaptation. It has been shown that the role of orthography in gemination is minimal. This suggests that although orthography can play an important role in the segmental adaptation of loanwords (e.g. Kang 2002, Iverson & Lee 2006, Vendelin & Peperkamp 2006), its role at the suprasegmental level is minimal.

APPENDIX

List of loanwords with gemination

Items 1–51: pattern one, 52–78: pattern two and 79–88: pattern three.

No.	Source word	IPA transcription	AA pronunciation
Pattern one			
1.	boss	bɒs	buṣṣ
2.	brake	breɪk	brikk
3.	bug	bʌg	bagg
4.	check	tʃek	ʃakk
5.	chef	ʃef	ʃiff
6.	chock	tʃɒk	tʃukk
7.	clip	klɪp	klibb
8.	cut	kʌt	katt
9.	dish	dɪʃ	diʃʃ
10.	drill	drɪl	drill
11.	drop	drɒp	drubb
12.	drum	drʌm	dramm
13.	full	fʊl	full
14.	fuss	fʌs	faṣṣ
15.	gel	dʒel	dʒill
16.	gin	dʒɪn	dʒinn
17.	hop	hɒp	hubb
18.	huff	hʌf	haff
19.	hush	hʌʃ	huṣṣ
20.	jack	dʒæk	dʒakk
21.	jeep	dʒiːp	dʒibb
22.	miss	mɪs	miss
23.	nag	næg	nagg

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24.	net	net	nɪtt
25.	roll	rəʊl	rull
26.	shell	ʃel	ʃill
27.	slush	slʌʃ	slaʃʃ
28.	stock	stɒk	stukk
29.	tape	teɪp	tibb
30.	ton	tʌn	ṭunn
31.	top	tɒp	tubb
32.	toss	tɒs	ṭaṣṣ
33.	truck	trʌk	trakk
34.	watt wa	wɒt	waṭṭ
35.	yen	jen	yann
36.	airbus	ˈe(ə)rˌbəs	ˈʔeer ˈbaṣṣ
37.	center locking	sentə lɒkɪŋ	ˈsantar ˈlukk
38.	cd rom	siːdiːˈrɒm	ˈsii di ˈrumm
39.	coffee shop	ˈkɒfi ʃɒp	ˈkufi ˈʃubb
40.	double kick	ˈdʌb(ə)l kɪk	ˈdabil ˈkikk
41.	double click	ˈdʌb(ə)l klɪk	ˈdabil ˈklikk
42.	hard luck	ˈhɑːd lʌk	ˈhard ˈlakk
43.	internet	ˈɪntənet	ˈʔantar ˈnitt ~ ˈʔintar ˈnitt
44.	intercom	ˈɪntəkɒm	ˈʔantar ˈkamm ~ ˈʔintar ˈkamm
45.	ketchup	ˈketʃəp, ˈketʃʌp	katˈʃabb ~ ˈkatʃ ˈʔabb
46.	kilowatt	ˈkɪləwɒt	ˈkeelu ˈwaṭṭ
47.	laptop	ˈlaptɒp	ˈlaab ˈtubb
48.	night club	ˈnʌɪtklʌb	ˈnaaytikˈlabb
49.	off side	ɒfˈsʌɪd	ˈʔuff ˈsayd
50.	off white	ɒfˈwʌɪt	ˈʔuff ˈwayt
51.	seven up	ˈsev(ə)n ʌp	ˈsivin ˈʔabb
Pattern two			
52.	academy	əˈkædəmi	ʔakadiiˈmiyye
53.	aristocracy	ˌærɪˈstɒkrəsi	ʔaarisṭugraaˈṭiyye
54.	baby	ˈbeɪbi	ˈbubbu
55.	barracks	ˈbærəks	barraaˈkiyye
56.	battery	ˈbætəri	baṭṭaaˈriyye
57.	block	blɒk	ˈblukke ~ blukk
58.	bourgeoisie	ˌbɔːʒwɑːˈziː	birdʒwaaˈziyye
59.	chat	tʃæt	ˈʃayyat
60.	dossier	ˈdɒsieɪ	dooˈsiyye
61.	fill	fɪl	ˈfallal
62.	flannel	ˈflænəl	faaˈnilla ~ faa ˈneella
63.	gorilla	gəˈrɪlə	ɣooˈrilla ~ ɣooˈreella
64.	hula-hoop	ˈhuːləhuːp	hilaˈhubba

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65.	marshmallow	mɑːʃˈmaləʊ	marʃaˈmillu
66.	marxism	ˈmɑːksɪzəm	maarikˈsiyye
67.	millimeter	ˈmɪləˌmitər	ˈmilli ~ ˈmiili
68.	monopoly	məˈnɒp(ə)li	munuˈbulli ~ munuˈbuli
69.	mortadella	ˌmɔːtəˈdɛlə	martaˈdilla ~ martaˈdeella
70.	party	ˈpɑːti	barˈtiyye
71.	roundel	ˈraʊnd(ə)l	runˈdilla ~ runˈdeella
72.	spaghetti	spəˈgeti	sbaaˈgitti ~ ʔisbaaˈgitti
73.	symphony	ˈsɪmfəni	simfuˈniyye
74.	toyota	tɔɪˈəʊtə	tooˈyutta
75.	trailer	ˈtreɪlə	ˈtreella
76.	trolley	ˈtrɒli	ˈtrulli
77.	vanilla	vəˈnɪlə	vaaˈnilla ~ vaa ˈneella
78.	villa	ˈvɪlə	ˈvilla ~ ˈveella
Pattern three			
79.	balloon	bəˈluːn	balˈloon
80.	bikini	bɪˈkiːni	bɪkˈkiini
81.	clipper	ˈklɪpə	kulˈlaab
82.	collage	ˈkɒlɑːʒ	kulˈlaadʒ
83.	collection	kəˈlekʃən	kulˈlikʃin
84.	dozen	ˈdʌzən	dazˈziine
85.	guava	ˈgwɑːvə	dʒawˈwaafe
86.	massage	ˈmæsɑːʒ	masˈsaadʒ
87.	okay	əʊˈkeɪ	ʔukˈkee
88.	tattoo	təˈtuː, tæ.tuː	tatˈtuu

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