International Journal of Linguistics, Literature and Translation
ISSN: 2617-0299 (Online); ISSN: 2708-0099 (Print)
DOI: 10.32996/ijllt
Journal Homepage: www.al-kindipublisher.com/index.php/ijllt

IJLLT
AL-KINDI CENTER FOR RESEARCH AND DEVELOPMENT

| RESEARCH ARTICLE

Gemination in Qassimi Arabic: An Optimality-Theoretic Analysis

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| ABSTRACT
The current study explores the distribution, phonological behavior and representation of geminates in Qassimi Arabic (QA) within the framework of Optimality Theory (OT). The study begins by showing the main properties of geminates crosslinguistically: the case where geminates work dual patterning (acting as both single segments or consonant clusters), and the cases which geminates show resistance to certain phonological processes such as lenition, deletion and epenthesis. These characteristics are then investigated in the context of QA to manifest their behavior within this dialect. To address the behavior of geminates in QA, the study adopts the Moraic Theory, arguing that geminates in QA are best analyzed as single consonants linked to a mora. The distributional patterns of geminates in QA show that initial geminates are prohibited in QA, as their initial surface leads to a violation of prosodic constraints such as the Strict Layer Hypothesis (SLH) and Prosodic Licensing, which requires that every moraic segment belongs to an immediate higher category on the prosodic hierarchy. In contrast, medial geminates are permitted to surface in QA but must be surfaced as heterosyllabic consonants (C.C), while Final geminates surface only in monosyllabic words. These distributional patterns of geminates in QA are analysed using OT constraint interaction, capturing how markedness constraints (e.g., *-GC-, *FINAL-C-μ) are ranked higher over faithfulness constraints (e.g., MAX-GEM, IDENT-GEM). The analysis of this study contributes universally to theoretical controversy on geminate distribution and representation and in particular, it adds an understanding on the bahvior of geminates in Arabic. Furthermore, the study demonstrates how prosodic theory shapes segmental realization.

| KEYWORDS

Geminates, Qassimi Arabic, Moraic Theory, Prosodic Structure, Optimality Theory.

| ARTICLE INFORMATION

ACCEPTED: 15 May 2025 **PUBLISHED:** 08 June 2025 **DOI:** 10.32996/ijllt.2025.8.6.9

1. Introduction

The phenomenon of gemination has been observed in many languages, such as in Italian and Trukese, a Micronesian language spoken on the islands of the Atoll known now as Chuuk Lagoon in the Pacific (Curtis, 2003), Maltese (Galea, 2016), Korean (Ko, 1998), Japanese (Hernawati, 2022), and in most Arabic dialects as in Qassimi Arabic (Alqahtani, 2020), Moroccan Arabic (Noaman, 2020), Jordanian Arabic (Mashaqba et al., 2021) and Lebanese Arabic (Khattab & Al-Tamimi, 2015).

Geminates are defined as "long or doubled consonant that contrasts phonemically with its shorter or singleton counterpart" (Davis, 2011, p. 873). These geminates, most of the time, are ntrastive to their singleton counterpart. For instance, in Qassimi Arabic (QA), the geminate /mm/ makes a minimal pair with its counterpart /m/ in words like /ħammam/ [bathroom] and /ħamam/ [pigeons].

Geminates have been classified as either true or fake geminates (Hayes, 1986). True geminates are geminates that are part of the underlying form of the word i.e. they are monomorphemic. On the other hand, fake geminates or accidental geminates arise from morpheme connection; thus, they occur across morpheme boundaries.

(1) Example of fake geminates in QA:

a. /gaal-li/ 'he told me' (Al Motairi, 2015, p. 27)

In this case, the word /gaal/ is followed by the dative particle /l/, which is then followed by the pronoun /i/ 'me'. As a result, the final /l/ in gaal ends up adjacent to an identical particle /l/, creating what is known as a fake geminate. However, fake geminates do not share the same properties and characteristics as true geminates and; thus, they are ignored in this study.

Geminates are characterized by three main features. The first is their behavior and patterning. In some contexts, geminates behave and pattern as single segments, such as in prosodic rules influencing stress, tone, and length. In other contexts, they behave and pattern as consonant clusters, such as rules affecting segment quality. Notably, this dual behavior can occur within the same language. Müller (2001) referred to this phenomenon as the 'duality of geminates', while Hayes (1986) termed it the 'ambiguity of geminates'.

Second, geminates are characterized by their immunity to some phonological processes, a phenomenon termed by Hayes (1986) as the 'inalterability of geminates'. For example, in Leti, a language spoken in Indonesia, a reduplication affix can break an initial consonant cluster, but it cannot break an initial geminate (Muller, 2001), as in (2):

(2) Reduplication in Leti: (Muller, 2001, p. 136)

a.	Reduplication affixing an initial consonant.			
Luli	'taboo'	Lululi	'taboo (adj)'	
b.	Reduplication breaking a consonant cluster			
krait	'to be slow'	Kririat	'slow'	*rikriat
c.	Reduplication not splitting a geminate			
kkɔi	'kid'	Kɔkkɔi	'child'	*kkɔkɔi

Third, geminates resist the application of rules of epenthesis. Both Hayes(1986) and Muller (2001) referred to this phenomenon as the 'integrity of geminates'. For instance, in Palestinian Arabic (PA), a CC cluster is not allowed; thus, the dialect employs an epenthesis rule that inserts the vowel /i/ to break this CC cluster, as in (3a). However, the same rule does not apply to geminates, as in (3b-c):

(3) Palestinian Arabic avoidance of CC clusters: Abu-Salim (1980)

a.	/ʔakl/	[ʔakil]	'food'
b.	/ʔimm/	[*ʔimim]	'mother'
c.	/sitt-na/	[*sititna]	'our grandmother'

Such inconsistency in geminate behavior reflects the complex nature of geminates across languages. Thus, the main purpose of the study is to investigate the behavior and representation of gemination in Qasimi Arabic and to provide a comprehensive analysis of geminates from an Optimality Theory (OT) perspective. Understanding gemination across different languages can enhance our understanding of the phenomenon from a cross-linguistic perspective.

2. Representation of gemination

This inconsistency in geminate behavior has led to the debate about the representation of gemination. Are geminates represented as one or as two phonological segments? Many (syllable) models such as autosegmental representation led by McCarthy (1979) and Leben (1980), the two-root node introduced by Selkirk (1990), and moraic representation led by Hayes (1989) and Davis (2011), have sought to address this question.

The most famous of these models is the CV model, proposed by McCarthy (1979) and Leben (1980). The CV model utilizes and advances the theory of Autosegmental Phonology proposed by Goldsmith (1976). In both Autosegmental Phonology and CV model, the well-formedness of a structure is motivated by two main principles of well-formedness. The first principle is that every unit on one level must be associated with one unit at every level. The second principle is that those association lines must not cross (Goldsmith, 1976; McCarthy, 1979). In the CV model, the representation is made of multiple tiers that are linked with association lines. The most notable of these tiers are the syllable tier, the melodic tier, and the CV tier, as seen in (4):

(4) The CV representation of the word cat.

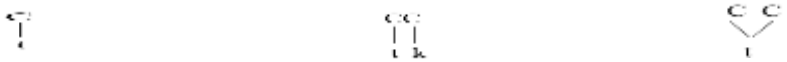
CV tier or timing slots

melodic tier

In the CV model, geminates are represented as a single long consonant that is mapped onto two C-slots in the skeletal tiers, as in (5).

(5) Geminate representation in CV model

a. Short consonant b. Consonant cluster c. Geminates



However, a problem with models that are based on Autosegmental theory is the limitation to quantity-sensitive and weight phenomena, such as compensatory lengthening (Hayes, 1989). Hayes claimed that in Latin, for instance, when the consonant /s/ is deleted, the vowel preceding it is lengthened as in /*kasnu/ to /ka:nu/. However, when /s/ occurs in the onset position, its deletion does not affect the quality or realization of the following vowel, as in /*snurus/ > /nurus/ (Hayes, 1989, p. 260-261).

Another criticism of autosegmental phonology in general came from Davis (2011). He claimed that in autosegmental models, the geminates are represented as consonant clusters. Thus, these models predict that geminates behave and pattern as consonant clusters. In other words, geminates should be affected by rules of epenthesis similar to consonant clusters. However, cross-linguistically, some cases go against this prediction. For example, in Trukese, initial geminates are allowed while initial consonant clusters are not. Similarly, intervocalic geminates are allowed while intervocalic consonant clusters are not.

This discrepancy between the patterns of geminates and consonant clusters cannot be explained under autosegmental models. Autosegmental models map geminates in the same manner as mapping consonant clusters, in both cases, they are mapped to CC. Thus, if a language allows initial geminates, then, in theory, it should allow initial consonant clusters. As a result of the criticism that the autosegmental representation received, Hayes (1989) advocated for the use of the Moraic Weight Theory to represent geminates. In the moraic weight representation, the weight unit mora is used to account for the weight of the syllable. In the version that Hayes (1989) adopted, the short vowel has one mora while long vowels have two moras. On the other hand, consonants have no inherent mora while geminates have one mora. This can distinguish geminates from consonants, which was not possible in autosegmental representation.

(6) Geminate representation in Moraic theory

a. Consonant b. Geminate

Davis and Ragheb (2014) claimed that geminates in Arabic and their behavior are evidence for the moraic weight representation. In particular, they noticed that when the child cannot pronounce a consonant cluster properly, they resort to geminating the easiest consonants, while deleting the more difficult consonants. For example, the child pronounced the word flowers in Arabic /ward/ as /wadd/. Davis and Ragheb concluded that gemination was used as a strategy to preserve the moraic weight of the word. Thus, arguing for the moraic nature of geminates in Arabic.

3. The phonology of QA

Qassimi Arabic is a dialect spoken in the Qassim region of Najd and; thus, is a sub-dialect of the Najdi dialects. The Najdi dialects most often refer to a homogenous group of dialects that include the speech of the sedentary population of Central Najd, and the speech of the Bedouin tribes that live in the area (Ingham, 1994). The minimal syllable structure in QA is CV. This means that in QA, the onset and nucleus are obligatory, while the coda is optional. Complex onset is not preferred in QA, while complex coda is allowed. Ten syllable types are allowed in QA: CV, CVC, CVV, CVVC, CVCC, CCV, CCVVC, CCVC, CCVCC, CCVV. The syllable types and an example of these types can be seen in (7).

(7) Examples of syllable patterns in QA: (Alhoody, 2019: 44)

a.	CV	/ki.tab/	'he wrote'
b.	CVC	/ki.tab/	'he wrote'
c.	CVV	/ka:.tib/	'writer'
d.	CVVC	/ra:ħ/	'he went'
e.	CVCC	/bint/	'daughter'
f.	CCV	/kta.bat/	'she wrote'
g.	CCVVC	/kta:b/	'book'
h.	CCVC	/gtˤaʃ/	'pieces'
i.	CCVCC	/ħrimt/	'I was deprived'

j. CCVV /jsaa.fir/ 'he travels'

In QA, the stress falls on the heaviest syllable. But more specifically, the stress falls on the ultimate if it is super heavy [CVVC-CVCC]. However, if the ultimate is not super-heavy, then stress falls on the penultimate if it is heavy [CVC-CVV]. If the penultimate is not heavy, then stress falls on the antepenultimate. Nevertheless, the stress never appears before the antepenultimate. In disyllabic words, stress falls on the penultimate if the ultimate is not super heavy.

(8) Stress patterns in QA: (Alhoody, 2019: 46)

a.	CVVCˈCVVC	[kaːtˈbiːn]	'they.MAS wrote'
b.	CVˈCVCC	[kaˈtabt]	'I wrote'
c.	ˈCVV.CV	[ˈraː.si]	'my head'
d.	ˈCV.CVC	[ˈka.tab]	'he wrote'
e.	CVVCˈCVV.CVC	[tˤaːbˈʕaː.tah]	'her printers'
f.	CVˈCVC.CV	[kaˈtab.tu]	'you.MAS.PL wrote'
g.	ˈCVC.CV.CV	[ˈman.za.li]	'my home'
h.	ˈCV.CV.CV	[ˈku.tu.bi]	'my books'

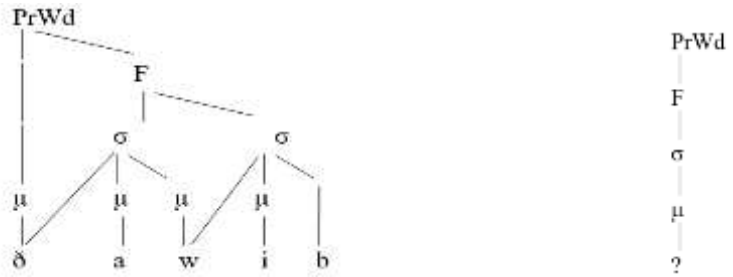
4. Theoretical background on OT

Optimality Theory (OT) is a phonological theory that was introduced by Prince and Smolensky in (1993). In this theory, the Universal Grammar consists of three main components, the constraint (CON), the generator (GEN), and the evaluator (EVAL). The first component CON is a set of violable and rankable constraints. These constraints are universal; however, the ranking of these constraints is language-specific. There are two main types of constraints in CON. The first is faithfulness constraints, which ensure the faithfulness of the output to the input, i.e. output is the same as the input. The second type is the markedness constraints, which ensure the well-formedness of the output. The second component in OT is the generator (GEN), this component's job is to generate as many candidates as possible. The third component in OT is the evaluator (EVAL). This component is responsible for evaluating the candidates that the generator produced based on the ranking of constraints in the grammar, and selecting the optimal candidate, i.e. the candidate with the least violation of the constraint. For example, the constraint ONSET which requires that a syllable must have an onset, is nonvoidable in QA, since QA prohibits a syllable occurring with no onset. On the other hand, the constraint CODA is ranked much lower, since QA allows for a syllable with no coda.

5. Distribution of Geminates in QA

While QA allows initial consonant clusters, initial geminates are prohibited to surface Alqahtani (2020). He attributed that to initial geminates violating the Prosodic Licensing/Strict Layer Hypothesis (SLH), which requires that every prosodic element belongs to an immediate higher category on the prosodic hierarchy, seen in (9) (Itô, 1986; Nespor & Vogel, 2007). However, initial geminates result in a moraic semi-syllable that violates the SLH, seen in (9):

(9) Representation of initial geminates SLH



[ð. ðaw.wib]

/t-ðaw.wib/ [ʔið.ðaw.wib] [*ð.ðaw.wib] 'you/she melt'

The lack of initial geminates in QA further supports the moraic nature of geminates. However, medial geminates in QA occur and can be from three different sources: lexical, phonologically derived, or morphologically derived. In contrast, final geminates can be lexical only. Lexical geminates are part of the underlying form of the word, thus they are contrastive. In other words, the geminate and its singleton counterpart make up minimal pairs, as in /hamam/ VS /hammam/ (Galea, 2016). Phonological geminates, on the other hand, arise from phonological processes such as total assimilation. For example, the lateral segment of the definite article /ʔal-/ assimilates to the following coronal in root-initial position, as in (10).

(10) Phonolagical geminates:

a.	/ʔal-sabat/	[ʔas.sabt]	'the Saturday'
b.	/ʔal-darb/	[ʔad.darb]	'the way'
c.	/ʔal-nafs/	[ʔan.nafs]	'the soul'

Finally, morphological geminates arise through the non-concatenative morphology of QA. For example, when deriving causative verbs, the medial consonant is geminated as in (11):

(11) Morphological geminates:

a.	/kattab/	'he caused them to write'
b.	/darras/	'he taught'
c.	/ʁassalh/	'washer; a machine that washes'
d.	/ʃasˁsˁarh/	'juicer; a machine that juices'

Final geminates are restricted to lexical geminates only. These geminates are often the result of the word minimal requirement. QA has a word minimality requirement, which requires that a prosodic word must be minimally bimoriac. In other words, light syllables are prohibited from occurring as a monosyllabic word. Under this principle, CV syllables are not allowed in monosyllabic words since they are inherently light. CVC syllables are prohibited since they are light in the final position due to the extrametricality principle. Thus, QA permits three types of syllables in monosyllabic words. The first is the CVVC, which is inherently bimoriac due to the long vowel. The second is the CVCC syllable, which is bimoriac due to the WBP principle that assigns a mora to the first consonant in the coda clusters. The third is the CVG syllable which is bimoriac due to the final geminates.

(12) Monosyllabic words in QA:

a.	/na:r/	CVVC	'fire'	(Al Motairi, 2015: 60)
b.	/dʒdaar/	CCVVC	'wall'	
c.	/bint/	CVCC	'girl'	
d.	/smint/	CCVCC	'cement'	
e.	/ʔumm/	CVG	'mother'	
f.	/raʃʃ/	CVG	'spray'	
g.	/sadd/	CVG	'close'	
h.	/ħakk/	CVG	'scratch'	
i.	/rasˁsˁ/	CVG	'stack'	
j.	/dubb/	CVG	'bear'	

6. OT Analysis of Geminates

In QA, geminates are allowed unrestrictedly in the word-medial position, while final geminates are permitted monosyllabic words only. On the other hand, geminates are prohibited from occurring word-initially in QA. This prohibition on initial geminates makes it evident that geminates are inherently moraic, since initial geminates would result in a moraic semi-syllable that violates the SLH. These patterns support two theoretical claims about the phonology of QA. The first claim is the extrametricality of the final consonant. If this principle were inactive in QA, then the CVC syllable would be treated as a heavy syllable and thus can occur as a monosyllabic word. However, the lack of CVC syllables in monosyllabic words, confirms that final consonants are extrametrical. The second claim is that QA requires the prosodic words to be minimally bimoriac. If no such constraint existed, then the light CV and CVC syllables would occur in monosyllabic words. However, CV and CVC do not occur in monosyllabic words, which is evident that QA requires the prosodic words to be minimally bimoriac.

The examples shown above in (12) illustrate that monosyllabic words in QA must be bimoraic, either through a long vowel, a complex coda, or a final geminate. Focusing on monosyllabic words with final geminates, as seen in (12 e-j), these words share two similarities. They all have a short vowel and a final geminate. In the case of the word /dubb/, it surfaces as /dubb/with a final geminate not */dub/, which can be explained by two principles: bimoraic minimality and extrametricality, as mentioned previously. The minimality condition requires prosodic words to be minimally bimoraic. This condition is active in many other Arabic dialects such as Moroccan Arabic (Noaman, 2019), Jordanian Arabic (Abu Guba, 2021), and Algerian Arabic (Bourzeg & Mahadin, 2020) to name a few. To satisfy the minimality requirement, QA geminate the final consonant. The constraint *FINAL-C-μ is used to account for the extrametricality principle in OT. This constraint renders the final consonant as moraless. On the other hand, the constraint MINWD is used to account for the minimality principle in OT. This constraint disallows any syllable that is monomoraic from being a prosodic word. Both of these constraints are undominated in QA.

1. *FINAL-C-: A word-final consonant is weightless. (Kager, 1999)

2. MINIMAL WORD (MINWD): A prosodic word is minimally bimoraic. (Kager, 1999)

Tableau 1

Input /sad/	MINWD	*FINAL-C-μ
a. /sa$_{\mu}$d/	*!	
b. /sa$_{\mu}$d$_{\mu}$/		*!
c. /sa:$_{\mu\mu}$d/		
d. /sa$_{\mu}$d$_{\mu}$d/		

In this tableau, candidate (a) is monomoraic, thus it violates the MINWD constraint, which requires prosodic words to be minimally bimoriac. While, candidate (b) does not violate the MINWD constraints, since it is bimoriac, it violates the *FINAL-C-μ constraint, which disallows the final consonant from being moraic. Thus both candidates fail due to violating undominated constraints. While both candidates (c) and (d) satisfy the undominated constraints MINWD and FINAL-C-μ, the tableau fails to determine the optimal candidate of the input. The difference between the two candidates is in how each candidate achieved the required bimoraicity. Candidate (c) achieved the required bimoraicity through vowel lengthening. While candidate (d) achieved it through geminate consonant. To differentiate between the two candidates, the faithfulness constraints DEP-μ (Vowel) and DEP-μ (Consonant) are added. DEP-μ (Vowel) requires every mora that is associated with a vowel in the output to have a correspondent in the input, which prohibits vowel lengthening. While the DEP-μ (Consonant) requires that every mora that is associated with a consonant in the output have a correspondent in the input, which prohibits geminating a consonant. Based on the surface form, the constraint DEP-μ (Vowel) is ranked higher than the constraint DEP-μ (Consonant).

3. (DEP- μ (V): A mora associated with a vowel in the output has a correspondent in the input. (Kager, 1999)

4. (DEP-μ (C): A mora associated with a consonant in the output has a correspondent in the input. (Kager, 1999)

Tableau 2

Input /sad/	MINWD	*FINAL-C-μ	DEP- μ (V)	DEP- μ (C)
a. /sa$_{\mu}$d/	*!			
b. /sa$_{\mu}$d$_{\mu}$/		*!		
c. /sa:$_{\mu\mu}$d/			*	
d. ☞/sa$_{\mu}$d$_{\mu}$d/				*

In this tableau, candidate (c) achieved bimoraicity through vowel lengthening, which is disallowed by the constraint DEP-μ (V). While, candidate (d) achieved bimoraicity through geminating the final consonant, which violates the DEP-μ (C) constraint. However, since the constraint DEP-μ (V) is ranked higher than the constraint DEP-μ (C), candidate (d) is chosen as the optimal candidate over candidate (c).

When a consonant-initial suffix is attached to roots with final geminates, QA avoids the -GC- cluster through schwa epenthesis between the geminate and the following consonant. This process triggers resyllabification, which breaks the -GC- cluster.

(13) Avoiding -GC- cluster in QA
   a. /ʃamm-na/ [ʃam.mə.na] 'our uncle'
   b. /duff-na/ [duf.fə.na] 'push us!' (imperative)

Geminate resistance to degemination in this context can be attributed to the constraint MAX-GEM, which preserves the geminate in input from degemination, whereas the constraint IDENT-IO[GEM] preserves the integrity of geminates, by prohibiting the insertion of an epenthetic vowel within the geminate. Lastly, the *-GC- constraint prohibits a medial -GC- cluster from surfacing in QA. What is most notable about this constraint is that it disallows the -GC- even when this cluster occurs in two adjacent syllables.

5. IDENT-IO[GEM]: Output correspondents of an input [Gem] are also [Gem].
6. MAX-GEM: Every geminate in the input has a correspondent in the output.
7. *-GC-: Geminates followed by a consonant are prohibited even in adjacent syllables. (Abu-Abbas et al., 2011: 8)

Tableau 3

/dʒadd-hum/	*-GC-	IDEN- GEM	MAX-GEM	IDEN-IO
a. [dʒad.dhum]	*!			
b. [dʒadd.hum]	*!			
c. [dʒa.dəd.hum]		*!		
d. [dʒad.hum]			*!	
e. ☞ [dʒad.də.hum]				*

In the tableau above, the geminate in candidate (a) is ambisyllabic. While the geminate in candidate (b) is continued. However, both candidates violate the *-GC- constraint. This constraint disallows the -GC- cluster from occurring in QA, even in adjacent syllables. On the other hand, while both candidates (c) and (d) avoid violating the *-GC- constraint, they do so differently. Candidate (c) avoids violating the *-GC- constraint by inserting a schwa within the geminate, thus breaking the integrity of the geminate, which violates the IDEN- GEM constraint. Candidate (d), on the other hand, avoids violating the *-GC- constraint by a process of degemination, thus violating the MAX-GEM constraint. Finally, candidate (e) avoided violating the *-GC- constraint by inserting a schwa between the geminate and the following consonant, resulting in a resyllabification.

7. Conclusion

This study has investigated the distribution, phonological behavior, and representation of geminates in Qassimi Arabic (QA), employing the Optimality Theory (OT) as a theoretical framework to account for the observed patterns. The data analysis provides theoretical contributions to knowledge of gemination in Arabic dialects and more broadly to prosodic phonology. The data of this study show that the distribution patterns of geminates in QA are systematic and based on phonological grounds. This is revealed when discussing the ban of realizing geminates initially in QA and attributing this ban to a prosodic restriction which assuring that geminates—being inherently moraic and given that onsets do not project mora- cannot occupy prosodically weak positions like onsets. Additionally, the data show that medial geminates in QA are possible to surface with a condition of being heterosyllabic—i.e., one consonant surfaces as the coda of one syllable and the other consonant as the onset of the next. Furthermore, given the prosodic constraint in QA that words should be minimally bimoraic, final geminates in QA are realized only in monosyllabic words, where they do not violate the minimality requirement of mora. These distributional patterns of geminates in QA parallel crosslinguistic observations about geminate distribution and provide additional support for the idea that geminates are subject to prosodic structure constraints. The proposed ranking of constraints utilized in this study successfully account for geminates distribution and behavior in QA and demonstrate how prosodic and segmental constraints shape the realization of geminates.

In conclusion, the study offers an analysis of the distribution of geminates in Qassimi Arabic and contributes to the typological debates on the representation of geminates. In particular, it provides empirical support to the idea that geminates are prosodically and phonologically inconsistent regarding their behavior. This entails that both language-specific constraints and universal prosodic principles shape the distribution patterns of geminates. Future research could extend this analysis to other Najdi dialects or incorporate experimental phonetic evidence to further validate the proposed analysis. Furthermore, while this study has not discussed the relationship between geminates and stress in QA, its conclusion that geminates are inherently moraic suggests that they influence the stress placement in QA. This proposed analysis suggests a need to conduct more studies on this relationship.

Funding: This research received no external funding.
Conflicts of Interest: The authors declare no conflict of interest.
ORCID iD (if any): 0009-0004-5645-9467

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