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CYPRriot GREEK AND THE PHONETICS AND PHONOLOGY OF GEMINATES

Abstract

This paper reports on how the acoustic characteristics and phonological patterning of Cypriot Greek geminates bear on the phonological representation of geminates, and by extension on the representation of weight and quantity more generally. Specifically, acoustic data suggest that the Cypriot geminates are ambisyllabic and nearly twice as long as single consonants; yet they neither add weight to the syllable they form the coda of, nor do they shorten the duration of the preceding vowel, as would be expected of moraic codas. On the other hand, the Cypriot geminates cannot be considered clusters of identical consonants, since phonological alternations affect them as a unit. Thus the phonetics and phonology of the Cypriot geminates show that they are “true” geminates yet they are non-moraic. These findings suggest that moraic structure cannot adequately represent both weight and quantity; rather, both a moraic and a skeletal tier are needed to represent weight and quantity respectively.

1. Background

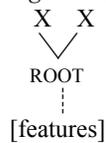
The present paper reports on how the acoustic characteristics and phonological patterning of Cypriot Greek geminates bear on the issue of the phonological representation of geminates more generally. In turn, the representation of geminates has far-reaching consequences, since it affects the phonological representation of quantity and weight, for which geminates are a good test case.

1.1. Quantity, weight and the representation of geminates

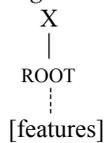
The representation of geminates has been a long standing problem in phonology. It is of course well known today that the difficulties faced by early analyses were due to the limitations of linear models. The advent of autosegmental phonology offered an appropriate framework, by allowing the separation of a root’s features from timing considerations. Simplifying somewhat, this separation was achieved by means of the skeleton, which represents timing information in the form of slots, notated as Cs and Vs (e.g. McCarthy, 1981; Clements & Keyser, 1983), or as Xs, (e.g. Levin, 1985).¹ Thus, in autosegmental terms, geminate consonants are represented as one root node that is linked to two timing slots, as can be seen in (1) (Leben, 1980; Clements & Keyser, 1983; Levin, 1985): (1a) shows the representation of a geminate, and (1b) that of a singleton consonant.

¹ The differences between the two conceptions of the skeleton, though significant in themselves, are immaterial to the arguments presented here.

(1) a. *geminate*



b. *singleton*



This type of representation makes no specific claim about the *weight* of geminates. It simply captures their *quantity*, that is the fact that geminates are longer than single consonants. Further, by linking the timing slots to one root node, the ‘inalterability of geminates,’ that is the fact that they behave as a single unit is also explained (see e.g. Schein & Steriade, 1986).

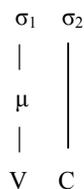
However, the skeleton and syllable structure were soon superseded by moraic representations (among others, Hyman, 1985; Hayes, 1989). Moraic theory is primarily a theory of syllable weight; but since weight is directly linked to quantity, moraic theory also deals with the representation of contrastive segment length. In fact it is held among its proponents that moraic structure can adequately represent both weight and quantity, and thus that there is no need for the skeleton. Several experimental studies provide phonetic evidence in favour of this view (e.g. Maddieson, 1993; Hubbard, 1995a; 1995b; Broselow, Chen & Huffman, 1997; Ham, 1998). Specifically, these studies examine data from several languages and conclude that moraic structure and related phenomena (such as compensatory lengthening and mora-sharing) are directly reflected in the phonetic duration of segments.

A fundamental tenet of moraic theory is that geminates are inherently moraic, i.e. they have weight, a view that has been put forward most forcibly by Hayes (1989). Thus, in moraic theory geminates are represented as shown in (2a).

(2) a. *geminate*



b. *singleton*



This representation shows that a geminate consonant has its own mora and is ambisyllabic, since it is linked to both syllable σ_1 and syllable σ_2 . A direct phonological consequence of this representation is that geminates affect the weight of the first syllable they are attached to: they make it bimoraic, therefore heavy. From the phonetic point of view, the fact that a geminate consonant is moraic means that it is longer than a singleton (the representation of which is depicted in (2b)), since moraic structure is—as mentioned—meant to represent not only weight, but quantity as well. The representation in (2a) captures the facts about geminates in several languages, in which weight and quantity go hand in hand. In these

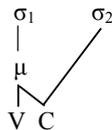
cases, the geminates contribute to syllable weight, i.e. they are moraic, and typically appear only in word-medial position, hence the assumption of ambisyllabicity poses no problems.

1.2. The representation of non-moraic geminates

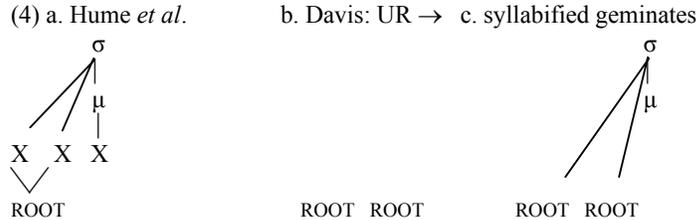
It has, however, been noted that not all geminates can be as easily accommodated within the moraic framework. Tranel (1991) mentions the cases of Selkup (a West Siberian language), Malayalam (a Dravidian language), and Tübatulabal (a Uto-Aztecan language), all of which appear to have *non-moraic* geminates. More recently, Hume, Muller and van Engelenhoven (1997) presented a detailed study of geminates in Leti, an Austronesian language. Hume *et al.* convincingly show that the Leti geminates are true geminates (i.e. not sequences of identical consonants), yet they appear word-initially and are non-moraic. In their studies, both Tranel and Hume *et al.* concluded that phonology must retain both a skeletal tier *and* moraic structure, if it is to adequately represent both quantity and weight. In the words of Tranel: “underlying geminate consonants appear to require a phonological theory able to encode length directly rather than by resorting to weight” (Tranel, 1991: 299).

In the face of evidence of this sort, proponents of moraic theory have suggested alternative representations for geminates like those of Leti or Malayalam. Thus, Broselow *et al.* (1997) propose that although all geminates are inherently moraic they may not necessarily head a mora at the surface. Broselow *et al.* work within an optimality theoretic framework and suggest that in languages in which geminates appear not to be weight-bearing, the constraint NOCMORA is ranked higher than MORAFATH. In other words, these languages prefer not to have consonants heading moras, and thus at the surface the geminates share the mora of the vowel to their left. This type of representation ensures well-formedness, as it keeps a geminate underlyingly moraic, but does not make the syllable to its left heavy. This surface mora-sharing is shown in (3).

(3) *surface mora-sharing geminate* (according to Broselow *et al.*, 1997)



This type of representation can account for non-moraic geminates, but it still does not solve the problem of how to represent word-initial geminates within the moraic framework. In a reply to Hume *et al.* (1997), Davis (1999) suggests a representation for word-initial geminates as two separate root nodes. The representations of Hume *et al.* and Davis are shown in (4). In (4a), which shows the representation proposed by Hume *et al.*, both moraic structure and a skeleton are employed. Davis on the other hand, conceives of the Leti geminates as two separate root nodes (4b), that are linked directly to the syllable node once syllabification has taken place (4c); Davis himself attributes the representation shown in (4c) to Hayes (1989).



Similar views to those advanced in Davis (1999) are also presented in Ham (1998), who suggests that languages like Selkup, Malayalam and Tübatulabal do not have real geminates but “double consonants,” which should be represented as two separate nodes with identical content, an analysis reminiscent of Selkirk (1991).

1.3. Some phonetic predictions

What is of most interest here is the fact that suggestions like those advanced in Ham (1998) or Broselow *et al.* (1997) come complete with explicit predictions about the phonetic timing of geminates; hence they are easily testable in the laboratory.

Specifically, Broselow *et al.* (1997) make a distinction between languages in which coda consonants share a mora with the vowel preceding them, and those in which coda consonants head their own mora. Broselow *et al.* found evidence that vowels shorten when they share their mora with a following consonant, compared to vowels in open syllables. In contrast, in languages in which coda consonants head their own mora, the vowels preceding them are of similar duration to vowels in open syllables. These observations suggest that mora-sharing geminates should also result in shorter duration for the vowels preceding them, while non-mora-sharing geminates should not.

On the other hand, Ham, following Hubbard’s proposals (1995a, 1999b), suggests that the timing of moraic segments is controlled by phonology, that is by their moraic nature itself. Specifically, Ham suggests that moraic segments show greater durational stability than non-moraic segments, which are more prone to “low-level” universal phonetic effects. For this reason, Ham explicitly hypothesizes that non-moraic geminates—or “double consonants” in his terms—should be more prone to durational variation than geminates proper, since the latter are moraic, while the former are not.

2. The case of Cypriot Greek geminates

2.1. Testing the phonetic predictions

As mentioned, these hypotheses that derive from alternative moraic representations of the geminates are explicit and easily testable. Cypriot Greek is a fruitful ground for such testing, having stop, fricative, affricate and sonorant geminates. All Cypriot Greek geminates appear regularly in word-medial position, where they contrast with singletons, as in the minimal pairs shown in (5).

- (5) a. [mil:a] “fat” vs. [mila] “apples”
 b. [nan:i] “sleep” NOUN vs. [nani] “dwarfs”

Cypriot geminates may also appear word-initially, though not as frequently as they appear word-medially. The examples in (6) show such word-initial geminates of Cypriot Greek.

- (6) a. [l:ion] “a little”
- b. [m:atin] “eye”
- c. [tʃ:ain] “tea”
- d. [ʃ:ilos] “dog”
- e. [p:efto] “I-fall”

These examples establish the fact that geminates may appear word-initially. It is also clear that word-initial geminates in Cypriot Greek contrast with singletons, as the minimal pairs in (7) show.

- (7) a. [ʃ:ili:] “dogs” vs. [ʃili] “lips”
- b. [p:efti] “s/he falls” vs. [pefti] “Thursday”

Although the issue of weight is not pursued here at length—or anywhere in the literature on Cypriot Greek, as far as I am aware—it is clear that the geminates of Cypriot Greek cannot be weight-bearing, since there are no weight distinctions in this language (see e.g. Newton, 1972). Evidence for weight distinctions would come from restrictions about minimal word structure (e.g. in the creation of hypocoristics) and from stress patterns. However, neither suggests that there are moraic distinctions in Cypriot Greek in which geminates could participate.

Now, if we accept that all syllables are monomoraic in Cypriot Greek, and therefore that coda consonants cannot possibly add weight to a syllable, then one possibility for the representation of Cypriot geminates within the moraic framework is to adopt Broselow *et al.*'s solution. That is to say that Cypriot geminates are inherently moraic, but at the surface they share the mora of the vowel to their left. In that case, we should find that geminates in Cypriot Greek shorten the vowel of the preceding syllable. But, this is precisely what Cypriot geminates do not do.

Data to this effect come from two studies on the phonetics of geminates (Arvaniti, 1999; Arvaniti & Tserdanelis, 2000; Arvaniti, in press; Tserdanelis & Arvaniti, in press). In these studies, the data were based on the speech of eight native speakers of CYG. Four of those were recorded for Arvaniti (1999), a study that involved only sonorants. The other four speakers were recorded for a larger study of stops, fricatives, affricates and sonorants (Arvaniti & Tserdanelis, 2000; Arvaniti, in press; Tserdanelis & Arvaniti, in press). The speakers in both studies were recorded reading seven repetitions of the test sentences in random order. The test sentences were of the structure shown in (8), in which the slot in the middle was filled by a test word.

- (8) [i'pendu ___ tʃefien] “S/he said to him ___ and left”

The test words were minimal or near minimal pairs of the form C_1VC_2V where C_2 was either a single or a geminate consonant. The word pairs in (9) are part of the materials used

in the larger study. In these examples, the consonants under investigation are shown in bold.

- (9) a. [p**ɒ**p**ɒ**] “pope” vs. [m**æ**p**ɒ**r**ɒ**] “ball”
 b. [p**ɒ**'t**ɒ**] “drinks” vs. [k**ɒ**'t**ɒ**] “s/he knocks”

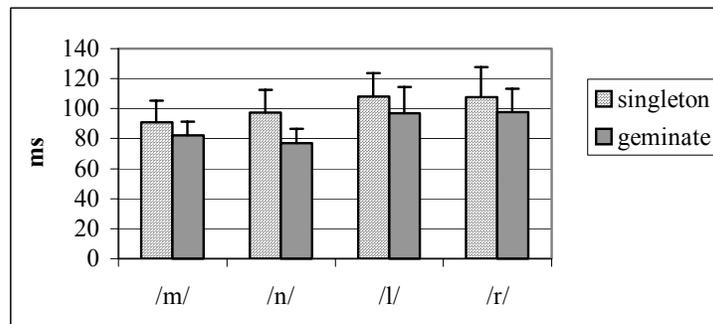


Figure 1: Mean durations and standard deviations of vowels preceding either a singleton or a geminate /m/, /n/, /l/ or /r/, separately for each sonorant. None of the differences is statistically significant. [From the presentation of Arvaniti (1999).]

Figures 1 and 2 come from the two studies and present the duration of the vowels preceding singletons and geminates. As these figures show, the duration of the preceding vowel was largely unaffected by the presence of the geminate, contrary to the mora-sharing hypothesis of Broselow *et al.* (1997). It is even the case that in the larger study /ʃ/ showed *longer* vowel duration before the geminate than before the singleton, an unexpected result marked with arrows in Figure 2 (Arvaniti & Tserdanelis, 2000).

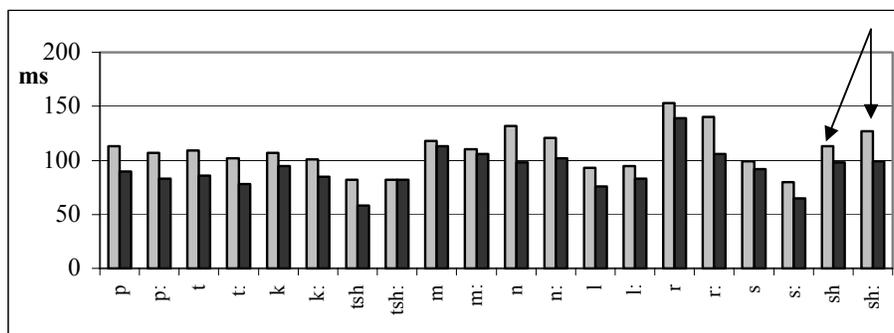


Figure 2: Mean durations of vowels preceding either a singleton or a geminate consonant, separately for each consonant type and stress condition. Grey bars for stressed vowels, black bars for unstressed vowels. ‘tsh’ stands for /tʃ/ and ‘sh’ for /ʃ/. Only /k/, /m/ and /r/ showed significantly shorter vowels before geminates than before singletons; /ʃ/ showed the *opposite* effect. [From Arvaniti & Tserdanelis (2000).]

Thus, the Cypriot data show that the hypothesis of Broselow *et al.* (1997) does not hold for at least *one* language with non-moraic geminates, Cypriot Greek. In other words, for Cypriot Greek at least, even word-medial geminates cannot possibly be underlyingly moraic and sharing at the surface the mora of the vowel preceding them. If that were the case, the vowel should be shortened when a geminate followed, a hypothesis that is not supported by the durational data of Arvaniti (1999) and Arvaniti & Tserdanelis (2000).

The alternative is to adopt the analysis of Davis (1999) or Ham (1998), that is to represent the Cypriot geminates as two separate root nodes. Such a solution is attractive, given that the Cypriot geminates can appear word-initially as well as word-medially. As mentioned in §1.3., according to Ham (1998), representing geminates as two separate root nodes means that phonetically these geminates should be more variable than moraic geminates; they should also be more variable than single consonants, since they comprise two root nodes instead of one.

It is evident that this variability should be most pronounced under contextual changes that affect segmental duration. However, Arvaniti (1999) and Arvaniti (in press) do not offer strong support in favour of this view. Concretely, in these two studies Cypriot singletons and geminates were compared to Greek singletons under changes of speaking rate, and it was shown that the geminates were not more variable than the singletons in either linguistic variety. Two indicators of this lack of greater variation, the standard deviations of the data and the fast-to-normal rate duration ratios, are presented in Table 1. These data suggest that the phonetic timing of Cypriot geminates is as stable as that of the singletons, and thus it does not offer support for the view that these geminates should be represented as two root nodes.

		SGR singletons	CYG singletons	CYG geminates
/m/	S.D.	13	20	18
	F/N	0.85	0.76	0.80
/n/	S.D.	16	12	18
	F/N	0.79	0.82	0.77
/l/	S.D.	12	12	20
	F/N	0.85	0.82	0.77
/r/	S.D.	4	9	19
	F/N	0.93	0.96	0.72

Table 1. Standard deviations (S.D.) and fast/normal ratios (F/N) for /m/, /n/, /l/ and /r/ according to type and language (CYG = Cypriot Greek; SGR = Standard Greek); the values are averaged across speakers. [Adapted from Arvaniti (1999).]

Further phonetic evidence against the two-root node analysis comes for data on the syllabification of Cypriot geminates. Specifically, the two-root analysis would require that such geminates are tautosyllabic, rather than ambisyllabic. Intonational data, however, strongly suggest this to be incorrect for Cypriot Greek. Concretely, Cypriot Greek has a low rising pitch accent similar to that found in Standard Greek. For Standard Greek we know that this accent should be analysed as a bitonal L+H, and that the Low tone appears at the

very beginning of the stressed syllable it is associated with it, or slightly before that (Arvaniti & Ladd, 1995; Arvaniti, Ladd & Mennen, 1998; 2000). On the basis of these data, Tserdanelis & Arvaniti (in press) tested the hypothesis that the Cypriot data involve a similar early Low target, the position of which is influenced by the presence of an intervocalic geminate. In particular, the hypothesis was that the L tone would appear at the onset of the stressed syllable, if that involved a single consonant. In contrast, the L tone would appear in the middle of the geminate's duration—if the L aligned in Cypriot Greek in a similar fashion to Standard Greek and geminates are ambisyllabic.

For obvious reasons, it was only possible to test this hypothesis with words with final stress (so that the L should fall on the intervocalic consonant), and with intervocalic segments that do not disrupt the fundamental frequency contour, i.e. /l/, /m/ and /n/. The investigation of these data (a total of 84 cases) showed that indeed the L tone of L+H pitch accents aligned with the middle of (sonorant) geminates, but with the onset of equivalent singletons. This suggests that in Cypriot Greek geminates are indeed ambisyllabic and not tautosyllabic, as Davis's or Ham's two-root representations would predict. An example of this difference in tone alignment is shown in Figure 3: on the left the label L (denoting the L tone) is just before C2 (denoting the onset of the single intervocalic /l/; on the right, the label L is between C2 and V2 (denoting the onset of the vowel, after the geminate intervocalic /l/).

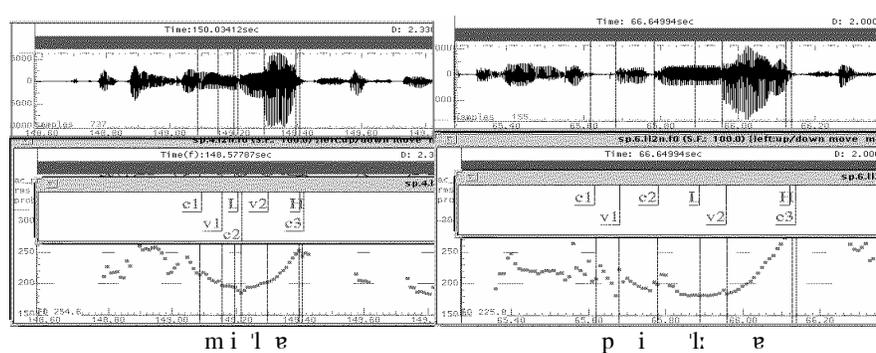


Figure 3. Low tone alignment. The vertical lines labelled *c1*, *v1*, *c2*, *v2*, *c3* demarcate the onset of the named segment in the test-words (*c3* marks the onset of the carrier phrase following the test word). The line labelled *L* shows the position of the L tone of the L+H pitch accent. [From Tserdanelis & Arvaniti (in press).]

2.2. The phonological patterning of Cypriot geminates

In addition to the phonetic facts that do not support the two-root analysis, there are serious phonological drawbacks to it. Apart from the obvious fact that the presence of two identical root nodes violates the OCP, such as analysis effectively suggests that these consonants are sequences and therefore not true geminates. Hume *et al.* (1997) have convincingly shown, using reduplication data, that this is the wrong assumption for Leti; that is they have shown that Leti geminates are characterized by the inalterability typical of true geminates. Unfortunately Cypriot Greek does not exhibit similar phenomena. However, it is indeed the case that Cypriot geminates do not behave like clusters in cases of morphophonemic

alternations. This has been pointed out both by Newton (1972), himself an advocate of the cluster analysis, and Malikouti-Drachman (1987, 1998), who first proposed an autosegmental analysis of the Cypriot geminates. For example, alveolar and velar consonants turn to palatals in front of /i/.² This change applies to the geminates as a unit. For clusters, however, it is only the second consonant that is affected. Compare the plural of (10), shown in (11), to that of (12), shown in (13): while the geminate /k:/ turns to /c:/ in the plural of /lak:os/, in the cluster /xn/ it is only the second consonant that is palatalised in the plural; i.e. /ja'xni/ does not become */ja'fɲa/ in the plural.

- (10) /lak:os/ “hole”
- (11) /laci:/ “holes”
- (12) /ja'xni/ “dish cooked with oil and tomato”
- (13) /ja'xɲa/ “dishes cooked with oil and tomato”.

5. Conclusion

In conclusion, both the phonetic characteristics and the phonological behaviour of Cypriot Greek geminates strongly suggest that these geminates must be analysed as non-moraic yet true geminates. So far, no model that insists on the moraic representation of geminates can account for both the distribution of Cypriot geminates and their phonetic timing. One could of course argue that the phonetic data do not provide evidence against the representations proposed by Broselow *et al.* (1997) or Ham (1998), which attempt to fit non-moraic geminates into a moraic framework. Rather, it could be argued that the phonetic data simply show that such representations may not have a bearing on segmental timing to the extent that these authors assume. Even in this case, however, the data do provide evidence against the view that segmental timing is controlled by moraic structure. Instead, it appears necessary to recognize the fact that although quantity and weight are closely linked and go hand in hand in most languages, one does not *always* entail the other. In short, we concur with Tranel (1991) and Hume *et al.* (1997) that a representation involving both a skeletal and a moraic tier is necessary, if phonology is to adequately represent both quantity and weight.

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² For the alveolars this applies only when /i/ is followed by a more sonorant vowel within the same syllable.

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