A typology of vowel-vowel and consonant-vowel-consonant phenomena in the dialectal variants of Western Crete and their use in education

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1. Introduction

Greek has a rather simple system of vowels in the sense that the language has a small inventory of vocalic segments. This five-vowel system is considered to be the most frequently attested cross-linguistically (cf. Ladefoged & Maddieson 1996; Maddieson 1984). The five Greek vowels occupy the edges of the vowel chart (chart 1) and as such they are considered to be perceptually clear (cf. Lindblom 1986). In this paper, we investigate the realization of Greek vowels drawing on dialectal and developmental child language data. We focus on V(owel)-V(owel) and C(onsonant)-V(owel)-C(onsonant) phenomena. We have been especially interested in vowel harmony which is not a process that applies frequently in standard Greek. Our account will be the product of the study and processing of (a) longitudinal developmental data from two children who acquire Greek as a mother language (age range 1;05-3;00), (b) samples of free speech, (c) data stemming from a structured picture naming task, and (d) indexed dialectal data (Tzakosta 2010; Tzakosta & Karra 2011). Our data underline the fact that vowel harmony phenomena depend on several morphophonological principles, such as the position of the vowels in the word, i.e. (a) whether they belong to stressed or unstressed syllables, (b) whether they are located in word initial, medial or final position, and (c) whether they belong to certain morphological environments, verifying previous claims about data from various dialectal zones of Greek (Revithiadou et al. 2006). The data have also shown that vowels trigger place fronting to their adjacent consonants irrespective of whether the latter are located on the left or the right side of the vowels. The combined study of child and dialectal data will provide us with the necessary evidence in order to propose vowel hierarchies for standard Greek and its dialects. Our claims will be supported by a statistical analysis which will underline the frequency of emergence of the Greek vowels and the salience of vowel affecting and vowel affected phenomena.

2. The data

Phonetic analyses of the vowels of the languages of the world have illustrated that /a/, /e/, /i/, /o/, /u/ are the most frequently attested vowels (cf. Ladefoged & Maddieson 1996; Maddieson 1984). Moreover, /a/, /e/, /i/, /o/, /u/ Greek vowels are considered to be well separated in the acoustic space a fact that allows for maximal contrast between vowel categories (cf. Lindblom 1986).[1] This is probably not irrelevant to the fact these same vowels are considered -directly or indirectly- to be perceptually clear in Greek[2] despite the emergent variability patterns (cf. Botinis et al. 1997; Fourakis et al. 1999; Hawks & Fourakis 1995; Jongman et al. 1989; Kontosopoulos et al. 1988). This further implies that vowels which are perceptually clear are easy to perceive and comprehend as well as easy to produce.

[1] However there are studies that cast doubt on that claim (see Arvaniti 2007 where a detailed list of references can be found).
[2] See also Bradlow (1993) for a relevant study of English and Spanish.

In addition, phonological accounts of dialectal data have suggested that since Greek vowels are considered to be structurally solid and, therefore, remain unchangeable, it is not strange that front vowels /e/ and /i/ trigger fronting, i.e. palatalization, of adjacent consonants both in standard Greek and its dialects (data in (1)).

(1)	a.	[**c**erí]	*[**k**erí]	'wax'
	b.	[**j**éros]	*[**ɣ**éros]	'old man'
	c.	[**c**imás]	*[**k**imás]	'minced meat'
	d.	[peðá**c**i]	*[peðá**k**i]	'little child'
	e.	[**c**ípos]	*[**k**ípos]	'garden'

It is important to notice that in all data in (1), the triggering vowel is located on the right of the target consonant. In other words, assimilation is regressive in nature. Moreover, vowel assimilation applies irrespective of whether the trigger belongs to a stressed or an unstressed syllable. Finally, C-V assimilation applies in morphologically complex (i.e. derived) (1d) and morphologically simple words (1a-c, e).

2.1 Dialectal data

Vowel harmony (hereafter VH) has been labeled as a process widely attested in adult speech (cf. Becker et al. 2007; Goldsmith 1984; Hayes et al. 2009; Hyman 1999; Hualde 1989; Rose & Walker 2011; Walker 2005). It is also reported that VH also applies in complex morphosyntactic structures (Nespor et al. 2003). It appears that certain vowels tend to trigger harmony, especially, stressed and high final vowels (Hualde 1989). In (2) and (3), we provide some representative data from Asia Minor Greek dialects which display two VH patterns (the data are drawn from Revithiadou et al. 2006). In the first pattern, VH is domain-initial and sonority-driven. More specifically, low /a/ and back /o/ are the triggers of harmony.

(2)	a.	/katevázi/	[kat**a**váz]	'lower-3SG.PRES'Ax, MK192
	b.	/sevastí/	[s**a**vastí]	'name' Ax, MK8
	c.	/meθóporo/	[m**o**x**ó**poro]	'fall' Ax, MK9
	d.	/éks**o**/	[**ó**ks**o**]	'out' Ul, D366
	e.	/embrós/	[**o**mbr**ó**]	'in front' Ax, MK216

In the second pattern, VH is domain-final. Again, /a/ and /o/ are the trigger vowels. Therefore, both patterns of the Asia Minor dialects VH are sonority-driven. They only differ with respect to the domain of application of VH. The salience of /a/ and /o/ are in accordance with the vowel hierarchies suggested for standard Greek (see discussion in 2.2 below). However, /o/ seems to outrank /a/ in terms of sonority.

(3)	a.	/ðáskal**o**s/	[ðásk**o**l**o**s]	'teacher' Far, A48:20
	b.	/ánem**o**s/	[án**o**m**o**s]	'unlawful' Axo, MK9
	c.	/fáɣ**o**/	[f**ó**ɣ**o**]	'eat-1SG.PRES' Ul

Both /a/ and /o/ have also been shown to act as VH triggers in the dialect of Western Crete targeting high vowels (see data in (4) and (5), respectively). Contrary to the data of Revithiadou et al. (2006) discussed above, when /a/ and /o/ coemerge in the dialect of western Crete, /o/ is the target of VH (data in (6)).

(4)	a.	/elafr-ís/	[alafrís]	‘light’
	b.	/δrepáni/	[δrapáni]	‘sickle’
(5)	a.	/ékso/	[ókso]	‘out’
	b.	/exθr-ós/	[oxθrós]	‘enemy’
	c.	/peδem-ós/	[peδomós]	‘suffering’
	d.	/iγr-ós/	[oγrós]	‘wet’
	e.	/éfceros/	[ófčeros]	‘empty-ADJ.MASC.NOM.SG.’

It is important to note that VH may apply to vowels of non-adjacent syllables (data in 5e) (contrary to Kappa to appear). This is in line with child data on consonant harmony (cf. Tzakosta 2007 for detailed discussion).

(6)	a.	/olácer-os/	[aláceros]	‘whole’
	b.	/monastíri/	[manastíri]	‘monastery’

Both /a/ and /o/ trigger regressive, i.e. left-to-right, VH, irrespective of whether the triggers belong to stressed or unstressed syllables. Consequently, the Western Crete dialectal data exhibit a sonority-driven regressive harmony pattern. It is worth mentioning that VH applies within disyllabic and/or trisyllabic stems ((4), (5a), (6b)) or between a stem and an inflectional suffix ((5b-d), (6a)).

However, VH is blocked if the target is the high vowel /i/ and /i/ appears in an environment where a labial or dorsal obstruent follows. In such cases, /i/ is realized as the round, back [u] (data in (7)).

(7)	a.	/príka/	[prúka]	‘dowry’
	b.	/θikári/	[fukári]	‘sheath’
	c.	/γarifal´ á/	[γarufal´á]	‘carnation’
	d.	/tibanízo/	[tubanízo]	‘beat a drum’

To summarize, the data described above constitute, clear instances of VH with certain vowels being the triggers of harmony, but also cases in which VH is blocked due to the influence of the place of articulation of the consonant following the harmonized vowel.

The dialect of western Crete exhibits two interesting patterns of progressive and regressive vowel-consonant interaction which differ from the common pattern of C-V assimilation reported for dialectal and standard Greek data (see the data in (1) above). To briefly repeat, palatalization of consonants applies across-the-board in Greek and its dialects when a front vowel follows a [back] or a [coronal] consonant. Kontosopoulos (2001, 2006) provides extra support from dialectal data in which vowels seem to trigger harmonic phenomena targeting not only other vowels, but also (non-adjacent) consonants. Such findings go against Autosegmental Theory (cf. Goldsmith 1984) according to which vowels and consonants are located at different harmonic tiers, a prediction that disallows V-C-V interactions.

The data illustrated in (8) provide instances of V-C-V interactions in which the consonant C is the target of assimilation, i.e. fronting/palatalization, irrespective of (a) the position of the vowel on the left or the right side of the target consonant, (b) whether the trigger is stressed or not, and (c) whether the target consonant is a cluster member (8a, e). More specifically, the triggering vowel may be located on either the left (see 8a, c) or the right of the target (see 8b, d, e). In that sense, assimilation may be both progressive and regressive, whereas standard Greek palatalization is only regressive in nature. Especially in (8a), the consonant cluster of the second syllable is reduced to its unmarked member /k/ which in turn undergoes palatalization. It is important to note that in the case of consonant clusters, the target consonant is the one closer to the syllabic nucleus causing assimilation. In addition, the trigger may be stressed, as in (8c), or unstressed, as in (8a, b, d, e).

(8)	a.	/mikrós/	[mićos]	‘small-MASC. NOM.SG.’
	b.	/lúzi/	[lúji]	‘shampoo-3PRES.SG.’
	c.	/míɣa/	[míǰa]	‘fly-FEM.NOM.SG.’
	d.	/madinάða/	[madiɲάða]	‘2-verse song-FEM.NOM.SG.’
	e.	/éfceros/	[ófčeros]	‘empty-ADJ.MASc.NOM.SG.’

2.2 Developmental data

Several studies report on the fact that VH does not apply in developmental child data. This is considered to be due to the fact that VH is morphologically-conditioned and morphology is not fully mastered by young learners (cf. Goad 2001). However, recent studies have pinpointed the fact that not only is VH present in child speech, but it is also universal in nature (Cohen 2012; Tzakosta 2014). Here, we draw on data from Tzakosta (2014) in order to discuss the VH patterns attested in Greek child speech. The longitudinal free speech data are taken from two children, Chrysanna (Chr, Ch1) and Maria Christina (Mar, Ch2), who grow in semi-dialectal environments. Their VH patterns appear between the children’s 15-36 months of age (Chr.: 20-36 months, Mar.: 15-29 months).

In general, the Greek child data exhibit three VH patterns. In the first pattern, stress determines the triggers and targets of VH irrespective of the degree of markedness of the trigger, in the second pattern, directionality governs the VH data, again, irrespective of the degree of markedness of the trigger. Finally, in the third pattern, VH is circumscribed by sonority/markedness considerations, irrespective of stress and/ or directionality.

Tables 1-3 provide some general information regarding the child VH patterns. Table 1 displays the VH rates in the production of child data. The percentages refer to types and not tokens of VH. This means that 166 out of 226 word types produced by Chr/Ch1 are harmonized during her 20-36 months of age. Correspondingly, for Mar/Ch2, out of the 41 word types produced during her 15-29 months of age 19 are harmonized. We prefer to provide the reader with type rates rather than token rates since all harmonized vowels undergo VH across-the-board.

	Chr	Mar
All productions (types)	226	41
VH	166	19
%	18,14	11,44

Table 1: *VH rates in the production of child data*

Tables 2 and 3, on the other hand, provide information regarding the starting and ending point of the different VH patterns per child. The tables underline that pattern 1: stress is more salient in Chr’s data while pattern 3: sonority/markedness is more frequently attested in Mar’s data with respect to the time span of VH activation.

	Stress	Directionality/ PF	Sonority/ Markedness
Chr:	01;05	01;05	02;02
Mar:	01;03	01;03	01;11

Table 2: *Start point of VH phenomena*

	Stress	Directionality/ PF	Sonority/ Markedness
Chr	03;02	02;09	02;09
Mar	01;07	01;07	02;02

Table 3: *End point of VH phenomena*

Going deeper into the child data, the examples in (9a-g) exhibit Chr's productions, while (9h-m) display Mar's productions. In these data, the stressed vowel causes VH irrespective of its position (left or right of the target) or its degree of markedness. For example, in the VH pattern 1: stress, /i/, /e/, /a/ trigger both regressive and progressive harmony (cf. (9a, 9m), (9g, 9i) (9b, c), respectively). /o/ triggers only regressive VH (cf. (9e, f, j, k)), while a single instance of progressive VH is reported for /u/ (cf. (9l)).

(9) Pattern 1: stress

a.	/marína/	[mi**n**ína]	'proper name'
b.	/me**γ**álos/	[ma**l**álo**θ**]	'big-MASC. NOM. SG.' (Chr: 01;10-02;01)
c.	/k**á**vuras/	[k**á**ba**b**a**θ**]	'crab'
d.	/**δ**omátio/	[ma**m**átio]	'room' (Chr: 2;02-2;06)
e.	/pa**γ**otó/	[po**γ**otó]	'ice cream'
f.	/pilótos/	[polóto**θ**]	'pilot'
g.	/**δ**ulévi/	[le**l**évi]	'work' (Chr: 2;02-2;09)
h.	/nonáː/	[nanáː]	'godmother' (Mar: 01;03)
i.	/étsi/	[éte]	'six'
j.	/feritópia/	[popópia]	'fairytopia' (Mar: 01;06-01;10)
k.	/stavrós/	[vojó**θ**]	'cross'
l.	/kútelo/	[tútuo]	'forehead' (Mar: 01;11-02;02)
m.	/tenia/	[inía]	'film' (Mar: 02;04-02;07)

In the second pattern of VH, directionality and/or positional faithfulness determine the shape of the harmonized forms. As is evident by the data in (10), VH is massively regressive, i.e. right-to-left, in nature. Like in pattern 1, the degree of markedness of the trigger does not matter as long as the trigger is located at the right edge of the harmonic domain.

(10) Pattern 2: Directionality/ positional faithfulness

a.	/porta/	[tá**t**a]	'door' (Chr: 1;05-1;08)
b.	/ní**k**os/	[dó**d**o]	'Nikos' (Chr:1;08-1;10)
c.	/fárma**k**o/	[fámo**k**o]	'medicine' (Chr: 1;10-2;01)
d.	/se**s**uár/	[**θ**u**θ**uá]	'hair dryer' (Chr: 2;02-2;06)
e.	/á**t**a**k**ti/	[á**t**i**t**i]	'naughty'
f.	/pe**δ**ikó/	[pi**δ**ikó]	'of a child-NEUT. NOM. SG.' (Chr: 02;02-02;09)
g.	/po**δ**ílato/	[íto**t**o]	'bicycle' (Mar: 01;11-02;02)
h.	/fárma**k**o/	[fá**k**o**k**o]	'medicine' (Mar: 02;04-02;07)

The third pattern circumscribes the shape of VH on the basis of sonority/markedness considerations. Given the sonority hierarchy proposed for Greek in (11) (cf. Malikouti-Drachman & Drachman

1992), [a] is the most sonorous/unmarked vowel while [e] is the least sonorous/most sonorous vowel. This entails that the more sonorous/unmarked the segment, the more probable it is to trigger VH.

(11) [a > o > u > i > e]

In all data in (10), the most sonorous/unmarked segment triggers VH across-the-board irrespective of its position in the word, whether it causes progressive or regressive VH, and its degree of markedness.

(12) Pattern 3: sonority/markedness

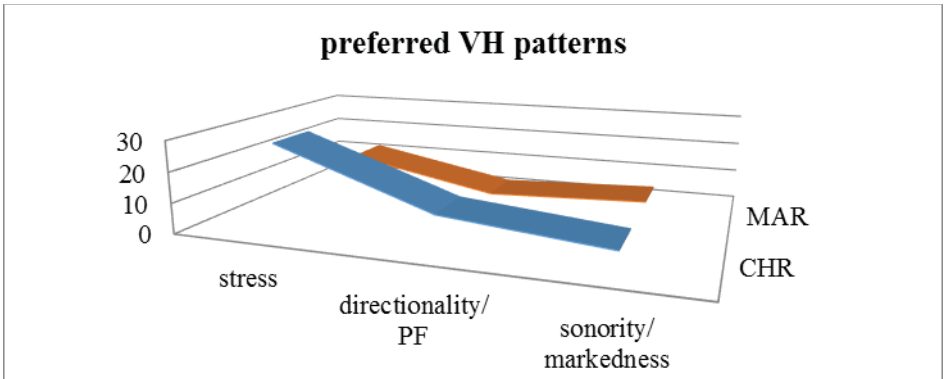
a.	/pórta/	[táta]	'door' (Chr: 01;05-01;08)
b.	/alifí/	[alafí]	'cream'
c.	/eryalío/	[ayalío]	'tool' (Chr: 02;02-2;06)
d.	/cerí/	[cecé]	'candle, wax' (Mar: 01;11-02;02)
e.	/peθaméni/	[paθaméni]	'dead-FEM.NOM. SG.' Mar: 02;03-02;06)

Finally, the data in (13) provide instances of morphologically complex, i.e. compound words, in which the three VH patterns discussed above apply. More specifically, 13a satisfies pattern 1, 13b satisfies patterns 1 and 2 and 13c apply patterns 1 and 3.[3] Therefore, morphological complexity does not influence the form of VH in any way.

(13)

a.	/peδótopos/	[potótoto]	'kindergarten' (Chr: 02;02-02; 09)
b.	/oδodóvurtsa/	[vovóvoθta]	'toothbrush'
c.	/pedakáθaros/	[padakáθaoθ]	'brand clean' (Chr: 02;09-03;00)

Graphs 1 and 2 summarize the preference for each VH pattern and the degree of salience of the triggers, respectively. Graph 1 illustrates that both Mar and Chr clearly prefer pattern 1, while sonority (pattern 3) is the least preferred pattern for Chr and pattern 2 is the least preferred pattern in Mar's data.



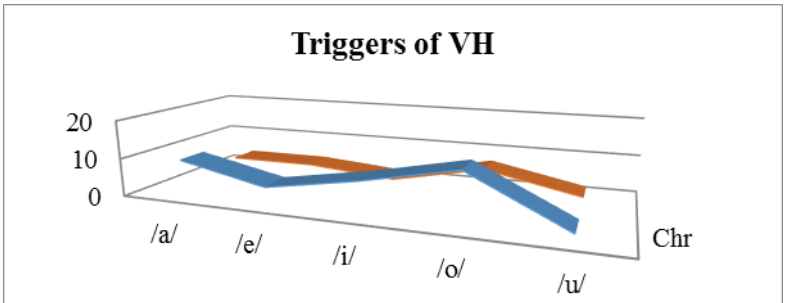
	stress	directionality/ PF	sonority/ markedness
CHR	28	10	5
MAR	13	3	5

Graph 1: *Preferred VH patterns*

Graph 2 displays that although /o/ is not the most sonorous/unmarked segment, it is preferred by both Chr and Mar to serve as triggers of VH. Therefore, this implies that, if /a/ is the most

[3] 13c is an instance of recursive harmony which is also attested in consonant harmony data (cf. Tzakosta 2007).

sonorous/unmarked vowel in standard Greek and Greek adult speech, this is not the case for child speech.



	/a/	/e/	/i/	/o/	/u/
Chr	9	4	8	13	1
Mar	4	4	2	7	2

Graph 2: *triggers of VH*

Finally, as for the C-V-C data discussed in 2.1, no similar patterns are reported in child speech.

3. Discussion

To summarize the above discussion, VH is a process which applies in Greek child data to an extent that could and should not be ignored. More specifically, the data are accounted for in terms of three VH patterns. In pattern 1, stress determines the triggers and targets of VH in the sense that the VH trigger is a stressed vowel. Pattern 2 defines regressive VH as the preferred directionality of VH, while pattern 3 governs child VH in terms of sonority/markedness. Both children (Chr and Mar) show preference for the stress pattern (pattern 1) while, again in both children's data, /o/ is the most frequent trigger of VH.

Given the above, the Greek child VH data exhibit different vowel hierarchies compared to those proposed up to now for standard Greek and its dialectal variants. To be more specific, Hatzidakis (1905) and Kaisse (1985) have proposed the vowel hierarchy in (14a), where /o/ is the most sonorous and /e/ the least sonorous segment. Malikouti-Drachman and Drachman (1992) argued for a slightly different hierarchy (14b) in which /a/ is the most sonorous segment. Kappa (to appear), on the other hand, for the dialectal variant of western Crete proposed the hierarchy in (14c), which seems to look more like the one suggested by Malikouti-Drachman and Drachman (1992).

(14) a. **o > a > u > i > e** (Hatzidakis 1905; Kaisse 1985)
b. **a > o > u > i > e** (Malikouti-Drachman & Drachman 1992)
c. **a > o > u > e, i** (Kappa to appear)

As for the Greek developmental data, it appears that children's unmarked vowel hierarchies differ from all hierarchies proposed for the standard language and its dialectal variants. To be more specific, /o/ seems to be the most sonorous/ unmarked segment in both hierarchies, while /u/ seems to be the most marked vowel. The position of /u/, /i/ and /e/ differs between the two children. We assume that this is due to inter-child variation and the fact that different children may follow variable development paths in the course of acquisition.

(15) a. **o > a > i > e > u** (Chr)
b. **o > a, e > i, u** (Mar)

As for the V-C-V dialectal data from the region of western Crete, we get some evidence regarding the salience of /i/ in causing V-C-V harmonic processes. This is expected since front vowels cause consonant fronting in standard Greek as well as its dialects. The /i/ salience is depicted in Chr's developmental grammar in which /i/ lands relatively high on the vocalic hierarchy. Translating the above findings, and our claims in general, in terms of Optimality Theory (OT, Prince & Smolensky 2004), a theory which interprets the nature of a grammatical system in terms of a constraint hierarchies, it is more than obvious that (general) AGREE constraints account for the data. AGREE constraints occupy very high positions in the hierarchies of children's developmental grammars and they are demoted during the process of grammar modification so as the children can finally acquire the grammar of the standard language. AGREE constraints are low ranked in the grammar of the standard language since VH is not frequently attested, however they are high ranked in the grammar of the dialect(s) where VH is quite popular.

4. Conclusion

The aim of this paper has been to explore how Greek vowels are realized in dialectal and developmental data. In our analysis, we have placed emphasis on V-V, and, C-V-C phenomena, in which vowels may affect the shape of consonants, in order to investigate differences and similarities in the produced patterns. The data have underlined the fact VH is determined by certain phonological principles, such as the position of the vowels in the word, i.e. whether they are located in word initial, medial or final position, or whether they belong to stressed or unstressed syllables. It has been shown that VH appears across-the-board during certain developmental stages, while statistically stress seems to be the major cue for VH, followed by directionality. Only in later stages does sonority/markedness affect the shape of the harmonized forms. We assume that Greek children use VH as a strategy which facilitates phonological acquisition as well as the order of vowel acquisition. We also assume that VH emerges in the speech of children who acquire complex linguistic systems, like Greek and Hebrew,[4] in which phonology and morphology both affect the shape of the emergent forms. Inter-language VH patterns are governed by morphophonological properties of the target language while inter-child VH patterns are determined by developmental paths followed by the language learners. The dynamic nature of VH also drives V-C-V interactions where consonants are harmonized to certain vocalic features.

The value of the theoretical and statistical analysis of our data is twofold; on the one hand, we offer a general picture of the vowels emerging in the dialects of Western Crete. On the other hand, vowel frequency and salience rates (will) facilitate the designation of certain strategies used in the teaching of vowels in preschool and primary school education.

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[4] Cohen (2012) has provided clear cases of VH in child Hebrew and has also discussed the universal nature of the process.

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