

Camuno height harmony

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This work describes and explains harmonic patterns in Camuno, an understudied, endangered Romance language spoken in Valcamonica, northern Italy, within the general framework of Evolutionary Phonology (Blevins 2004, 2006, 2013). Camuno exhibits a unique system of stress-dependent height harmony within a nine-vowel system /i u y e ε ø o ɔ a/. In all words, stressed high vowel /i/ triggers raising of preceding mid vowels, while stressed /u/ only raises preceding mid rounded vowels. Although stressed /y/ as a trigger is not found in the native vocabulary, distributional patterns suggest that it is an even weaker trigger than /u/, potentially raising only preceding /ø/. The low vowel /a/ blocks harmony. In addition, this study attempts to illuminate the special status of the front rounded vowel /ø/ in harmony contexts. Due to its historical origins from stressed Latin short /o/ in open syllables (cf. Loporcaro 2011) this Camuno vowel is contrastive only in stressed syllables in the native lexicon. While one might expect raising of /ø/ to [y] under harmony, a range of factors determines [u] in some cases and either [u] or [y] in others. While height harmony in Camuno is a phonetically natural process with origins in common co-articulatory patterns, the details of this sound pattern also reflect accidents of history, and aspects of the Camuno lexicon.

KEY WORDS: Eastern Lombard, Height harmony parasitic on rounding, Dialects of Italy, Evolutionary Phonology, Endangered languages

1. Introduction

This is the first study that explores the characteristics of vowel harmony in Camuno, a variety of Eastern Lombard. This study has three main purposes. The first purpose is to provide evidence for Camuno harmony, based on extensive fieldwork carried out in 2010 and 2012 with over thirty native speakers of the language. The second purpose is to account for the synchronic patterns that emerge from the data. Finally, the last purpose is to provide historical and phonetic explanations for the same sound patterns.

Results suggest that Camuno exhibits a complex system of height harmony parasitic on rounding, different from the Eastern Lombard model illustrated in Sanga (1997). For example, while both the Eastern Lombard model and Camuno have *uzi'li* 'bird/s-DIM', for 'buckwheat' the Eastern Lombard model has *furmin'tu*, while Camuno has *formen'tu*.

In Camuno, the harmony triggers are the stressed high vowels /i/ and /u/ and potentially /y/, although there is not much evidence for the raising power of /y/. The harmony targets are the mid vowels /e ε ø o ɔ/. While stressed /i/ raises all preceding mid vowels, stressed /u/ raises only preceding rounded vowels, suggesting that the round trigger needs a round target for height to spread. Data gathered and discussed in this work suggest that /y/ does not raise preceding unrounded mid vowels, while distributional patterns suggest that /y/ potentially raises only preceding /ø/. Variation is observed between [u] and [y] as raised alternants of stressed /ø/. No variation is observed when stressed /ø/ occurs in the suffix /-ʔø/. In this case, the raised alternant of stressed /ø/ is [u]. Low vowel /a/ does not undergo raising and it blocks harmony. Mid vowels /e/ and /ε/ can also act as blockers when they intervene between a round trigger and a round target, which fails to raise. A raised mid vowel raises a preceding mid vowel whenever rounding restrictions are met. These facts suggest that raising is local and iterative. In addition, given that the triggers are stressed, and stress tends to fall on the final syllable of the word, the harmony is stress-dependent and regressive. The domain of harmony is the phonological word.

The system of Camuno height harmony comprises different patterns. The frequency of these patterns varies, as we shall see. Some of them are categorical (frequency equals 100%); some are non-categorical. Some of them are regular, while some show variability.

In addition to regular and variable patterns, minor patterns were observed: unexpected and/or long distance raising, lack of iterativity, and lack of raising.

The data reveal a change in progress within the system of height harmony. As we shall see, there are reasons to believe that the variation between [u] and [y] as raised alternants of /ø/ signals a change from /ø/ alternating with [u] to /ø/ alternating with [y].

This complex system of height harmony finds its natural explanation in the sound changes that occurred in the language and in the phonetics of speech production and perception.

This work is framed within Evolutionary Phonology (Blevins, 2004, 2006, 2013), a holistic approach to sound patterns whose central goal is to explain why certain patterns have the properties and typological distribution they do (Blevins 2013). Evolutionary Phonology is a concrete and comprehensive attempt to explain the majority of the world's recurrent sound patterns in terms of well-understood instances of phonetically motivated sound change.

In order to explore both the form and content of a speaker's grammar as well as questions regarding explanations for the form and

content of Camuno patterns, I will use a range of tools and concepts developed over the years within Generative approaches to Phonology (cf. Chomsky & Halle 1968; Goldsmith 1976, 1990; Clements 1977, 1984; Clements & Sezer 1982; McCarthy 1984) without taking a stance whether the phonological categories and rules, arise from UG, are learned, or some combination of the two. The basic assumptions that inform this work are (i) that linguistic competence can be modeled as a combination of words, rules and exceptions to these rules. Exceptions may be listed in the lexicon, or expressed in the rules themselves; (ii) surface forms are derived from underlying forms through ordered rules. The form of rules is not assumed to have psychological reality. They are simply a useful and precise way of representing relationships between surface forms and more abstract phonological representations.

2. *Camuno*

Camuno is a variety of Eastern Lombard spoken in Valcamonica, Italy, together with the local variety of Italian. Valcamonica, or *al ka'm'neg'v* in Camuno, takes its name from ‘Camunni’, the Roman name for the ancient population who inhabited the valley. Located in Eastern Lombardy, it is one of the largest valleys in the central Alps.

Though referred to as a dialect of Italy, Camuno is not a local variety of Italian, but a sister of Italian, a local divergent development of the Latin originally spoken in Italy (Maiden & Perry 1997: 2). Native speakers never refer to the language as Camuno. They simply call it *dia'let* ‘dialect’. As a variety of Eastern Lombard, Camuno is quite different from Standard Italian, the national language of Italy, which derives from a Florentine variety of Tuscan. *Ethnologue* (Lewis et al. 2013) classifies Lombard [lmo] as a language of Italy, whose varieties are currently spoken in Lombardy, and in Switzerland (Ticino and Grisons or Graubünden). Over time, Lombard developed into two different but related languages: Western Lombard, whose model was the city of Milan, and Eastern Lombard, whose models were the cities of Brescia and Bergamo. The split dates back to the 13th century, when Bergamo and Brescia began to use a popular, anti-Latin vernacular, setting themselves apart from Milan (Sanga 1997: 257).

Camuno is a spoken language that lacks a writing system, and it is severely endangered. Despite local attempts to collect and document cultural traditions and folklore, the language is understudied (Bonfadini 1995: 26). Cresci (2014) is, to date, the only synchronic description of the phonology of two varieties of the language.

Camuno exhibits phonetic, phonological and grammatical features in common with three neighbouring varieties in the region: Western Lombard (Milan), Bresciano (Brescia), and Bergamasco (Bergamo) (Bonfadini 1990). Camuno also shows local innovations, including a phonetically unique pattern of final obstruent devoicing,¹ patterns of nasals alternating with zero² and a unique system of height harmony, the subject of this work. A more detailed description of the language, including the patterns mentioned above, is found in Cresci (2014).

This study is based on two varieties of the language spoken in the lower valley. They are mainly distinguished by the presence of /z/ in one variety (Camuno-z) and of /ð/ in the other (Camuno-ð). /z/ or /ð/ occur word-initially, medially between two vowels, and after /r/, /n/ and /l/. Some examples are: 'zøk or 'ðøk 'game', 'azen or 'aðen 'donkey', ar'zent or ar'dent 'silver', man'zøl or man'ðøl 'two-year-old beef' and val'zel or val'del 'stream-DIM'. Word-finally, both varieties exhibit an alternation with [h]. For example, both 'hpuzɔ and 'hpuðɔ 'bride' alternate with 'hpuh 'bridegroom'. Examples in this work are given in Camuno-z.

The article is organized as follows. The vowel inventory and its evolution from Latin is presented in § 2.1 and § 2.1.1. Evidence of harmonic patterns from the lexicon is introduced in § 3. In § 3.1 through § 3.4.1 the details and the results of data gathering are presented and discussed. In § 4 a synchronic account for the harmony patterns is provided. In § 5 the diachronic dimension is explored to explain some characteristics of the synchronic patterns. A phonetic explanation for the evolution of the Camuno height harmony is set forth in § 6. Conclusions are in § 7.

2.1. Vowel inventory

The Camuno vowel inventory is in (1).

| | | | | |
|-----|---|---|---|---|
| (1) | i | y | | u |
| | | e | ø | o |
| | | | ɛ | ɔ |
| | | | a | |

It is a nine-vowel system which exhibits two front rounded vowels, high /y/ and mid /ø/, and a tense/lax contrast for mid vowels /e/ vs. /ɛ/, and /o/ vs. /ɔ/. Length is not contrastive, and vowel sequences are hetero-syllabic. Though there are some positions in the word where all vowels contrast, there are other positions with highly limited contrasts. All vowels contrast in stressed position. In unstressed

position, there is no tense/lax contrast. The only lax unstressed vowel that occurs in absolute word-final position is /ɔ/. In this position, /ɔ/ contrasts only with final unstressed /e/ as in the pair 'hkøls 'school' vs. 'hkøle 'schools'. Elsewhere, stressed /ɔ/ neutralizes to unstressed /o/ (e.g. 'kɔt 'kid' vs. kota'ri 'small kid'), and stressed /ɛ/ to /e/ (e.g. 'pɛ 'foot' vs. peha'ti 'foot-DIM.'). /ɛ/ occurs unstressed only in closed syllables (e.g. 'forɛh 'scissors' vs. forbe'zuna 'big scissors'). Apparently, /ø/ also occurs only stressed, although there is evidence of unstressed /ø/ in the language, as we shall see. Camuno exhibits /ɛ/ alternating with zero as in 'azen 'donkey', ah'ni 'donkey-DIM',³ 'mager 'skinny', ma'gri 'skinny-DIM', 'furen 'oven', for'nɛɔ 'stove'. When a segment alternates with zero, there are at least two abstract analyses: the alternation may reflect regular insertion or regular deletion. An analysis as unstressed medial /ɛ/ deletion makes incorrect predictions, as shown in (2).

| | | | | | |
|-----|--------|-----------|----------|---------------|---------------|
| (2) | BASE | | DERIVED | | UNGRAMMATICAL |
| | 'azen | 'donkey' | ah'ni | 'donkey-DIM' | - |
| | 'ryzen | 'rust' | ryze'net | 'rust-ADJ' | **ryz'net |
| | 'peten | 'comb' | piti'ni | 'comb-DIM' | **pit'ni |
| | 'pahɛr | 'sparrow' | pahi'ri | 'sparrow-DIM' | **pah'ri |

On the other hand, OR# words (where O is an obstruent and R a sonorant) are not attested in the language. For these reasons, an analysis of vowel epenthesis rather than deletion in Camuno is preferable, such that $\emptyset \rightarrow \varepsilon / C_R\#$.

2.1.1. Historical evolution of the Camuno vowel system

Following Loporcaro (2011), the system in (3) may be assumed for Classical Latin as a starting point for the divergent developments of the Romance languages. The top row represents the Latin phonological system of vowel contrasts, while the bottom row shows Loporcaro's (2011: 210) hypothesized phonetic realizations of these vowels.

| | | | | | | | | | | |
|-----|-----|---|----|---|---|----|---|----|---|-----|
| (3) | /i: | i | e: | e | a | a: | o | o: | u | u:/ |
| | [i: | i | e: | ɛ | a | a: | ɔ | o: | u | u:] |

Latin had a basic five-vowel system, with a phonological contrast between long and short vowels. Furthermore, short vowels were relatively lax, while long vowels were tense. This Classic Latin system evolved into the common Romance system in (4), which is exemplified by a set of Italian words in their orthographic forms (Loporcaro 2011: 111). The first row shows Classic Latin; the second row shows the common Romance system. The last row, needless to say, shows the Latin sources.

| | | | | | | | | | |
|-----|-------------|-------------|---------------|--------------|-------------|--------------|-------------|--------------|-------------|
| (4) | i: | i | e: | e | a(:) | o | o: | u | u: |
| | i | i | e | ε | a | ɔ | o | u | u |
| | <i>filo</i> | <i>pera</i> | <i>stella</i> | <i>ferro</i> | <i>male</i> | <i>porco</i> | <i>voce</i> | <i>croce</i> | <i>duro</i> |
| | ‘thread’ | ‘pear’ | ‘star’ | ‘iron’ | ‘bad’ | ‘pig’ | ‘voice’ | ‘cross’ | ‘hard’ |
| | FĪLUM | PĪRUM | STĒLLAM | FĒRRUM | MĀLUM | PŌRCUM | VŌCEM | CRŪCEM | DŪRUM |

The evolution of Camuno vowels diverges from the common Romance system, as can be seen from (5) and (6). The segments in the tables are contrastive.

| | | | | |
|-------------------------------------|-------------------------------|--------|----------------|--------------------------------------|
| (5) | OPEN SYLLABLES – FRONT VOWELS | | | |
| Latin | Romance | Camuno | Camuno example | |
| PĪRU(M) | i | e | e | <i>'per</i> ‘pear’ |
| FĪLU(M) | i: | i | i | <i>'fil</i> ‘yard’ |
| DĒCE(M) | e | ε | e | <i>'deh</i> ‘ten’ |
| ACĒTU(M) | e: | e | e | <i>'a'zet</i> ‘vinegar’ |
| LĀCU(M) | a | a | a | <i>'lak</i> ‘lake’ |
| AMĀRU(M) | a: | a | a | <i>'mar</i> ‘bitter’ |
| OPEN SYLLABLES – BACK VOWELS | | | | |
| Latin | Romance | Camuno | Camuno example | |
| NŌVU(M) | o | ɔ | ó | <i>'nof</i> ‘new’ |
| BŌNU(M) | o/_n | ɔ | u | <i>'bu</i> ‘good’ |
| HŌMINE(M) | o/_m | ɔ | ɔ | <i>'om</i> ‘man’ |
| SŌLE(M) | o: | o | u | <i>'hul</i> ‘sun’ |
| CRŪCE(M) | u | o | u | <i>'kruh</i> ‘cross’ |
| MŪRU(M) | u: | u | y | <i>'myr</i> ‘wall’ |
| (6) CLOSED SYLLABLES – FRONT VOWELS | | | | |
| Latin | Romance | Camuno | Camuno example | |
| FRĪCTU(M) | i: | i | i | <i>'frit</i> ‘fried’ |
| SĪCCU(M) | i | e | ε | <i>'hek</i> ‘dry’ |
| STĒLLA(M) | e: | e | ε | <i>'htelɔ</i> ‘star’ |
| FĒRRU(M) | e | ε | ε | <i>'fer</i> ‘iron’ |
| DĀMNU(M) | a | a | a | <i>'dan</i> ‘damage’ |
| ARĀNEU(M) | a: | a | a | <i>'raj</i> ‘spider’ |
| CLOSED SYLLABLES – BACK VOWELS | | | | |
| Latin | Romance | Camuno | Camuno example | |
| MŌRTU(M) | o | ɔ | o r | <i>'mort</i> ‘dead’ |
| ŌCTO | o | ɔ | ɔ C | <i>'ɔt</i> ‘eight’ |
| PŌNTE(M) | o/_n | ɔ | u | <i>'put</i> ‘bridge’ |
| COGNŌSCO | o: | o | ɔ | <i>ko'nɔhe</i> ⁴ ‘I know’ |
| MŪSCA(M) | u | o | o | <i>'mohkɔ</i> ‘fly’ |
| FRŪCTU(M) | u: | u | y | <i>'fryt</i> ‘fruit’ |

Attested /o/ and /ɔ/ can also be reflexes of *au, as in 'or < AURU(M) ‘gold’, and 'ɔr < TAURU(M) ‘bull’. Final unstressed /e/, when it is not the plural feminine marker, is the reflex of either *iu or *eu, as in 'albe < ALVEU(M), ‘trough’ and 'htabe < *stabiū < STABLU(M), ‘stable’.⁵

3. Harmonic sound patterns: evidence from the lexicon

An analysis of the Camuno lexicon provides further evidence for height agreement in terms of distributional regularities, both in native items and in potential Italian loans. In both cases, the general overriding harmonic restriction in the language is that adjacent non-low vowels agree in height with the stressed vowel.

Some evidence of alternations between mid vowels in base forms, and high vowels in derived forms suffixed with stressed high vowels is in (7).

| | | | | |
|-----|---------|-----------|----------|-----------------|
| (7) | 'porɔ | 'fear' | pu'ruzɔ | 'fearful' |
| | 'golɔ | 'throat' | gu'luzɔ | 'sweet-toothed' |
| | 'det | 'tooth' | din'ti | 'tooth-DIM' |
| | 'pɛtɛn | 'comb' | piti'ni | 'comb-DIM' |
| | 'grop | 'knot' | gru'pu | 'knot-AUG' |
| | pon'dor | 'tomato' | pundu'ru | 'tomato-AUG' |
| | 'bee | 'I drink' | bi'i | 'to drink' |
| | 'dorme | 'I sleep' | dur'mi | 'to sleep' |

Patterns in (8) provide evidence of high and mid vowel alternations in which a high vowel alternates with a mid vowel in the environment of a stressed mid vowel. These are static alternations, since the suffixes /-'ɛt/ and /-'er/ do not appear to be productive any more.

| | | | | |
|-----|--------|--------------|---------|---------------------|
| (8) | pu'da | 'to prune' | po'det | 'pruning knife' |
| | 'furen | 'oven' | for'ner | 'baker' |
| | 'kut | 'whetstone' | ko'der | 'whetstone-case' |
| | 'murɔ | 'blackberry' | mo'ret | 'dark complexioned' |
| | 'murɔ | 'blackberry' | mo'rel | 'bruise' |

More examples of static height harmonic patterns in which adjacent non-low vowels in the word agree in height with the stressed vowel are in (9).

| | | |
|-----|---------|-------------------|
| (9) | pir'li | 'spinning top' |
| | du'lur | 'pain' |
| | ku'lur | 'color' |
| | ku'niif | 'rabbit' |
| | pu'i | 'chick' |
| | ku'hi | 'pillow' |
| | vi'dur | 'vineyard' |
| | hky'tym | 'family nickname' |
| | by'tym | 'tar' |
| | ny'gy | 'nobody' |
| | hy'dur | 'sweat' |
| | ky'zi | 'cousin' |
| | ko'lomp | 'pigeon' |
| | pon'dor | 'tomato' |
| | be'hot | 'ram' |

Given that unstressed /ø/ was unattested in Camuno, at least up to the beginning of the 20th century (cf. Tempini 1908), no example of words with a sequence of mid front rounded vowels is expected. There are possibly only two known words that exhibit a sequence of mid vowels that includes /ø/: *lɛn'høɫ* 'bed-sheet', and *pø'zøɫ* 'balcony'.

Disharmonic words like those in (10) suggest lack of height agreement between a high rounded stressed vowel and mid unrounded vowels.

| | | | | |
|------|----------------|----------------|--------------|--------------|
| (10) | <i>pe'ryk</i> | 'wild spinach' | <i>re'zu</i> | 'reason' |
| | <i>pe'rhyt</i> | 'ham' | <i>me'lu</i> | 'cantaloupe' |
| | <i>pre'zu</i> | 'prison' | <i>te'lu</i> | 'tarpaulin' |

Whether /y/ agrees in height with rounded vowels is unclear. While evidence of words with a vowel sequence [u...y] is hard to find, there is clear evidence of words with vowel sequence [y...y], such as *by'tym* 'tar', *hky'tym* 'family nickname', *ky'htym* 'bathing suit', *ny'gy* 'nobody', *kyl'tyre* 'tilled fields', *pyn'tyrɔ* 'injection', *hkyl'tyrɔ* 'sculpture', *ky'my* 'city hall', among others.

(11) reveals that /a/ is unaffected by a high stressed vowel (cf. (11a-b)), does not agree in height with a non-high stressed vowel (cf. (11c-d.)), and apparently blocks agreement when it intervenes between a non-low stressed vowel and an unstressed vowel (cf. (11e)).⁶

| | | | |
|------|----|------------------|---|
| (11) | a. | <i>pa'htu</i> | 'hen food' |
| | b. | <i>ka'di</i> | 'basin' |
| | c. | <i>higa'retɔ</i> | 'cigarette' |
| | d. | <i>kara'melɔ</i> | 'candy' |
| | e. | <i>boka'li</i> | 'night-pot-DIM' (** <i>buk'ali</i> is not attested) |

The overall hypothesis that emerges from the distribution of vowels in the lexicon is that Camuno has a system of mid-vowel raising triggered by high stressed vowels, usually referred to as height harmony. Data, however, suggest that /i/ and /u/ might have different degrees of strength, with /i/ raising all preceding mid vowels, and /u/ raising preceding mid rounded vowels only. The segment /y/ is potentially the weaker trigger, raising only preceding mid vowel /ø/.

In § 3.1 through § 3.4 the details and results of the two data collections for samples of height harmony are presented and discussed.

3.1. Height harmony: evidence from elicited data

Since this is the first work that describes and analyzes vowel harmony in Camuno, data from a representative number of native speak-

ers were needed in order to assess whether a harmonic system is part of the phonology of the language, and what its characteristics are.

The first fieldwork session to collect samples of vowel harmony was carried out in 2010. Since stressed /i/ and /u/ are productive suffixes in Camuno, with /-i/ functioning as a diminutive suffix, and /-u/ as an augmentative suffix, Picture Elicitation Task 1 was designed to elicit diminutives, augmentatives and their base forms. I selected the stimuli on the basis of my knowledge of the language as a heritage speaker. These stimuli were designed to explore the behavior of mid and low vowels in the environment of a high stressed trigger. Multisyllabic and monosyllabic bases with mid and low vowels were used to assess the domain of harmony, and whether raising is local or long distance. Although the language has three high vowels, /i/, /u/, and /y/, only stressed /i/ and /u/ are productive suffixes. While the raising power of stressed /y/ could not be assessed directly, the raising power of unstressed [y] was investigated instead. To this purpose, the stimulus *lenh'øł* 'bedsheet' was included in the stimuli set. Assuming that /ø/ in *lenh'øł* is raised to [y] by a following high stressed vowel, the raising or lack of raising of the vowel preceding [y] could provide information on the raising power of [y]. As observed, there are only two known words that can be used to assess the raising power of [y], *lenh'øł* 'bedsheet', and *poz'øł* 'balcony'. Diminutives and augmentatives are existing words in Camuno, although their productivity may vary, as we shall see. The picture-elicitation task required speakers to name objects on cards. The objects were grouped with respect to number (singular vs. plural), and size (diminutive vs. augmentative), such that each card presented the full combination of a singular noun, its related plural, diminutive and augmentative forms. The participants were 32 native speakers, 17 females and 15 males whose age range was 49-92. Twenty-eight of them were from the upper part of the lower valley (Bienno, Breno, Cogno, Darfo, Esine, Gorzone, Malegno, Prestine); four from the upper valley (Garda, Rino, Temú). Speakers from Bienno, Breno, Cogno and Prestine speak Camuno-z; speakers from Darfo, Esine, Gorzone and Malegno speak Camuno-ð. Speakers from Garda, Rino and Temú speak different varieties of Camuno, but they appear to have the same vowel inventory and distribution. The session was carried out in Camuno, and it was digitally recorded with Olympus Digital Voice Recorder WS-400S. Participants were instructed to use their own variety of the language, which could be different from mine. They were aware that the experiment examined pronunciation, but were not aware of the research question.

Recording took place in the participants' homes. Care was taken in each location to ensure that background noise was minimal. The session lasted about 15 minutes; there was no repetition. The task was the first of a set of 4 tasks. Speakers did not receive any compensation.

The quality of the vowels in the elicited words was evaluated impressionistically by three native speakers including the present author. The other two native speakers were in their early 60s and were not linguists. They were instructed to write down the vowels they heard using the IPA symbols /ø/ and /y/ for front rounded vowels, and the symbols /ɔ/ and /ɛ/ for mid lax vowels; the symbols for the other vowels (/a/, /o/, /e/, /u/, /i/) are the same as the Italian spelling, so they used the Italian spelling. As a training session, I presented all the Camuno vowels for them three times randomly and checked what they wrote. When I saw that they were confident, I played the words, one by one. Each of us listened, and wrote the target vowels, separately on a piece of paper. We compared them. In case of disagreement, we re-listened to the tape. Judgment agreement was unanimous.

The whole set of picture stimuli (PS), grouped by target vowels (TV) and the expected responses for the base forms (BF), the diminutives (DIM) and augmentatives (AUG) is in (12). Stimuli (12cc) through (12ii) were used as distractors.

| (12) | PS | TV | BF | DIM | AUG |
|------|------------------|-----------|----------|-------------------|-------------------|
| a. | 'tooth' | e | 'det | din'ti | den'tu |
| b. | 'church' | e | 'fɛzɔ | f'izino | f'ezuno |
| c. | 'toilet' | ɛ | 'fɛho | f'i'hi | f'e'hu |
| d. | 'bed' | ɛ | 'let | li'ti | le'tu |
| e. | 'comb' | ɛ...ɛ | 'peten | piti'ni | pete'nu |
| f. | 'mountain trail' | ɛ...e | hen'ter | hinti'ri | hente'ru |
| g. | 'Stephen' | ɛ...ɛ | 'htefen | htifi'ni | htefe'nu |
| h. | 'cap' | ɛ...ɛ | be'ret | biri'ti | bere'tu |
| i. | 'brain' | ɛ...ɛ | her'vel | hiri'li | herve'lu |
| j. | 'loom' | ɛ...e | te'ler | tili'ri | tele'ru |
| k. | 'cow-pie' | ɔ | 'hɔɔ | hu'tino | hutu'no |
| l. | 'nail' | o | 'fɔt | fu'di | fu'du |
| m. | 'knot' | o | 'grop | gru'pi | gru'pu |
| n. | 'tomato' | o...o | pon'dor | pundu'ri | pundu'ru |
| o. | 'mouse' | o...ɛ | ho'rek | huri'gi | hore'gu |
| p. | 'hen-house' | o...e | po'ler | puli'ri | pole'ru |
| q. | 'coin' | o...e | mo'nedɔ | muni'dino | mone'duno |
| r. | 'nun' | ɔ...e | 'mɔnegɔ | muni'gino | mone'gunɔ |
| s. | 'umbrella' | o...ɛ | om'brelɔ | umbri'lino | ombre'luno |
| t. | 'hare' | ɛ...o | le'gor | legu'rino | legu'runɔ |
| u. | 'fire' | ø | 'fɔk | fɔga'ti / foga'ti | fɔga'tu / foga'tu |
| v. | 'eye' | ø | 'ɔf | ɔza'ti / oza'ti | ɔza'tu / oza'tu |
| w. | 'apron' | i...a...ø | biga'rɔl | bigaru'li | bigaru'lu |
| x. | 'bed-sheet' | ɛ...ø | len'hɔl | lenhu'li | lenhu'lu |
| y. | 'basket' | a | ka'ano | kaa'nino | kaa'nuno |

| | | | | | |
|-----|-----------------|-------|----------|------------|------------|
| z. | 'chair' | a | 'hkaɲɔ | hka'ɲinɔ | hka'ɲunɔ |
| aa. | 'fountain' | o...a | fon'tanɔ | fonta'ɲinɔ | fonta'ɲunɔ |
| bb. | 'necklace/yoke' | o...a | ko'lanɔ | kola'ɲinɔ | kola'ɲunɔ |
| cc. | 'axe' f. | a...ɛ | ma'nerɔ | mani'rɪnɔ | mane'rɪnɔ |
| dd. | 'hammer' | a...ɛ | mar'tel | mart'iɪ | mart'eɪ |
| ee. | 'bag' | a...ɛ | ha'kel | haki'li | hake'lu |
| ff. | 'pebble' | a...ɔ | ba'lot | balu'ti | balu'tu |
| gg. | 'glass' | i...e | bi'fɛr | bi'fɪri | bi'fɛru |
| hh. | 'clog' | y...ɛ | hy'pɛl | hy'pɪli | hy'pɛlu |
| ii. | 'rabbit' | u...i | ku'niʃ | kuni'ʃi | kuni'ʃu |

The expected responses are based on my knowledge of the language and were checked with the other two native speakers. Stimuli (12u) and (12v) were quite problematic. The two native speakers' intuitions and mine were that the diminutives of 'fɔk 'fire', and 'øʃ 'eye' could either be *føga'ti* or *foga'ti*, and *øza'ti* or *oza'ti* respectively. Likewise, the augmentatives could either be *føga'tu* or *foga'tu*, and *øza'tu* or *oza'tu*, with variation between [o] and [ø]. Notice that *føga'ti*, *øzati*, *føga'tu*, and *øza'tu* exhibit unstressed /ø/, which was not expected to occur in Camuno. In addition, we all thought that diminutives like *fu'gi/fy'gi*, and *y'ʃi/u'ʃi*, and augmentatives like *fu'gu/fy'gu*, and *y'ʃu/u'ʃu* could also occur, although possibly not in the two varieties of Camuno under investigation. These forms exhibit variation between [u] and [y]. Variation between [u] and [y] was not expected for the derived forms of *biga'røɭ* 'apron' and *len'høɭ* 'bedsheet' ((12w) and (12x)). The stimuli/cards were presented in a randomized order. Although the stimuli were not perfectly balanced with respect to monosyllables and multisyllables, and target vowels (for example there is only one stimulus with vowel sequence [o...o]), the data collected allowed for an initial description of the system of height vowel harmony in Camuno.

The data collected confirmed our intuitions with respect to occurrence of unstressed /ø/, and revealed variation between [u] and [y] as raised alternants of /ø/, but the details of these facts were not clear. Two of the stimuli used to assess the behavior of /ø/ in harmonic domains were *biga'røɭ* 'apron' and *len'høɭ* 'bed-sheet', both ending in [øɭ]. However, the final string [øɭ] appeared to have a different status in the two lexemes. In *biga'røɭ* 'apron' it was treated as a suffix by some native speakers, since a few of them supplied *biga'ri* as a diminutive and *biga'ru* as an augmentative. No speakers treated the final string [øɭ] in *len'høɭ* 'bed-sheet' as a suffix; no forms like ***len'hi* or ***len'hu* were supplied. The data are in (13). "tk." refers to the number of tokens supplied; "NA" refers to the number of tokens not supplied.

| | | BASE | | DIMINUTIVE | | | | |
|------|------------|-----------------|-----|--------------------------------|-----|-----------------|-----|----|
| (13) | | | tk. | | tk. | | tk. | NA |
| | 'bed-sheet | <i>len'høł</i> | 32 | <i>lenhu'li</i> | 24 | <i>linhu'li</i> | 1 | - |
| | - | - | - | <i>lenhy'li</i> | 5 | <i>linhy'li</i> | 2 | - |
| | 'apron' | <i>biga'røł</i> | 32 | <i>bigaru'li / bigaru'linɔ</i> | 26 | <i>biga'ri</i> | 4 | 1 |
| | | | | <i>bigary'li</i> | 1 | - | - | - |
| | | BASE | | AUGMENTATIVE | | | | |
| | | | tk. | | tk. | | tk. | NA |
| | 'bed-sheet | <i>len'høł</i> | 32 | <i>lenhu'lu</i> | 20 | <i>linhu'lu</i> | 1 | 9 |
| | - | - | - | <i>lenhy'lu</i> | 2 | - | - | - |
| | 'apron' | <i>biga'røł</i> | 32 | <i>bigaru'lu / bigaru'lunɔ</i> | 16 | <i>biga'ru</i> | 1 | 15 |

The other two stimuli were 'føk 'fire' and 'øf 'eye'. They elicited for the most part diminutives and augmentatives with a suffix /-at/ intervening between the base and the diminutive and augmentative suffixes. /a/ in /-at/ blocks, as expected, raising /ø/ in the base. Derived forms with suffixes following the bases 'føk 'fire' and 'øf 'eye' were supplied almost exclusively from speakers from the upper valley. The data are in (14).

| | | BASE | | DIMINUTIVE | | | | | |
|------|--------|------------|-----|--------------|-----|----------------|-----|----------------|----|
| (14) | | | tk. | | tk. | | tk. | NA | |
| | 'fire' | <i>føk</i> | 32 | <i>fy'gi</i> | 1 | <i>føga'ti</i> | 18 | <i>fuga'ti</i> | 4 |
| | | | | <i>fu'gi</i> | 1 | <i>foga'ti</i> | 4 | <i>fyge'ti</i> | 1 |
| | | | | | | <i>fygi'ti</i> | 1 | | |
| | 'eye' | <i>øf</i> | 32 | <i>y'fi</i> | 3 | <i>øza'ti</i> | 25 | <i>yza'ti</i> | 4 |
| | | BASE | | AUGMENTATIVE | | | | | |
| | | | tk. | | tk. | | tk. | NA | |
| | 'fire' | <i>føk</i> | 32 | <i>fu'gu</i> | 1 | <i>føga'tu</i> | 16 | | 14 |
| | | | | | | <i>føge'tu</i> | 1 | | |
| | 'eye' | <i>øf</i> | 32 | <i>y'fu</i> | 1 | <i>øza'tu</i> | 24 | <i>yza'tu</i> | 2 |
| | | | | | | <i>oza'tu</i> | 1 | | 4 |

These facts raised two additional questions: (i) what determines /'ø/ alternating with [u], vs. /'ø/ alternating with [y]; and (ii) what determines /'ø/ alternating with [o] vs. /'ø/ alternating with [ø]. These two questions were addressed with a subsequent data collection in 2012, whose details are discussed in § 3.1.1 through § 3.1.2.

3.1.1. Behavior of /'ø/ in harmonic domains

The second fieldwork session to collect samples of vowel harmony was carried out in 2012. One focus was the raised alternant of /'ø/. The general question that drove the research in 2012 was whether the variation observed between [u] and [y] was systematic. Specifically, the hypothesis was whether /'ø/ alternating with [u] was a morpho-phonological process. In this case, /-'øł/ and /-ul/ would be two allomorphs of the same morpheme /-'øł/, with /-ul/ occurring in the environment of a following high stressed vowel. The expectation would be

for /ø/ to alternate with [u] in the suffix /-ø/; elsewhere both [u] and [y] were possible as raised forms of /ø/.

A related purpose was to assess the unstressed alternant of /ø/. As observed in § 2.1 and § 2.1.1, unstressed /ø/ was not assumed to be part of the phonology of the language, but data collected in 2010 revealed otherwise. In this case, the driving questions were (i) whether unstressed /ø/ occurs as unstressed alternant of /ø/, and, in the case of alternation with [o], (ii) whether this alternation is systematic.

The questions related to the raised alternant of /ø/ are addressed in § 3.1.2. The questions related to the unstressed alternants of /ø/ are addressed in § 3.4.

3.1.2. *The raised alternant of /ø/*

In order to identify the raised alternant of /ø/, data were collected with Picture Elicitation Task 2 which required speakers to name objects on cards and to supply the diminutive, but not the augmentative for each object. Fieldwork 2010 revealed that /u/ exhibits low productivity as an augmentative suffix. Each card had one object, and the whole set of cards was presented in a randomized order interleaved with distractors. The participants were 15 native speakers, 8 females and 7 males whose age range was 49-94. All of them were from the upper part of the lower valley. Ten of them were a subgroup of participants from fieldwork 2010. Five new participants were added, 4 males and 1 female. The new participants were relatively younger (their age span is 55-62); two of them were discouraged to use Camuno as children, but they learned it nonetheless from the community; three of them were very conservative speakers, with lower schooling, while the other conservative speakers in the group had higher schooling. They were from Cogno, Esine and Malegno. The new participants were tested with the material used in 2010 to elicit samples of height harmony. Their results are compatible with the results observed for the other group. The procedures were the same as the previous data collection. The only difference was that speakers wore an Opus 55.18 II Omnidirectional Condenser Microphone (Byerdynamic), and their utterances were recorded in stereo with Fostex FR-2LE recorder at 48kHz/24bit, BWF file mode, and were re-digitized in Praat (Boersma & Weenink 2011). The picture stimuli (PS) are in (15). They were selected with respect to three morphological environments (ENV): suffix /-ø/ (15a-g), verbs ending in [ø] (15h-j), verbs ending in /ø/ followed by a segment different from /l/ (15k-l); and four phonological environments (ENV): in base-final syllables before /l/ (15m-p), in base-initial syllables before /l/ (15q), in

base-final syllables before a consonant different from /l/ (15r-t), and in base-initial syllables before a consonant different from /l/ (15u-w). The expected responses are grouped by base form (BF), diminutive (DIM) and imperfective (IMP).

| | | | | | |
|-----------------|----|----------------------|----------------------------|--|------------------------------------|
| (15) MORPHOLOGY | | | | | |
| ENV | PS | | BF | DIM | IMP |
| 'ø]# | a. | 'bib' | <i>baa'røɫɔ</i> | <i>baaru'linɔ</i> | |
| | b. | 'apron' | <i>biga'røɫ</i> | <i>bigaru'li</i> | |
| | c. | 'food-cabinet' | <i>mohka'røɫɔ</i> | <i>mohkaru'linɔ</i> | |
| | d. | 'hanker-chief' | <i>fa'høɫ</i> | <i>fahu'li</i> | |
| | e. | 'armful' | <i>bra'høɫ</i> | <i>brahu'li</i> | |
| | f. | 'balcony' | <i>po'zøɫ</i> | <i>puzu'li</i> | |
| | g. | 'fennel' | <i>torta'røɫ</i> | <i>tortaru'li</i> | |
| 'ø]# | h. | 'it hurts' | <i>'døɫ</i> | | <i>du'liɔ / dy'liɔ</i> |
| | i. | 's/he/it wants' | <i>'vøɫ</i> | | <i>vu'liɔ / vy'liɔ</i> |
| 'øC-L# | j. | 's/he/it is able to' | <i>'pøɫ</i> | | <i>pu'diɔ / py'diɔ⁷</i> |
| | k. | 's/he/it moves' | <i>'møɫ</i> | | <i>mu'icɔ / my'icɔ⁸</i> |
| | l. | 'it rains' | <i>'pjøɫ</i> | | <i>pju'icɔ / pjy'icɔ</i> |
| PHONOLOGY | | | | | |
| ENV | PS | | BF | DIM | |
| 'ø]# | m. | 'orchard' | <i>'brøɫ</i> | <i>bru'li / bry'li</i> | |
| | n. | 'bean' | <i>fa'zøɫ</i> | <i>fazu'li / fazy'li</i> | |
| | o. | 'bedsheet' | <i>len'høɫ</i> | <i>lenhu'li / lenhy'li</i> | |
| | p. | 'hazelnut' | <i>ni'høɫɔ</i> | <i>nihu'linɔ / nihy'linɔ</i> | |
| #C0ø] | q. | 'home spool' | <i>hpo'letɔ / hpø'letɔ</i> | | |
| 'øC-L# | r. | 'louse' | <i>pi'øɫ</i> | <i>hpuli'tinɔ / hpyli'tinɔ</i> | |
| | s. | 'cross-eyed' | <i>hka'løɫ</i> | <i>piu'ɣi / piy'ɣi</i> | |
| | t. | 'knee' | <i>zi'nøɫ</i> | <i>hkalu'ɣi / hkaly'ɣi</i> | |
| #'C0øC-L | u. | 'heart' | <i>'køɾ</i> | <i>zinu'ɣi / ziny'ɣi</i> | |
| | v. | 'wheel' | <i>'rødɔ</i> | <i>kuri'zi / kyri'zi</i> | |
| | w. | 'rose' | <i>'røzɔ⁹</i> | <i>rudi'linɔ / rydi'linɔ</i> <i>ru'zinɔ / ry'zinɔ</i> | |

With respect to the initial hypothesis, [u] is expected as the raised alternant of /ø/ in the suffix /-ø]/; elsewhere, both [u] and [y] are possible. The language has no disyllabic bases with /ø/ or unstressed /ø/ in base-initial syllables. However, a number of speakers supplied *hpø'letɔ* for 'home spool' in the task for the unstressed alternant of /ø/ instead of the expected *hpo'letɔ* (this task is discussed in § 2.4). Stimulus (15q) was thus added to assess whether speakers who supplied *hpø'letɔ* and *hpo'letɔ* 'home spool' are consistent in raising /ø/ to [y], and /o/ to [u] respectively.

The quality of the target vowel (/u/ vs. /y/) was investigated impressionistically by three native speakers (including this author). In case of doubts, the vowel formants were inspected by the writer. Being front vowels, unstressed /ø/ and /y/ have F1 and F2 more apart, while /o/, and /u/, being back vowels, have F1 and F2 closer to one another.

The results are presented in § 3.2. They are divided by target vowel.

3.2. Results

3.2.1. Target vowels /e/, /ɛ/, /o/, and /ɔ/

A first observation is that although diminutives and augmentatives with final /i/ and /u/ exist in Camuno, their productivity differs. Diminutives in /-i/ are more productive than augmentatives in /-u/; men prefer not to use diminutives; older speakers prefer not to use augmentatives in /-u/. In addition, speakers appear to have slightly different vocabulary. For example, the stimulus for ‘basket’ elicited three different words: *ka'aŋɔ*, *kaa'nɔɔ*, and *his'telɔ*. This is consistent with the amount of systematic variation observed across individual towns and/or villages which may be less than a mile apart. Other items had two variants that depended on different vowels (e.g. *be'ret* and *ba'ret* for ‘cap’). For this reason, the results that will be presented are based on items that did not exhibit dialectal variation, nor vowel variation. They are 'det 'tooth', 'ʃezɔ 'church', 'ʃɛho 'toilet', 'let 'bed', 'petɛn 'comb', hɛn'ter 'trail', 'hteʃɛn 'Stephen', hɛr'vel 'brain', 'ʃot 'nail', 'grop 'knot', pon'dor 'tomato', ho'rek 'mouse', mɔnegɔ 'nun', legor 'hare', fɔk 'fire', øʃ 'eye', biga'rɔl 'apron', lɛn'hɔl 'bedsheet', skajɔ 'chair', fon'tanɔ 'fountain'. (16) shows how the data were coded and how the frequency of the target pattern was computed.

| (16) | BASE | | DIMINUTIVE | | | | | | | | |
|---------|-------|-----|------------|-----|---------|-----|------|-----------|-----|-----|----|
| | | tk. | E&C | tk. | NE&NC | tk. | Tot. | NE&C | tk. | GT | NA |
| 'tooth | 'det | 32 | din'ti | 27 | den'ti | 3 | 30 | - | - | 30 | 2 |
| 'church | 'ʃezɔ | 32 | ʃi'zinɔ | 15 | ʃe'zinɔ | 3 | 18 | ʃezu'linɔ | 14 | 32 | - |
| 'bed | 'let | 32 | li'ti | 31 | le'ti | 1 | 32 | - | - | 32 | - |
| 'toilet | 'ʃɛho | 30 | ʃi'hi | 10 | ʃe'hi | 1 | 11 | ʃehu'li | 11 | 22 | 8 |
| | | 126 | | 83 | | 8 | 91 | | 25 | 116 | 10 |

E&C stands for “expected & conforming” and it refers to the expected pattern. NE&NC stands for “not expected & not conforming”. It refers to a pattern that is not expected because it does not conform. In this case, it is the non-raising pattern. NE&C stands for “not expected & conforming”. It refers to patterns that are not expected on the basis of the base form, or stimulus, but that conform to the height harmony in place in the language. The frequency of the expected pattern (E&C) is calculated over the total of E&C and NE&NC. In this case it will be $83/91 = 91.2\%$. In fact, the harmonic patterns are more frequent ($83+25/116=93\%$) because NE&C are also harmonically well-

formed, but they do not allow assessment of the raising of /e/ and /ɛ/ in the environment of /i/.

(17) illustrates the patterns capturing the behavior of mid vowels /e/, /ɛ/, /o/, and /ɔ/ in monosyllabic and multisyllabic words, in the environment (ENV) of a following high stressed vowel, and their frequencies (FREQ).

| | | | |
|------|-------------------|----------------------------------|-------|
| (17) | ENV | MONOSYLLABLE | FREQ |
| | 'C ₀ i | a. /ɛ/, /e/ → [i] | 91.2% |
| | | b. /ɔ/, /o/ → [u] | 100% |
| | | c. /a/ → [a] | 100% |
| | 'C ₀ u | d. /ɛ/, /e/ → [ɛ], [e] | 100% |
| | | e. /ɔ/, /o/ → [u] | 100% |
| | | f. /a/ → [a]/_ 'C ₀ u | 100% |
| | ENV | MULTISYLLABLE | FREQ |
| | 'C ₀ i | g. /e...e/ → [i...i] | 72.5% |
| | | h. /o...o/ → [u...u] | 100% |
| | | i. /o...e/ → [u...i] | 100% |
| | | j. /e...o/ → [e...u] | 93% |
| | | k. /o...a/ → [o...a] | 90% |
| | 'C ₀ u | l. /e...e/ → [e...e] | 98% |
| | | m. /o...o/ → [u...u] | 87.5% |
| | | n. /o...e/ → [o...e] | 89% |
| | | o. /e...o/ → [e...u] | 94.7% |
| | | p. /o...a/ → [o...a] | 96.6% |

3.2.2. Target vowel /ʊ/

(18) shows the results for the behavior of mid vowel /ʊ/ in the environment of a following stressed /i/, and the frequency of [u] vs. [y] as raised alternants of /ʊ/ with respect to three morphological environments (ENV): suffix /-ʊ/ (18a), verbs ending in [ʊ] (18b), verbs ending in /ʊ/ followed by a segment different from /l/ (18c); and four phonological environments (ENV): in base-final and initial syllables before /l/ ((18d) and (18e) respectively), in base-final and initial syllables before a consonant different from /l/ ((18f) and (18g) respectively).

| | | | | |
|------|------------|----------|-------|---------|
| (18) | MORPHOLOGY | [u] | [y] | RAISING |
| | ENV | | | |
| | -ʊl# | a. 100% | 0% | 100% |
| | ʊl# | b. 95.5% | 4.5% | 100% |
| | ʊC-L# | c. 46.4% | 53.6% | 100% |
| | PHONOLOGY | | | |
| | ENV | [u] | [y] | RAISING |
| | ʊl# | d. 91.5% | 8.5% | 100% |
| | #C0ʊl | f. 50% | 50% | 100% |
| | ʊC-L# | g. 35.5% | 57.7% | 93.2% |
| | #C0ʊC-L | h. 14.3% | 85.7% | 100% |

3.3. Discussion

The results reveal a number of different patterns. /i/ raises all preceding mid vowels (cf. (17a-b), (17g-j) and (18)); /u/ raises only preceding rounded vowels (cf. (17e), (17m) and (17o)); /a/ does not undergo raising (cf. (17c), (17f) and (17p)) and it blocks harmony (cf. (17k) and (17p)). Raising is local, affecting one segment at a time. This is visible from pattern (17n), for example, where /u/ does not raise base-initial syllable /o/ though rounded, because it is not adjacent to it, and unrounded /e/ intervenes between the two rounded vowels. Raising is iterative. It applies to its own output, and it keeps applying until it can no longer be matched to an input. This is visible from pattern (19g), for example, where raised [i] raises preceding /e/; from pattern (17h), where raised [u] raises preceding /o/, and from pattern (17i) where raised [i] raises preceding /o/.

/ø/ raises to [u] without exception in the suffix /-ø/, elsewhere, it raises either to [u] or [y], with [u] being more frequent in base-final syllables before /l/, and [y] elsewhere. The hypothesis that /ø/ alternating with [u] is a morpho-phonological process finds support from the data. The fact that /ø/ alternates without exception with [u] only in the suffix /-ø/ suggests that /-ø/ and /-ul/ are two allomorphs of the same morpheme /-ø/, with /-ul/ occurring in the environment of a following high stressed vowel. The distribution of [u] and [y] does not appear to be systematic, neither with respect to the speakers (the same speaker can have a word with [y] and another with [u]), nor to the word (the same word can be pronounced with [y] or [u] by different speakers); further, speakers have no strong feelings about either one.

As observed, the raising power of stressed /y/ can only be assessed by looking at raised [y] since the language does not have a suffix with stressed /y/. *po'zø* 'balcony' and *len'hø* 'bedsheet' are possibly the only two Camuno words that allows assessment of the raising power of [y] on preceding rounded and unrounded vowels. Data are in (19).

| (19) | BASE | DIMINUTIVE | | | | | |
|------------|---------------|------------|-----------------|-----|-----------------|-----|----|
| | | tk. | 'ø / u | tk. | 'ø / y | tk. | NA |
| 'balcony' | <i>po'zø</i> | 9 | <i>puzu'li</i> | 14 | - | - | 1 |
| | <i>pø'zø</i> | 6 | - | - | - | - | - |
| 'bedsheet' | <i>len'hø</i> | 15 | <i>lenhu'li</i> | 12 | <i>lenhy'li</i> | 3 | - |

As one can notice, /ø/ in *pø'zø* 'balcony' was never raised to [y]. /ø/ in *len'hø* 'bedsheet' was raised to [y] by three speakers, but no /e/ raising occurs, which is in line with what was observed in (10).

Whether or not [y] can raise preceding rounded vowels needs more investigation;¹⁰ so far it appears that [y] cannot raise preceding unrounded vowels.

The frequency of these patterns varies. Some of them are categorical (frequency equals 100%); some are non-categorical (frequency is less than 100%). Some are regular while some are variable. The patterns that comprise the system of Camuno height harmony are summarized in (20). They are divided into monosyllable and multisyllable and grouped by environment (ENV) and frequency (FREQ).

| | | | |
|------|-------------------|--------------------------------|-------|
| (20) | ENV | MONOSYLLABLE | FREQ |
| | 'C ₀ i | /ɛ/, /e/ → [i] | 91.2% |
| | | /ɔ/, /o/ → [u] | 100% |
| | | /a/ → [a] | 100% |
| | | /ø/ → [y] / [u] | 100% |
| | 'C ₀ u | /ɛ/, /e/ → [ɛ], [e] | 100% |
| | | /ɔ/, /o/ → [u] | 100% |
| | | /a/ → [a] / 'C ₀ u | 100% |
| | ENV | multisyllable | FREQ |
| | 'C ₀ i | /e...e/ → [i...i] | 72.5% |
| | | /o...o/ → [u...u] | 100% |
| | | /o...e/ → [u...i] | 100% |
| | | /e...o/ → [e...u] | 93% |
| | | /o...a/ → [o...a] | 90% |
| | | /ɛ...ø/ → [ɛ...y] / [ɛ...u] | 100% |
| | | /X11... ø/ → [X...y] / [X...u] | 96.6% |
| | | /ø...e/ → [y...i] / [u...i] | 100% |
| | | /-ø/ → [ul] | 100% |
| | 'C ₀ u | /e...e/ → [e...e] | 98% |
| | | /o...o/ → [u...u] | 87.5% |
| | | /o...e/ → [o...e] | 89% |
| | | /e...o/ → [e...u] | 94.7% |
| | | /o...a/ → [o...a] | 96.6% |

All the patterns in (20) that comprise the system of Camuno height harmony show very high frequency. Most of them are categorical. Non-categorical patterns result from unexpected raising, lack of iteration, or lack of raising. These results are taken as evidence that a height harmony system with the characteristics detailed so far is an active sound pattern of Camuno.¹²

In addition to regular and variable patterns (EXPECTED), more patterns were observed: unexpected and/or long distance raising (U&LDR), lack of iterativity (LOI), and lack of raising (LOR). Unexpected raising is characterized by raising of /e/ in the environment of a following /u/ (e.g. *peti'nu* < *pɛten* 'comb' vs. expected *pete'nu*); long distance raising is characterized by mid vowel raising in base-initial syllable, but not in base-final syllable (e.g. *hure'gu* < *ho'rek* 'mouse' vs. expected *hore'gu*), or raising of /o/ in base-initial syllable when /a/ occurs in

base-final syllable (e.g. *funta'ni* < *fon'tanɔ* vs. expected *fonta'ni*). Lack of iterativity is characterized by raising of the pretonic vowel only (e.g. *henti'ri* < *hen'ter* 'trail' vs. expected *hint'iri*). Lack of raising is characterized by regular suffixation, but lack of expected raising of the mid vowels (e.g. *pete'ni* < *'peten* 'comb' vs. expected *piti'ni*). (21) summarizes all the patterns observed in the data and their frequencies.

| | | | | | | | |
|------|-------------------|-------------------------------|----------|----|-------|------|-------|
| (21) | ENV | monosyllable | EXPECTED | UR | U&LDR | LOI | LOR |
| | 'C ₀ i | /ɛ/, /e/ → [i] | 91.2% | - | - | - | 8.8% |
| | | /ɔ/, /o/ → [u] | 100% | - | - | - | - |
| | | /a/ → [a] | 100% | - | - | - | - |
| | | /ø/ → [y] / [u] | 100% | - | - | - | - |
| | 'C ₀ u | /ɛ/, /e/ → [ɛ], [e] | 100% | - | - | - | - |
| | | /ɔ/, /o/ → [u] | 100% | - | - | - | - |
| | | /a/ → [a] / 'C ₀ u | 100% | - | - | - | - |
| | ENV | multisyllable | EXPECTED | UR | U&LDR | LOI | LOR |
| | 'C ₀ i | /e...e/ → [i...i] | 72.5% | - | - | 10% | 17.5% |
| | | /o...o/ → [u...u] | 100% | - | - | - | - |
| | | /o...e/ → [u...i] | 100% | - | - | - | - |
| | | /e...o/ → [e...u] | 93% | - | 7% | - | - |
| | | /o...a/ → [o...a] | 90% | - | 10% | - | - |
| | | /ɛ...ø/ → [ɛ...y] / [ɛ...u] | 100% | - | - | - | - |
| | | /X...ø/ → [X...y] / [X...u] | 96.6% | - | - | - | 3.4% |
| | | /ø...e/ → [y...i] / [u...i] | 100% | - | - | - | - |
| | | /-ø/ → [ul] | 100% | - | - | - | - |
| | 'C ₀ u | /e...e/ → [e...e] | 98% | - | 2% | - | - |
| | | /o...o/ → [u...u] | 87.5% | - | - | 12.5 | - |
| | | /o...e/ → [o...e] | 89% | - | 11% | - | - |
| | | /e...o/ → [e...u] | 94.7% | - | 5.3% | - | - |
| | | /o...a/ → [o...a] | 96.6% | - | 3.4% | - | - |

3.4. The unstressed alternant of /ø/

The initial assumption was that /ø/ occurs only stressed in the language. This observation was suggested by the absence of contrastive unstressed /ø/, and by the presence of morphologically related pairs as the ones in (22), where /ø/ in the base form corresponds to /o/ in the derived form.

| | | | | |
|------|-------|--------------|----------|-------------------|
| (22) | 'nødɔ | 'brand' | no'der | 'notary public' |
| | 'nøf | 'new' | no'el | 'newly born' |
| | 'kør | 'heart' | ko'radɔ | 'lung' |
| | 'møɔ | 'grindstone' | mo'letɔ | '(knife) grinder' |
| | 'hø | 'pavement' | ho'ler | 'attic' |
| | ka'rø | 'termite' | karo'let | 'termite-eaten' |
| | pa'rø | 'kettle' | paro'lɔt | 'kettle repairer' |
| | 'brø | 'orchard' | bro'let | 'small orchard' |

Further evidence of /ø/ alternating with [o] comes from the suffix /-ø/ /, which apparently alternates with /-o/ /, as exemplified in (23).

| | | | | |
|------|-----------------|---------------------|--------------------|---------------------|
| (23) | <i>man'zøł</i> | 'two-year-old beef' | <i>manzo'let</i> | 'two-year-old beef' |
| | <i>biga'røł</i> | 'apron' | <i>bigaro'lado</i> | 'apronful' |
| | <i>ni'høło</i> | 'hazelnut' | <i>nihø'lerø</i> | 'hazelnut groves' |

In addition, unstressed /ø/ is not listed in the inventory of unstressed vowels for the variety of Camuno spoken 15km north in Tempini (1908: 14-19). Nevertheless, in data collected in 2010, /ø/ was frequently observed in derived words whose bases had /'ø/ ('føk 'fire', and 'øf' 'eye').

In order to assess the back value of the unstressed alternant of /'ø/, and in case of variation between [o] and [ø] whether this variation is systematic, data were collected in 2012 with the stimuli in (24). These stimuli were used as distractors in Picture Elicitation Task 2. Five different words were used, each with /'ø/ in a different phonological context: before /l/ (24a); before voiced stops /d/ ((24b) and /g/ (24c)); before voiced palatal /ʒ/ (24d); and before vowel /a/ (24e). The whole set of picture stimuli (PS) and expected responses are in (24). The expected responses are grouped by base form (BF), derived form with /o/ (o) and derived form with /ø/ (ø).

| | | | | | |
|------|--------------------|--------|-----------------|-----------------|---------------|
| (24) | PS | BF | [o] | [ø] | |
| | a. 'factory spool' | 'hpøło | <i>hpo'letø</i> | <i>hpø'letø</i> | 'quill' |
| | b. 'lining' | 'fødre | <i>fø'dretø</i> | <i>fø'dretø</i> | 'pillow case' |
| | c. 'fire' | 'føk | <i>foga'ti</i> | <i>føga'ti</i> | 'fire-DIM' |
| | d. 'eye' | 'øf | <i>øʒa'ti</i> | <i>øʒa'ti</i> | 'eye-DIM' |
| | e. 'egg' | 'øf | <i>oa'ti</i> | <i>øa'ti</i> | 'egg-DIM' |

3.4.1. Results

(25) shows the frequency of [o] vs. [ø] as alternants of /'ø/ in unstressed position with respect to the five phonological environments investigated (ENV).

| | | | |
|------|---------------|--------------|---------------|
| (25) | ENV | [ø] | [o] |
| | a. before /l/ | 46.6% (7/15) | 46.6% (7/15) |
| | b. before /d/ | 7.1% (1/14) | 7.1% (1/14) |
| | c. before /g/ | 40% (6/15) | 46.7% (7/15) |
| | d. before /a/ | 26.6% (4/15) | 66.6% (10/15) |
| | e. before /ʒ/ | 46.6 (7/15) | 33.3% (5/15) |
| | AVERAGE/MEAN | 33.3% | 40% |

3.4.2. Discussion

The frequency of [ø] and [o] as unstressed alternants of /'ø/ suggests that the two segments are in free variation. When some speakers were informally asked whether [o] or [ø] was intended, they replied that both were acceptable, suggesting that they are not contrastive in unstressed position. Additional evidence that /o/ and /ø/ are

in free variation as unstressed alternants of /'ø/ comes from the fact that the same speaker can have a word with [o] and another with [ø].

These data confirm what was surmised from data collected in 2010. There does not seem to be any doubt that /ø/ occurs in the language, although at the moment it is observed in derived forms only. The fact that /ø/ is not listed in the inventory of unstressed vowels in Tempini (1908: 14-19) suggests that its evolution is a recent phenomenon.

4. Synchronic account

The system of height vowel harmony appears to be regular. All mid vowels are raised when followed by a high stressed vowel. Front unrounded vowels /e/, /ɛ/ are regularly raised to /i/ before /'i/; back rounded /o/, /ɔ/ are regularly raised to [u] before /'i/ and /'u/. Variation is observed in the back value of raised /'ø/, which can either be [u] or [y] in the environment of a following /'i/. In contrast, /'ø/ is systematically raised to [u] in the suffix /-'ø/. Variation in the back value of the unstressed alternant of /'ø/ is also observed. It can either be [o] or [ø]. The fact that variation is observed between [o] and [ø], and [u] and [y] does not seem to be a coincidence, since [y] and [u] stand in a mid-high relationship with [ø] and [o] respectively.

In order to capture this synchronic picture, the morphological rule of allomorph selection in (26), and the phonological rule of mid vowel raising in (27) will be posited.

The rule of allomorph selection in (26) accounts for the allomorphy /-'ø/ alternating with /-ul/, with /-ul/ being the selected allomorph when preceding a high stressed vowel.

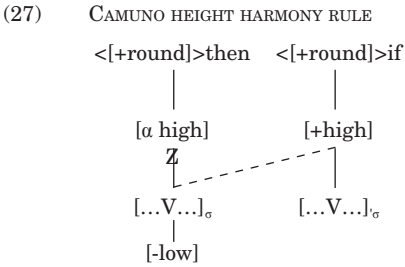
(26) CAMUNO RULE OF ALLOMORPH SELECTION

/-'ø/ is spelled out as /-ul/ _ {'i, 'u}

The rule of mid vowel raising accounts for the regular process of mid-vowel raising triggered by a high stressed vowel. The unique harmonic system of Camuno is analyzed as autosegmental spreading (cf. Goldsmith 1976, 1990; Clements 1977, 1982; McCarthy 1984) of a [+high] feature that occurs iteratively within a word, from the stressed vowel in a regressive fashion. As exemplified in rule (27), the feature [+high] spreads from the stressed vowel to an adjacent and preceding [-low] vowel. The stressed vowel is indicated by the stressed sigma symbol. The asymmetrical rounding restriction is expressed with 'if' 'then' next to the feature [+round].¹³ This means that if the

trigger is [+round], [+high] will only spread to another [+round] vowel. The Z sign stands for ‘delinking’, because once the feature [+high] has spread and reached the target, the target substitutes the old feature with the new one. The feature [high] has changed its value and the assimilation process is complete. This process iterates until all the targets in the domain have been assimilated.

The variation between [o] and [ø], on the one hand, and between [u] and [y] on the other, will be accounted for by assuming that unstressed /ø/ is underspecified for backness. Although speakers can tell the difference between [o] and [ø], they accept them both as unstressed alternants of /ø/, suggesting that /o/ and /ø/ are not contrastive in unstressed position. Assuming underspecification in backness for unstressed /ø/ allows one to capture the variation in the raised alternant of unstressed /ø/, which can either be [u] or [y] without noticeable difference on the part of the speakers.



As noted in § 3, the same pattern of stressed dependent height harmony is clearly visible in non-derived lexical items where the stressed vowels determine the height of adjacent unstressed vowels. To account for this, we assume that rule (27) also holds as a static constraint on the lexicon. The possible origins of this system are in § 5 through § 6.

5. Diachronic account

As pointed out, the system of height harmony appears to be regular. All mid vowels are raised when followed by a high stressed vowel. Front unrounded vowels /e/, /ɛ/ are raised to [i] by following /i/; back rounded vowels /o/, /ɔ/ are raised to [u] by following /i/ and /u/. Mid vowel /ø/ /is regularly raised to [u] by following /i/ in the suffix /-ø/, and to [u] and [y] elsewhere due to variation between [o] and [ø] as unstressed variants of /ø/.

Segments in free variation are suggestive of a change in progress. One might argue that the two front rounded vowels /ø/ and /y/ are merging with the two back rounded vowels /o/ and /u/ respectively, possibly under the influence of Italian that does not have front rounded vowels. Camuno is, after all, an endangered language spoken by a population bilingual in Camuno and Italian. However, this hypothesis is unlikely for several reasons. First, as demonstrated in Cresci (2014), Camuno shows sound patterns that, overall, are extremely regular and suggest a long independent development in the post-Latin period. Sound patterns from final obstruent devoicing to nasal deletion can be related to regular sound change with little evidence of Italian influence possibly limited to a few high frequency words. Bilingualism in Camuno and Italian is a fairly recent phenomenon. Second, no variation between /ø/ and /o/, and /y/ and /u/ is observed outside of the system of height harmony. Third, there is evidence of /ø/ spreading in unstressed position, which would run counter to /ø/ loss.

What seems, in fact, to be occurring, is a restructuring of the harmony system. There is a sense in which the system is becoming more surface-true. In other words, the underlying system is becoming more transparently related to the surface patterns. Synchronically, /ø/ alternating with [u] is opaque, and if it were observed across-the-board, it would require positing an abstract level of representation in which /ø/ is backed to /o/ before being raised to /u/. In light of these observations, my working hypothesis is that the system is progressively substituting /ø/ alternating with [u] with /ø/ alternating with [y]. This hypothesis suggests two chronological details: (i) /ø/ alternating with [u] predates /ø/ alternating with [y]; as a consequence, (ii) evolution of /ø/ predates /y/. These are supported by the discussion that follows.

In Camuno, /ø/ evolved from Latin short stressed o in open syllables, such that 'ö > 'ø]_σ. This sound change may go as far back as the 6th century, when the evolution of the open-syllable lengthening rule marked the end of the Latin quantitative system (Loporcaro 2011). The increased duration of the stressed vowel in open syllable is very likely to be the phonetic source of the sound change. Lengthened vowels tend to be unstable. They may diphthongize, and eventually change their quality altogether. When the sound change occurred in Pre-Camuno, a base form like 'NOVU 'new' changed into *'nøvu, possibly through *'nwovu (although there is no evidence of /wo/ in the language). The stressed vowel in an open syllable met the structural description for the sound change 'ö > 'ø]_σ and underwent the change. Derived forms like NO'VELLU 'newly-born' and *novel'linu 'newly-born,

diminutive', on the other hand, were not affected by the sound change, since Latin short *o* is unstressed in these words. A base form like 'CORVU 'crow', and its derived form *COR'BACIU 'biggish crow' were also unaffected, because Latin short *o* is stressed but in closed syllable in 'CORVU, and it is in unstressed closed syllable in *COR'BACIU. The synchronic alternation between /'ø/ and [o] observed in morphologically related pairs in (28) finds a natural historical explanation by observing that only Latin short *stressed* *o* of the base forms went to /'ø/. Latin short *unstressed* *o* of the derived forms did not undergo any change, since being unstressed it did not meet the structural description for the sound change.

| | | | | |
|------|--------|--------------|----------|-------------------|
| (28) | 'nødɔ | 'brand' | no'der | 'notary public' |
| | 'nøf | 'new' | no'el | 'newly born' |
| | 'kør | 'heart' | ko'radɔ | 'lung' |
| | 'mølɔ | 'grindstone' | mo'letɔ | '(knife) grinder' |
| | 'høl | 'pavement' | ho'ler | 'attic' |
| | ka'røl | 'termite' | karo'let | 'termite-eaten' |
| | pa'røl | 'kettle' | paro'let | 'kettle repairer' |

The evolution of /'ø/ from Latin short stressed *o* in open syllables resulted in a new distribution of /'ø/, /'o/ and /o/. /'ø/ occurred in open syllables, /'o/ in closed syllables, and /o/ in open and closed syllables. This new distribution gave rise to the alternations between /'ø/ and /o/ and between /'o/ and /o/ in morphologically related pairs (cf. *'nøvu/NO'VELLU, and 'CORVU/*COR'BACIU). My hypothesis is that these facts drove the generalization that /'ø/ went to [o] in unstressed position. At some point in time, this generalization was phonologized as the synchronic /'ø/-backing rule in (29) taking /'ø/ to [o] in unstressed position, whose main consequence was to prevent /'ø/ from occurring in unstressed position.

(29) CAMUNO /'ø/-BACKING RULE

'ø → o / unstressed position

While the /'ø/-backing rule was taking hold in the phonology, other sound changes occurred, in particular the system of height harmony and the evolution of /y/.

Height harmony is attested in Eastern Lombard, but not in Western Lombard (Sanga 1997). This suggests that its evolution postdates the split between Eastern and Western Lombard, which occurred between the 13th and 14th centuries (Sanga 1987). When height harmony evolved, the pretonic mid vowels in a word like NO'VELLU remained unchanged, since it was not adjacent to a high

stressed vowel. In contrast, a derived form like *novel'linu with a sequence of two mid vowels followed by a high stressed vowel changed into *nuvil'linu, thus giving rise to the alternation between /ø/ and [u] (*'nøvu/*nuvil'linu). *'nøvu, NO'VELLU, and *nuvil'linu are the protoforms of present day *nøf* 'new', *no'el* 'newly-born', and *nui'li* 'newly-born-DIM.', respectively. They exhibit the same synchronic alternations between /ø/ and [o], and between /ø/ and [u].

Further evidence for /ø/ alternating with [o], and /ø/ alternating with [u] being historical and predating /ø/ alternating with [ø], and /ø/ alternating with [y] comes from the morpho-phonological alternation between /-ø/ and /-ul/. In this case, the original phonological alternation between /ø/ and [u] has been morphologized giving rise to the rule of allomorph selection (26).

/y/ is assumed to have evolved from Latin long u through an unconditioned sound change (Rohlf's 1966: 57). Although both front and rounded, the two vowels /ø/ and /y/ evolved along different paths, and at different times. While /ø/ evolved from Latin short stressed o, /y/ evolved from Latin long u. The sound change that targeted Latin short stressed o in open syllables possibly dates to the 6th century for Gallo-Romance, and to 7th century for Florentine, Italo-Romance (cf. Sampson 1999; Loporcaro 2011). There is some consensus that the sound change that took Latin long u to /y/ spread from Gallo-Romance to Italo-Romance; /y/ probably only became established in Lombardy in the 12th and 13th centuries (cf. Sampson 1999: 268).

What these historical facts suggest is that the synchronic alternations between /ø/ and [o] and between /ø/ and [u] predate the alternations between /ø/ and [ø] and between /ø/ and [y]. When /y/ evolved in the language, Camuno already had the /ø/-backing rule in (29) that prevented /ø/ from evolving in unstressed position, and maintained the alternation between /ø/ and [o] in place. A relative chronology for the evolution of /y/ and the system of height harmony is hard to establish. They appear to have evolved roughly in the same period. However, this may not be crucial. The point is that when they evolved, Camuno did not have unstressed /ø/. As a consequence, /ø/ could not be raised to [y]. At the same time, [o] as the unstressed alternant of /ø/ was regularly raised to [u].

These historical facts support my hypothesis that a restructuring of the height harmony system is in place, with the alternation between /ø/ and [u] being replaced by the alternation between /ø/ and [y]. The fact that unstressed /ø/ is observed in the language, and that /ø/ patterns with /y/, suggests that the /ø/-backing rule may no longer be active in the phonology of Camuno.

As it appears, Camuno facts are consistent with a time differential between the evolution of /ø/ and the evolution of /y/, and with /ø/ predating /y/.

With this chronology in place, we turn to an overview of concomitant phonetic factors that may have determined the evolution of a height harmony system parasitic on rounding as found in Camuno.

6. Height harmony parasitic on rounding: the role of phonetics

Vowel-to-vowel coarticulation is the most widespread explanation for vowel harmony patterns. A number of scholars have tested the degree to which vowels undergo coarticulation in a vowel-to-vowel context. One of the first to report the discovery of vowel-to-vowel coarticulation in a VCV sequence was Öhman in 1966. Since then, several studies have explored the phenomenon from different perspectives. Acoustic studies (Fowler 1981; Magen 1997; Beddor et al. 2002) show that in some languages unstressed vowels undergo co-articulation more than stressed vowels, and that languages with smaller vowel inventories may exhibit greater vowel-to-vowel coarticulation (Manuel & Krakow 1984; Manuel 1990; Manuel 1999). Perceptual studies (Ohala 1994; Busá & Ohala 2001) evidence that listeners are perceptually aware of vowel-to-vowel coarticulation and that they routinely make adjustments for it.

Majors (2006) builds on these studies to formulate and test her hypotheses. She posits that stress-dependent harmonies are the natural evolution of a stress asymmetry in the precursor language such that a stressed vowel exerts a great deal of co-articulatory influence on the unstressed vowel while the reverse is not true. She believes that this asymmetry is related to both perceptual saliency, and articulatory ease. For these two reasons the speech community eventually adopts it. Her findings support these hypotheses. She shows that a stressed vowel does exert a great deal of influence on the unstressed vowel while the reverse is not true, but this pattern varies across vowels and speakers. American-English vowel /i/ is definitely sensitive to stress. Unstressed /i/ undergoes coarticulation to a greater degree than its stressed counterpart, which, on the contrary, resists it. Vowel /i/ is more likely to trigger a stress-dependent harmony, given its sensitivity to stress asymmetry. The results of Majors' (2006) perceptual experiment indicate that vowel-to-vowel coarticulation observed on unstressed /i/ is perceptible to naïve listeners. These results provide evidence that stress-dependent har-

monies triggered by stressed /i/ could be rooted in vowel-to-vowel coarticulation.

Walker (2005) comes to the same conclusions in her discussion of the role of “weak” and “strong” triggers. Weak triggers are unstressed and word-final vowels, while strong triggers are stressed and word-initial vowels. She posits that harmonies depending on a weak trigger are perceptually-driven phenomena, while harmonies depending on a strong trigger are articulatory-driven phenomena. Under Walker’s analysis, Camuno’s harmony would be both a perceptually- and articulatorily-driven phenomenon, since the trigger is a word-final stressed vowel.

Majors’ (2006) findings are particularly interesting for Camuno stress-dependent height harmony because the strongest of the two triggers, /i/ and /u/, is stressed /i/. As Majors points out, the quality of vowels plays a role and it varies across-speakers. Farnetani, Vagges, & Magno-Caldognetto (1985) found results similar to Majors’ in a study on vowel-to-vowel coarticulatory influence of three Italian vowels, /i/, /a/ and /u/. Among them, vowel /i/ turned out to have the strongest vowel-to-vowel coarticulatory influence.

Gafos’ (1999) argument for locality in assimilation processes is also rooted in articulatory mechanisms and has major implications for vowel harmony. He argues that sounds can assimilate to each other only if they are in a phonologically local relation, which occurs if and only if the articulations of the two sounds are contiguous. He refers to this condition as ‘Articulatory Locality’. Evidence shows that in a VCV sequence, the two vowels are articulatory and acoustically contiguous. In such configurations, there is a smooth transition from the articulation of the first vowel to that of the second. The claim made by Articulatory Locality entails that the assimilating feature propagates through all articulatorily contiguous sounds. This account of assimilation as a very local phenomenon that affects one segment at a time and moves from one segment to the next without ‘skipping’ is just what we see in Camuno harmony.

The studies just discussed suggest that Camuno height harmony could well have originated in co-articulatory factors.

In addition to height, Camuno harmony is also parasitic on rounding. While a non-round trigger can raise any preceding mid vowel, a round trigger can raise only preceding mid rounded vowels. Kaun (2004) provides articulatory explanations for these processes. Her observation concerns the articulation of rounded vowels in rounding harmony. She notices that cross-height rounding harmony, when the target and the trigger exhibit different height, is typo-

logically rare. The most natural explanation is that the lip rounding gesture is not equivalent for high and non-high rounded vowels; typically, high vowels are more rounded than non-high. A harmony span including vowels mismatched for height would necessarily involve re-adjustments in lip aperture and lip width, which could inhibit articulation. This would account for rounding harmony in Yawelmani, that is parasitic on height. Kaun's (2004) observations are particularly relevant for Camuno, which exhibits a pattern that is complementary to Yawelmani, being a height harmony parasitic on rounding. In Camuno, stressed /i/ raises all preceding mid vowels, but stressed /u/ only raises preceding rounded vowels. These patterns follow directly from the observation that the lip rounding gesture is not equivalent for high and non-high vowels. If high vowels are naturally more rounded than non-high, the difference in rounding is more remarkable between /u/ and /e/, than it is between /i/ and /o/. Thus, /u/ would fail to raise preceding /e/ because in a harmony span including vowels mismatched for rounding this would imply an articulatory cost in terms of a re-adjustment in lip rounding, aperture and width. Apparently, there are good articulatory reasons for a round high trigger to raise only preceding mid rounded vowels, and for a non-round high trigger to raise all preceding mid vowels.

7. Conclusions

The study of Camuno height harmony has revealed a complex and unique harmony system whose origin is mostly due to articulatory factors, as Gafos (1999), Kaun's (2004), Walker's (2005), and Major's (2006) findings suggest, with stress, height and rounding being the key elements. The system is complementary to the system observed for Yawelmani (Kaun 2004; Kuroda 1967; Newma 1944). In both systems, the two interacting features are [high] and [round]. In Camuno, [high] always spreads from a front stressed high trigger; the back stressed high trigger, however, needs a [+round] target to spread [high]. In Yawelmani, [round] spreads only if the round trigger and target share the same [high] feature. Apparently, there are good articulatory reasons for these two features to interact.

The study has also revealed a change in progress. The system is apparently undergoing restructuring. The underlying system is becoming more transparently related to surface patterns. While there are historical reasons for /'ø/ being raised to [u], there is synchronic evidence of /'ø/ being raised to [y], two behaviors that are consist-

ent with / \emptyset / having evolved from Latin short stressed o, and with /y/ being the last phoneme to be added to the Camuno vowel inventory. A concomitant recent phenomenon is the spreading of / \emptyset / in unstressed position, which is consistent with / \emptyset / being raised to [y].

Notes

¹ A poster on the phonetic and phonological characteristics of final devoicing in Camuno was presented by the author at 2nd Workshop on Sound Change, Institute of Phonetics and Speech Processing, Munich, Germany, May 2-4, 2012.

² An unpublished paper explaining the absence of nasalized vowels in Camuno through *n-loss and *m-maintenance in word-final syllables was presented by the author at 21st International Conference on Historical Linguistics, University of Oslo, Norway, August 5-9, 2013.

³ Notice the alternation between /z/ and [h] in the pair 'azen 'donkey'/ ah'ni 'donkey-DIM'. The variety of Camuno under study exhibits final obstruent devoicing (Cresci 2014). This pair suggests that final obstruent devoicing occurs in syllable-coda as well as in word-final position.

⁴ Bonfadini Giovanni (personal communication, August 4, 2013) notices that the evolution of Latin \bar{o} to / \emptyset / is apparently limited to this word. Usually, Latin \bar{o} in closed syllables has evolved as /u/. However, in the few attested cases (cf. 'urden < ORDINE(M) 'order', 'turt \bar{o} < T \bar{O} RTA(M) 'cake', re'dur < RASORIUM(M) 'razor', 'kurt < COHORTE(M) 'yard') Latin \bar{o} > /u/ before /r/, suggesting that a following /r/ may be the environment for the sound change.

⁵ I believe that *iu, *eu > e is possibly the result of two sound changes. First, unstressed, non-low vowels were lost word-finally which resulted in *iu, *eu > *i, *e; subsequently, unstressed, high vowels were lowered: *i > e. Final unstressed /e/ occurs in 'mare < MATRE(M) 'mother', and 'pare < PATRE(M) 'father'. These two words may appear exceptions to regular sound change, although it could be assumed that they were re-formed on the Latin, or that they are loans from Venetan.

⁶ The placename hae'da (Standard Italian <Cividate> /fivi'date) is pronounced with a sequence of non-high vowels by the inhabitants of this small town. Inhabitants of neighbouring villages/towns pronounce it hii'da. If historically this form was *sii'da <CIVIT \bar{A} S 'city', then this example could illustrate a case of lowering triggered by stressed /a/.

⁷ As can be noticed, /l/ in the present alternates with /d/ in the past.

⁸ As can be noticed, /f/ in the present alternates with zero in the past. This alternation is the result of three sound changes: non-low word-final vowel loss, final obstruent devoicing, and *v loss in intervocalic position.

⁹ This stimulus turned out to be problematic since speakers supplied two forms: 'r \emptyset z \emptyset and 'r \emptyset z \emptyset . For this reason it was discarded.

¹⁰ There is some evidence from experimental work with nonce words that stressed /y/ can in fact raise only preceding / \emptyset / (Cresci 2014).

¹¹ "X" stands for vowels that are not affected by [y] or [u], with the exception of /o/ that is raised to [u] when / \emptyset / is raised to [u].

¹² Camuno also has a number of words that exhibit progressive agreement, such as 'peten 'comb', 'perhek 'peach', 'htr \bar{o} hek 'logging trail', ka'lyzen 'soot', 'furen 'oven'. Additional evidence for a progressive pattern comes from placenames. A few examples are 'ezen, 'prehten, 'honek, 'hem, 'edol, 'luzen. However, the progressive pattern is rather rare with respect to the regressive pattern. In addition, there do

not appear to be examples of words where a high stressed vowel is followed by a high vowel.

¹³ For the use of “if”, “then” and angle brackets, see Chomsky & Halle (1968).

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