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UNIVERSITY OF CALIFORNIA

Los Angeles

**Epenthesis and prosodic structure in Armenian:
A diachronic account**

A dissertation submitted in partial satisfaction
of the requirements for the degree
Doctor of Philosophy in Indo-European Studies

by

Jessica L. DeLisi

2015

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ABSTRACT OF THE DISSERTATION

Epenthesis and prosodic structure in Armenian:

A diachronic account

by

Jessica L. DeLisi

Doctor of Philosophy in Indo-European Studies

University of California, Los Angeles, 2015

Professor H. Craig Melchert, Chair

In this dissertation I will attempt to answer the following question: why does Classical Armenian have three different reflexes for the Proto-Armenian epenthetic vowel word-initially before old Proto-Indo-European consonant clusters? Two of the vowels, *e* and *a*, occur in the same phonological environment, and even in doublets (e.g., Classical *elbayr* beside dialectal *albär* ‘brother’).

The main constraint driving this asymmetry is the promotion of the Sonority Sequencing Principle in the grammar. Because sibilants are more sonorous than stops, the promotion of the Sonority Sequencing Principle above the Strict Layer Hypothesis causes speakers to create a semisyllable to house the sibilant extraprosodically. This extraprosodic structure is not required for old consonant-resonant clusters since they already conform to the Sonority Sequencing Principle. Because Armenian has sonority-sensitive stress, the secondary stress placed on word-initial epenthetic vowels triggers a vowel change in all words without extraprosodic structure, i.e. with the old consonant-resonant clusters. Therefore Proto-Armenian */əlbayr/ becomes Classical Armenian [ɛl.báyɾ] ‘brother,’ but Proto-Armenian */<əs>tipem/ with extraprosodic <əs> becomes [<əs>.ti.pém] ‘I rush’ because the schwa is outside the domain of stress assignment.

The dissertation of Jessica L. DeLisi is approved.

Jared Klein

Brent Harmon Vine

Kie Ross Zuraw

H. Craig Melchert, Committee Chair

University of California, Los Angeles

2015

To my family, especially my parents.

Sirem zjez.

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Symbols and Abbreviations

Phonological Symbols:

V	Vowel
C	Consonant
T	Stop
S	Sibilant
R	Sonorant
H	Laryngeal
U, <i>v</i>	Utterance
IP	Intonational Phrase
PPh, Φ	Phonological Phrase
CG	Clitic Group
PW, ω	Prosodic Word
F, Σ	Foot
σ	Syllable
μ	Mora
O	Onset
R	Rhyme
N	Nucleus
C	Coda

Morphological Abbreviations:

nom.	Nominative
acc.	Accusative
gen.	Genitive
dat.	Dative
abl.	Ablative
fem.	Feminine
sg.	Singular
pl.	Plural
pres.	Present
aor.	Aorist
pass.	Passive
part.	Participle
det.	Determiner
D.O.	Direct object

Acknowledgements

I would first and foremost like to thank my committee members, who provided invaluable comments and insights throughout this process and undoubtedly improved the final product immeasurably. It was Jared Klein's enthusiasm for the more remarkable aspects of the Armenian language that first got me interested in its phonology, and Kie Ross Zuraw's guidance that helped me find sense in the apparent madness. Craig Melchert has patiently waded through multiple incarnations of the present work and all of its antecedents. Brent Vine's healthy skepticism encouraged me to strengthen my arguments about extraprosodicity and find more concrete evidence to support the very existence of the phenomenon.

I would also like to thank the present and former graduate students and friends of the UCLA Program in Indo-European Studies who have greatly influenced my ideas about historical phonology, the Armenian language, and Indo-European studies in general, especially Andrew Byrd, whose 2010 dissertation on Indo-European syllabification has been incredibly influential to me, and Anna Pagé and Christina Skelton, who (hopefully) found every typo in this manuscript. The phylogenetic work underlying much of Chapter 2 was completed with Christina Skelton; our co-authored paper is forthcoming. Additionally, I would like to thank the participants of Armenian Club in its many iterations, Chiara Bozzone, Michael Erlach, Steve Faulkner, Doug Fraleigh, Jesse Lundquist, Toru Minamimoto, Ryan Sandell, and Tony Yates, whose probing questions forced me to navigate the murky waters of Armenian historical phonology so carefully. I also owe a large debt to Renee Crane, Carl Evans, Mattyas Huggard, Rhiannon Knol, Alex Lessie, Caley Smith,

and Elizabeth Thornton for their friendship and support through this whole process.

Finally, I would like to thank Felicia Steele, Diane Steinberg, and Glenn Steinberg for encouraging me to study linguistics and to pursue graduate studies in the first place. The interest they take in their students has set the standard in pedagogy for me.

This dissertation was partially funded by the A. Richard Diebold Endowment in Indo-European Studies, which allowed me the opportunity to concentrate solely on research and writing during both the winter and spring quarters. Without the Diebold family's generosity, this work would have suffered in both time to completion and quality.

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Chapter 1

Introduction

The state of Armenian etymological studies has fallen far behind those in many other branches of the Indo-European family, such as Indic and Greek, for two primary reasons. First, the historical phonology of Armenian is notoriously full of unnatural sounding rules (e.g., the infamous change of **d_u- > -rk-*), making the prospect of finding and defending Armenian etymologies far more daunting a task than in languages with more straightforward developments. Secondly, only a small percentage of the Armenian lexicon is actually native vocabulary directly inherited from Proto-Indo-European. In fact, Armenian is so full of Iranian loans that Indo-Europeanists thought Armenian was an Iranian language until Hübschmann (1875) identified a core of native vocabulary. In this dissertation, I will work with a sample of well-established native lexemes in order to investigate some of the diachronic phonological processes that impacted the form of the Armenian lexicon.

The primary focus of this dissertation is the explanation of variations in epenthetic vowel quality attested in Classical Armenian texts and preserved into the modern dialects. From the earliest attestation of the Armenian language, there have been three different word-initial epenthetic vowels: *ə*, *e*, and *a*. There is no clear distribution between the last two vowels; *e* and *a* are found in exactly the same phonological contexts, and occur in byforms such as Standard Eastern Armenian *elbayr* ‘brother’ beside *atb’ar* found in the

dialect Mirak^c (Martirosyan 2010:252). These two vowels contrast sharply in distribution with *ə*; whereas *e* and *a* are found word-initially before old Proto-Indo-European stop-resonant clusters, *ə* is always found before sibilant-stop clusters.

In order to motivate this distribution, I will fully describe the prosodic system of the language in diachrony, including both primary and secondary stress, and discuss how this prosodic system interacted with phonotactic constraints during different stages of development. Finally, I will compare the diachronic prosodic and phonotactic developments found in Armenian to similar phenomena in Romance languages and elsewhere in the Indo-European family to build a theory of prosodic structure that can account for the special behavior of sibilant-stop clusters as compared to stop-resonant clusters.

1.1 A Brief History of the Armenian Language

Armenian is an Indo-European language spoken in the Republic of Armenia and in the Armenian diaspora. Eleven centuries before the first attestation of Armenian, the Behistun inscription (6th century BC) of Old Persian mentions a region of the Persian Empire called *Armina* where people called the *Arminiya* live. This region, located in modern day Eastern Turkey, near Mt. Ararat and Lake Van, was also inhabited by the Urartians, who spoke a dialect of Hurrian. Other than *Armina*'s description in the Behistun inscription, little is known of the early history of the Armenian people.

After the fall of the Achaemenid Old Persian dynasty, the northwest Iranians came under Greek rule. In 52 AD, the Arsacid Persians conquered Armenia, leading to more contact with Iranian languages in the form of Parthian, a dialect of Middle Iranian. After the Arsacid dynasty, Armenia came into contact with Middle Persian through their Sassanid rulers until the seventh century AD.

Because of all this contact with Iranian languages, Armenian native lexemes account for only about 40% of the vocabulary. In fact, it was not until Hübschmann (1875) found

strands of native vocabulary in Armenian, which is otherwise saturated with loans from Iranian, that Armenian was finally recognized as its own subgroup. Before this time, it was assumed that Armenian was an Iranian language.

The Armenian language can be separated into five main periods:

1. Classical Period: 5th century AD
2. Post-Classical Period: 6–7th century AD
3. Pre-Middle Period: 8–11th century AD
4. Middle Armenian: 12–17th century AD
5. Modern Armenian: 17th century AD to present

Although we have a textual history dating to the fifth century, no manuscripts from that time are still in existence. The earliest extant manuscripts date to the ninth century AD, and most are no earlier than the end of the twelfth century.

1.1.1 First Attestation: Classical Armenian

Classical Armenian, also known as *Grabar* or ‘written language,’ was first attested in the fifth century, when the cleric Mesrop Maštoc[՝] (361 – 440) completed a translation of the Bible. During the *oskedar* or Golden Age of Classical Armenian, the first Armenian texts were composed:

- *Astuacašunč[՝]* (Bible)
- *Ełc Ałandoc[՝]* (Against the Sects) by Eznik Kołbac[՝]i
- *Vark[՝] Mašt[՝]oc[՝]* (The Life of Maštoc[՝]) by Koriwn
- *Patmut[՝] iwñ Hayoc[՝]* (History of the Armenian People) by Agat[՝]angelos

- *Patmut'iwon Hayoc'* (History of the Armenian People) by Movses Xorenac'i¹

While the first four texts are valuable as the earliest attestations of Classical Armenian, the last is famous for preserving the pre-Christian poem known as “The Birth of Vahagn.” This poem, along with etymological notes highlighting the vocabulary most of interest to Indo-Europeanists, can be found quoted in its entirety in Fortson (2010:395–396).

Little, if any, dialectal variation is observable in the texts of this time (see Section 2.4.1 for traces of dialectal variation in the Classical Armenian period).

Armenian orthography, transliteration, and the phonemic inventory

The Armenian alphabet (the *aybuben*, named after the first two letters *ayb* and *ben*), which Mesrop Maštoc' invented for the purpose of his Bible translation, continues to be used to write Armenian to the current day.² It consists of 36 characters (29 consonants, and 7 vowels). The consonants of Classical Armenian are transliterated as follows:

¹Attribution of this text to the fifth century is generally accepted by Armenian scholars, but is contested by Western scholars based upon literary and historiographic issues. Toumanoff (1961:471) has argued that the text ought to be dated to the eighth or ninth century instead, often called the Post-Classical or Pre-Middle Period, because of the significant departures in this text from traditional Grabar grammar and usage.

²Two new letters were added to the alphabet in the Middle Armenian period to accommodate the sounds [ō] and [f], which were not found in the Classical Armenian phonemic inventory.

	Bilabial	Alveolar	Post-Alveolar	Palatal	Velar	Glottal
Stops						
•Voiceless	p	t			k	
•Voiced	b	d			g	
•Aspirated	p ^ʰ	t ^ʰ			k ^ʰ	
Fricatives						
•Voiceless		s	ʃ		x	h
•Voiced		z	ʒ			
Affricates						
•Voiceless		c [ts]	č [tʃ]			
•Voiced		j [dz]	ǰ [dʒ]			
•Aspirated		c ^ʰ [ts ^h]	č ^ʰ [tʃ ^h]			
Nasals	m	n				
Liquids		l, r [r], ř [r]			ł	
Glides	w			y [j]		w

Fig. 1.1: The Consonants of Classical Armenian

The stops of the third series, transliterated here as <p^ʰ, t^ʰ, k^ʰ> represent voiceless aspirated stops, although they are sometimes referred to as ejectives based on pronunciations in some modern dialects, e.g. the Erevan dialect, see Dum-Tragut (2009:17-18). This pronunciation is likely to be a recent development due to contact with Caucasian languages. These consonants are used to transliterate Greek voiceless aspirates, and Greek writers use voiceless aspirates to transliterate them into Greek.

The letters transcribed <v> and <w> are allographs; <v> is found word-initially, and <w> is found medially and finally. After <o>, <w> would be ambiguous, since <ow> is already a digraph representing the vowel [u] (see below), so only <v> is used for the sequence [ow(-)].

The two rhotics appear to have been in complementary distribution until shortly before the attestation of Classical Armenian. The flap *r* is by far more common, whereas the trilled *ṙ* is found almost exclusively before *n*, although some amount of paradigmatic leveling has obscured this distribution. The original distribution is still found in *learn* ‘mountain (nom. sg.)’ \approx *lerin* (gen. sg.). In *jern* ‘hand (nom. sg.)’ \approx *jerin* (gen. sg.), the paradigm has leveled towards the trilled variant, whereas in *verin* ‘upper (nom. sg.)’ \approx *vernoy* (gen. sg.), the paradigm has leveled towards the flap. The trilled *ṙ* also arises through sound change; in *k’oyr* ‘sister (nom. sg.)’ \approx *k’ēr* (gen. sg.), the *ṙ* comes from an earlier cluster **sr* < Proto-Indo-European **sṷésōr* \approx **sṷesrés*.

Armenian’s seven monophthongs are transliterated as follows:

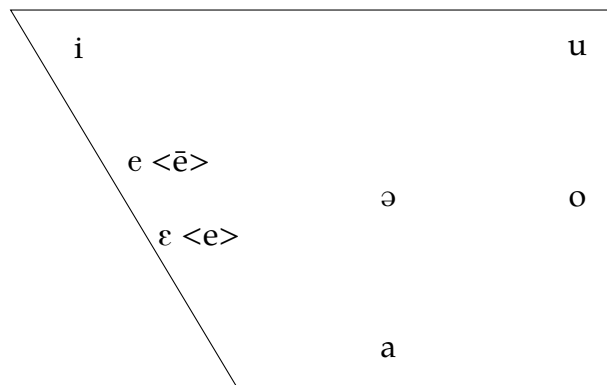


Fig. 1.2: The Vowels of Classical Armenian

Classical Armenian also has six diphthongs and three triphthongs:

- <ay> [ai]
- <ew> [ɛu]
- <iay> [iai]
- <oy> [ui]
- <iw> [iu]
- <eay> [ɛai]
- <aw> [au]
- <ea> [ia]
- <eaw> [ɛau]

Armenian lacks a length distinction in its vowels; the vowel that is transliterated with a macron, <ē>, actually represents the tense vowel [e], in opposition to <e> which represents [ɛ]. The vowel written <ow> represents the monophthong [u], an orthographic

practice reminiscent of the Greek spurious diphthong <ov>. To simplify transcriptions and aid the reader, I render [u] as <u> throughout, rather than preserving the potentially confusing digraph spelling.

For further discussion of the phonetics of Classical Armenian, see Schmitt (2007:29–33).

1.1.2 Middle Armenian

Although Classical Armenian continued to be used as a written standard up to the nineteenth century, the first important non-Classical variety to emerge in manuscripts and inscriptions was Middle Armenian, also called Cilician Armenian because it was spoken in the medieval kingdom of Cilicia. Middle Armenian is based upon the regional variety spoken in Cilicia at the time, and has many features – especially the pronunciation of voiced and voiceless stops – which later become characteristic of the modern Western dialects. Middle Armenian preserves the language in a state of flux; many of the changes in phonology and morphology between the classical language and modern dialects have their roots here, but there remain many archaic features as well. For instance, Middle Armenian shares with the modern dialects nominal plurals in *-ear* (Modern *-er*), while with the classical language it shares the augment on +past monosyllabic verbal stems.

1.1.3 Modern Dialects

By the modern era, two major dialects of the Armenian language have emerged: Eastern, spoken mainly within the Republic of Armenia, Azerbaijan, and Georgia today; and Western, which is spoken in the diaspora (e.g., the Middle East, Europe, and the United States). The most obvious phonological difference between the dialects is seen in voiced and voiceless stops (Romanized below according to their voicing value):

(1)	Standard Eastern	Standard Western	gloss
	Petrossian	Bedrossian	personal name, ≈ Peterson
	et	ed	‘gave’ (3 sg. aor.)
	ed	et	‘placed’ (3 sg. aor.)

By the time the two dialects were first described in the nineteenth century, voiceless stops in Eastern Armenian had come to correspond to voiced stops in Western Armenian, and voiced stops in Eastern Armenian to voiceless stops in Western Armenian. The diachronic details of this development are unclear, although a straightforward phonemic switch is completely implausible.

1.2 Phonological theories employed in this dissertation

This dissertation will be written within the framework of Optimality Theory (Prince & Smolensky 2004), although I will borrow from other frameworks, particularly Government Phonology, where necessary. Throughout I will assume a highly articulated form of syllable structure of the type seen in, for example, Vaux (2003). I will also make use of a modified form of the Prosodic Hierarchy (Selkirk 1981), similar to Ito & Mester (2007, 2009), to ground my discussions of extraprosodic structure.

1.2.1 Syllable Structure

The term syllable refers to a phonological entity in which segments are organized around a single sonority peak (i.e., the nucleus of the syllable), and often – though not exclusively – arranged according to the Sonority Sequencing Principle (SSP),³ with the least sonorous segments at the margins and interior segments increasing in sonority towards the peak, following the universal sonority hierarchy Vowels » Glides » Liquids » Nasals » Frica-

³This principle, which is by far the most commonly cited means by which syllables are described, can be found first in Sievers (1881:203–206).

tives \gg Stops:⁴

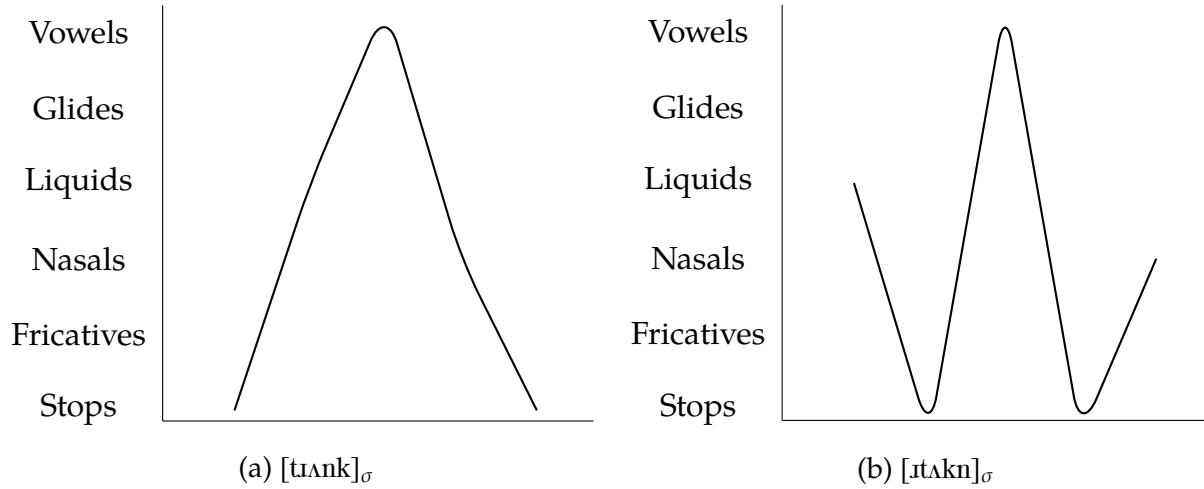


Fig. 1.3: Sonority profiles for SSP-conforming [tʌnk]_σ and SSP-violating [ɪtʌkn]_σ

Fig. 1.3 shows the difference in sonority profiles between unmarked and marked complex margins. In (a), all onset segments rise in sonority towards the peak, and then the coda segments fall in sonority towards the margin. In (b), however, onset and coda segments are not arranged according to sonority, causing the sonority profile to fall before rising again. The profile in (b) is illicit in many languages, whereas profiles like (a) are quite common in the world's languages.

This dissertation will assume a highly articulated form of syllable structure theory, with distinct onset, rhyme, nucleus, and coda positions, as seen in (Blevins 1995:212–213):



Fig. 1.4: Schematized syllable diagram

The onset, nucleus, and coda may branch to allow for the hosting of multiple or long segments under a single node.

⁴The only major difference between the formulation of the SSP presented here and that of Clements (1990), is that here fricatives and stops are assigned to different layers in the hierarchy, whereas he assigned them both to a single Obstruent layer. That fricative and stops differ in sonority will be crucial in motivating the behavior of sibilant-stop clusters.

Do we need syllables in phonological theory?

The reality of syllables as a phonological or psychological entity has been questioned in recent years, in particular by scholars of phonetics and perceptibility. While speakers are adept at counting the number of syllables in the word, psycholinguistic experiments show high levels of variability for syllable division tasks.⁵ Speakers are relatively good at dividing syllables when sequences closely parallel common word-initial or word-final sequences. In experiments, Spanish speakers tend to supply -V.TRV-, whereas Arabic speakers supply -VT.RV-. These results are expected in view of word-initial phonotactic constraints; Spanish allows stop-resonant initial words, but Arabic does not.

Speaker judgments get much fuzzier, however, when presented with sequences without obvious word-level phonotactic judgments, or when word-level phonotactics interfere with word-medial sequences. When English speakers were presented with the words *lemon* and *demon* and asked to pause in between syllables (inserting unnatural prosodic word boundaries), responses showed greater variability for *lemon*, due to the presence of the lax vowel in the first syllable: speakers are uncomfortable with [lɛ.mŋ] because [ɛ] does not occur word-finally, [lɛm.ŋ] fails to maximize onsets, and [lɛm.mŋ] assumes ambisyllabicity, in which the segment [m] is shared by both the first and second syllables (Steriade 1999). The variability of speaker judgments with respect to syllable structure bears a striking contrast to judgments in other phonological domains. Speakers do not vary this way in their judgments regarding phonotactics; English speakers uniformly reject nonce words such as [bnɪk] as ungrammatical, but accept [blɪk]. If syllables are a real phonological entity, why are speakers so much less sensitive to their boundaries than to phonotactic constraints?

Critiques of the syllable in phonological theory can be found, e.g., in Côté (2000:22), who asserts that syllables are “insufficient,” “inadequate,” and “unnecessary.” Her main

⁵For a thorough discussion of the types of experiments and their relative merits, see Côté & Kharlamov (2011).

issue with syllable theory is the over-reliance on extrasyllabicity, in which a segment is not properly associated with a canonical syllable position,⁶ as a cure-all when epenthesis and deletion fail to apply in contexts where segments appear unsyllabifiable, because “[extra-syllabicity] considerably weakens the syllabic licensing approach and makes it in essence unfalsifiable” (Côté 2000:23). Instead, she favors sequential constraints which dispense with syllables entirely. That is to say, in a purely sequential analysis of epenthesis and deletion phenomena, syllables are unnecessary if triggering environments are described in terms of number or type of segments intervening before a sonority peak.

For instance, many analyses of Arabic epenthesis (e.g. Kiparsky 2003) involve constraints on complex syllable margins, in that the medial consonant in sequences of VC-CCV are unsyllabifiable. The medial C cannot be an onset or a coda (both [-VC.CCV-] and [-VCC.CV-] are illicit in Arabic), and thus the consonant must be saved by an epenthetic vowel, either [-VC.VC.CV-] or [-VC.CV.CV-] depending on dialect. For Côté, these epenthesis phenomena can just as easily be captured without reference to syllable structure; instead, she describes a general tendency of consonant sequences: “Consonants want to be adjacent to a vowel, and preferably followed by a vowel” (Côté 2000:36). Because constraints on margin phonotactics can be easily translated into sequential constraints (i.e., *COMPLEX = *CCC), she finds syllables to be an unnecessary mechanic.

Furthermore, some straight syllabic analyses do not capture the data to her satisfaction. She discusses optional deletions in Hungarian, where word-internal consonant clusters tend to simplify. She presents example words in their Hungarian orthography, with both the unsimplified and simplified pronunciations:⁷

(2)	Orthographic	Unsimplified	Simplified	Gloss
a)	<i>lambda</i>	[lɔmbdɔ]	[lɔmdɔ]	‘lambda’
b)	<i>asztma</i>	[ɔstmɔ]	[ɔsmɔ]	‘asthma’

But not all medial clusters are subject to this optional simplification:

⁶For more on extrasyllabicity in phonological theory, see Section 1.2.2.

⁷All of the following forms quoted from Côté (2000:38ff.).

(3)	Orthographic	Unsimplified	Simplified	Gloss
a)	<i>ámbra</i>	[a:mbrɔ]	*[a:mrɔ]	'ambergris'
b)	<i>eszpresszó</i>	[ɛspres:ɔ:]	*[ɛsres:ɔ:]	'espresso'

She presents the obvious syllabic interpretation; the trigger seems to be gradient licensing of complex onsets: "1. Complex codas are not allowed (at least word-internally); 2. Consonantal nuclei are not allowed; 3. Only the most unmarked complex onsets are tolerated" (Côté 2000:38). Thus, the deletions found in the first group (her 24) stem from stray erasure, i.e., the deletion of unsyllabifiable segments. In the second group (her 25) stray erasure is not required because the complex onsets are less marked; in fact, these sequences do occur as word onsets in Hungarian (e.g. *bronz* 'bronze' and *prém* 'fur').

She then presents further evidence which confounds the syllabic approach:

(4)	a)	<i>aktfotó</i>	[ɔktfotɔ:]	*[ɔkfotɔ:]	'nude photograph'
	b)	<i>hangsor</i>	[hɔŋkʃor]	*[hɔŋʃor]	'sound sequence'
	c)	<i>handlé</i>	[hɔndle:]	*[hɔnle:]	'second-hand dealer'
	d)	<i>bazaltkő</i>	[bɔzɔltkø:]	*[bɔzɔlkø:]	'basalt stone'
	e)	<i>szerbtől</i>	[serptø:l]	*[sertø:l]	'From a Serb'
	f)	<i>sejtmag</i>	[fejtmɔg]	*[ejmɔg]	'cell nucleus'
	g)	<i>szenvtelen</i>	[senftɛlɛn]	*[sentɛlɛn]	'indifferent'
	h)	<i>narancsból</i>	[nɔrɔnd ³ bɔ:l]	*[nɔrɔnbɔ:l]	'from (an) orange'

Because the second and third consonants in these examples would be rather marked as complex onsets cross-linguistically and they do not occur in initial position in Hungarian words, the explanations given for the contrast between the first two groups above cannot hold. It turns out, the correct analysis (at least according to Côté 2000) is sequential, rather than syllabic, in nature: Stops (and only stops) delete if not preceded by a [+sonorant, +continuant] segment or followed by a [+continuant]. Again, like the Arabic example above, the restriction is based upon the adjacency to certain segments: "Stops, more than other consonants, want to be adjacent to a vowel, and preferably followed by a vowel."

This optional deletion, then, is triggered by the obscured cues of interconsonantal stops.

Syllables are Sufficient, Adequate, and Necessary

Sequential constraints may prove to be a better analysis for Hungarian deletion than syllabic structure; however, I do not agree with Côté that syllabic theory is never sufficient and useful. While it is true that speakers give variable judgments when asked to draw syllable boundaries, the fact that they are able to supply consistent counts for the number of syllables in a given word and draw boundaries in the cases of clear phonotactic patterns should not be understated. Speakers are sensitive enough to syllables, even if most have no conscious knowledge of the intricacies of their patterns, that many writing systems use them as the minimal unit. Should we be surprised that their judgments are not always in line with phonological theories of metrics and phonotactics? Grammaticality judgments in syntax are also extremely variable, especially in the realm of marginal sentences, but we have yet not discarded phrase structure. Furthermore, we never ask speakers to manipulate phrase structure directly in the way that we ask them to manipulate syllable structure; for instance, a syntactician would never ask speakers to judge whether a given set of words constitutes a VP. Anyone who has ever taught introductory linguistics courses knows how difficult untrained speakers find phrase structure. Why should we expect speakers to have more access to explicit knowledge of their phonological grammars than their syntactic ones?

Rather than trying to force speakers to access tacit knowledge, a more fruitful endeavor would be to search for syllable-based effects in grammars. Syllables have been implicated as a domain for many phonological environments. For instance, languages such as Kuuku-Ya?u require that stressed syllables be long (the Stress-to-Weight Principle, see Kager 1999:268). When primary stress falls on a syllable without a long vowel, speakers geminate the following consonant to close the syllable (McGarrity 2003:123):

- (5) a) /pama/ [pámma] 'Aboriginal person'
 b) /waliʔi/ [wálliʔi] 'spotted lizard'
 c) /wukuṭuru/ [wúkkuṭuru] 'coral cod'
 d) /kacinpinta/ [káccinpinta] 'female'
 e) /maʔupimana/ [máʔʔupimana] 'build/make'

In this language, geminates are completely predictable: they are only found after short vowels bearing primary stress. If the primary stress occurs in a syllable with a long vowel or a coda consonant, no gemination occurs. Gemination also does not occur with secondary stress. It is not the vowel itself which controls stress assignment here, but rather the syllable as a whole.⁸

Syllables are also the domain of weight assignment, another prosodic feature which often interacts with stress. In Latin, for instance, weight is the primary determining factor for stress assignment: primary stress falls on the penultimate syllable if it is heavy (i.e. has either a long vowel or coda consonant), but if the penult is light, primary stress falls on the antepenultimate syllable. Other processes beyond stress assignment are also dependent upon syllable weight. Various Germanic languages show vowel quantity effects conditioned by the presence of certain coda consonants. In Icelandic, for example, tonic vowels are long in open syllables but short in closed syllables (Kager 1999:267):

- | (6) long vowel in open syllable | | short vowel in closed syllable | |
|---------------------------------|---------|--------------------------------|--------|
| a) <i>h'ó'ó.fuð</i> | 'head' | b) <i>har.ður</i> | 'hard' |
| c) <i>aa.kur</i> | 'field' | d) <i>el.ska</i> | 'love' |
| e) <i>faa.ra</i> | 'ride' | f) <i>kal.la</i> | 'call' |

A similar quantity distinction obtains in monosyllables, where long vowels are found word-finally or before single consonants, but short vowels before clusters (Kager 1999:267-8):

⁸The syllable is not the only prosodic unit implicated in stress assignment. For example, in Latin the crucial unit is the foot.

(7)	long vowel in CVV	long vowel in CVVC	short vowel in CVCC
a)	<i>skoo</i> 'shoe'	b) <i>haas</i> 'hoarse'	c) <i>bj'orn</i> 'bear'
d)	<i>buu</i> 'homestead'	e) <i>ljoos</i> 'light'	f) <i>haft</i> 'have'
g)	/tɛɛ/ 'tea'	h) <i>skiiip</i> 'ship'	i) <i>skips</i> 'ship's'

As Kager points out, both vowel length phenomena can be easily captured by a constraint on syllable quantity: syllables may not be superheavy.⁹

Syllables do not only interact with prosodic phenomena; they can also serve as the conditioning environment for other phonological processes. Cairene Arabic shows a process of emphasis (pharyngealization) spread that only applies within syllables (adapted from Broselow (1979:348)):¹⁰

(8)	a)	[l ^ʕ ɑ.t ^ʕ i:f ^ʕ]	'pleasant (masc.)'	b)	[l ^ʕ ɑ.t ^ʕ i:fa]	'pleasant (fem.)'
	c)	[r ^ʕ ɑg ^ʕ .lɛm]	'two men'	d)	[r ^ʕ ɑ:gil]	'man'

Both roots show the effect of syllable boundaries on the spread of emphasis within a prosodic word: compare (a) to (b), where the spread to /f/ is blocked when a syllable boundary is introduced between the [f] and the syllable [t^ʕi:]. Likewise in (c) versus (d), the introduction of the syllable boundary before /g/ interrupts the pharyngealization spreading from /r^ʕ/. Note that in both instances a purely sequential analysis will be less parsimonious than an analysis with syllable boundaries, since the sequence in question (from the emphatic consonant(s) to the alternating consonant) is identical.

The highly articulated nature of syllable structure as depicted in figure Fig. 1.4 with its separate onset, rhyme, nucleus, and coda nodes is indicated by positional asymmetries between coda and onset consonants. Many languages show allophonic variation between coda and onset positions: for example, English, Albanian and many other languages distinguish between light (alveolar) and dark (velarized) varieties of /l/, where the alveolar

⁹That CVV and CVVC pattern together against CVCC is not surprising; many languages give evidence that word-final consonants do not count towards syllable weight. These prosodically-neutral consonants are often called *extrametrical*.

¹⁰According to Broselow (1979:347), additional rules can spread emphasis to adjacent syllables, but even these rules always apply to the entire syllable, and not just part of it.

occurs in onset position and the velar occurs in codas. Furthermore, different phonotactic constraints often hold for codas versus onsets; coda phonotactics are not just mirror images of onsets. English allows a greater variety of consonant clusters in codas than in onsets: [-Vnt] but *[tnV-], [-Vrs] but *[srV-], etc. Evidence from speech errors also shows positional asymmetries for onsets and codas: speakers produce disproportionately more speech errors in onset consonants than coda consonants (Rusaw & Cole 2011:1735).¹¹

Timing data collected in Articulatory Phonology research may shed some light on why and how these positional asymmetries manifest themselves. Browman & Goldstein (1988:88) measured onsets of between one and three consonants within carrier phrases ([-pi#C(C)(C)ats-]) and compared the timing of each onset to a single anchor point (in this case, the acoustic closure for [t]). As clusters change in size, both the right and left edge of the cluster change with respect to their timing; however, the middle of each of the clusters does stay consistent with reference to the anchor point. This middle point, what Articulatory Phonologists call the *C-center*, is the organizing principle for onset clusters. “The consonants in an initial [=onset] cluster are dispersed around the C-center, thereby overlapping the vowel on the one hand, and pushing the onset of the syllable to the left of the C-center on the other hand” (Browman & Goldstein 1988:97):

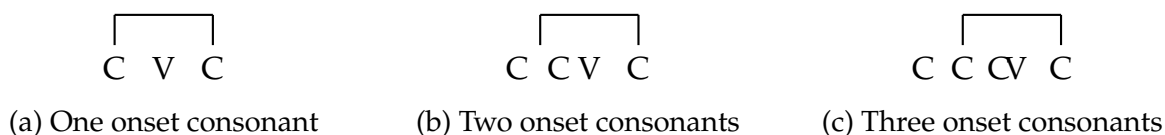


Fig. 1.5: Schematized syllables showing the C-centering effect.

In figure Fig. 1.5, the C-centering effect is depicted. The lines connecting the onset and coda in each syllable represents the anchor, a consistent period of time across all three syllable types. Compare the position of the consonant in the simplex onset (a) to the bi-consonant cluster in (b) and the triconsonantal cluster in (c). In (b), both onset consonants

¹¹Steriade (1999) and Côté (2000), on the other hand, motivate positional asymmetries by appealing to variability in the perceptibility of cues rather than syllable structure. In certain positions, phonetic cues may become obscured, leading to difficulty with perception on the part of the listener. According to this view, segment loss is due to less salient cues.

center around the position occupied by the simplex in (a). In (c), the middle of the cluster is again in the same position as the middle of the simplex in (a), while the first and last consonants are pushed outward in either direction. The last consonant intrudes on the space of the vowel, thereby shortening the vowel's duration.

Surprisingly, this C-center effect cannot be found for coda consonants; instead, "post-vocalic consonants are organized on the basis of their sequential relation to the vowel rather than on the basis of their syllable affiliation" (Browman & Goldstein 1988:96). The differing structural relations onsets and codas have with respect to their vowels may be the reason for coda asymmetries observable in phonological processes, especially metrics. The more consonants are added to an onset, the further it overlaps with the vowel; whereas the more consonants are added to a coda, the further from the vowel the coda extends. The fact that coda consonants add so much more post-vocalic time may be the reason that in most languages coda consonants, but not onset consonants, are moraic (Browman & Goldstein 1988:98). This overlap between onset and vowel may also explain why there is a greater degree of coarticulation between onsets and vowels than between vowels and codas (Browman & Goldstein 1988:99).

In the analysis of Armenian that follows, I will assume a highly articulated syllable with separate onset, rhyme, nucleus, and coda nodes, similar to the syllable diagram found in Fig. 1.4 on Page 9 above and discussed by Blevins (1995:212-213). That the nucleus and coda form a unit to the exclusion of the onset (as indicated by the different timing relations of onset-vowel vs. vowel-coda discussed above) is reflected in the inclusion of the rhyme node. Any of the terminal nodes (the onset, nucleus, and rhyme) may branch to accommodate long or multiple segments as licensed by the phonotactic constraints of the language.

1.2.2 Prosody and Prosodic Structure

The Prosodic Hierarchy

The Prosodic Hierarchy (see, among others, Selkirk 1978; Nespor & Vogel 1986; Peperkamp 1997; Selkirk 2011) refers to the relationship between increasingly larger phonological units, which seem to have at least some correspondence with morphological and syntactic units. It can be represented as follows:

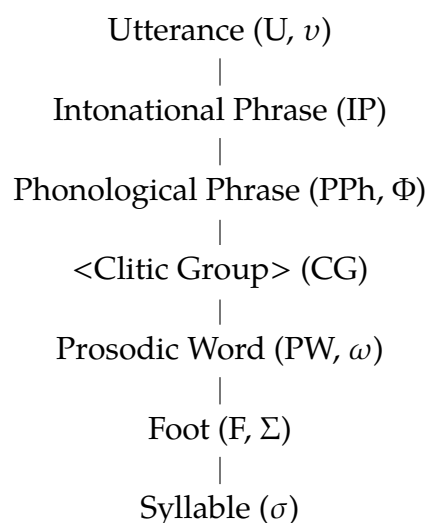


Fig. 1.6: The Prosodic Hierarchy

The Phonological Phrase and above are largely the domain of the syntax-phonology interface; the effects of these units are mainly seen in phenomena such as phrasal and clausal prosodic patterns including pitch contours, pauses, etc. In the case of Modern Eastern Armenian, these patterns are relatively well described (see Dum-Tragut 2009:53ff). Studies of prosodic phrasing in the classical language are based upon the placement of diacritics (the accent mark in the E manuscript of the Gospels and the question mark) and punctuation (see Künzle 1984:I 90ff. for details concerning the Gospels).

This dissertation will largely be concerned with the syllable, prosodic word, and clitic group. For general remarks on the syllable as a phonological unit see Section 1.2.1 above. Discussions of syllable structure in Classical and Modern Armenian can be found in Sec-

tion 3.3 and Section 3.2, respectively. Feet are the “minimal bracketed units of metrical theory” (Hayes 1995:40), usually consisting of pairs of syllables or morae. Feet are a convenient way to analyze many stress systems, particularly when stressed and unstressed syllables alternate in an obvious way. I will argue below in Section 2.5 that Proto-Armenian, like many Romance languages (see Hayes 1995:180 ff), must have had a trochaic system in which syllables are organized in a pattern of stressed-unstressed alternating pairs. By the first attestation of the language and through to the current day, most varieties of Armenian are better described using Alignment constraints on stressed syllables alone rather than foot structure (see Section 2.4.2), so I will not discuss the foot as a unit of prosodic structure in Armenian after the Proto-Armenian period. If they exist at all in attested Armenian, they are not relevant for the stress system.

The bulk of the following discussion will be concentrated on the prosodic word, which is similar, but not always identical to, the grammatical word. In its usual formation, the prosodic word is the domain of stress assignment, and may contain one and only one primary stress. The relationship between prosodically deficient categories such as clitics and the prosodic word that hosts them is a topic of some debate: some analyses assume clitics are hosted in the clitic group above the prosodic word (see Hayes 1989; Nespor & Vogel 1986), whereas analyses that lack an explicit clitic layer host the clitics at the level of the phonological phrase or adjoined to the prosodic word. In Section 3.5 I will advocate for the last option (prosodic word adjunction) for Classical Armenian, based upon similarities between phonological developments in clitics and word-initial consonant clusters.

Extraprosodicity

There is a well-described dichotomy found in the world’s languages in the treatment of word-initial clusters of the shape sibilant+stop (ST) versus stop+liquid (TR). In many languages, ST- is the only cluster allowed to violate the Sonority Sequencing Principle. Onsets of the type RC- are generally banned because the Sonority Sequencing Principle requires

that segments of relatively high sonority be adjacent to sonority peaks, whereas lower sonority segments occur at syllable edges. ST-clusters seem to violate the Sonority Sequencing Principle, because S is more sonorous than T, and therefore ought to occur closer to the syllable peak than T. That is to say, we ought to expect syllables of the type [TSVC] to be much more common than [STVC], since they would be much less marked in terms of the Sonority Sequencing Principle.

Further, not all languages that license complex onsets allow ST-clusters in initial position, cf. Proto-Romance **#st-* > Spanish *#est-*.¹² Although the prohibition on initial ST-clusters must have been a common Romance development (inscriptional *ISPOSE* = Latin *spōnsae* ‘spouse’ at CIL 8.3485; see Weiss 2011:511), it has been lost in Italian where synchronically ST-clusters do occur in initial position: cf. Spanish *escuela* vs. Italian *scuola* ‘school’. That the Spanish situation reflects a synchronic reality and not a fossilized diachronic development can be seen in loan incorporation, where epenthesis is regularly triggered to repair initial SC-clusters in English loanwords.

In some dialects of Portuguese,¹³ /s/ and /ʃ/ are neutralized to [ʃ] when in a coda *or* in a /ST/ cluster (Mateus & d’Andrade 2000:11-13):

(9) Intervocalic sibilants (both [s] and [ʃ]):

- a) [káʃɐ] ‘hunt’
- b) [áʃɐ] ‘s/he finds’

(10) Word-medial sibilants in clusters (only [ʃ]):

- a) [páʃtu] ‘pasture’
- b) [Ráʃkɐ] ‘(of) bad quality’
- c) [suʃpíru] ‘sigh’

(11) Word-final sibilants (only [ʃ]):

¹²Interestingly, this epenthesis is also invisible to the stress system (Harris 1970; McCarthy 1981). This point will become relevant in Section 4.3.

¹³Including varieties from Portugal, the Brazilian variety from Rio, and African varieties (Lipski 1975).

a) [máj] ‘bad (fem. pl.)’

b) [páj] ‘peace’

(12) Word-initial sibilants in clusters after the application of [i]-deletion (only [ʃ], Ferreira & Holt 2014:135):

a) [ʃpasu] <espaço> ‘space’

b) [ʃtar] <estar> ‘to be’

The most parsimonious explanation is that /ST/ forms a heterosyllabic cluster, and thus [ʃ] is in a coda in both environments, even when that /ST/-cluster occurs secondarily in initial position.

Evidence from first and second language acquisition studies shows that speakers acquire clusters of the shape ST- differently than CR- clusters. In the early stages of first language acquisition, speakers tend to reduce consonant clusters to eliminate complex onsets. When CR-clusters are reduced, it is generally the second segment that is deleted. When ST-clusters are reduced, however, speakers generally delete the first segment. Compare the following reductions in the speech of English-speaking child Amahl (age 2;2-2;6): [b̥e:t] ‘plate,’ [gi:m] ‘cream’ vs. [b̥aidə] ‘spider’ and [gɪp] ‘skip’ (Smith 1973:67–68). These word-initial reductions are not atypical for young English-speaking children. The exceptionlessness of Amahl’s rules shows that these two clusters, CR and ST, have very different structures for the purposes of first language acquisition.

In second language acquisition and loan adaptation, speakers often employ epenthesis rather than deletion to accommodate illicit complex onsets. For Hindi speakers producing initial clusters in English loanwords, the epenthetic vowel intrudes between the two consonants in a CR-cluster, while in ST clusters the vowel occurs in initial position: cf. [frut] ‘fruit’ vs. [ɪskul] ‘school’ (Gouskova 2001:175–176).¹⁴

At least in languages which show these asymmetries between ST- and CR-clusters, ST-clusters seem not to form true complex onsets; instead, they behave more like heterosyl-

¹⁴For further discussion and many more examples of this epenthesis asymmetry between CR- and ST-clusters in the world’s languages, see Broselow (1992); Fleischhacker (2001, 2005).

labic sequences, with T forming the onset and S attached elsewhere. Phonologists have come up with quite a few different structural and abstract reasons why these clusters behave so strangely. Most of the major approaches can be found catalogued in Vaux & Wolfe (2009:104–105):¹⁵

1. Complex margins: the usual architecture associated with Generative Phonology. All segments are associated with the syllable itself, either directly or with an intervening onset node. This is basically the “there’s no such thing as extrasyllabic segments” approach, in which violations of syllable well-formedness constraints are accommodated by allowing typologically marked phonotactic patterns within syllables rather than creating extrasyllabic structures.

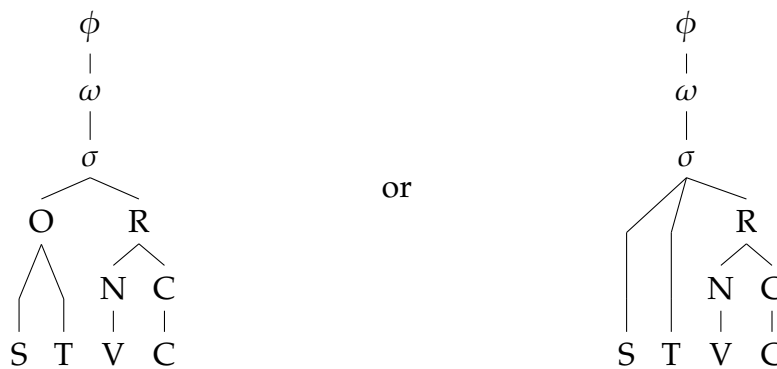


Fig. 1.7: Complex margins with and without an onset node for the syllable [STVC]

2. Degenerate syllables / semisyllables: prosodically deficient units sometimes composed of an empty nucleus and a coda, and sometimes only a coda-like segment. This approach is most associated with Kaye (1992) and other Government Phonologists.

¹⁵For clarity and consistency, each diagram below begins with the phonological phrase and prosodic word nodes. In actual practice, there is a great deal of debate in the field as to the actual structure of prosodic constituency; for more discussion, see Section 4.3

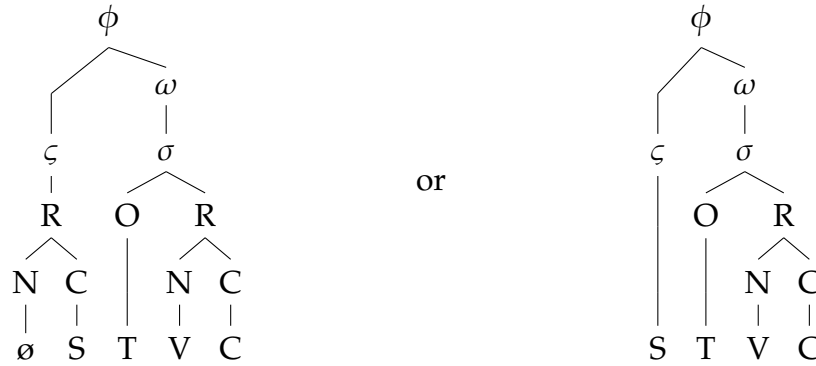


Fig. 1.8: Semisyllables with and without an empty nucleus.

3. Appendices: segments are attached to a node higher in the prosodic structure than the syllable, usually the Prosodic Word. This is the structure championed by Vaux & Wolfe (2009). For Vaux, it is critical that these appendices not be coda-like as was shown for the semisyllables above, because they do not always pattern with word-medial codas Vaux (2014).

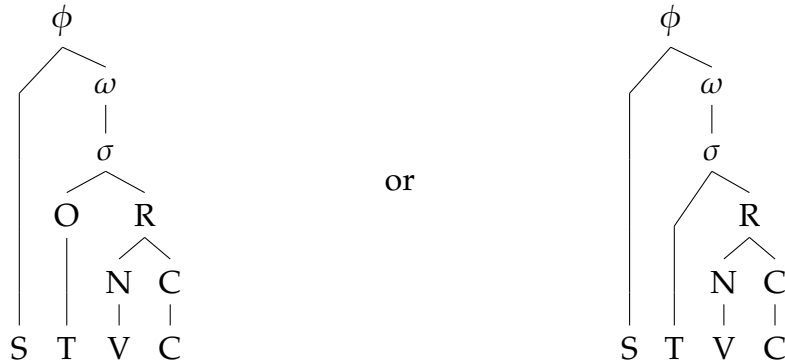


Fig. 1.9: Appendices with and without onset nodes.

4. Stray segments: stray segments are entirely unattached in the prosodic structure. Vaux & Wolfe (2009:123-124) rightly critique this approach for being too unconstrained. Because the segments are not attached to prosodic structure in any way, this theory suffers for lack of predictive power.¹⁶

¹⁶Throughout, I will use < > to indicate an extraprosodic segment in phonetic transcription.

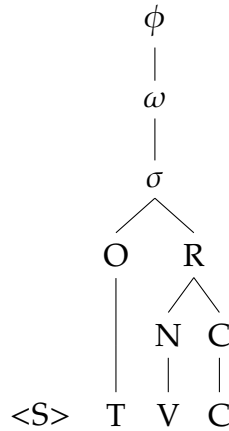


Fig. 1.10: Stray <S> unattached to the Prosodic Word containing the syllable [TVC].

In addition to these structural approaches, Keydana (2012:101–104) has proposed a subsegmental approach to ST-clusters at least for Latin and Gothic. Keydana proposes that at least in these two languages sibilant-stop clusters form a single segment, somewhat like a backwards affricate, an approach which follows Wiese (1996:262) and Weijer (1994). I have argued elsewhere (DeLisi forthcoming) that Keydana’s subsegmental approach is problematic with respect to both the phonetics of these clusters and the diachronic developments he proposes. Cross-linguistically these clusters time like two separate segments (although their relative timing in comparison to their surroundings varies from language to language, see Section 4.2). Further, Keydana’s analysis requires that Latin and Germanic independently innovated these subsegmental sibilant-stop clusters only to have them lost within Italic by the Old French period, whereas Vedic and Greek innovated semisyllables for the same sequences (Keydana 2012:104–107). Because the subsegmental approach is so much at odds with the phonetic realities of these clusters, I will not consider it any further in the discussions that follow.

Proponents of the four structural approaches above have spent a fair amount of time searching for tiny bits of phonological evidence to construct typological arguments against the other three structures. Open questions remain: First, what structure should we be setting up for ST-clusters in languages like Spanish, Portuguese, and Hindi where these

ST/CR asymmetries can be found? Secondly, should these structures be applied universally, or is there some cross-linguistic variability? That is to say, should we apply this structure (whatever it may look like) to both Spanish-type languages, where the two types of clusters function differently, and English-type languages, where these asymmetries do not seem to obviously obtain, or are the Spanish-type languages “special” in some respect?

We will see in Chapter 3 that Classical Armenian, like Spanish, does not license ST-initial words, and that sibilants in original word-initial ST-clusters were extraprosodic. This extraprosodic structure will be the driving force behind the variation in epenthetic vowel quality found between original ST-initial words on the one hand and original CR-initial words on the other. ST-initial words will be associated with the epenthesis of an unstressable [ə], whereas old CR-initial words will be associated with stressable [e]- or [a]-epenthesis.

1.2.3 Optimality Theory

Optimality Theory (Prince & Smolensky 2004) is a method of modeling grammar as a series of competing violable constraints on possible output forms. For any input form¹⁷ an infinite candidate set of possible outputs is generated. These candidates are evaluated against two types of constraints: markedness constraints penalize the realization of marked structures in the output, and faithfulness constraints penalize deviation from the original input form. Depending on the ranking of these constraints, the candidate that best satisfies the highest ranked constraints will be selected as optimal, i.e. the surface form generated by the grammar.

The interaction among inputs, constraints, and outputs is depicted in tableaux:

¹⁷OT inputs are similar to underlying forms in rule-based phonology.


/input/	CONSTRAINT 1	CONSTRAINT 2	CONSTRAINT 3
A. output candidate a	*!	*	*
B. output candidate b		*!	
 C. output candidate c			*

Tableau 1.1: Illustration of a typical OT tableau

In this illustrative mini-tableau, three potential candidates (a, b, and c) are evaluated against three constraints (1, 2, and 3). Violations are marked with an asterisk. A fatal violation, i.e. the violation that eliminates a candidate from consideration, is marked with both an asterisk and an exclamation mark. Elimination is also signaled by cell shading. Candidate a violates all three constraints. Candidate b violates only constraint 2. Candidate c is chosen as the optimal output candidate, indicated with the pointer finger icon, because it satisfies both of the highly ranked constraints (1 and 2). While candidate c does violate constraint 3, this violation is non-fatal because all of the other candidates have already been eliminated.

Ideally, a critical ranking should be demonstrated for all constraints (i.e., that in one ranking, the correct optimal candidate is selected, whereas in the opposite ranking an incorrect optimal candidate would be selected). Just such a ranking can be demonstrated for constraints 2 and 3; constraint 2 must be ranked higher than constraint 3 because the winning candidate violates constraint 3 but not constraint 2. In this tableau, constraints 1 and 2 cannot be critically ranked since either ranking ($1 \gg 2$ or $2 \gg 1$) would select the correct output candidate. Critical rankings are indicated with a solid line between the two columns. The dotted line between constraint 1 and constraint 2 indicates that no critical ranking could be found based on just these candidates.

OT in Diachrony

Optimality Theory has some benefits over and above traditional rule-based grammars for the analysis of language change. First, it models synchronic cross-linguistic variation straightforwardly through the diverse ranking of a small number of constraints. That is to say, when multiple languages are presented with the same marked structure, they present different resolutions.

In addition to modeling synchronic cross-linguistic variation, OT can also shed light on mechanisms of language change. Language change is nothing more than the accumulation of successive generations of speakers with different grammars; thus OT models diachrony as changes in constraint rankings from one stage of grammar to the next.¹⁸ As children learn the grammar of the language (i.e. the constraint rankings), constraints that do not directly interact – or interact only in a small corner of the grammar – will create dilemmas for learners, because they do not receive enough data input to construct reliable constraint rankings. If children assume a different ranking for these constraints than the adults use, a change in the grammar will result. The majority of rerankings likely stem from innocent misapprehension of constraint rankings as learners acquire the grammar.

Some surface structures may be compatible with multiple rankings. Word initial ST-clusters present just such a case; speakers do not seem to be sensitive to the phonetic distinction between extraprosodic [<s>t-] and tautosyllabic [st-] pronunciations revealed by Articulatory Phonology experiments (see Section 4.2). Thus, learners encountering ST-initial words are forced to make a decision when presented with /st-/ words: is it better to create a structure that violates the SSP and allow a branching onset with falling sonority, or is it better to violate constraints on prosodic structure and allow clusters across a prosodic boundary (i.e. allow an extraprosodic segment)? Below, I will demonstrate that Proto-Indo-European and Pre-Latin speakers acquired the first grammar, but that by the

¹⁸For a more complete discussion of OT in diachrony, see Green (1997); Cho (1998); Kiparsky (2008). For an argument that OT is not suited to diachronic studies at all, see McMahon (2000).

Classical period, speakers had changed to the latter grammar. Since ST- clusters are the only SSP-violating clusters in Latin, unambiguous data would have been lacking, allowing for the observed change in ranking to occur eventually.

1.3 Roadmap

In Chapter 2, I will describe the stress systems found in modern Armenian dialects and show that one of them, the so-called *hammock pattern* with primary stress on the final syllable and secondary stress on the initial, must predate the breakup of the two major dialect groups and thus can be reconstructed for Classical Armenian as well. The alternate stress pattern, found only in a group of Eastern Armenian dialects, must be an innovation post-dating the break up of the two major varieties (Eastern and Western), as well as the attestation of Classical Armenian. In Chapter 3, I will show how this hammock pattern interacted with phonotactic constraints in the Proto-Armenian period to drive epenthetic vowel changes if and only if those epenthetic vowels were under secondary stress. Words with original sibilant-stop clusters in initial position in Proto-Indo-European show an epenthetic schwa, such as in the root **steib-*, which develops into the Classical Armenian verb *əs.ti.pem* ‘I rush’, whereas original consonant-resonant clusters in initial position in Proto-Indo-European developed secondarily stressed epenthetic vowels which could not remain schwa: **bhrātēr* > *el.bayr* ‘brother’.¹⁹ I will show that the secondary stress of the hammock system is the underlying cause for the variation in epenthetic vowel quality between the original Proto-Indo-European stop-resonant and sibilant-stop clusters. Because the sibilant was already extraprosodic by the time the epenthesis was triggered, the schwa was outside the domain of stress. Schwas associated with stop-resonant clusters, however, were not outside the stress domain and were forced to change their quality under secondary stress. In Chapter 4, I will develop a general theory of extraprosodic structure

¹⁹The phonological changes in consonantism between Proto-Indo-European and Classical Armenian will also be covered in some detail in Chapter 3.

to explain how and why the stress and phonotactic systems interact in the way they do in Armenian, as well as in Romance languages and elsewhere in Indo-European. Chapter 5 will present my conclusions and directions for further study.

Chapter 2

Armenian Stress

In order to discuss how prosody has interacted with phonotactics to motivate the observed variation in epenthetic vowel quality, we must first establish the accent system for the earliest stages of the Armenian language. There are two different types of stress patterns found in the modern dialects (see Section 2.4), and I will argue that the more common of these systems must be inherited from the Proto-Armenian period. The prosodic system traditionally reconstructed for Proto-Indo-European has left few, if any, traces on the Armenian language.

2.1 Prosody in Proto-Indo-European

Based on comparative evidence from Greek, Sanskrit, Germanic, and Balto-Slavic, most scholars reconstruct a mobile pitch accent system for Proto-Indo-European. This pitch accent was contrastive, as we see in minimal pairs such as Greek *tómos* ‘a cut’ and *tomós* ‘cutting’. Proto-Indo-European also shows prominence-driven vowel reduction in its system of quantitative ablaut: compare forms of the verbal root ‘to be’ where root-accented full-grade forms like **h₁és-ti* (3 sg) alternate with suffix-accented forms such as **h₁s-énti* (3 pl). This vowel reduction may have occurred within the pitch-accent system due to the greater phonetic length often found on tonic vowels, or there may have been an ear-

lier stress-accent system predating the pitch-accent system reconstructable for Proto-Indo-European (for one such account, see Lehmann 1952:109).

In the athematic nominal system, various paradigmatic classes have been described to depict the movement of accent among the various morphemes (the root, suffix, and ending):¹

1. Acrostatic: the accent is fixed on the root; the suffix and endings are consistently in the zero grade (i.e., exhibit vowel reduction).
2. Proterokinetic: the accent moves from the root in the “strong” cases (e.g., nom. sg.) to the suffix in the “weak” cases (e.g., gen. sg.); the endings are consistently in zero grade.
3. Hysterokinetic: the accent moves from the suffix in the strong cases to the endings in the weak; the root is consistently in zero grade.
4. Amphikinetic (or Holokinetic): the accent moves from the root in the strong cases to the endings in the weak; the suffix is in *o*-grade in the strong stems and zero grade in the weak.

These classes are based on a few assumptions. First, only one accented vowel is allowed per word. Second, zero grade is derived through the deletion of unaccented ablauting (= [e] and [o]) vowels. Third, these classes may be reconstructed even if no language preserves the pattern in full; for example, proterokinetic inflection is reconstructed partially on the basis of accented zero-grade forms (e.g., Sanskrit *gáti-* ‘moving’ presupposes an earlier alternating paradigm **g^wém-ti-* / *g^wm-téi-*) beside unaccented full-grades (e.g., Sanskrit *matís* (nom. sg.) / *matés* (gen. sg.) ‘thought’ presupposes **mén-tis* / *mṇ-téi-*). Proponents of this theory argue that these two types of nouns originally inflected according to the same pattern (with accented full grade roots in the strong stem, and accented full grade suffixes

¹For a more comprehensive discussion of these classes, see Meier-Brügger (2000:194ff.). I will also ignore the peculiarities often associated with the locative singular in this discussion.

in the weak stems), but later leveled their accent and ablaut patterns to preserve uniformity of the root. The *gáti*-type preserved the accent from the strong stems and zero grade root from the weak stems; the *matí*-type preserved both the accent and ablaut patterns from the weak stem, although the strong stems do not show the expected full grade root.

The dearth of direct evidence for proterokinetic inflection in particular has been a source of controversy within Indo-European linguistics (for discussions of the problems associated with the reconstruction of this paradigmatic type, see for example Vine 2004; Kümmel 2014; Lundquist 2014). Furthermore, the typological naturalness of such a system of paradigmatic accent in general has recently been challenged (see Halle 1997; Hyman 2009; Kiparsky 2010).

According to an alternate theory, a given Proto-Indo-European morpheme was lexically marked as either stressed or unstressed, and a series of rules move or delete underlying lexical accents to create well-formed surface structures. For instance, the BASIC ACCENTUATION PRINCIPLE deletes all but the left-most accent (Kiparsky 2010:144). When a word is comprised only of unstressed morphemes, default accent is assigned to the initial syllable. The ablaut classes described for Proto-Indo-European nouns, then, would be epiphenomenal and related to underlying lexical stress properties of the morphemes rather than being real organizing principles for the grammar. Acrostatic nouns, for example, simply have inherent accent on the noun stem, while proterokinetic nouns may be conditioned either by accent retraction rules in the weak stems versus default initial accent in the strong stems in the absence of inherent lexical accent (Halle 1997:39) or by syllable structure constraints (Kiparsky 2010:150-153). Proponents of this compositional theory maintain that it is both more typologically natural and more in line with morphophonological theory than the traditional account. Another benefit of the compositional approach is the ease by which it derives attested systems like those found in Germanic and Celtic with primary accent on the initial syllable (through simple loss of underlying lexically specified accent and application of the default left-most accent), as well as systems with accent on one of the last

three syllables of a word, where the directionality has been reversed (Halle 1997:299–305).

We will see in Section 2.5 that the earliest reconstructable stages of Proto-Armenian are compatible with the late stages of the compositional account, whereas the traditional mobile pitch accent and ablaut classes bear no resemblance to the Proto-Armenian system.

2.2 Primary Stress in Classical Armenian

Classical Armenian texts exhibit both orthographic and phonological evidence for persistent stress on the final syllable of the word. Although accent is not standardly indicated in Classical Armenian, the E manuscript of the Gospels shows accent marks where words may have differed from the productive pattern, e.g., in foreign names or titles: *Pétros*, *P[˘]íliḡpos*, *rābbi*, and a small class of adverbs with non-final accent: *nóynpēs* ‘in that way’, *áyspēs* ‘in this way’, *aháwadik* ‘lo!’ (Künzle 1984:I 93). Word-final accent is also corroborated by the placement of the question mark, which is generally written above the last syllable of polysyllabic words in the E manuscript (I 99).

Classical Armenian has a vowel alternation pattern² whereby underlying high vowels and most diphthongs in final syllables reduce when they become non-final:

(13) **i** ≈ **ø** or **ə**

sirt ‘heart (nom. sg.)’ ≈ *srti* (gen. sg.)

amis ‘month (nom. sg.)’ ≈ *amsoy* (gen. sg.)

(14) **u** ≈ **ø** or **ə**

k[˘]un ‘sleep (nom. sg.)’ ≈ *k[˘]noy* (gen. sg.)

hur ‘fire (nom. sg.)’ ≈ *hroy* (gen. sg.)

(15) **ē** [ei] ≈ **i**

sēr ‘love (nom. sg.)’ ≈ *sroy* (gen. sg.)

tēr ‘lord (nom. sg.)’ ≈ *tirem* ‘I rule (1 sg.)’

²This vowel alternation is sometimes misleadingly referred to as ablaut, although it is an Armenian-internal development completely unrelated to Proto-Indo-European ablaut. See Schmitt (2007:44).

(16) **oy** ≈ **u**

loys ‘light (nom. sg.)’ ≈ *lusoy* (gen. sg.)

e-c[˘]oyc[˘] ‘showed (3 sg.)’ ≈ *c[˘]uc[˘]i* (1 sg.)

(17) **ea** ≈ **e**

leaṙn ‘mountain (nom. sg.)’ ≈ *lerin* (gen. sg.)

sireac[˘] ‘loved (3 sg.)’ ≈ *sirec[˘]i* (1 sg.)

This alternation pattern is most easily explained as vowel reduction due to stress shift. When syllables are added to the end of a word, the primary stress moves to the new final syllable, causing the formerly stressed vowel to reduce.

Although this formulation of primary stress is uncontroversial for Classical Armenian, a description of the secondary stress system – if the language had secondary stress – is lacking in the literature. Below I will describe the two different stress systems attested in the modern dialects and assess whether the evidence from these dialects and the historical record can shed light on the question of Classical Armenian secondary stress.

2.3 Stress Systems in the Modern Dialects

The two stress systems attested in modern Armenian dialects, the so-called “hammock” system and the penult accent system, are well described in the literature.

2.3.1 The Hammock Dialects

Modern Western Armenian and most dialects of Modern Eastern Armenian (including Standard Eastern Armenian) show the hammock pattern, where primary stress is fixed on the final syllable of the word, and secondary stress on the initial. In these dialects, secondary stress can be diagnosed through the failure of vowels in initial syllables to reduce (Vaux 1998:148):

- (18) a) /jalakel/ → [ʃàlkél] 'to carry on one's back'
 b) /sovorel/ → [sòvrél] 'to study'
 c) /jalak/ → [ʃàlák], *[ʃlak] 'back'

We probably should not expect the vowel in the initial syllable of [jalak] to delete completely, since *[ʃl-] is not a licit onset in Modern Armenian. Its failure to reduce to schwa is more crucial in demonstrating that it bears secondary stress.

2.3.2 Penult Dialects

Vaux (1998:148) contrasts this hammock pattern above with the penultimate pattern found in certain Eastern dialects, like that of the city of Goris (about 150 miles from Erevan), where vowels in initial syllables reduce to schwa because they are completely unstressed:

Classical	MWA	Goris	gloss
harsanik ^ε	[hàrsník ^h]	[hərsánik ^h]	'wedding'

No secondary stress has been documented for these penult-stress dialects of Modern Eastern Armenian.

2.4 Using Modern Data to Study a Classical Language

It may seem methodologically problematic to rely on data from modern dialects to make claims about classical languages, unless there is a secure way to ensure the data do not reflect later innovations postdating the classical period. Armenian could present just such a case: if we can demonstrate that the Eastern and Western dialects became differentiated before the classical period, then any feature shared by the two dialects which is unlikely to be independently innovated or spread from one variety to another can be securely reconstructed for the classical language as well.

2.4.1 Dating the Split of Eastern and Western Armenian

The most detailed modern account of Armenian dialectology and its historical developments is Djahukian (1972), in which he distinguishes six basic dialects and their relationship to the written standards (Classical, Eastern, and Western).

Native authors were aware of dialectal variation long before it is documented by linguists. Eznik Kořbac'ı (fifth century) famously noted an example of lexical variation: "When we say *sik* (wind) blows, the lowers say *ays* (demon, evil spirit) blows" (quoted from Djahukian 1986:9). An example of phonetic variation is preserved in the Armenian translation *K'erakanakan aruest* of Dionysius Thrax "The Art of Grammar" from the fifth or sixth century,³ which notes that speakers of the dialect of Gordayk' use the form *Man-ayč* instead of *Manēč* (an Iranian personal name). The eighth century author Step'annos Siwnec'ı mentions seven regional varieties of Armenian: "Further you should know all words of marginal areas of your own language, those of Korcayk', Tayk', Xut', the Fourth Armenia, Sperk', Siwnik', and Arc'ax and not only the central ones and those of royal domain" (quoted from Djahukian 1986:9).

Modern scholars both inside and outside of Armenia are in agreement that the dialectal variation in question must predate the attestation of Classical Armenian, although there are no ancient sources documenting the split. Based upon old isoglosses, Weitenberg (2002:151–2) projects the dialectal split to some point before the fifth century AD. Dum-Tragut (2011) attributes the split of Eastern and Western dialects to the separation of Roman and Persian influences in 385/87 AD, while Vaux (1998:239) cites the reign of Tigran II in the first century, when Armenia achieved its greatest size: "As soon as isolated communities came into being as a result of this expansion, separate dialects must have developed." Although little, if any, dialectal variation is directly indicated in the texts from the classical period, it seems this apparent uniformity must be a mirage. After all, no modern language is devoid of variation; we should not expect historical languages to be any

³The dating of this text is highly controversial. See Clackson (1995).

different in this respect.

In fact, irregularities within the historical phonology of the earliest texts of the language led Werner Winter to question this apparent uniformity within the oldest layer of the language: “[I]f conflicting developments from identical or analogous forms can be found to cluster in a systematic fashion, the presence in the corpus of more than one dialectal component can be assumed with a high degree of confidence” (Winter 1966:201). He lists many examples of these irregularities, of which I reproduce only one type here:⁴

(19) Proto-Indo-European $*p-, t-, k^w > [A] p^{\acute{e}}-, t^{\acute{e}}-, k^{\acute{e}}-; [B] h-; [C] y-$ (Winter 1966:203-204):

	Classical Armenian	Armenian Gloss	Comparandum
[A] a)	<i>p^éesay</i>	‘suitor’	Lat. <i>procus</i>
	b) <i>t^éanjr</i>	‘thick’	Lith. <i>tánkus</i>
	c) <i>k^éan</i>	‘than’	Lat. <i>quam</i>
[B] d)	<i>harsn</i>	‘bride’	Lat. <i>procus</i> ‘suitor’
	e) <i>hiwsn</i>	‘carpenter’	Gk. <i>téktōn</i>
	f) <i>him</i>	‘why’	Lat. <i>quid</i> ‘what’
[C] g)	<i>yawray</i>	‘stepfather’	Gk. <i>pátrōs</i> ‘father’s brother’
	h) <i>yawsem</i>	‘weave’	Lat. <i>texō</i>

The data above leaves us with only a few possibilities. First, the Neogrammarian Regularity Hypothesis that all sound change must be regular and rule governed is in serious trouble. Second, most of the Classical Armenian etymologies are simply wrong. Third, Winter is correct in assuming that the earliest texts in Classical Armenian represent a mixture of at least three dialects. As Winter himself characterizes the problem, “the analysis of the composition of classical Armenian as presented here [i.e., as composed of three different dialects mixed together] constitutes a tour de force. However, the alternative we are faced with is widespread anarchy” (Winter 1966:209). After sorting through the data and attempting to dispose of the dialectal diversity by carefully questioning all of the et-

⁴A similar discussion with even more data can also be found in Djahukian 1972:245–260.

ymologies,⁵ he concludes that Classical Armenian as we have it represents a sort of koine of preclassical dialectal features (Winter 1966:210), much like Homeric Greek is composed of many different early Greek dialects, rather than representing one monolithic variety.

In order to investigate the historical and genetic relationships in more detail, Christina Skelton and I performed a phylogenetic systematic analysis on a sample of Eastern and Western dialects:

- | | |
|---|---|
| 1. Grabar = Classical Armenian | 12. Melri (G&K 1986:116–127) |
| 2. Middle (Cilician) Armenian (Karst 1901) | 13. Mush (G&K 1986:128–141) |
| 3. Agulis (G&K 1986:1–10; Vaux 2008) ⁶ | 14. New Julfa (G&K 1986:142–154) |
| 4. Aslanbeg Vaux (2001a) | 15. Polis (G&K 1986:155–168) |
| 5. Erznkay (G&K 1986:22–36) | 16. Sasun (G&K 1986:169–178) |
| 6. Goris (G&K 1986:37–49) | 17. Shamaxi (G&K 1986:179–191) |
| 7. Hajen (G&K 1986:50–64) | 18. Smyrna (Vaux 2012:111–126) |
| 8. Hamshen (G&K 1986:65–76; Vaux 2001b) | 19. Svedia (G&K 1986:192–201) |
| 9. Karchevan (G&K 1986:77–90) | 20. T ^ˆ blisi (G&K 1986:202–212) |
| 10. Karin (G&K 1986:91–102) | 21. Tigranakert (G&K 1986:213–223) |
| 11. Lori (G&K 1986:103–115) | 22. Van (G&K 1986:224–239) |
| | 23. Xoy (G&K 1986:240–253) |

These dialects were chosen primarily because of the accessibility of dialect descriptions

⁵For example, “while it might be possible to consider *y-* in *yawsem* as the prefix *y-* (cf. *y-arnem* ‘I rise’), such an analysis seems precluded for *yisun* ‘fifty’... moreover, even if we could extract **hawsem* from *yawsem*, the *-aw-* vocalism would still force us to retain a separate category” (Winter 1966:209).

⁶G&K 1986 = Greppin & Khachaturian 1986.

and text samples, as well as their coverage in Djahukian (1972). We limited ourselves to dialects still spoken in the general vicinity of the Armenian homeland; for instance, although Artial is covered in both Greppin & Khachaturian (1986) and Djahukian (1972), we eliminated it from our phylogenetic study because it is now spoken in a diaspora community in Poland. The rationale behind this restriction is simple; the farther away from the Armenian homeland dialects became, the more language contact could have affected the current form of the dialects and the less information they are likely to give about the historical breakup of the eastern and western varieties. While a full phylogeny including all available dialectal material would certainly be fruitful, it is beyond the scope of the current study.

In our phylogenetic study, we prepared a data matrix of 172 binary phonetic, phonological, morphological, and syntactic features for the twenty-three dialects listed above, primarily drawn from Djahukian (1972), with additional data from the descriptions and text samples cited above for each dialect. We ran a Maximum Parsimony analysis (i.e., one that produces a tree with the fewest number of feature changes are required)⁷ using PAUP* 4.0b10 for Windows (Swofford 1998). The full data matrix with descriptions of the 172 features, as well as PAUP* commands will be made available with Skelton & DeLisi (forthcoming).⁸

The map below shows the location of 21 of the dialects in our survey, as well as the medieval Armenian Kingdom of Cilicia:

⁷For more on Maximum Parsimony, see Swofford et al. (1996:415ff.); Semple & Steele (2003:84ff.)

⁸For a more complete discussion of the methodology of phylogenetic systematics as it applies to problems in historical linguistics, see Nichols & Warnow (2008); Skelton (2008, 2014).

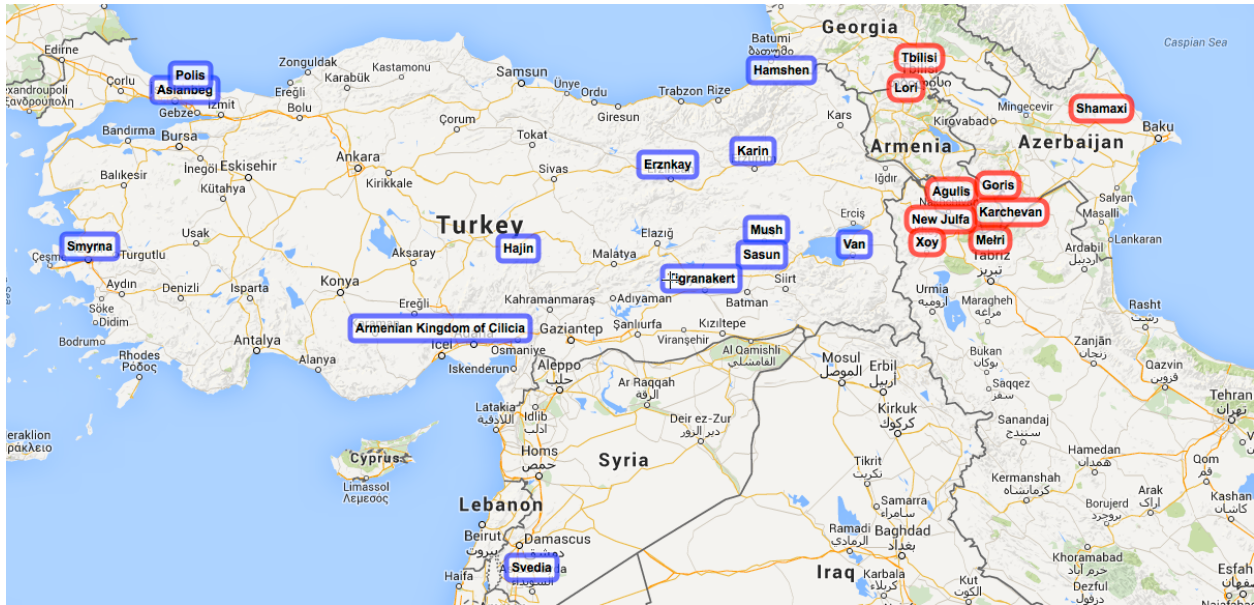


Fig. 2.1: Map of Modern Armenian Dialects, also showing the historical location of the medieval Armenian Kingdom of Cilicia. Map data: Barasoft, Google, ORION-ME (2015).

The two historical dialects in our survey, Grabar (i.e. Classical Armenian, see Section 1.1.1) and Middle Armenian, are not shown on the map. Classical Armenian was not associated with a single geographical location, but Middle Armenian was largely confined to Cilicia, except for inscripational material distributed throughout the Near East. Western dialects, marked in blue where color data is available, are all located in Turkey and Syria. Eastern dialects, marked in red, are all within the present-day boundaries of the Republic of Armenia, Azerbaijan, and Georgia. The linguistic reality of this geographical split is reflected in our phylogenetic tree, which shows all of the Eastern dialects dominated by a single node (40):

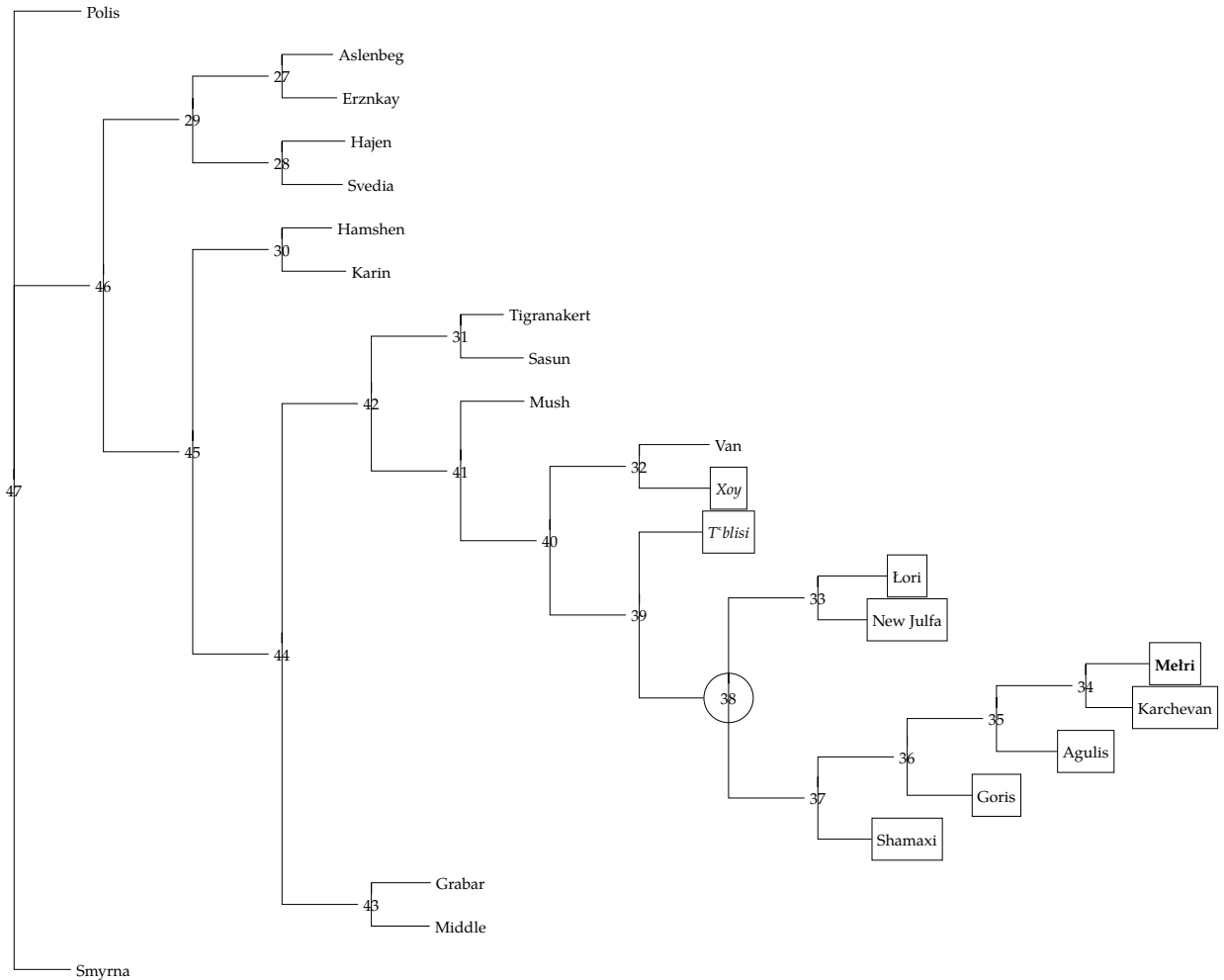


Fig. 2.2: Phylogenetic Tree of Armenian Dialects. The boxes indicate Eastern dialects. The two hammock dialects of Eastern Armenian outside the penult sub-tree (*Xoy* and *T'bilisi*) are italicized. The one hammock dialect of Eastern Armenian within the penult subtree (**Meñri**) is bold.

For our purposes, the most important split in this tree happens at node 38, circled above; this node dominates all of the penult dialects in our sample. The phylogenetic analysis supports the conclusion that the hammock dialects are more prosodically conservative, whereas the penult dialects innovated their stress system together sometime after the differentiation of Eastern and Western Armenian, since the Eastern hammock dialects Tbilisi and Xoy dominate node 38. The only hammock dialect to be captured in the penult subtree is Meñri, but because this dialect is spoken geographically quite close to Karchevan,

perhaps later contact between the dialects has obscured the original grouping. It should also be noted that this tree is unrooted, meaning that the true original split for the tree has not yet been determined. For more on unrooted trees, see Nichols & Warnow (2008:761ff.).

2.4.2 The Spreadability and Learnability of the Hammock Pattern

It is unlikely that Eastern and Western both independently innovated the hammock stress pattern for two reasons. The first is based on typology, and the second on the distribution of hammock dialects versus penult dialects.

Typologically, the hammock system is exceedingly rare, especially in comparison to penult accent systems. According to Gordon (2011:158–9), the only other language varieties documented with this stress pattern are Udihe⁹ (Kormushin 1998; Nikolaeva & Tolskaya 2001; Gordon 2002) and some dialects of Canadian French (Gendron 1966:139ff; Gordon 2002).¹⁰ In Udihe the primary stress is quantity sensitive and preferentially falls on a long vowel: *geléni* ‘he called (3 sg. past)’, not **gelēní* (Nikolaeva & Tolskaya 2001:90). A parallel development can be seen in the Modern Armenian pattern, where non-final syllables are assigned primary stress when the final syllable contains a schwa: *mánər* ‘small’ and *erbémən* ‘sometimes’.

Perhaps it should not be surprising that the hammock stress pattern is so rare. From a theoretical standpoint, it is a somewhat difficult system to model in comparison to the prosodic systems found in languages like English or Latin. In a metrical stress framework, the hammock pattern inherently involves a mismatch in foot structure between the primary and secondary stress, where primary stress is driven by right-to-left iambic feet and secondary stress is driven by left-to-right trochees. There is no grid in the style of Hayes (1995) that can generate this pattern. The stress assignment procedure detailed by Vaux

⁹An Altaic language spoken in Russia.

¹⁰Note, the diachronic analysis I will present in Section 2.5 below will rely on the assumption that Canadian French is conservative with respect to its prosody, whereas Standard French has innovated away from the hammock system, since it no longer has a synchronic system of lexical accent; see Vaissière (2001).

(1998), following Halle & Idsardi (1995), is likewise incapable of correctly predicting secondary stress on the initial syllables, and thus he is forced to assume a somewhat complicated and ad hoc grid adjustment to correctly generate the modern Armenian forms he is attempting to account for (1998:150). Optimality Theoretic alignment constraints (see Section 3.4.3) are able to correctly generate this rare pattern, as well as the variation exhibited by modern dialects.

Another typological curiosity of the hammock pattern is that disyllabic words with secondary stress on the initial syllable and primary stress on the final syllable will violate *CLASH, an Optimality Theoretic markedness constraint against stress clash (the surfacing of stress on adjacent syllables), unless one of the underlying stresses is deleted. *CLASH is tolerated in Canadian French, but in Udihe the secondary stress is suppressed in clash contexts Gordon (2002:500); Nikolaeva & Tolskaya (2001:90). According to Vaux (1998:142-143), some dialects of Modern Armenian delete stresses due to clash, but I will argue below (Section 3.4.4) that forms such as *eris* ‘three (acc. pl.)’ demonstrate that Proto-Armenian must have tolerated stress clash, and the promotion of *CLASH must have post-dated the development of [ə] to [e] and [a]. The precise date of this change in constraint ranking, i.e. whether *CLASH was already ranked highly enough to cause deletion of secondary stress in disyllabic words during the Classical Armenian period, is unclear.

The six penult dialects in the sample analyzed above – Agulis, New Julfa, Karchevan, Goris, Shamaxi, and Lori – are all located in the very center of the Eastern Armenian dialect area surrounded by hammock dialects to the north, west, and south:

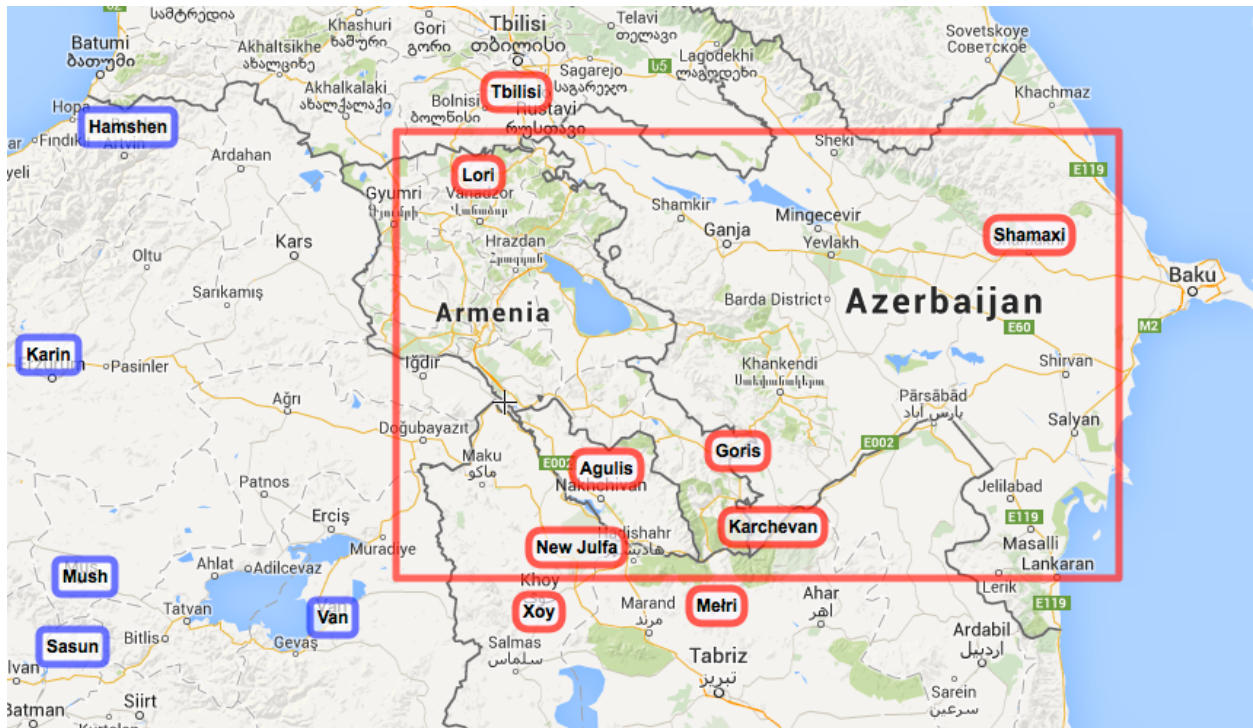


Fig. 2.3: Map of Modern Armenian dialects. Penult dialects of Eastern Armenian are enclosed in the box; all dialects outside the box are hammock dialects.

Distributions of this type often happen as an innovation spreads outward from its focal point. Just such a situation likely occurred within the history of Armenian; a group of speakers gave up the hammock pattern in favor of the less typologically marked penult pattern, and this new accent system spread through a significant portion of the Eastern Armenian dialect area. The hammock dialects at the periphery have maintained the more conservative accent pattern. This relationship was also indicated by the phylogenetic tree in Fig. 2.2 above; recall, all six of the penult dialects are nested together in the tree under node (38).

While it is not entirely impossible that the hammock system started in one dialect and then spread to the other, it seems to me highly unlikely on both linguistic and geo-historical grounds. Eastern and Western Armenian have developed separate phonemic inventories¹¹ and inflectional morphology. Furthermore, given the isolating nature of the mountainous

¹¹As Garrett (1998) argues, the Armenian Sound Shift applied in only some dialects, while others were unaffected.

terrain and vast size of the Armenian-speaking area of the time (Vaux 1998:239), areal spread of phonological features between the Eastern and Western groups would have been non-trivial. Although the Armenian speakers of the time maintained contact with their Middle Iranian-speaking ruling class, there is no evidence that there was widespread contact among the Armenians themselves. With no compelling reason to assume the two dialect groups affected each other, Occam's Razor dictates we should assume the easiest possible path, i.e. that the hammock pattern developed only once in the Proto-Armenian period and was subsequently retained in most of the dialects to the present day.

Because the dialect split between Eastern and Western Armenian predates the attestation of the classical language and the hammock system is unlikely to have been spread from one dialect to the other, we can securely project it back to the period of common innovation, i.e., the Proto-Armenian period. The few dialects of Eastern Armenian which show penult stress and lack secondary stress on the initial syllable must have innovated their stress patterns after the break up of the two dialects.

2.4.3 Earliest Evidence of the Hammock System

Because the earliest Armenian texts do not indicate secondary stress, any evidence for the hammock system before the modern era will, by nature, be indirect.¹² Beyond the evidence presented above from historical dialectology, there is also some indication from variants in the manuscript and inscriptional traditions that the hammock pattern predates the modern era.

¹²Using the modern Armenian as the basis for reconstructing classical pronunciations is by no means a new idea: it has been the standard way among philologists since at least Meillet, particularly for restoring unwritten schwas resulting from the reduction of high vowels, e.g. *stoy* [səto(j)] not *[əsto(j)], gen.sg. of *sut* 'falsehood.'

Manuscript Evidence

Reduction of medial vowels, similar to that seen in Modern Western Armenian in Section 2.3.1 above, can be found throughout the manuscript tradition, including sporadic attestation in the M. manuscript of the Classical Armenian Gospels (Künzle 1984:I 61, 65):¹³

(20)	E. Manuscript	M. Manuscript	Gloss
a)	<i>andamaloyc</i>	<i>andamloyc</i>	'paralytic (nom./acc. sg.)'
b)	<i>pataxani</i>	<i>patsxani</i>	'response (nom./acc. sg.)'
c)	<i>barjakc'ac'-n</i>	<i>barj/kc'ac'</i>	'companion (gen. pl.)'

Reduction of medial vowels, particularly *a*, is also found in the Middle Armenian textual tradition (Karst 1901:18, 42ff):

(21)	Middle Armenian	Classical Armenian	Gloss
a)	<i>alčem</i>	<i>alač'em</i>	'I entreat'
b)	<i>ařčew</i>	<i>ařařeaw</i>	'before'
c)	<i>pažnel</i>	<i>bažanel</i>	'to distribute'

Note crucially that, like the reductions we see in modern hammock dialects, none of the variation between [a] and \emptyset above occurs in initial syllables. Unfortunately, no manuscripts actually date from the fifth century; the earliest Grabar manuscript, the E Manuscript of the Gospels, dates to the ninth century, and most postdate the 12th. Therefore, it is impossible to exclude the possibility that these vowel reductions are simply a later feature creeping into the manuscript tradition during the Post-Classical era.

Inscriptional Evidence

One last source of data on early Armenian orthographic variants is the inscriptional record left behind by Armenian pilgrims to the holy land, dating between the fifth and the fifteenth century Stone (1982, 1991); Greenwood (2004). So far I have identified one instance of this sort of medial vowel reduction:

¹³A slash indicates that the word was interrupted by a linebreak in the manuscript.

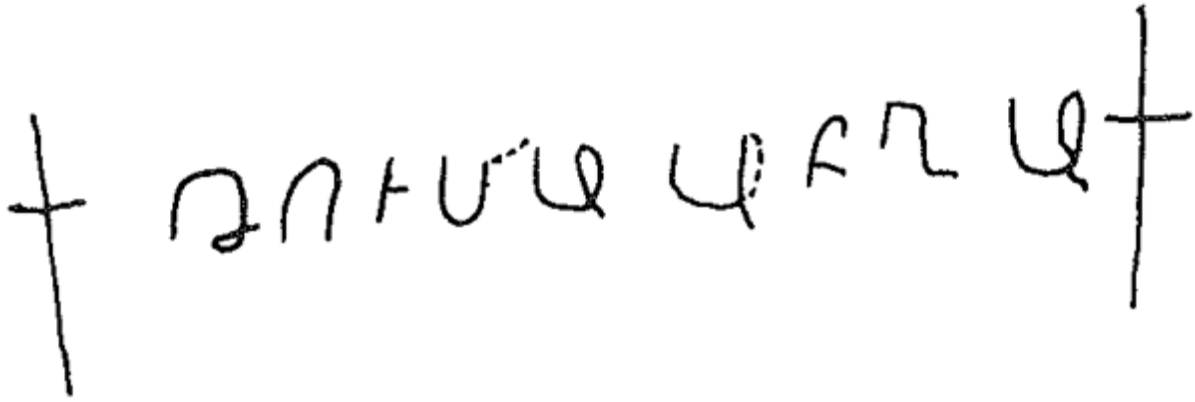


Fig. 2.4: Inscription H Arm 36, with medial syncope in *abla* < *abeta* (Stone 1982:127).

In this inscription, reading *T'OWMA ABLA* (*T'owma* = *T'ovma* 'Thomas' and *abla* < *abeta* 'monk' (Stone 1982:127)), the second word gives evidence of medial vowel reduction. This inscription is not dateable.

That these vowel reductions are found in both Grabar and Cilician manuscripts – the earliest eastern and western varieties respectively – as well as the inscriptional record lends support to the notion that the medial vowel reductions stem from the period of shared innovation, and therefore the hammock pattern must be a Proto-Armenian feature. That the reduction remains a sporadic feature until the modern language probably indicates that it was purely phonetic; the standard spellings with medial vowels preserved likely represent careful speech, since the register of most Grabar and Cilician texts is quite high.

Phonological Evidence

A possible piece of phonological evidence for the hammock system might be seen in the few exceptions to the otherwise strict rule of vowel alternations discussed above in Section 2.2. When high vowels occur in monosyllables, they sporadically (but not always – note three of the four examples of high vowel reduction above are monosyllables) fail to reduce in both the classical and modern language:

- (22) *i* fails to alternate with \emptyset or *a*

iž 'snake (nom. sg.)' \approx *iži*, **əži* (gen. sg.)
ink^cn 'self (nom. sg.)' \approx *ink^cean*, **ənk^cean* (gen. sg.)
ji 'horse (nom. sg.)' \approx *jioy*, **jəoy* (gen. sg.)
mi 'one (nom. sg.)' \approx *mioy*, **məoy* (gen. sg.)

(23) *u* fails alternate with \emptyset or ə

us 'shoulder (nom. sg.)' \approx *usoy*, **əsoy* (gen. sg.)
unkn 'ear (nom. sg.)' \approx *unkan*, **ənkān* (gen. sg.)
ult 'camel (nom. sg.)' \approx *ultu*, **əltu* (gen. sg.)
ju 'donkey (nom. sg.)' \approx *juoy*, **jəoy* (gen. sg.)

It seems unlikely that the reduction here is blocked by analogy,¹⁴ since the high vowel / schwa alternation is so pervasive throughout the grammar of the Armenian language. Armenian paradigms seem very tolerant of this non-uniformity in polysyllabic stems. Note also that the failure to alternate is only attested with high vowels; monosyllables with diphthongs systematically participate in the expected alternation pattern. Instead, perhaps the alternation is blocked by the hammock pattern. After all, if these forms underwent the expected alternation rule, we would see secondary stress on the reduced vowel. As we will see below in Section 3.4.3, stressed schwas are very marked in Armenian. That this non-alternation pattern is sporadic can be attributable to variation in the grammar, either through dialect mixture of the type proposed by Winter (1966) or through variable ranking of the constraints controlling vowel reduction and stress assignment in the language.

¹⁴Or Output-Output correspondence, in Optimality Theoretic terms.

2.5 From Proto-Indo-European to the Hammock System

Late in the Proto-Armenian period, vowel deletion targeted final syllables: **bher-e-mi*¹⁵ > *berem* ‘I carry.’ It is generally accepted in the literature (e.g., Meillet 1936:19; Godel 1975:12; Schmitt 2007:32) that this deletion was triggered by persistent stress on the original penult syllable, i.e., the syllable that will become the accented final syllable in the attested classical language. This assumption is grounded both in the typological naturalness of the change and in the ease of deriving the attested persistent final stress from an earlier persistent penult stress. The question remains, though, how we can derive the penult-to-final stress system from either of the reconstructed prosodic systems of Indo-European date.

If we accept the traditional account of Proto-Indo-European accent and ablaut found in the majority of Indo-European handbooks, little can be said about the transition from that system to what is found in the attested Armenian dialects. Since all Armenian varieties show a persistent stress-based accent on the final or penult syllable of the word and most attest to secondary stress on the initial syllable, the Proto-Indo-European system must simply have been entirely given up at some point in the Proto-Armenian period. This replacement could perhaps be ascribable to substrate influence, since Urartian seems to have also had a penult accent system “at least in certain cases, defined by unknown conditions” (Wilhelm 2004:123). If Proto-Armenian acquired its primary penult accent from contact with Urartian, however, its secondary stress and the typological rarity of the hammock pattern in general remain unexplained (secondary stress has not been described for Urartian).

On the other hand, if the compositional approach to Proto-Indo-European accent is correct, Armenian stress can be derived from the parent language quite straightforwardly, in much the same way that Jacobs (2003:279–281) derives Latin and Polish stress. The first step would be simplification of the grammar in the form of the loss of the majority of the

¹⁵The thematic vowel has been leveled to *e* throughout the paradigm and, as in Indo-Iranian, the original thematic 1.sg. ending has been replaced by the athematic **-mi*.

paradigmatic types described in Section 2.1 and the generalization of the Basic Accentuation Principle. At this time, Proto-Armenian would have had a persistent initial accent, as has also been reconstructed for at least the earliest stages of Italic, Celtic, Germanic, and some Baltic and Slavic languages (Halle 1997:298–299).¹⁶

If the Indo-European languages with persistent initial stress also develop trochaic secondary stress of the type [$\acute{\sigma}\sigma\grave{\sigma}\grave{\sigma}\dots$], the development of penult stress systems could result from the switch of primary and secondary stress in words of up to four syllables, where the difference between [$\acute{\sigma}\sigma\grave{\sigma}\sigma$] and [$\grave{\sigma}\sigma\acute{\sigma}\sigma$] was not salient enough to be reliable for perfect first language acquisition (Jacobs 2003:280). This switch of primary and secondary stress is seen in all of the penult languages of the Indo-European family, such as Latin,¹⁷ Polish, and Proto-Armenian, although the development in each branch is independent.

After the switch of primary and secondary stress gave rise to the penult accent system, it is clear that the trochaic feet lost their iterativity and instead became bound to the initial and final word boundaries. Thus, regardless of the length of the word beyond two syllables, all words in Proto-Armenian had primary stress on the penult and secondary stress on the initial syllable. This change was perhaps driven by the fact that the majority of both nouns and verbs in Proto-Armenian, apart from compounded forms, would have been two to three syllables long. Evidence for iterativity would only come from the rare words with five or more syllables. Persistent penult stress eventually led to deletion of the vowel in the post-tonic syllable, giving rise to the attested hammock pattern.

The changes from Proto-Indo-European to attested Classical Armenian proposed here can be summed up as follows:

¹⁶Yates (2015) also assumes a great deal of generalization of the Basic Accentuation Principle in Anatolian to account for so-called “accent retraction” in Hittite.

¹⁷A switch of primary and secondary accent in Latin was proposed already by Dietrich (1852:554), Thurneysen (1883–1885:313), and Brugmann (1897:973), although some words, such as *àdsimiliter* ‘similarly’, present problems for this account. See Nishimura (2008:207–211) for discussion and references.

- | | |
|---|------------|
| 1. Generalization of the Basic Accentuation Principle | [óσσσ...] |
| 2. Development of Secondary Stress | [óσòσò...] |
| 3. Reversal of Primary and Secondary Stress | [òσσσ...] |
| 4. Loss of iterativity | [òσσσ] |
| 5. Final Vowel Deletion | [òσσ] |

The tidiness of the changes from Proto-Indo-European to attested Classical Armenian proposed here and following Halle (1997) and Jacobs (2003) for Latin and Polish are heavily dependent upon the Basic Accentuation Principle. Without this first step, there is no clear way to motivate the rest of the developments. If this account is correct, Armenian stress adds more support to the compositional theory of Proto-Indo-European accent.

It is further interesting to note how similar the pathway from Proto-Indo-European into Canadian French is to that proposed here for Proto-Indo-European to Armenian. Classical Latin, abstracting away from its quantity sensitivity, had approximately the same stress system as the third stage above: [òσσσ]. By Old French, the final post-tonic syllable had been lost, compare Lat. *òrnaméntum* > Old French *ornement* ‘embellishment’ and *sàcraméntum* > *soirement* ‘oath’ (Jacobs 1989:21).¹⁸ That the only Indo-European languages with the hammock pattern followed the same diachronic stages is either a very striking coincidence or evidence of pathway bias¹⁹ in the development of this typologically-rare system.

2.6 Conclusion

It has been the aim of this chapter to establish a complete description of the accentual system of the earliest period of the Armenian language. While it has long been known that Classical Armenian had persistent final primary stress, no account of secondary stress is found in the literature. Based on geohistorical, phylogenetic, and typological factors, I have argued that the hammock pattern found in all Western and most Eastern dialects of

¹⁸For more on the change from Latin to French, see Jacobs (1990); Mester (1994); Lahiri et al. (1999).

¹⁹For biases in diachronic phonology, see Kiparsky (2006); Moreton (2008).

the modern language can be reconstructed for the period of common innovation, Proto-Armenian, and thus must also be reconstructed for the classical language. This early date for the development of the stress pattern was also supported by vowel reduction rules found in the earliest manuscripts and in the inscriptional record.

Finally, the possibility that the hammock system, like stress systems found in other branches such as Italic, can be derived from only the compositional theory of Proto-Indo-European accent lends further credibility to this theory as opposed to the traditional, non-compositional theory found in most Indo-European handbooks.

Now that the facts of Proto-Armenian stress assignment have been established, we can use them to motivate certain phonological developments that have heretofore received little attention and no explanation. Chief among our objects of inquiry will be the status of epenthetic vowels in initial position. We will see that initial vowels subject to the secondary stress assigned by the hammock pattern will be forced to change in sonority in order to bear this stress, while vowels outside the scope of stress assignment will be able to maintain their low sonority ranking.

Chapter 3

Armenian Prosodic Structure

Now that the full stress system for the earliest stages of the Armenian language has been established, we can investigate how prosody has interacted with phonotactics to influence the surface form of epenthetic vowels. The discussion will begin by tracing diachronic developments in phonotactics from the Proto-Indo-European period to Modern Armenian, focusing particularly on the loss of complex onsets during the Proto-Armenian period, when vowels were epenthesized in word-initial position to break up illicit clusters.

Armenian is somewhat unusual in presenting three different epenthetic vowels in what appears to be in the same phonological environment.¹ All three occur in word-initial position to break up a consonant cluster, and there is no reason to believe they belong to different chronological strata of the language. As Hall points out, cross-linguistically the epenthetic vowel is usually the default vowel of the language (often [ə], [i], or [i]), or its quality is determined by copying the vowel of the next syllable (Hall 2011:1581). Old Consonant-Resonant clusters inherited from Proto-Indo-European show either [e]- or [a]-epenthesis:

(24) Proto-Indo-European *#CR clusters:

¹For good overview of the typology of epenthetic vowels, see Hall (2011).

- a) **b^hrātēr* > *elbayr* 'brother'
- b) **drāku* > *artasuk^c* 'tear (nom. pl.)'
- c) **b^hreh₁-uer/n-* > *albewr* 'fountain'
- d) **g^wreh₂-uon-* > *erkan* 'millstone'

The examples of [e]- and [a]-epenthesis show that the quality of epenthetic vowel associated with old Proto-Indo-European CR-clusters cannot be determined by vowel copy (contrast *elbayr* 'brother' and *albewr* 'fountain').

Epenthetic schwa, on the other hand, systematically occurs before old Sibilant-Stop clusters:²

(25) Proto-Indo-European *#ST clusters:

- a) **steib-em-i* > *astipem* 'I rush'
- b) **sprH-n-am-i* > *asparnam* 'I threaten'
- c) **sth₂-n-am-i* > *astanam* 'I acquire'
- d) **sterih₂-* > *asterj* 'sterile'

In (25) we see that [ə] can occur in a syllable preceding high, mid, and low vowels. Therefore, vowel copy cannot explain the discrepancy in epenthetic vowel quality. It seems best to seek a phonological explanation. Can the epenthetic vowels be derived from a common source? I will argue below that there was only one original epenthetic vowel [ə], and that [e]- and [a]-epenthesis are derived from this default vowel due to interactions with secondary stress.

The secondary stress associated with the hammock pattern, by virtue of being sonority-sensitive, does not allow schwa to surface in the initial syllable of a prosodic word. Therefore, any epenthetic schwa in this position will be forced to change its quality. Epenthetic schwas associated with sibilant-stop clusters, however, remain unchanged due to the special nature of sibilant-stop clusters within prosodic structure. That the discrepancy in epenthetic vowel quality is due to stress will be supported by parallel developments in

²I give the renewed Proto-Armenian verbal endings rather than the original Proto-Indo-European forms.

prosodically deficient words such as appositions derived from old Proto-Indo-European preverbs.

3.1 Proto-Indo-European Syllable Structure

Proto-Indo-European allowed relatively complex margins, where sequences of three consonants were not unknown in onset or coda position:

(26) **psten-* ‘breast, nipple’: Avestan *fštāna-*, Sanskrit *stāna-*

(27) **h₂uékst* ‘made grow (3 sg. aor.)’: Gathic Avestan *vaxšt*

Based upon the reconstructable initial and final sequences of Proto-Indo-European words, Byrd (2010:107) sets up a Maximum Syllable Template “consist[ing] of two consonants in the onset and two consonants in the coda. The onset may violate the SSP [Sonority Sequencing Principle];³ the coda may not.” One extrasyllabic segment was allowed at the left edge of the word, and multiple were allowed finally: thus **<p>sten-*, **h₂uék<st>*. Byrd’s Maximum Syllable Template successfully accounts for a wide range of phonological phenomena:

- Deletion of laryngeals or vowel epenthesis next to laryngeals, e.g. **#CHC-*, **CHCC*, **#CH.CC* (Byrd 2010:40–63, 87), as well as the stop deletion process known as the *métron* rule (Byrd 2010:110–111).
- SSP violation in onsets, where otherwise we might expect stray erasure of unsyllabifiable consonants: **uk.stó-* ‘grown’, **s₆uek.sto-* ‘sixth’, **dhug.h₂ter-* ‘daughter.’

Because the Maximum Syllable Template works so well to predict so many seemingly unrelated phonological phenomena, I will follow Byrd in assuming it for the Proto-Indo-European period.

³For the SSP, see Section 1.2.1.

3.2 Syllable Structure in Modern Dialects

Modern Armenian has strict phonotactic constraints: “Armenian allows only simple and C(onsonant) + [j] onsets. Nuclei invariably consist of a single simple vowel. Codas contain a maximum of two segments” (Vaux 2003:102). The only violations of the SSP occur word-finally, where [s, k^h, m, r, ɸ] may be retained extraprosodically ([*mak^hs*] ‘tax (Eastern)’, [*partk^h*] ‘debt (Eastern)’, [*dak^hr*] ‘brother-in-law (Western)’, [*asɸ*] ‘star (Western)’, [*razm*] ‘battle’).⁴ In addition to these segments,⁵ [n] also may occur extraprosodically in the classical language. The extraprosodic segments attested in Classical Armenian were left behind after the deletion of final vowels in the late Proto-Armenian period (see Section 2.5 for a discussion of this deletion), e.g. Proto-Indo-European **pod-m* > Classical Armenian *otn* [ot<n>] ‘foot (nom./acc. sg.)’.

The best evidence for maximum syllable size comes from schwa epenthesis. Vaux (1998) and Dum-Tragut (2009) give underlying sequences of six or more consonants which are broken up with schwa to conform to the maximum syllable C(j)VRC: e.g., *hrmštkel* [hər.məʃ.təkəl] ‘to jostle’ and *mrt^çmrt^çal* [mər.t^h.mər.t^hal] ‘to mumble’ (Dum-Tragut 2009:37). These schwas must be epenthetic rather than underlying for a few reasons. First, Armenian speakers insert them in predictable slots in the word when presented with unfamiliar lexemes with unwritten schwas.⁶ Second, their positions are predictable by context (e.g., /lmnc^çnem/ must be syllabified as [ləmən^{t^h}sənem], not *[əlmənət^hsənem] or *[ləmnət^hsnem]). Third, their “deletion” due to morphological processes (especially pluralization) and the fact that they only sometimes participate in high vowel reduction would require many more complicated rules than assuming a simple epenthesis after these other processes occurred (Vaux 1998:66–70).

In sequences of sibilant + stop, however, the schwa is inserted word-initially: *spasel*

⁴For more discussion of these extraprosodic segments, see (Vaux 1998:83–84).

⁵[ɸ] is the Modern Eastern Armenian descendent of classical [f].

⁶It is a normal, though inconvenient, practice in Armenian orthography to leave schwas unwritten. See Section 3.4.1 below.

[əʂ.pa.sɛl] ‘to wait’, *zgal* [əz.gal] ‘to feel,’ *štap* [əʃ.tap] ‘urgent.’ This rule does not apply, however, if the sibilant and stop come into contact with one another (at least orthographically) due to the stress-dependent vowel alternation rules according to which high vowels reduce to schwa in non-final syllables.⁷ In cases like *stel* ‘to lie, speak falsely’, the reduced schwa occurs in the same position as the underlying high vowel, rather than in initial position as expected for the epenthetic schwa: [sə.tɛl] ‘to lie’ < *sut* [sut] ‘lie’ (Dum-Tragut 2009:31).

3.3 Classical Armenian Syllable Structure

The prehistory of the Armenian language is extremely obscure, but we do know that the area that would become the Armenian homeland was earlier the kingdom of Urartu. It appears the Armenians entered and displaced the Urartians at some point before the Persian conquest. Similarity in phonology and morphology points to extensive prehistoric contact with Georgian, which shows evidence of Iranian loans which must have traveled through Armenian and other Caucasian languages (Clackson 2008:125). After extensive contact with Proto-East Caucasian, Armenian acquired much stricter phonotactic constraints than the Maximum Syllable Template it had inherited from Proto-Indo-European: “The usual maximal syllable in modern [East Caucasian] languages is CVRC... CR clusters were prohibited in Proto-East Caucasian in both initial and medial position” (Kassian & Yakubovich 2002:44). These strict phonotactic constraints were an areal feature, affecting at least Proto-East Caucasian, Armenian, and Ossetic.

Furthermore, the Syllable Contact Law was very highly ranked in Classical Armenian:

THE SYLLABLE CONTACT LAW (SLC): A syllable contact A.B is more preferred, the greater the sonority of the offset A and the lower the sonority of the onset B

⁷See Section 2.2. These phonological operations seem to be identical in the classical and modern languages.

(Vennemann 1988:40).⁸

That is to say, a structure such as [-R.T-] is preferred over [-T.R-] cross-linguistically. Therefore, the preferred Classical Armenian polysyllabic word had the shape #(C)VR.CV...#. There is no obvious preference for word initial or word final segments; that is to say, they may be either vocalic or consonantal. There also does not seem to be any preference for how many syllables a word must have; there are many monosyllables attested, such as *tun* ‘house (nom/acc.sg.)’, and polysyllabic words, especially compounds, can attain considerable length.⁹

3.4 Epenthesis in Proto-Armenian

We have, by Armenian standards,¹⁰ ample evidence of the final result of word-initial stop-resonant clusters, repeated from (24) above:

(28) Proto-Indo-European *#CR clusters:

- | | | | | | |
|----|---|---|----------------------------|-------------------|--|
| a) | <i>*b^hrātēr</i> | > | <i>elbayr</i> | ‘brother’ | cf. Sanskrit <i>bhrátar-</i>
(Martirosyan 2010:252) |
| b) | <i>*drākū</i> | > | <i>artasuk^c</i> | ‘tear (nom. pl.)’ | cf. Greek <i>dákru</i>
(Martirosyan 2010:147) |
| c) | <i>*b^hreh₁-uer/n-</i> | > | <i>albewr</i> | ‘fountain’ | cf. Greek <i>p^hrēār</i> ‘spring’
(Martirosyan 2010:32) |
| d) | <i>*g^wreh₂-uon-</i> | > | <i>erkan</i> | ‘millstone’ | cf. Gothic <i>-qairnus</i>
(Martirosyan 2010:265–266) |

⁸In his book, Vennemann uses \$ to mark syllable boundaries and the term *consonantal strength* as his measurement. In this dissertation, I will use the more common term *sonority* and mark syllable boundaries with a period.

⁹There is some evidence that there may have been a minimal word constraint; the only words attested in Classical Armenian composed of only a single monophthong are function words: *i* ‘toward, in, away from’ and *o* ‘who? (nom. sg.)’.

¹⁰Recall that a minority of the Armenian lexicon is made of native material, so having more than one example of any given inherited structure is considered exciting.

In all examples of Proto-Indo-European #CR- words, the attested Classical Armenian form shows both metathesis of the cluster and initial prothesis of either [e] or [a]. All stops have undergone a consonant shift, somewhat like Grimm’s Law in Germanic, in which Proto-Indo-European voiced aspirates became Classical and Eastern Armenian voiced stops and Proto-Indo-European voiced stops have become voiceless stops.¹¹ The Proto-Indo-European voiceless stops usually become voiceless aspirates (or perhaps ejectives), although their developments are much more complicated than the other two series. The other phonological process evident in some of the forms above is liquid dissimilation, as seen in both *elbayr* and *albewr*. This dissimilation is completely regular in Armenian historical phonology.

The development of Proto-Indo-European initial clusters of the type #CR into Classical Armenian is relatively straightforward:

1. The ban on complex onsets triggers epenthesis preceding the cluster: #CRV > #əC.RV
2. Metathesis is triggered by the Syllable Contact Law: #əC.RV > #əR.CV
3. Initial schwa develops variously to either [e] or [a] under secondary stress.

There is no clear pattern for (3): the [e] and [a] variants lack a clear phonological distribution, and there are doublets for some words showing both [e] and [a] developments (e.g., *elbayr* beside *alb’ar* in the Mirak’ dialect. See Chapter 1). There is a lot of literature about the variation between [e] and [a], mostly attempting to figure out phonological distributions. For a good summary of the forms, arguments, and relevant citations, see Ravnæs 1991:16–25. For instance, Peters (1986) contends that the variation is due to dialect mixture, but there is no clear A-dialect vs. E-dialect attested at any point. Kortlandt (2001:11)¹² assumes that *e-* was the only real prothetic vowel in Armenian: “Since *a-* is limited to nouns and occurs side by side with *e-*, I think that it represents an original preposition after which

¹¹The end result of the consonant shift in Western Armenian is quite different, as shown in Section 1.1.3.

¹²Reprinted in Kortlandt 2003:131–132.

the prothetic vowel did not arise, in particular the expected cognate **a* of Slavic *po.*” Kortlandt’s etymology runs into some serious phonological trouble; for one, I know of no parallels for a word-final change of **o > a* in Armenian. In the absence of a clear phonological or dialectal explanation, I consider the issue an open problem and hope to have a more satisfactory solution in the future.

The outcome of these three processes can be seen in the developments of Proto-Indo-European **b^hrātēr* ‘brother’ and Proto-Indo-European **drakū-* ‘tear.’ I have glossed over the irrelevant phonological developments (e.g., the consonant shift and liquid dissimilation) already covered above:

(29)	Step	Process	<i>*bhrātēr</i>	<i>*drakū</i>
	1	#CRV > #əC.RV	<i>*əb^h.rā.tēr</i>	<i>*əd.ra.kū</i>
	2	#əC.RV > #əR.CV	<i>*ər.b^hā.tēr</i>	<i>*ər.da.kū</i>
	3	#ə > [è] or [à]	<i>èr.b^hā.tēr</i>	<i>àr.da.kū</i>
	4	Other Processes	<i>èl.báyr</i> ‘brother’	<i>àr.tá.su-k^ε</i> ‘tear (nom. pl.)’

These developments traced here for consonant-resonant clusters contrast sharply with those seen with original Proto-Indo-European sibilant-stop initial words, repeated from (25) above:

(30)	Proto-Indo-European <i>*#ST</i> clusters:				
	a)	<i>*steib-em-i</i>	>	<i>astipem</i> ‘I rush’	cf. Greek <i>steíbō</i> (Rix 2001:592)
	b)	<i>*sprH-n-am-i</i>	>	<i>aspařnam</i> ‘I threaten’	cf. Latin <i>spernō</i> ‘I despise’ (Winter 1962:256)
	c)	<i>*sth₂-n-am-i</i>	>	<i>astanam</i> ‘I acquire’	cf. Cretan Greek <i>stanúō</i> ‘I set’ (Rix 2001:590)
	d)	<i>*sterih₂-</i>	>	<i>asterj</i> ‘sterile’	cf. Sanskrit <i>starīs</i> (Olsen 1999:771)

1. The ban on complex onsets triggers epenthesis preceding the cluster: #STV → #əS.TV

2. Because sibilants are more sonorous than stops, there is no violation of the Syllable Contact Law. There is no cause for the cluster to undergo metathesis.
3. The epenthetic vowel remains schwa instead of changing to [e] or [a].¹³

3.4.1 Evidence of Schwa Placement

Although schwas are indicated in initial position before ST- clusters in the forms in Section 3.4 above, they are rarely if ever actually seen in Classical Armenian texts, since schwa is generally left unwritten in Armenian orthography. In the modern language direct evidence for schwa placement is easily attained: Native speakers generally produce [əS.T-] for underlying initial /ST-/.¹⁴ Evidence for its presence in the classical language, however, must be adduced on philological and morpho-phonological grounds.

There may be some direct evidence for schwa placement in the form of manuscript variants. Orthographic conventions dictate that a scribe write a schwa when he got to the end of a line in a manuscript and did not have space to finish his word. If a word of the shape ST- fell in just such a position in the line, the scribe would write <əs/t->. Unfortunately, I have not been able to locate any examples of this phenomenon for ST-clusters in available editions of early manuscripts. Further philological data comes from the spelling of foreign names: both <Skariovtac^ˈi> and <Iskariovtac^ˈi> ‘Iscariot’ are attested in the manuscripts of the Classical Armenian version of the Gospels. Because /i/ reduces to [ə] in non-final syllables (see Section 2.2), /#isk-/ and /#əsk-/ would be homophonous to the Armenian-speaking scribes.

In both the classical and modern language, ST-initial roots are treated as polysyllabic by morphology that is sensitive to syllable count. In Classical Armenian, aorist verb forms will bear a prefix *e-* (the so-called “augment” better known from Greek and Indic) if and

¹³The reason this vowel does not change will be given below in Section 3.4.3.

¹⁴Modern Eastern Armenian dialects have developed a certain amount of variation with respect to schwa placement since the 1970s. More conservative dialects still have [əS.T-], but some dialects now show [Sə.T-] or just [ST-]. Dum-Tragut (2009) attributes MEA variation to Russian influence from the Soviet era. All descriptions of Modern Western Armenian dialects indicate the conservative [əS.T-] variant only.

only if the verb form would be monosyllabic without it. The 3 sg. aor. form *span* ‘killed’ is unaugmented, contrasting with forms like *e-ber* ‘carried.’ The presence of the augment shows that speakers felt *span* was not truly a monosyllabic form. In the modern language, the plural morpheme has two allomorphs: *-er* is suffixed to monosyllabic stems, while *-ner* is suffixed to polysyllables. The monosyllabic plural morpheme cannot attach to roots beginning in ST-; instead, these roots take the polysyllabic plural morpheme *-ner*, cf. *stak* ‘coin,’ plural *stak-ner* vs. *k^har* ‘rock,’ plural *k^har-er* (Vaux & Wolfe 2009:121–122). Note, though, that while these morphological phenomena show the disyllabic nature of these forms, they do not necessarily show the exact location of the unwritten schwa for the classical language where speakers are not available to give pronunciations; i.e., the possibility of [səpan] like [sətəl] in Section 3.2 cannot be entirely excluded on the basis of the non-appearance of the augment alone.

The schwa is also apparent through productive sandhi rules in both the classical and modern languages. In Classical Armenian, the preposition *i*¹⁵ appears as *y* before vowel-initial words, e.g. *i leārn* ‘onto a mountain (acc.sg.)’ but *y-erkins* ‘in heaven (acc.pl.)’ ST-initial words sometimes behave as if vowel-initial with respect to the preposition *i*. MS variants show both *i štemarans* and *y-štemarans* ‘in chambers’ (Mt 24.26). This variation probably stems from the scribes treating the ST-initial word as consonant initial based on orthography in the first instance, and as truly vowel-initial based on pronunciation in the latter.

This behavior is paralleled in the modern language by sandhi rules involving the postposed definite article *-n*. When *-n* precedes a vowel-initial word, it remains *-n*; however, when it precedes a consonant-initial word, it reduces to *-ə*. Modern examples showing that the reduction to schwa in front of ST-clusters is blocked are abundant:

- (31) *Mek šabat^c ic^c arjakurd-n sksvoim ē.*
 one week_{gen.pl.} holiday_{nom.sg.} begin_{pres.part.} be_{3sg.pres.}

¹⁵This preposition is variously translated as ‘to, in, away from’ depending on the case of its noun complement.

‘The holidays start in one week.’ (Dum-Tragut 2011:32 fn.41).

In this example, the definite article surfaces as *-n* rather than *-ə* because ST-initial words are not actually consonant-initial. Because of the recent development in variation in schwa placement discussed above in Footnote 14, this sandhi rule is now highly violable in Eastern Armenian.

3.4.2 Armenian Epenthesis in Optimality Theory

In Section 1.2.2, we laid the foundation for our explanation of the difference between the [e] of [etbayr] and the [ə] of [əstipem]: the special nature of sibilant-stop clusters in many languages. Whereas stop-resonant clusters are able to form tautosyllabic clusters in languages with complex onsets, many languages require that the S of a sibilant-stop cluster be hosted somewhere higher in the prosodic hierarchy than the adjacent stop. In these languages, phonotactic constraints related to sonority outrank those related to prosodic structure. In order to formalize this account of Armenian prosodic structure in Optimality Theory, we will need the following constraints for the first stage of development in Proto-Armenian:

1. STRICT LAYER HYPOTHESIS: “a prosodic constituent of level C^i [should] immediately dominate only constituents of the next level down in the prosodic hierarchy, C^{i-1} ” (Selkirk 1995, updating Selkirk 1981 for implementation in Optimality Theory).
2. SONORITY SEQUENCING PRINCIPLE: Segments in complex onsets should rise in sonority towards the nucleus, and in complex codas they should fall in sonority away from the nucleus. Abbreviated SSP.
3. MAX: Do not delete segments.

The Strict Layer Hypothesis will be used here to penalize extraprosodic structures where segments are not contained within a syllable, but instead attach somewhere higher in the prosodic hierarchy, e.g.:

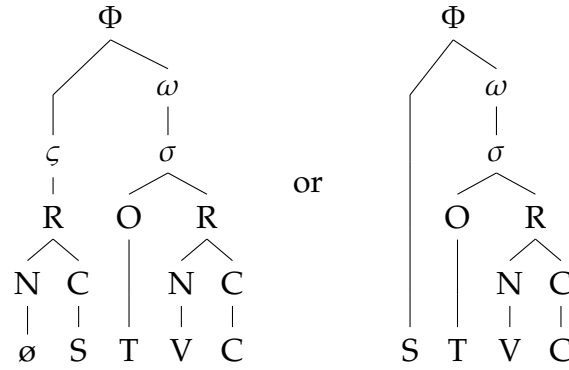


Fig. 3.1: Two possible extraprosodic structures, repeated from Section 1.2.2.

According to the Prosodic Hierarchy ($U \gg IP \gg \Phi \gg \omega \gg (\Sigma)^{16} \gg \sigma$, see Section 1.2.2), the phonological phrase ought to directly dominate the prosodic word, but in these structures it is shown dominating either (a) a semisyllable or (b) a segment. In both versions, levels are skipped within the prosodic hierarchy, incurring a violation of the Strict Layer Hypothesis.

In its original formulation, the Strict Layer Hypothesis was intended to be an inviolable cross-linguistic generalization, but it is now common in Optimality Theoretic treatments to assume this constraint, like most (if not all) others, is violable (e.g., Selkirk 1995; Kiparsky 2003; Ito & Mester 2013). By ranking the Strict Layer Hypothesis against other phonotactic and prosodic markedness and faithfulness constraints, Optimality Theory analyses are able to account for the wide variety of phonological patterns observable in languages. In the next chapter, I will advocate for a single type of representation, but for the present discussion all that is necessary is that Armenian ST-clusters are not tautosyllabic, and the S of such clusters violates the Strict Layer Hypothesis in attaching to a prosodic category higher than ω , the domain of stress assignment.

Because of the diachronic nature of the present analysis, the tableaux below will differ from the illustrative mini-tableau presented in Section 1.2.3 above in one very obvious way. In synchronic Optimality Theory tableaux, most input candidates are unsyllabified

¹⁶I omit the Foot node from Armenian discussions since there is no clear evidence that this level is relevant for Armenian prosody in any way.

since it is generally the task of the grammar to generate the syllabification. Here, however, the prosodic status of the previous generation’s grammar will be fully encoded in the input candidate, since the tableaux are intended to show the difference between two generations’ grammars, rather than synchronically generating either one. Therefore, the tableaux here are not intended to truly generate a grammar for any particular stage of Armenian, but instead they model how the grammars changed over time. For further discussion of Optimality Theory in diachrony, see Section 4.4 .

For the stop-resonant initial words, we will see no change for the earliest chronological layer of Proto-Armenian:¹⁷

[błayr] _ω ‘brother’	SSP	MAX	STRICTLAYER
☞ A. [błayr] _ω			
B. [błayr] _ω			*!
C. [bayr] _ω		*!	
D. [łayr] _ω		*!	

Tableau 3.1: Proto-Armenian *[błayr] > Proto-Armenian *[błayr] ‘brother’

Candidates B, C, and D are eliminated for incurring unnecessary violations. Because the syllable [błayr] is already well-formed according to the current grammar and violates no constraints, Candidate A is chosen as optimal and nothing happens at this stage of development. Furthermore, because the winning candidate violates no constraints, it is impossible to tell from just this tableau how the three constraints are ranked.

Changes will be seen, however, with the sibilant-stop clusters:

¹⁷The candidates represent a stage of Proto-Armenian after the consonant shift, loss of final syllables, and liquid dissimilation occurred. This choice is not intended to be a comment on relative chronology, but rather an attempt to make the candidates more recognizable to readers familiar with the attested forms.


[stipem] _ω ‘I rush’	SSP	MAX	STRICTLAYER
A. [stipem] _ω	*!		
 B. [s[tipem] _ω]			*!
C. [sipem] _ω		*!	
D. [tipem] _ω		*!	

Tableau 3.2: Proto-Armenian *[stipem] > Proto-Armenian *[s[tipem]_ω] ‘I rush’

Here, the candidate [stipem]_ω is eliminated because of the violation of the Sonority Sequencing Principle in the onset. Rather than delete the sibilant (Candidate D) or the stop (Candidate C), speakers chose to host the sibilant extraprosodically (Candidate B). The violation of the Sonority Sequencing Principle is alleviated by violating the Strict Layer Hypothesis. Since only the winning candidate violates the Strict Layer Hypothesis, we can securely rank SSP, MAX ≫ StrictLayer, but there is no way to tell from just these candidates what the ranking between the SSP and MAX is. At this stage, Proto-Armenian has developed a similar structure to what we will see in Italian (see Section 4.2–4.3), where sibilant-stop clusters are prosodically distinct from stop-resonant clusters, but there is not yet any epenthesis. At this point, the outputs for both the stop-resonant clusters and sibilant-stop clusters will be, at least perceptually, equivalent to the previous stage of the language. Phonologically, the sibilant-stop clusters have undergone an important change, but speakers do not seem to be sensitive to the difference between [ST-]_ω and [S[T-]_ω] pronunciations; for instance, no language that I know of contrasts the two structures synchronically (for more on this point and the phonetics behind this distinction, see Section 4.2).

In the next stage, speakers will gain the new phonotactic constraints described in Section 3.4 above. The metathesis and schwa epenthesis will be motivated by the following constraints:

4. SYLLABLE CONTACT LAW: Do not allow adjacent [-syllabic] segments to rise in sonority across a syllable boundary.

5. *#CC: A word may not begin with two consonants.
6. CONTIGUITY: If two segments are adjacent in the input, they must remain adjacent in the output.
7. LINEARITY: If two segments are adjacent in the input, they must remain in the same order in the output (i.e., no metathesis).
8. DEP: Do not epenthesize.

It is worth noting that the constraint *#CC makes no mention of prosodic structure. Following Côté (2000:36), I assume that word-level phonotactic constraints are purely sequential (see Section 1.2.1), whereas constraints like the Syllable Contact Law and Sonority Sequencing Principle refer to prosodic structure (of which the syllable is only one level). I leave for now the definition of “word” in the *#CC constraint’s definition vague; in the next chapter, we will specify what kind of structures underlie words like Armenian *astipem*, and at that point we can refine the definition of *#CC.

The highly ranked phonotactic constraints will trigger cluster metathesis and epenthesis in initial position in the following way:

[bʎayɾ] _ω ‘brother’	SCL	MAX	*#CC	CONTIGUITY	LINEARITY	DEP	STRICTLAYER
A. [bʎayɾ] _ω			*!				
B. [ʃbayɾ] _ω			*!		*		
C. [bʃayɾ] _ω			*!				*
D. [ʃbayɾ] _ω			*!		*		*
E. [bayɾ] _ω		*!					
F. [ʃayɾ] _ω		*!					
G. [bə.ʎayɾ] _ω				*!		*	
H. [əb.ʎayɾ] _ω	*!					*	
I. [əʃ.bayɾ] _ω					*	*	

Tableau 3.3: Proto-Armenian *[bʎayɾ] > Proto-Armenian *[əʃ.bayɾ] ‘brother’

Now that consonant clusters are illicit in word-initial position, the faithful candidate (A) will be eliminated by the constraint *#CC. Because this constraint does not make reference to prosodic structure, simply hosting the initial consonant extraprosodically does not satisfy the constraint. Therefore, both candidates C and D are eliminated. Candidate B is eliminated both for having a consonant cluster and for violating the low ranked faithfulness constraint against metathesis, LINEARITY. In fact, Candidate B is harmonically bounded (i.e., there is no ranking according to which it could win). In all rankings of the present constraints, Candidate A would always be chosen as optimal over Candidate B because B violates the same constraint as A plus one more. Similarly, Candidate D is harmonically bounded by C for the same reason. Both C and D are harmonically bounded by A and B, respectively, because of their violations of the Strict Layer Hypothesis. In the rest of the tableaux, I will minimize discussion of harmonically bounded candidates, since they will never be phonologically relevant.

Rather than delete one of the segments in the consonant cluster (Candidates E and F), a schwa is epenthesized to break it up. There are two possible sites for the schwa;

both prothesis and cluster-internal epenthesis will create licit structures. The constraint CONTIGUITY is used to penalize the medial intrusion of the schwa in Candidate G. The rationality behind this constraint is that speakers must have perceived the intrusive variety of epenthesis less similar to the original cluster pronunciation than the prothesis variety was (see Fleischhacker 2005:172-177 for further discussion of CONTIGUITY, particularly concerning Iraqi Arabic, which also shows initial prothesis with both sibilant-stop and consonant-resonant clusters). The metathesis is driven by the SYLLABLE CONTACT LAW, which penalizes stop-resonant contacts because stops are less sonorant than resonants are. Although the winning candidate I has undergone both metathesis and epenthesis (i.e., has violated both LINEARITY and DEP), it is chosen as optimal because all other candidates have already been eliminated.

Sibilant-stop clusters will also undergo epenthesis at this stage, but there will be no metathesis:

[s[tipem] _ω] 'I rush'	SCL	MAX	*#CC	LINEARITY	DEP	STRICTLAYER
A. [sti.pem] _ω			*!			
B. [tsi.pem] _ω			*!	*		
C. [s[ti.pem] _ω]			*!			*
D. [t[si.pem] _ω]			*!	*		*
E. [si.pem] _ω		*!				
F. [ti.pem] _ω		*!				
☞ G. [əs[ti.pem] _ω]					*	*
H. [ət[si.pem] _ω]				*!	*	*

Tableau 3.4: Proto-Armenian *[s[tipem]_ω] > Proto-Armenian *[əs[tipem]_ω] 'I rush'

Here, the epenthesis is also motivated by the highly-ranked constraint against initial clusters, which eliminates candidates A through D. Again, epenthesis is preferable to deletion (MAX ≫ DEP), and therefore the two deletion candidates (E and F) are eliminated. Be-

cause sibilants are more sonorous than stops, the metathesis candidate H is harmonically bounded by the optimal candidate G.

One obvious possible candidate has not yet been discussed: [əʰ.tipem]_ω, prosodically like the winner [əʰ.t.bayr]_ω above. From the constraints listed here alone, it seems like [əʰ.tipem]_ω ought to harmonically bound our winner (i.e., it only violates DEP and not STRICTLAYER like our winner does). This candidate, and the reason that it is not in fact optimal, will be discussed in Section 4.4 below.

3.4.3 Determining the Quality of Epenthetic Vowels

The Proto-Armenian development of schwa to [e] or [a] seen in words like Proto-Armenian **ərbayr* > Classical Armenian *əbayr* ‘brother’ is due to the intersection of phonotactic effects with stress patterns. As seen in Section 2.3.1, secondary stress has been documented on the initial syllable in Modern Western Armenian and most dialects of Modern Eastern Armenian. If we accept the proposal that Classical Armenian also had secondary stress on the initial syllable of the prosodic word (see Section 2.4), this would explain why the schwa that had been epenthesized to break up initial CR clusters developed variously to either [e] or [a]. The change in vowel quality was due to the low sonority of schwa:

SONORITY HIERARCHY FOR VOWELS: a > e, o > i, u > ə (Kenstowicz 1996)

This sonority hierarchy is based upon the fact that various phonological processes preferentially target certain vowels. The most obvious instantiation of this phenomenon is sonority-sensitive stress, i.e., prosodic systems in which languages prefer to stress low vowels if possible, followed by mid vowels, then high vowels, and finally reduced vowels (or some subset of these categories in this order). This prosodic bias towards low vowels can be easily motivated by phonetics; low vowels have intrinsically “longer durations and higher amplitudes” because of the longer travel time required to produce them (Keating 1985:119-120). This difference in duration and amplitude makes stress easier to perceive on low vowels than on less sonorous vowels.

A good example of this type of stress system comes from Takia, a language spoken in North New Guinea (de Lacy 2007:281, quoting Ross 2002, 2003):

- (32) Stress the rightmost syllable with [a]:
- a) [ta.mán] ‘father (sg.)’ b) [a.ra.tám] ‘you (pl.) bite us’
c) [ŋi.sá.ŋes] ‘hawk’ d) [ŋá.sol] ‘flee_{1sg.}’
e) [á.bi] ‘garden’ f) [bu.gu.gá.ru] ‘twins’
- (33) If there is no [a], stress the rightmost syllable with a mid vowel:
- a) [kir.ŋén] ‘her/his finger, toe’ b) [ŋi.é.mi] ‘your (pl.) legs/feet’
c) [i.fu.nó] ‘s/he hit you’ d) [mul.mól] ‘a kind of tree’
- (34) If there is no [a] or mid vowel, stress the rightmost syllable:
- a) [i.fi.ní] ‘s/he hit him’ b) [tu.bún] ‘her/his grandparent’

As de Lacy (2007) shows, the stress is attracted to the right edge of the word, but is also sensitive to the relative sonority of vowels.

In languages with sonority-sensitive stress like Old Church Slavonic, Chamorro, Yimas, and Mokshan Mordwin (McGarrity 2003), a highly-ranked constraint prevents schwa from bearing stress. In these languages, the ban on low-sonority vowels bearing stress can be repaired by either (a) altering the vowels to become more sonorous (Old Church Slavonic, Chamorro) or (b) moving the stress to a more sonorous vowel (Yimas, Mokshan Mordwin). The behavior of epenthetic vowels presented here strongly suggests Proto-Armenian must have had the first type of sonority-sensitive stress, and therefore changed the quality of low-sonority epenthetic vowels when they occurred initially in a prosodic word in order for them to bear secondary stress assigned according to the hammock pattern.

The system found in Classical Armenian can be motivated in Optimality Theory as follows:¹⁸

9. P/ó: Do not stress schwa.

¹⁸Constraints based on McGarrity (2003).

10. ALIGN(PWD, R, HD- $\acute{\sigma}$, R): The right edge of every word must be aligned with a primary stressed syllable. Abbreviated ALIGN-1R.

11. ALIGN(PWD, L, $\acute{\sigma}$, L): The left edge of every word must be aligned with a stressed syllable. Abbreviated ALIGN-2L.

Although typically alignment constraints are evaluated gradiently (i.e., the farther from the edge a given feature is placed, the more violations the candidate incurs; see Kager 1999:120–121 for discussion), it will not be necessary to assume that either alignment constraint is gradient in the tableaux below. Violations will be assessed based purely on whether or not the appropriate syllable bears stress. I will also assume a given alignment constraint is violated when stress does not surface at all.

12. IDENT(V): Do not change vowel features.

Although ALIGN(PWD, R, HD- $\acute{\sigma}$, R) is not actually necessary in any of the tableaux below, I have included it for the sake of showing the full hammock stress system.

[əł.bayɾ] _ω ‘brother’	P/acute sigma	ALIGN-1R	ALIGN-2L	STRICTLAYER	ID(V)
A. [əł.bayɾ] _ω		*!	*		
B. [əł.báyɾ] _ω	*!				
C. [əł.báyɾ] _ω			*!		
D. [báyɾ] _ω			*!		
E. [əł.bàyɾ] _ω		*!	*		
F. [èł.báyɾ] _ω					*

Tableau 3.5: Proto-Armenian *[əł.bayɾ]_ω > Classical Armenian [èł.báyɾ]_ω ‘brother’

Here, the faithful candidate A is eliminated because it violates the highly ranked alignment constraints by not surfacing with lexical stress at all. Candidate B violates the constraint against stressed schwa. In Classical Armenian, rather than deleting the stress (candidate C), deleting the syllable bearing the problematic stressed schwa (candidate D) or

moving the stress to a non-initial syllable (candidate E),¹⁹ the schwa developed into a more sonorous vowel in order to bear stress (candidate F).²⁰

The question remains, however, why the schwa is tolerated with ST-clusters in both the classical and modern language. I propose that this asymmetry, whereby schwa is allowed in initial position with ST-clusters but not with original CR-clusters, stems from the different structures discussed in Section 1.2.2, i.e., that the S of an ST-cluster is extraprosodic, and therefore any vowel epenthesized before it will be outside the prosodic domain, as we see in *stipem* ‘I rush’:

[ə̯s.[ti.pém] _ω] ‘I rush’	P/ó	ALIGN-1R	ALIGN-2L	STRICTLAYER	ID(V)
A. [ə̯s.[ti.pém] _ω]		*!	*	*	
B. [ə̯s.[ti.pém] _ω]	*!		*	*	
☞ C. [ə̯s.[ti.pém] _ω]				*	
D. [ti.pém] _ω			*!		
E. [è̯s.[ti.pém] _ω]			*!	*	*

Tableau 3.6: Proto-Armenian *[ə̯s[ti.pém]_ω] > Classical Armenian [ə̯s[ti.pém]_ω] ‘I rush’

Candidate E, which is seemingly similar to the winner [è̯l.báyr] above, is eliminated because the vowel is not initial in the stress domain, i.e., the prosodic word. Candidate C, the only one which shows stress on the initial syllable of the prosodic word, satisfies all of the markedness constraints and does not require any violations of highly ranked faithfulness constraints. We will return to the potential candidate (not listed in the tableau above)

¹⁹Candidate E also violates the constraint CULMINATIVITY (not shown in the tableaux), which requires words to have one syllable more prominent than the rest (Prince 1983), meaning that primary stress always surfaces preferentially over secondary stress when the two compete for the same syllable. It is likely that primary stress outranks secondary stress in all languages.

²⁰The constraints above are not enough to derive the synchronic variation between *e*- and *a*-epenthesis. As discussed above in Section 3.4, both variants are attested side by side in the texts with no obvious phonological or dialectal distribution. The Peak Prominence Hierarchy from McGarrity (2003) alone should favor *a*-epenthesis as less marked, but there may be other factors at play in deciding the optimal vowel quality, although, as pointed out to me by Kie Zuraw, [e] is more faithful to schwa. Perhaps it was the tension between these two options that created the variation in surface forms in the attested language.

[əs.ti.pem] > [ès.ti.pém] in Section 4.4 below.

3.4.4 *CLASH in Armenian

It was remarked in Section 2.4.2 above that languages with the hammock pattern sometimes do not allow stress clash (Gordon 2002:500); however, forms such as [ʃàlák] ‘back’ discussed above in Section 2.3.1 show that Modern Western Armenian must tolerate it because the vowel in the initial syllable does not reduce, in contrast to trisyllabic words such as /ʃalakel/ → [ʃàlkél] ‘to carry on one’s back’ (Vaux 1998:148). The change of [ə] to either [e] or [a] by the time of attested Classical Armenian, which I have argued was triggered by secondary stress on initial syllables, shows that Proto-Armenian, like Modern Western Armenian, must have tolerated stress clash because this change also occurs to the epenthetic vowel added before word-initial clusters in old Proto-Indo-European monosyllables, such as *trins ‘three (acc. pl.)’ > Classical Armenian *eris*:

13. *CLASH: Do not allow stress clash.

[ə.ris] _ω	P/ó	ALIGN-1R	ALIGN-2L	STRICTLAYER	ID(V)	CLASH
A. [ə.ris] _ω		*!	*			
B. [ə̇.ris] _ω	*!					*
☞ C. [è.ris] _ω					*	*
D. [ə̇.ris] _ω	*!	*				
E. [ə.ris] _ω			*!			

Tableau 3.7: Proto-Armenian *[əris]_ω > Classical Armenian [èris]_ω ‘three (acc. pl.)’

If *CLASH caused deletion of the secondary stress, Classical Armenian disyllabic forms would surface with initial [ə] rather than [e] or [a]. Because Candidate C ([è.ris]) wins, rather than Candidate B ([ə̇.ris]), it is clear that the alignment constraint dictating stress placement must have been more highly ranked than the constraint against stress clash.

This analysis relies on two assumptions: first, that Proto-Armenian had one and only one epenthetic vowel (see Hall 2011:1581 for a discussion of epenthetic vowel quality), and secondly that this original epenthetic vowel was [ə] and not [e] or [a]. If the sporadic failure of high vowels to reduce to [ə] in initial syllables in the classical language is due to secondary stress, as I tentatively proposed in Section 2.4.3, this is support that *CLASH remained ranked lower than ALIGN-2L into the classical period.

3.5 Initial Orthographic Schwa in Armenian

Initial orthographic schwa²¹ has a highly constrained lexical distribution. It is only consistently found in old Proto-Indo-European preverbs and words derived from compounds with Proto-Indo-European preverbs as first members:

- *ənd* ‘for, with’ < **h₂enti* (Beekes 2003:173),
- *ən-ker* ‘friend’ < **h₂ent-g^werh₃*- ‘one who eats with’ (Schmitt 2007:81),
- *ənd-o-cin* ‘a slave born into the house of his master’ < **h₂ent-o-ĝenh₁*- (Martirosyan 2010:280),
- *əst* ‘after, according to’ < **post*- (Pedersen 1982:209 = Pedersen 1906:431),
- *əst-gtanem* ‘I accuse’ < **post-uid-ṇn-em-i*²² (Schmitt 2007:86).
- *ən-tan-i* ‘kinsman (nom. sg.)’ < **en-dṃm-io*- (Olsen 1999:446),
- *əm-pem* ‘I drink’ if from **en-pib-e/o*- (Praust 1996:193–199; Viredaz 2004:76),²³
- *ənder-k^s* ‘innards’ < *(*h₁*)*enter-h₂*, cf. Greek *éntera* ‘intestines, bowels’ (Martirosyan 2010:280),

²¹Recall, the schwa before ST-clusters in words such as *stipem* and *stanam* is generally left unwritten according to Armenian orthographic practices. See Section 3.4.1 above.

²²With renewed verbal ending.

²³There are other proposed etymologies for this form. Meillet (1892:164), for instance, set up a nasal-infix present **pimb-e/o*-. See Martirosyan (2010:277–279) for discussion and citations.

Proto-Indo-European *[e] raised to [i] before nasals in the Proto-Armenian period (e.g., *cin* ‘birth’ < **ġenh₁-os*, cf. Lat. *genus*, Greek *génos* (Ravnæs 1991:6)) and was then subject to the vowel alternation rule that reduces [i] to [ə] in pretonic syllables (see Section 2.2); therefore, the schwa in forms with Proto-Armenian **en-* like *əntani* could be explained simply by appealing to the vowel alternation rule. However, the schwa in forms without **en-* in the first syllable cannot be explained in the same way. By normal sound laws, Proto-Indo-European **h₂enti-* and its derivatives ought to have become ***hant(-)* (cf. **h₂en-* > *han* ‘grandmother’ beside Latin *anus* and Hittite *hannas*), and similarly **post-* and its derivatives should probably have become ***ost(-)* (cf. **pod-m* (acc. sg.) > *otn* ‘foot (nom./acc. sg.)’ beside Latin *ped-em* and Greek *pód-a* (Beekes 2003:171)).²⁴ The initial schwa is completely unexplained by normal phonological developments.

The tendency for Armenian words of this type to have explicit schwas where the rest of the orthographic system discourages the writing of this letter shows that there must have been something markedly different about these forms. This difference, I believe, is related to their prosodic structure. Adverbial particles often have anomalous prosodic structures in many languages, especially where they tend to become cliticized. For instance, as Andrew Byrd points out to me, preverbs and postpositions were among the only words in the Proto-Indo-European lexicon²⁵ that broke the otherwise exceptionless minimal word constraints by being vowel initial, at least as reconstructed by the majority view. I will argue that their prosodic deficiency, both in Proto-Indo-European and in Armenian, is the reason they were so different from the rest of the lexicon. By the Proto-Armenian stage they were not independent prosodic words of their own, but rather obligatorily attached to an adjacent prosodic word, i.e. they were proclitic.²⁶

One of the best discussions of the prosodic structure of clitics and their relationship to the word that hosts them is found in Peperkamp (1997:157–211). She first reviews the

²⁴The fate of Proto-Indo-European **p* in initial position is somewhat complicated. See Ravnæs (1991:120–123) for discussion.

²⁵In addition to other prosodically deficient lexemes, like pronouns.

²⁶At least by the time of attested Classical Armenian.

phonological processes that target the juncture between clitics and host, such as English *r*-intrusion (Peperkamp 1997:171-3, following McCarthy 1993):

- (35) a) I saw *him* I [sɔ̃rɪm]
 b) *to* add [tə(*r)æd]
 c) give *you it* [gɪvjə(*r)ɪt]

Here the relevant clitics are marked with italics, and intrusive *r* is underlined in the phonetic spelling. In this variety, *r*-intrusion occurs between a host and enclitic (example A), but not between a proclitic and its host (example B), or when the enclitic is non-final in its prosodic word (*you* in example C). To explain this distribution, she sets up the following structures for English proclisis and enclisis, respectively:

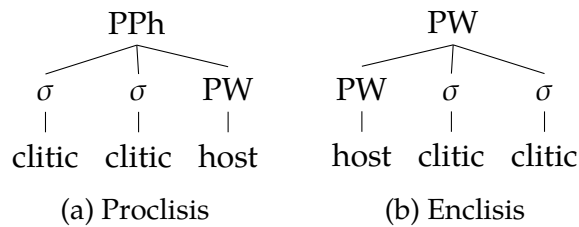


Fig. 3.2: Proclisis and Enclisis according to Peperkamp (1997:173).

For Peperkamp (1997), both types of clitics are prosodically deficient syllables attached to the prosodic structure in some way that violates the Strict Layer Hypothesis. The difference in attachment for proclisis versus enclisis is intended to reflect the difference in phonological effect that proclitics have on their hosts in comparison to the effect enclitics have on theirs. Because there is greater phonological cohesion between enclitics and their hosts than between proclitics and their hosts, proclitics attach to the Phonological Phrase, whereas enclitics attach to a recursive Prosodic Word. This analysis is able to capture the following facts about *r*-intrusion: “the rule applies at the right edge of lexical words (a) and at the right edge of phrase-final enclitics (b), whereas it is blocked at the right edge of proclitics (c) as well as between enclitics (d) and between proclitics (e)” (Peperkamp 1997:173). The commonality between (a) and (b) to the exclusion of (c) and (d) is that they

both occur at the right edge of a PW; (a) occurs at the right edge of the lower PW, and (b) at the right edge of the higher one. On the other hand, (c) occurs at the left edge of the PW; (d) is PW-medial; (e) is PPh-medial.

The structures in figure 3.2, however, are not universal. Language specific rankings of the constraints on prosodic structure (i.e., subparts of the Strict Layer Hypothesis) instead determine where in the prosodic hierarchy clitics can attach. Depending on how languages rank faithfulness (FAITH) constraints against EXHAUSTIVITY (the constraint which penalizes the skipping of layers) and NONRECURSIVITY (which penalizes the recursion of layers), languages may host clitics through prosodic phrase incorporation, prosodic word adjunction, or prosodic word-incorporation:

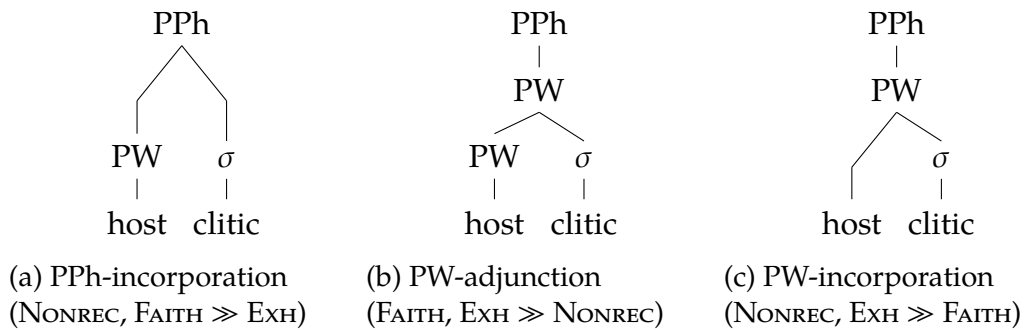


Fig. 3.3: Typology of structures associated with enclitics (Peperkamp 1997:196).

The first structure requires level skipping but does not allow recursive levels. In the second, there is recursion of the prosodic word, but no level skipping. In the last, neither level skipping nor recursion is allowed, and the clitic is incorporated directly into the host's prosodic word. These structures are motivated by the fact that languages and language varieties (in this case various dialects of Italian) differ with respect to the treatment of their clitics. The factorial typology presented here can explain the strength of the effect clitics have on their hosts; the closer they are in prosodic structure, the stronger the effect is predicted to be. With PPh-incorporation, it is predicted that clitics will have little if any prosodic or phonological effect on their hosts. With PW-adjunction, there is some effect, but it is not as great as with PW-incorporation, which shows the strongest effect because

of the close relationship between clitic and host.²⁷

The structures that Peperkamp (1997) presents to explain the behavior of clitics are strikingly similar to those presented above for extraprosodic S. In both structures, the Strict Layer Hypothesis is violated in order to host a prosodically deficient syllable (cf. the semisyllable analysis in Kaye 1992; Kiparsky 2003; Goad 2011, 2012) or a somewhat syllable-like group of segments (cf. the appendix analysis in Vaux 2003, 2014; Vaux & Wolfe 2009). Compare Peperkamp's Prosodic Phrase Incorporation and the Semisyllable analysis of ST-Clusters (adapted here from figure 3.1 above):

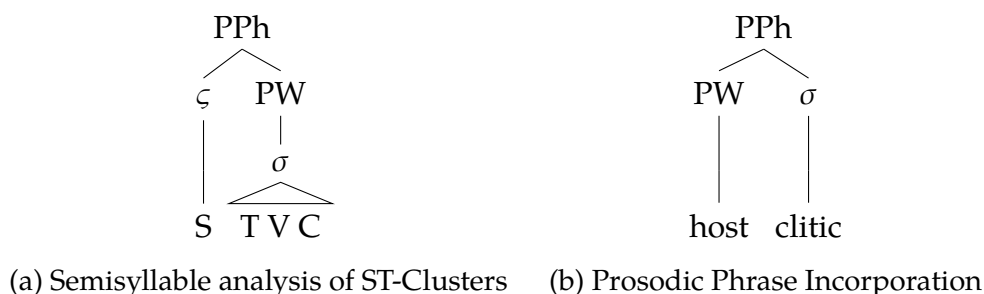


Fig. 3.4: Semisyllable Analysis of ST-Clusters beside Peperkamp's PPh-Incorporation.

Despite the difference in treatment by the orthography, old Proto-Indo-European preverbs and ST-clusters have developed initial vocalisms of the same quality because they are formed from prosodically identical or very similar structures. In both cases, a prosodically deficient unit is attached to a node higher in the prosodic structure than the domain of stress assignment. That these old preverbs, like the ST-clusters, must be prosodically deficient is obvious from their vowel qualities. Had the preverbs been stressed, their vocalisms would be completely unexplained. In the case of compounds with **h₂enti*, we expect the laryngeal to color the [e] to [a], and that the [a] would be retained into the classical language. Similarly, with **post*, the [o] vocalism should have been retained. That both Proto-Armenian *a* and *o* were reduced to schwa here can only be explained by the prosodic deficiency of these forms. Although the schwas associated with the two struc-

²⁷Ito & Mester (2007, 2009, 2013) advocate for similar structures based on the behavior of function words in English, German, and Japanese.

tures in figure 3.4 above arose via different pathways (in the first case through epenthesis before phonotactically illicit sequences, and in the second through vowel reduction), they ultimately function the same way in the prosodic phonologies of the classical and modern languages.

3.6 Conclusion

In this chapter, we traced diachronic changes in phonotactics from the parent language Proto-Indo-European, through the Proto-Armenian period, and into Classical Armenian. Inherited complex onsets were lost sometime in the Proto-Armenian period, and a vowel was epenthesised to support the consonantal sequence. If the original cluster conformed to the Sonority Sequencing Principle, the classical language shows an epenthetic [e] or [a]. If the original sequence had rising sonority, however, the epenthetic vowel is [ə]. I argued that the difference between surface epenthetic vowels in the classical language was due to the different prosodic structures of the clusters in the Proto-Armenian period when the epenthesis occurred. Specifically, the sibilant of ST-clusters at a certain stage of Proto-Armenian became extraprosodic, and thus any vowel epenthesised before it was outside the domain of stress assignment: the prosodic word. Old CR-clusters did not have any reason to form these extraprosodic structures, and therefore vowels epenthesised before the resonant were not outside the domain of stress assignment. Because Armenian stress is sonority sensitive, stressed schwas were forced to change their quality to bear stress, much like in Old Church Slavonic and Chamorro.

I next argued that during the Proto-Armenian period the constraint against stress clash, *CLASH, must have been ranked lower than the alignment constraints controlling stress placement, since epenthetic schwas developed to [e] even in original monosyllabic forms (which became disyllabic by epenthesis). This ranking may have persisted into the classical language, since high vowel reduction sporadically fails to apply in initial syllables, and

seems to be retained into the modern era in the western dialects.

Finally, I argued for the similarity in structure between extraprosodic sibilant clusters and clitics, based on the exceptional development in vowel quality in forms derived from old Proto-Indo-European preverbs, where expected [a] or [o] surfaces as [ə] instead due to the prosodically deficient nature of these preverbal elements.

In the next chapter, I will develop a theoretical account for extraprosodic structure to explain the various phenomena associated with sibilant-stop clusters in Armenian and elsewhere, based on articulatory phonology experiments performed on speakers of modern Indo-European languages. An ideal theory should be able to account for all of these behaviors without overgenerating possible phenomena not actually attested in the language data, as well as be constrained enough to explain why certain phenomena are never witnessed with these phonological sequences.

Chapter 4

The Structure of Sibilant-Stop Clusters

4.1 Introduction

In Section 1.2.2, I introduced some evidence from modern Romance languages and language acquisition that sibilant-stop clusters tend to be treated as phonologically special in some way by many languages. In Section 3.4.2, I proposed that the difference in vocalism of the epenthetic vowel associated with ST- versus old CR-clusters in the Proto-Armenian period stems directly from the special status of sibilant-stop clusters. The analysis presented in Section 3.4.2 is compatible with most current theories of extraprosodic structure found in the literature. In this chapter, I will review the competing theories of extraprosodic structure and present evidence in support of an analysis featuring semisyllables similar to those first proposed by Kaye (1992) and recursion of prosodic structure.

This chapter will attempt to answer three fundamental questions:

1. Is extraprosodicity necessary in phonological theory?
2. Is extraprosodicity universal for ST-clusters in all languages?
3. What structures are created by extraprosodicity?

In answering these questions, I hope to develop a constrained theory of extraprosodicity

that can generate the attested typology of behaviors associated with sibilant-stop clusters without overgenerating unattested phenomena.

4.2 Articulatory Phonology Data

One of the biggest problems with the debate surrounding extraprosodicity is that these structures are very abstract, and thus the evidence that can be advanced by any of the camps can easily be waved away by supporters of other theories. Because of its abstract nature, extraprosodicity looks a little bit like phonological cheating: we want our syllable structures to be arranged by the Sonority Sequencing Principle, and when this principle fails, we invent workarounds. Concrete data would be useful to show that extraprosodicity is a real phenomenon; further, it might shed some light on which of the structures we should set up, and whether the structures are universal or language-specific.

Articulatory phonologists have done a fair amount of work measuring timing relationships among consonants in different syllabic positions; for our purposes here, the most important observation is the so-called “C-center” effect of consonants in onset clusters (introduced briefly above at Section 1.2.1):

“As Cs are added to an onset, the timing of all Cs relative to the vowel is shifted: the C closest to the vowel shifts rightward to overlap the vowel more; while the first C slides leftward away from the vowel. The temporal center of the sequence, the c-center, maintains a relatively invariant timing to the vowel” (Nam et al. 2009:307).

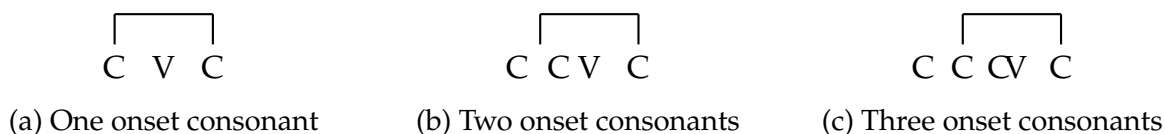


Fig. 4.1: The C-centering effect, repeated from Fig. 1.5.

This C-centering effect seems to hold for all true branching onsets cross-linguistically. Because this metric is so reliable, it can be used to diagnose anomalous prosodic structures for word-initial clusters that do not form real branching onsets.

Hermes et al. (2013) tested native speakers of Italian to determine if sibilant-obstruent clusters timed like true branching onsets by asking speakers to produce words with initial [C-], [SC-], and [CC-] in carrier sentences, e.g., *Per favore dimmi la rima di nuovo*. The four speakers were presented with each target word ten times in pseudo-randomized order, and the timing data for their gestures was recorded. The results are summarized in the following table, showing the target words in pairs of simplex onsets versus word-initial clusters. For each target word, the mean latency in milliseconds with respect to the vocalic anchor is given for the rightmost consonant (with standard deviations in parentheses):

speaker	target words	C	CC	target words	C	CC
S1	rima–prima	166 (11)	117 (7)	pina–spina	197 (8)	191 (11)
	rema–prema	151 (11)	124 (6)	fila–sfila	189 (17)	184 (10)
	rema–krema	151 (11)	119 (13)	vita–zvita	163 (12)	169 (15)
	lina–plina	203 (12)	165 (21)	kina–skina	248 (13)	259 (7)

Fig. 4.2: Timing measurements (ms) of Speaker 1 comparing the rightmost consonants for C-/CR- vs. C-/SC- (Hermes et al. 2013:11).

In the table, there is a stark contrast between the mean latencies for the simplex onsets versus stop-resonant clusters on the one hand and the simplex onsets versus sibilant-obstruent clusters on the other. Speaker 1 systematically shows a greater difference in latency for the first group; compare *rima–prima*, where the mean latency for the /r/ drops from 166ms to 117ms in the complex onset. The difference in mean latency is much smaller for the C and SC pairs; compare *pina–spina*, where the mean latency only drops from 197ms to 191ms.

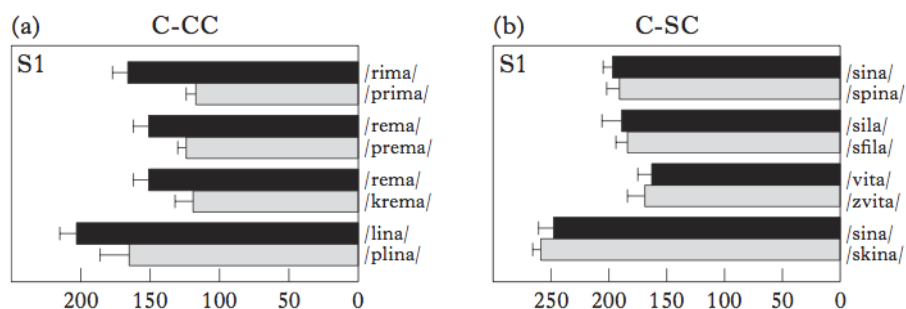


Fig. 4.3: Timing measurements (ms) of Speaker 1 comparing the rightmost consonants for C-/CR- vs. C-/SC- (Hermes et al. 2013:12).

The data show that Speaker 1 systematically exhibits the C-center effect in the C-/CR- pairs; the rightmost consonant intrudes on the vowel space after the branching onset to a much greater degree than after the simplex onset. This effect is far smaller (as trivially small as 2 milliseconds for Speaker 2) in the C-/SC- pairs. This discrepancy is also found for the other three speakers in Hermes et al.'s study. They found the effect on the rightmost consonant to be significant, with $p < 0.05$ for the CC vs. SC cluster type (Hermes et al. 2013:14).

The special status of SC-clusters is also evident in Italian phonology. For instance, SC-initial words take the *lo* allomorph of the definite article rather than the expected *il* seen with C-initial words (Hermes et al. 2013:2):

(36) Definite article allomorphs with various word-initial shapes:

- | | | |
|------------------------------|-----------------------------|---------------------------------|
| a) with Simplex Onsets | b) CC-initial words | c) SC-initial words |
| <i>il caffè</i> 'the coffee' | <i>il treno</i> 'the train' | <i>lo sport</i> 'the sport' |
| <i>il sale</i> 'the salt' | <i>il primo</i> 'the first' | <i>lo stipendio</i> 'the grant' |

Further, *raddoppiamento sintattico* (a gemination process of external sandhi that applies to word-initial consonants after certain vowel-final words) fails to apply across word boundaries if the second word is SC-initial (Hermes et al. 2013:3):

(37) Raddoppiamento Sintattico:

- a) *a presto* → [ˈapːɾɛsto] 'see you soon'
- b) *città sporca* → [tʃitˈtasːpɔrka] not *[tʃitˈtassːpɔrka] 'filthy city'

The phonological facts, together with the timing data above, lead Hermes et al. (2013) to conclude that SC-clusters in Italian do not form true branching onsets; instead only the C of the SC-cluster is truly in the onset anchored to the syllable nucleus:

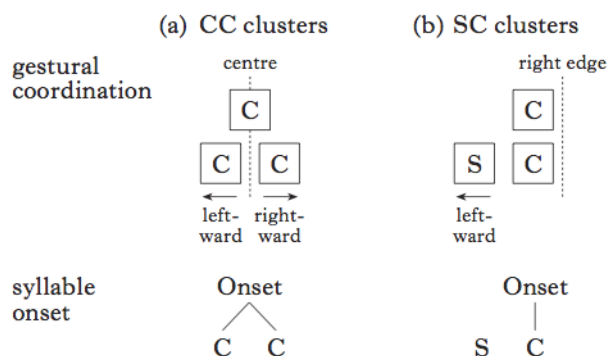


Fig. 4.4: “Schematised gestural coordination pattern and affiliation to the onset of the components of (a) CC clusters and (b) SC clusters” (Hermes et al. 2013:18).

The above diagram contrasts the structures built by Italian speakers for true branching onsets such as [tr-] in (a) versus non-branching SC-onsets in (b). Branching onsets exhibit the C-center effect, so that both consonants are displaced from the center, with the first consonant pushed slightly leftward and the second consonant shifted slightly rightward in comparison to the location of a simplex onset in relation to the anchor point. SC-clusters, however, do not show this shift. Instead, the right edge of the rightmost consonant shows approximately the same timing relation with respect to the anchor point as the right edge of a simplex onset does; the sibilant is significantly shifted to the left. These findings support the hypothesis that sibilant clusters may have special prosodic properties, and that these properties can be measured experimentally.

From Hermes et al.’s experiment alone, however, it is impossible to state whether the structures presented in Fig. 4.4 are universal or language specific. Marin & Pouplier (2010) tested both sibilant+stop onsets and stop+liquid onsets, among other clusters, to look for the C-centering effect in English, which lacks the strong dichotomy between sibilant-stop clusters and stop-resonant clusters found in Italian phonology. Native speakers were asked to produce sibilant-stop and stop-liquid clusters within carrier sentences, and the

results were measured in much the same way as described above for Hermes et al.'s experiment:

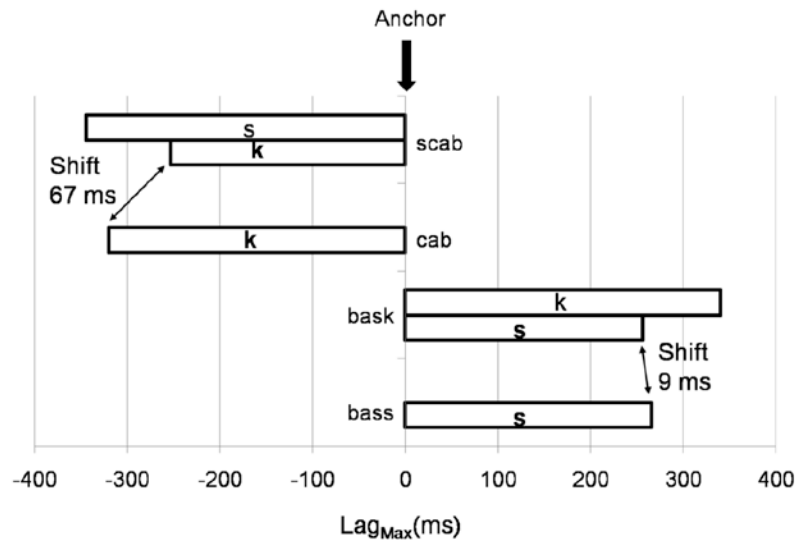


Fig. 4.5: Timing measurements of [sk-] vs. [k-] onsets and [-sk] vs. [-k] codas by one speaker of English. The [k] in the [sk-] onset is shifted with respect to the bare [k] of *kæb* (Marin & Pouplier 2010:388).

Marin & Pouplier (2010) found that the “/k/ in *scab* (preceded by /s/ and followed by a vowel) was timed differently compared with both singleton /k/ in *tea cab* and in *tease cab*. The observed temporal shift of the consonant in the cluster relative to its timing as a singleton could therefore not be due to its coarticulation context in the cluster, but rather to syllable affiliation” (392). Stop-resonant clusters were also found to exhibit the same displacement in complex onsets in comparison to their simplex counterparts. Again, the effect was found to be significant for cluster type, with $p = .002$ for /p/ vs. /sp/ in intervocalic position (Marin & Pouplier 2010:392).¹

The results of Marin & Pouplier’s experiment confirm that English sibilant-stop onsets exhibit the C-centering effect predicted of branching onsets². We should probably not be

¹Marin & Pouplier also found an unexpected C-center effect in complex codas made of resonant-stop clusters (recall, this relationship is expected in onsets but not in codas, see Section 1.2.1), but this finding is beyond the scope of the present discussion.

²These C-centering effects are generally found only in onsets; thus the [-ps] coda shows only a 2ms shift (reminiscent of the 2ms shift seen for [SC-] onsets in Italian above). The lack of C-centering in codas is a major point in the Articulatory Phonology literature, but beyond the scope of this discussion.

surprised that sibilant-stop clusters form true branching onsets in English; phonologically, they behave like onset clusters, as shown by their participation in the aspiration rule. If we assume that voiceless stops are aspirated when absolute initial in a word or a stressed syllable, then the blocking effect observed for medial [-sT-] clusters is easily explained. The presence of the [s] in the branching onset of a word like *discover* [di.skʌ.vɪ] bleeds aspiration. Contrast this with *discolor* [dis.kʰɹ.lɪ] where the morpheme boundary forces the cluster to be heterosyllabic. Articulatory Phonology can now answer questions #1 and 2 above; the experiments show that extraprosodic structure is necessary to explain the different prosodic behaviors exhibited between branching and non-branching word-initial clusters in languages like Italian. However, the results obtained for Italian cannot be universal, since English (and, it turns out, many other languages) does not show the same dichotomy between C-centering in CC-clusters and non-C-centering in SC-clusters that was observed for Italian.

4.3 Prosodic Structures and Extraprosodicity

At this point we are in better shape to start to answer question #3: what structure should we be setting up for ST-clusters in languages like Spanish, Portuguese, Italian, and Hindi where these ST/CR asymmetries can be found? In Section 1.2.2 I introduced four possible structures proposed in the literature to model extraprosodic structure: complex margins, semisyllables, appendices, and stray segments. Articulatory Phonology experiments tell us that in these languages, ST-clusters do not form true branching onsets; thus, complex margins cannot be the correct analysis. Further, as Vaux & Wolfe (2009:123) point out, stray consonants without attachment to higher prosodic structure would create problems concerning language-specific constraints, which would have no domain to specify. That is to say, if the stray consonant is attached to nothing, where is it? In a theory incorporating articulated syllable and prosodic structure, stray consonants make very little sense. This

leaves us with two options: syllable appendices or semisyllables.

One further bit of evidence that should be incorporated into a theory of prosodic structure and extraprosodicity is that in both diachrony and loan incorporation these extraprosodic structures are heavily correlated with a specific type of epenthesis; when a language lacking initial ST-clusters borrows an ST-initial word, speakers insert the epenthetic vowel *before* the cluster, whereas most other cluster phonotactic problems are resolved by epenthesizing a vowel *between* the two consonants of the cluster (compare the Hindi loan adaption of [firut] ‘fruit’ vs. [ɪskul]) ‘school’).³ Languages that show cluster-medial epenthesis with /ST/ almost always do so because they do not license sibilants in codas more generally, e.g. Korean [si.t^him] ‘steam’ and Japanese [su.pu:n] ‘spoon’. As Fleischhacker (2001:8) points out, “the result of prothesis before an initial ST cluster [in Korean], e.g. *[ist^him] ‘steam’, would be phonotactically illformed.” The one real exception, discussed already by Fleischhacker (2005:61–62), is Kamtok or Cameroonian Creole. Although Kamtok does allow some coda sibilants,⁴ ST-clusters sourced from English show cluster-medial anaptyxis: [sitón] ‘stone’, [sipún] ‘spoon’ (Fleischhacker 2005:61). Perhaps the lack of prothesis in Kamtok comes from the general avoidance of codas in most creoles.

In diachrony, many languages with extraprosodic ST-clusters eventually develop initial prothesis. Examples include Spanish, Portuguese,⁵ and Armenian. In both Spanish (Harris 1970; McCarthy 1981) and Armenian, when this epenthetic vowel is in a syllable that would ordinarily bear stress, the stress rule is modified; e.g. forms of Spanish *estar* ‘to be’ with unexpected final stress: *estóy* (1sg. pres), *estás* (2sg. pres.), *está* (3sg. pres.). That is to say, the Spanish [#es-], like Armenian [#əs-], somehow does not “count” in terms of metrical stress.

³Fleischhacker also discusses the case of Egyptian Arabic, where borrowed [SC-] sequences show prothesis and [CR-] sequences show medial epenthesis. The exception to the generalization occurs when Egyptian Arabic speakers encounter [SCR-] sequences; in these cases, they are forced to epenthesize the vowel between the first two consonants because triconsonantal sequences are not licit word medially: [sitrit] ‘street’, [siblaʃ] ‘splash’ (Fleischhacker 2001:8).

⁴Fleischhacker (2005:62) notes a “general preference (but not an absolute requirement) in Kamtok for consonants to be prevocalic.”

⁵In some dialects of Portuguese the [i] is optional; see Section 4.4 below.

Ideally, a full theory of extraprosodicity should be able to integrate the results of the Articulatory Phonology experiments above with the preferences seen in loan incorporation and diachrony. Vaux & Wolfe’s appendix theory cannot account for the bias towards initial prothesis associated with these segments. If the sibilant is a mere appendix, why would it preferentially attract a prothetic rather than cluster-internal epenthetic vowel? This distribution remains unsatisfactorily unexplained. The appendix theory also leaves unexplained why this prothetic vowel is opaque to stress assignment procedures.

The prosodic properties associated with sibilant-stop clusters addressed here can be modeled straightforwardly with Prosodic-Word Adjoined Semisyllables, compatible with the prosodic hierarchy as proposed by Ito & Mester (2007, 2009). According to this theory, the prosodic hierarchy has six inviolable (or rarely violated) properties (Ito & Mester 2009:138):

14. ROOTEDNESS: “There is exactly one node that dominates every other node.”
15. LINEAR ORDER: “The nodes immediately dominated by a node are linearly ordered from left to right.”
16. NO TANGLING: “For any nodes x and y , if x precedes y , then all nodes dominated by x precede all nodes dominated by y . This excludes both line crossing and improper bracketing (since nodes do not precede themselves).”
17. LABELING: “Each node bears a label, an element of the ordered set $PH = \{v > \iota > \phi > \omega > F > \sigma > \mu\}$, the *prosodic hierarchy*, whose elements stand in a relation of containment, as indicated.”
18. CONTAINMENT: “Each immediate dominance relation respects the containment structure of the prosodic hierarchy, in the sense that lower ranked elements do not immediately dominate higher-ranked elements.”

19. HEADEDNESS: “Every (non-terminal) prosodic category dominates a *head*, a prosodic category at the next lower level in the prosodic hierarchy.”

These properties generate well-formed prosodic trees for utterances, as illustrated by Ito & Mester for the utterance *Dinosaurs roamed Arizona* (Ito & Mester 2009:140):

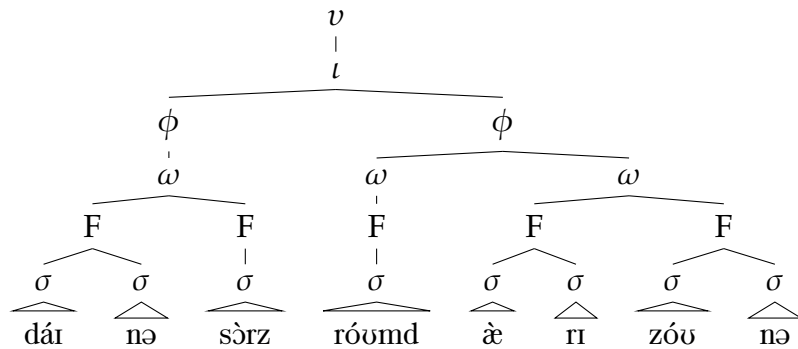


Fig. 4.6: Prosodic tree for the utterance *Dinosaurs roamed Arizona*.

The tree here is rooted in only one node (the Utterance, v). The constraints LINEAR ORDER and NO TANGLING prohibit branch-cross or improper precedence relations of the kind also barred from most theories of syntax; thus, prosodic groups ought to be contiguous and ordered from left to right. LABELLING specifies the prosodic hierarchy as it applies to this theory of prosodic structure. We will not require feet or morae in the discussion below, and therefore those two nodes will be omitted. CONTAINMENT prohibits lower levels of prosodic structure from dominating higher levels; e.g., a prosodic word (ω) cannot dominate a phonological phrase (ϕ). HEADEDNESS prohibits level-skipping within the structure, so that for example every phonological phrase will immediately dominate a prosodic word.

In addition to the six inviolable (or rarely violable) properties above, extraprosodicity also requires some of the violable constraints that make up the Strict Layer Hypothesis, for which see Section 3.4.2:

20. NO-RECURSION: “An element is parsed only once into a given category. Assign one violation mark for each additional parse of an element into the same category” (Ito

& Mester 2009:145).

21. PARSE-INTO-X: “Every element of the terminal string is parsed at the X-level” (Ito & Mester 2009:139).

Ito & Mester’s NO-RECURSION operates like Peperkamp (1997)’s NONRECURSIVITY (see Section 3.5). PARSE-INTO-X is similar to EXHAUSTIVITY, but Ito & Mester (2009) point out some important differences: “Whereas PARSE-INTO-X starts with the terminal string and asks whether it has been parsed into all the levels of the prosodic hierarchy, EXHAUSTIVITY looks at the tree structure itself, and scrutinizes the daughters of every node” (Ito & Mester 2009:148). If a language ranks PARSE-INTO- $\omega \gg$ NO-RECURSION, ω -adjunction will result. Ito & Mester (2009) use just such a structure to model the relationship between functional and lexical words in English (Ito & Mester 2009:157):

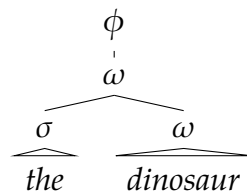


Fig. 4.7: ω -adjoined function word structure for *the dinosaur*

Here, the constraint NO-RECURSION is violated by the ω -level, where the function word adjoins to the maximal ω . Evidence that functional words do not form prosodic words of their own comes from their lower prominence relative to content words and their tendencies to reduce in various ways. Ito & Mester distinguish a maximal and minimal projection of ω (Ito & Mester 2009:170):

$$(38) \quad \chi_{\max(\text{imal})} =_{\text{def}} \chi \text{ not dominated by } \chi$$

$$(39) \quad \chi_{\min(\text{imal})} =_{\text{def}} \chi \text{ not dominating } \chi$$

By these definitions, the maximal ω is the highest ω in a structure, and the minimal ω is the lowest. When there is no recursion, ω is simultaneously maximal and minimal. Any

of these levels can serve as the domain for phonological rules; for instance, the R-intrusion rule of various dialects of English discussed above in Section 3.5 is sensitive to the maximal vs. minimal ω distinction (Ito & Mester 2009:170):

- | | | |
|------|--------------------------|-------------------|
| (40) | Example | Structure |
| a) | Pamela -r- Anderson | <i>lex-r-lex</i> |
| b) | Pamela -r- and Andy | <i>lex-fnc</i> |
| c) | writing to -*r- Anderson | <i>fnc-*r-lex</i> |
| d) | add to -*r- 'is troubles | <i>fnc-*r-fnc</i> |

According to their analysis, R-intrusion is proclitic and operates only on maximal prosodic words. It is blocked in (c) and (d) because the word it would attach to is already dominated by ω , and is therefore not a maximal prosodic word (depicted in boxes):

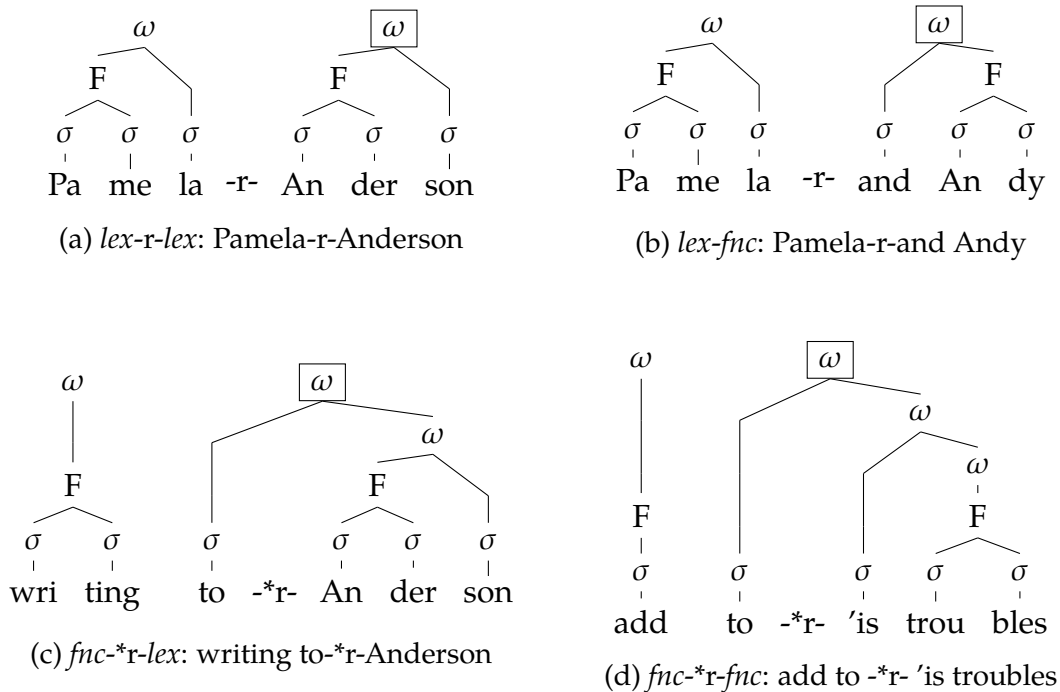


Fig. 4.8: Prosodic Structures for English R-intrusion (Ito & Mester 2009:170).

In both (a) and (b), the intrusive R is proclitic to a maximal prosodic word, the highest prosodic word projection in the structure. When the intrusive R is proclitic to a non-

maximal prosodic word projection, either the minimal ω in (c) or the medial ω in (d), it is ungrammatical. The specification of this domain explains why it is blocked between function words and their hosts, since this juncture would constitute a minimal prosodic word (Ito & Mester 2009:168–175).

We now have all the structure and constraints needed to build a theory of extraprosodicity that captures all of the insights above but does not overgenerate unattested structures. We need a structural position that precedes the onset to which segment(s) can attach. This position is provided by any structural position higher in the prosodic hierarchy than the minimal prosodic word (the domain of stress assignment). Further, the epenthesis facts are best captured if we assume this extraprosodic segment co-occurs with an optional (or empty) nucleus to be filled where required by sequential constraints; therefore, the segment must be hosted within a semisyllable, as first proposed by Kaye (1992). Because prothesis does not interact with stress, stress must be governed by a lower structural position than the one that these semisyllables attach to. We have already established that functional elements (=clitics) adjoin to the prosodic word. Thus, if semisyllables attached to the phonological phrase or higher, we would need to violate at least one of the inviolable constraints on prosodic structure above, either *CONTAINMENT* or *NO TANGLING*. The only sensible structure to set up for extraprosodic segments that captures all of these patterns is a prosodic-word adjoined semisyllable above the minimal prosodic word, but below the domain of clitic attachment:

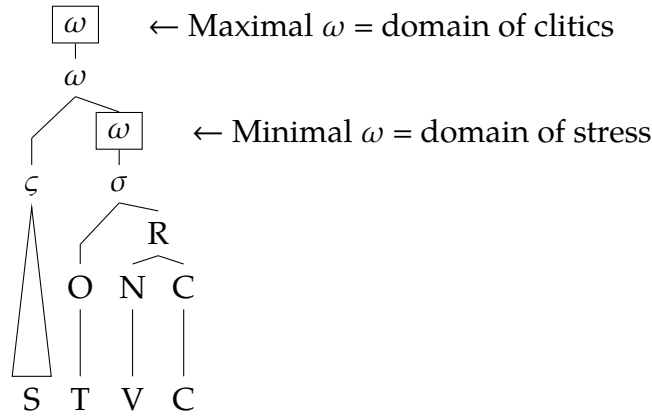


Fig. 4.9: [S]TVC] with extraprosodic initial [S]

Finally, when unsyllabifiable segments occur word internally, they tend to be deleted. This “stray erasure” of segments stems directly from the structure of extraprosody; because extraprosodic segments adjoin to the prosodic word, and prosodic wellformedness prohibits the tangling of branches within the structure, there is no way for ω -adjoined extraprosodic segments to surface word-medially. For example, Byrd (2010:85) discusses the case of Proto-Indo-European $*/d^hugh_2tr\acute{e}s/ > *[d^huk.tr\acute{e}s]$ ‘daughter (gen. sg.)’, where the medial laryngeal is deleted by stray erasure because Sonority Sequencing Principle violations are not permitted in Proto-Indo-European codas, and only two onset consonants were permitted by Byrd’s syllabification algorithm (see Byrd 2010:107 and Section 3.1 above). The stray erasure of the laryngeal predicted by Byrd’s algorithm is directly reflected in the prosodic tree for this word:⁶

⁶See Byrd (2010:83ff.) for further examples and discussion of stray erasure in Proto-Indo-European.

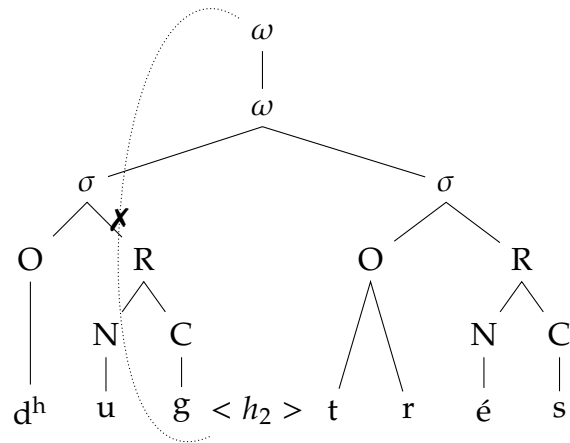


Fig. 4.10: *[dʰug <h₂> trés] with ungrammatical medial extraprosodic segment.

It is the constraints on prosodic wellformedness above that cause the stray erasure of medial unsyllabifiable segments. There is no way for a medial segment to adjoin to the ω node without violating LINEAR ORDER or NO TANGLING. Notice also that this constraint on the realization of extraprosodic segments (i.e., that they must occur at ω -boundaries in order to satisfy the prosodic wellformedness constraints) is not predicted by the Stray Segment theory. If we assume that extraprosodic segments are unattached within prosodic structure, there is no reason for stray erasure to delete medial segments.

4.4 The Typology and Diachrony of Extraprosodicity

The cross linguistic variation we find in prosodic structure, i.e. that some languages license ST-branching onsets and others create <S>T- structures, falls out directly from the interactions between prosodic constraints and the Sonority Sequencing Principle. Learners acquiring a language like Italian or English would encounter word-initial clusters that generally obey the Sonority Sequencing Principle. They would have no evidence, for instance, that [rt-] is an acceptable word onset. The only exception to this generalization in

these languages would be the ST-clusters. Faced with such words, learners have a choice to make: is it better to violate the Strict Layer Hypothesis (or some of its subparts) or the Sonority Sequencing Principle? If learners choose the ranking STRICT LAYER HYPOTHESIS \gg SONORITY SEQUENCING PRINCIPLE, they will end up with an English-type language; with SONORITY SEQUENCING PRINCIPLE \gg STRICT LAYER HYPOTHESIS, they acquire an Italian-type language:


#ST-	NO-RECURSION	SSP
A. <S>T-	*!	
 B. ST-		*

Tableau 4.1: English-type grammar: NO-RECURSION \gg SSP


#ST-	SSP	NO-RECURSION
A. ST-	*!	
 B. <S>T-		*

Tableau 4.2: Italian-type grammar: SSP \gg NO-RECURSION

There is likely no difference in pronunciation of initial sibilant-stop clusters between the two languages that speakers would be sensitive to, although we should expect a C-center effect on the clusters in the English-type grammar but not in the Italian-type. If the two languages have phonological processes sensitive to coda consonants, there would be word-medial processes that differentiate their grammars, since the high-ranking of the Sonority Sequencing Principle would create heterosyllabic S.T clusters, but the English-like grammar would maximize ST-onsets.

Spanish- and Armenian-like prothesis is generated by a sequential constraint against initial /ST-/ (in the Spanish case) or consonant clusters in general (in the Armenian case, for which see Section 3.4.2):

#ST-	SSP	*#ST	NO-RECURSION
A. ST-	*!	*	
B. <S>T-		*!	*
☞ C. <əS>T-			*

Tableau 4.3: Spanish-type grammar: SSP, *#ST-, ≫ NO-RECURSION

I have argued that in languages like Spanish and Armenian, where the initial prothetic vowel is invisible to stress assignment, the segments [əS] are extraprosodic, but from just these constraints there is no obvious reason why they should be. There is one additional candidate, which I briefly mentioned in Section 3.4.2 above, that should fare better against these constraints than Candidate C does: [əST-]:

#ST-	SSP	*#ST	NO-RECURSION
A. ST-	*!	*	
B. <S>T-		*!	*
☹ C. <əS>T-			*
☞ D. əS.T-			

Tableau 4.4: Pseudo-Spanish-type grammar with optimal [əST-]

Because Optimality Theory candidates are judged against the constraints in parallel, on the surface it seems that the non-extraprosodic epenthesis structure ought to be chosen in all epenthesis languages; i.e., [<əS>T-] should be harmonically bounded⁷ by [əST-] regardless of the relative rankings of the constraints on prosodic structure and phonotactics.

However, we know that speakers are sensitive to the similarity between syllable phonotactics and word phonotactics. One such proposal is the Word-Based Syllables approach: “the possibility of parsing a string abc into ab and c is, in part, a function of the similar-

⁷A candidate is harmonically bounded when there is no possible ranking in which it could be chosen optimal (i.e., there is another candidate that always fares better against the constraints than it does). See Section 3.4.2.

ity between b and known word-finals and of the similarity between c and known word initials" (Steriade 1999:223). Conversely, if speakers have knowledge of medial syllabification because of various phonological processes, they should be able to interpolate from that knowledge the structure of initial and final segments. Consider the case of European Portuguese, for instance, repeated here from Section 1.2.2 (Mateus & d'Andrade 2000:11-13, 43):

(41) Intervocalic sibilants (both [s] and [ʃ]):

- a) [káʃ] 'hunt'
- b) [áfʃ] 's/he finds'

(42) Word-medial sibilants in clusters (only [ʃ]):

- a) [páʃtu] 'pasture'
- b) [Ráʃkɐ] '(of) bad quality'
- c) [suʃpíru] 'sigh'

(43) Word-final sibilants (only [ʃ]):

- a) [máʃ] 'bad (fem. pl.)'
- b) [páʃ] 'peace'

(44) Word-initial sibilants in clusters after [i]-deletion (only [ʃ], see also Ferreira & Holt 2014:135):

- a) [ʃpásu] <espaço> 'space'
- b) [ʃtár] <estar> 'to be'

In a language such as this, speakers would have reason to believe that initial S in ST-clusters was coda-like based on its medial behavior. In contrast to European Portuguese, in Brazilian Portuguese ST-clusters are not permitted in initial position (Mateus & d'Andrade 2000:45):

(45) Word-initial sibilants in clusters with [i]-epenthesis:

- a) [iʃpásu] <espaço> 'space'
- b) [iʃtár] <estar> 'to be'

The word-initial vowel in Brazilian Portuguese, like its Spanish equivalent, is unstressable. My proposal is that speakers acquiring languages with extraprosodic structures are sensitive to Word-based Syllables, and therefore bootstrap their word-initial prosodic structure off their medial syllabifications. Languages with overt clues to the status of word-medial ST syllabification, such as Portuguese, would allow speakers ample evidence that initial ST- is not a branching onset.⁸ From there, faithfulness constraints on prosodic structure do the rest of the work to keep speakers from re-incorporating the sibilant into the prosodic word once an epenthetic vowel is triggered by sequential constraints:

22. FAITH: “Do not modify lexically built prosodic structure” (Peperkamp 1997:189).

#<S>T-	FAITH	SSP	*#ST	NO-RECURSION
A. ST-	*!	*	*	
B. <S>T-			*!	*
C. <əS>T-				*
D. əS.T-	*!			

Tableau 4.5: Spanish-type grammar with optimal [<əS>T-]

Here, the expected winner from tableau 4.4, Candidate D, is eliminated by the constraint FAITH. Although the winner, [<əS>T], violates the prosodic constraint against recursion in prosodic structure, this constraint is non-fatal because the constraint against changing prosodic structure is higher than NORECURSION. This epenthesis likely started out life as an optional postlexical process,⁹ and therefore the next generation would have encountered these vowels as inherently unstressed, since the epenthesis occurred after stress was applied in the lexical cycle. Prosodic bootstrapping by language learners would reinforce the extraprosodic structure of the vowel in any language with prosodic word-initial stress

⁸For Romance languages these developments can be traced as far back as Classical Latin. See DeLisi (forthcoming) for the synchronic and diachronic phonological details.

⁹For the association between postlexical phonology and diachronic changes in grammar, see Kiparsky (2008).

(e.g., Spanish, Armenian), where these vowels would be the only exception to their normal stress rule, especially if the vowel in the following syllable surfaces with the normal word-initial stress.

This analysis relies on a very specific pathway. First, the Sonority Sequencing Principle is promoted in the grammar and medial -ST- clusters are resyllabified as heterosyllabic [S.T]. A single grammar would not allow the simultaneous surfacing of medial [S.T] and tautosyllabic initial [ST-] because of the violation of Word-Based Syllables; therefore, initial S becomes extraprosodic. At this stage, we have an Italian-type language. Epenthesis is later triggered by sequential constraints, but the re-incorporation of the semisyllable into the prosodic word is blocked by FAITH.

The various stages of development are depicted below with the words for “school” in English (with tautosyllabic ST-), Italian, and Spanish:

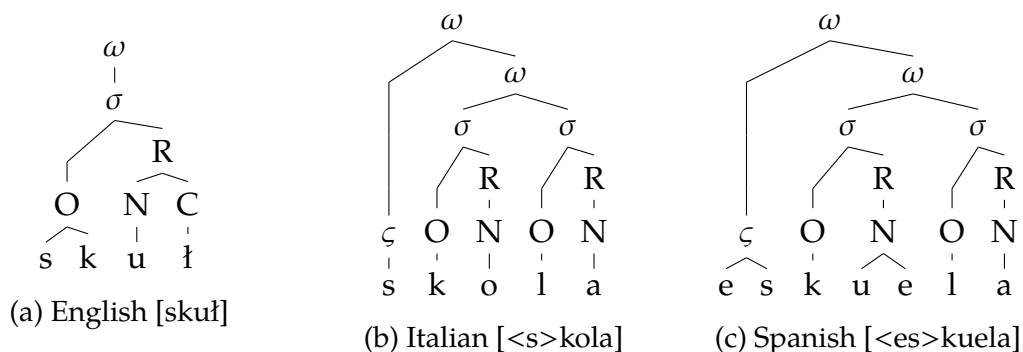


Fig. 4.11: Prosodic structures for word-initial /ST/ in English, Italian, and Spanish.

The English structure (a) shows a tautosyllabic branching onset, as predicted by the articulatory phonology experiments of Marin & Pouplier (2010)’s finding that English initial sibilant-stop clusters show the C-centering effect just like all other branching onsets. Similarly, the lack of aspiration on the [k] shows that the stop is not initial in its syllable. The Italian structure in (b) shows the semisyllable [<s>] adjoined extraprosodically to the maximal projection of the prosodic word. This structure is likewise consistent with the findings of articulatory phonology experiments (Hermes et al. 2013), as well as the strange behavior of initial sibilant-stop clusters within synchronic Italian phonology. It is

likely the empty nucleus of the semisyllable that causes speakers to associate sibilant-stop initial words with the *lo* allomorph of the definite article, rather than the expected *il* associated with other consonant-initial words (Goad 2011:908). In Spanish, the nucleus of the extraprosodic semisyllable is obligatorily filled. This vowel is invisible to stress assignment procedures because it is outside the domain of stress, the minimal prosodic word.

4.5 Conclusion

The intent of this chapter was to answer three basic questions about sibilant-stop clusters:

1. Is extraprosodicity necessary in phonological theory?
2. Is extraprosodicity universal for ST-clusters in all languages?
3. What structures are created by extraprosodicity?

The answer to question 1 was *yes*: extraprosodicity is the most parsimonious explanation for the various phenomena that are associated with word-initial consonant clusters of the shape sibilant-stop, including the synchronic phonological processes targeting them but not other onset clusters, their behavior in first and second language acquisition, and their failure to exhibit the C-centering effect expected of branching onsets in certain languages. Extraprosodicity is not phonological cheating, contrary to the criticism of Côté (2000:23),¹⁰ but rather a measurable phenomenon.

The answer to question 2 must be *no*: there is cross-linguistic variation in the ranking between the Sonority Sequencing Principle and the constraints on prosodic structure. In languages like English, there is no synchronic asymmetry between sibilant-stop clusters and stop-resonant clusters. In fact, ST-clusters participate in the C-center effect as expected of tautosyllabic branching onsets. Therefore, extraprosodicity must not be universal; in-

¹⁰See Section 1.2.1: “[Extraprosodicity] considerably weakens the syllabic licensing approach and makes it in essence unfalsifiable” (Côté 2000:23).

stead, it is an option that languages can use to rescue marked sonority profiles rather than deleting one or more of the cluster segments.

I have argued that languages exhibiting sibilant-stop extraprosodicity build semisyllables that adjoin to the prosodic word. This adjunction creates recursion within the prosodic word projection. The minimal prosodic word, the lowest ω , is the domain of word-level stress assignment. The maximal prosodic word allows for the attachment of the semisyllable outside the domain of stress. The semisyllable is built of a coda-like segment (the sibilant) and a nucleus that can be either empty, as in Italian and European Portuguese, or filled, as in Spanish, Brazilian Portuguese, and most dialects of modern Armenian. That the semisyllable is outside the minimal prosodic word explains why the vowel in the filled nucleus is invisible to stress assignment in languages that otherwise show word-initial stress.

It is this bias towards word-initial prothesis that furnishes the best argument against the appendix theory of extraprosodicity; if an extraprosodic segment is a mere appendix with no other structure, there is no reason why sibilant-stop clusters should overwhelmingly attract prothetic rather than cluster-medial epenthetic vowels.

I argued against stray segments by showing that extraprosodicity is constrained by prosodic position; because extraprosodicity involves adjunction to the prosodic word projection, extraprosodic segments cannot occur word-internally; this limitation is the mechanism that drives so-called stray erasure, where unsyllabifiable segments occurring word-medially must be deleted because extraprosodic structure cannot be built without violating the constraints *NOTANGLING* or *LINEAR ORDER*. That is to say, there is no way to adjoin a word-medial semisyllable without creating illicit prosodic structure.

Chapter 5

Conclusion

In this dissertation I have attempted to answer the following question: why does Classical Armenian have three different reflexes for the Proto-Armenian epenthetic vowel word-initially before old Proto-Indo-European consonant clusters? Two of the vowels, *e* and *a*, occur in the same phonetic environment, and even in doublets (e.g., Classical *elbayr* beside dialectal *albär* ‘brother’). These two vowels may have originally been confined to separate dialects with this distribution later obscured by dialect mixture, or there may have been some phonological conditioning that has since been lost. The third vowel, *a*, however, has a very different distribution. This vowel is associated with old sibilant-stop clusters inherited from Proto-Indo-European, whereas *e* and *a* are associated with old consonant-resonant clusters.

In Chapter 2, we investigated the historical dialectology of Armenian to determine what the original stress system in the language must have been, at least at the last stage of common innovation, the Proto-Armenian period. The distribution of modern dialects and the phylogenetic analysis agree in indicating that the hammock pattern ($\check{\sigma} \dots \acute{\sigma}$), found in all dialects of Modern Western Armenian and most dialects of Modern Eastern Armenian, must be the more conservative accent system, in comparison to the penult system found only in certain Eastern Armenian dialects. The penult dialects are central in their area,

forming a focal point from which the change must have emanated, with the conservative hammock varieties along the periphery of the innovation; see the map in Fig. 2.1.

This story is corroborated by the phylogenetic analysis of 21 modern and historical dialects. In the maximum parsimony tree produced by PAUP* (see Fig. 2.2), all six penult dialects are grouped together under a single node (38), suggesting common descent with modification. That the hammock dialect Mełri was also dominated by this node may be attributable to later contact between the dialects Mełri and Karchevan, which are spoken very nearby to each other.

Synchronic phonological processes further support the conclusion that the hammock pattern should be projected back to the earliest stages of Armenian; the same kind of medial vowel reduction found in hammock varieties of Modern Western Armenian dialects is also found sporadically in both the manuscript tradition and inscriptional record. Compare the following deletions, discussed in Section 2.3.1 and Section 2.4.3, respectively:

(46) Modern Western Armenian:

- a) /falakel/ → [falkél] ‘to carry on one’s back’
- b) /sovorel/ → [sòvrél] ‘to study’
- c) /falak/ → [fálák], *[flak] ‘back’

(47) Classical Armenian Gospels:

	E. Manuscript	M. Manuscript	Gloss
a)	<i>andamaloyc</i>	<i>andamloyc</i>	‘paralytic (nom./acc. sg.)’
b)	<i>patasxani</i>	<i>patsxani</i>	‘response (nom./acc. sg.)’
c)	<i>barjak^cac^c-n</i>	<i>barj/kc^cac^c</i>	‘companion (gen./dat./abl. pl.)’

In both the Modern Western and Classical Armenian examples, medial vowels are lost because they are atonic.

Having established the full stress system for Proto-Armenian, we are able to address how the prosody has interacted with phonotactics and syllable structure constraints to drive the variation in epenthetic vowel quality between *ə* on one hand and *e* and *a* on

the other. The main constraint driving this asymmetry is the promotion of the Sonority Sequencing Principle in the grammar. Because sibilants are more sonorous than stops, the promotion of the Sonority Sequencing Principle above the Strict Layer Hypothesis causes speakers to create a semisyllable to house the sibilant extraprosodically. This extraprosodic structure is not required for old consonant-resonant clusters since they already conform to the Sonority Sequencing Principle. Because Armenian has sonority-sensitive stress, the secondary stress placed on word-initial epenthetic vowels by the hammock pattern triggers a vowel change in all words without extraprosodic structure, i.e., with the old consonant-resonant clusters. Therefore Proto-Armenian */əlbayr/ becomes Classical Armenian [ɛ̌l.báyɾ] ‘brother,’ but Proto-Armenian */<əs>tipem/ with extraprosodic <əs> becomes [<əs>.t̪i.pém] ‘I rush’ because the schwa is outside the domain of stress assignment.

In Chapter 3, we investigated the possible structures for capturing the phonological properties associated with extraprosodicity:

1. Lack of C-center effect
2. Coda-like behavior (as in European Portuguese)
3. Attraction of prothetic vowels
4. Invisibility to stress assignment
5. Inability to occur in ω -medial position

The most parsimonious structure was found to be the semisyllable, as originally proposed by Kaye (1992), which attaches extraprosodically to a recursive prosodic word (Ito & Mester 2007, 2009):

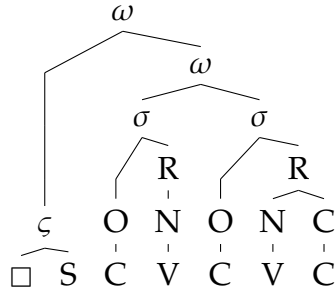
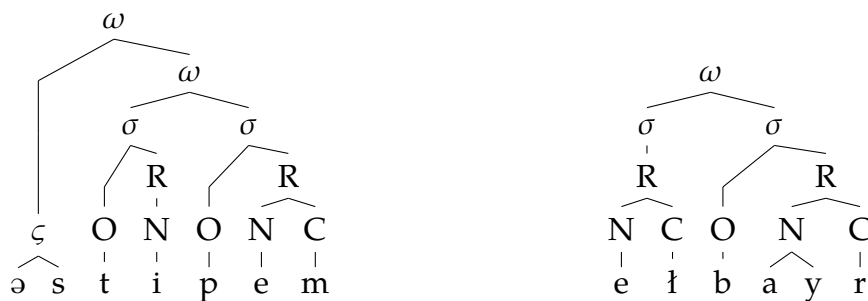


Fig. 5.1: Schematic extraprosodic semisyllable adjoined to the maximal prosodic word. The box signifies an empty nucleus.

These semisyllables lack the C-center effect because they exist outside the domain of the syllable that they would otherwise attach to. Their coda-like behavior and ability to attract prothetic vowels stem directly from the inherent nature of semisyllables; they are prosodically-deficient units composed of only a nucleus and coda. This nucleus may be either empty (as in Italian and European Portuguese) or filled by an unstressable vowel (as in Spanish, Brazilian Portuguese, and Armenian). That the vowel can neither bear stress nor effect the stress placement of ω -internal vowels shows that the semisyllable must be outside the minimal prosodic word, the domain of stress assignment. That they do not occur word-medially is further support for their status as prosodic word adjuncts; the inability of well-formed prosodic structures to license branch crossing or non-linearly ordered nodes drives word-medial stray erasure.

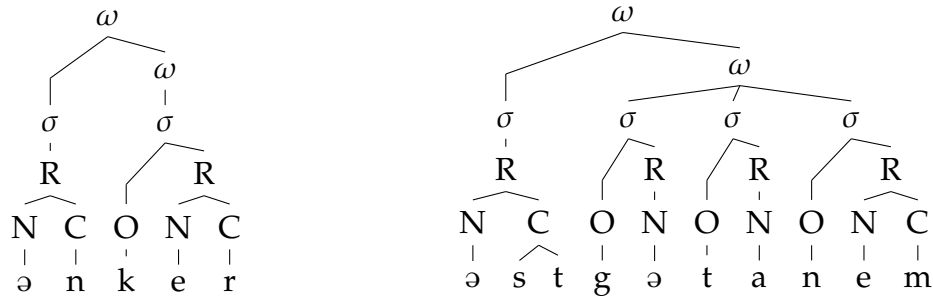
Classical Armenian *əstipem* and *ətbayr*, then, are associated with the following structures:



(a) Classical Armenian [$\langle \text{əs} \rangle \text{ti.pém}$] 'I rush' (b) Classical Armenian [ət.báyɾ] 'brother.'

Fig. 5.2: Prosodic structures for Classical Armenian *əstipem* 'I rush' and *ətbayr* 'brother.'

Following Ito & Mester (2009), both clitics with their hosts and words derived by forming compounds with clitics have basically the same prosodic structure as *astipem* above; compare *anker* ‘friend’ and *ast-gtanem* ‘I accuse’ from Section 3.5 above:



(a) Classical Armenian *ən-ker* ‘friend.’ (b) Classical Armenian *ast-gtanem* ‘I accuse.’

Fig. 5.3: Prosodic structures for *anker* ‘friend’ and *ast-gtanem* ‘I accuse.’

There is no reason to assume that clitics form semisyllables, since it is possible for clitics to have onsets. Instead, following Ito & Mester (2009), I have assigned them to syllables adjoined directly to the prosodic word. That they are stressless is due to the fact that clitics, like semisyllables, are adjoined above the minimal prosodic word.

Clitics can, of course, be adjoined to words beginning with semisyllables. An example can be found in Matthew 22.7:

- (48) *Satakeac*^c *z-* *spanołs* *-n z-* *aynosik*
 destroyed_{3sg.aor. D.O.} murderers_{acc.pl. det. D.O.} those very
 ‘He destroyed those very murderers.’

We know that the noun *spanoł* must begin with schwa, since it is derived from the verb *spanem* ‘I kill,’ discussed above in Section 3.4.1. This root makes an unaugmented third singular aorist *span*, showing that it must not be a real monosyllable form (contrast *e-ber* ‘he carried’ beside present tense *berem* ‘I carry’). Therefore, multiple recursion must occur in words with both clitics and semisyllables, with the clitic dominating the semisyllable, which in turn dominates the minimal prosodic word:

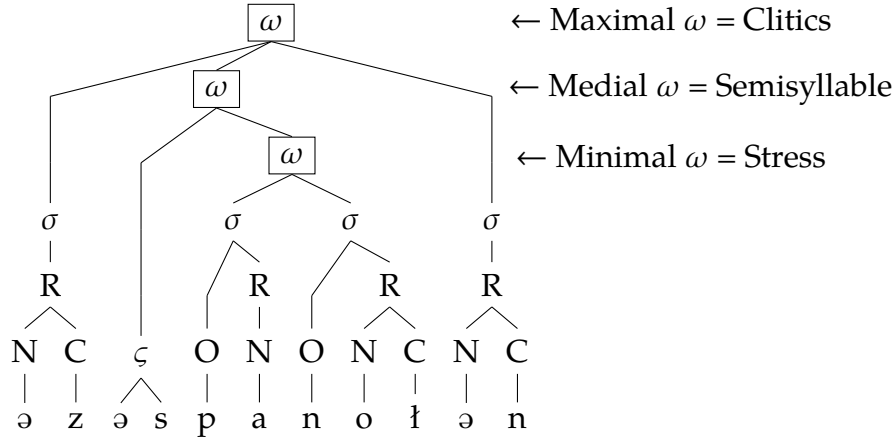


Fig. 5.4: Prosodic structure for *əz-əspanot-ən* ‘the murderers.’

Here, the two clitics adjoin to the prosodic word in the maximal projection. The proclitic *əz-*, which marks the direct object, and the enclitic neutral demonstrative *-ən* dominate both the ω -projection housing the semisyllable and the minimal prosodic word. While it is possible that they are attached at separate levels (i.e., perhaps *əz-* dominates *-ən* or vice versa), I know of no evidence for the relative ranking of these two clitics in the prosodic structure and nothing in Ito & Mester (2009)’s recursive prosodic structure seems to prohibit attaching both at the same time. They briefly discuss a similar nonbinary structure for the English phrase “for the house” (i.e., [ω for the [ω house ω] ω]), but reject it for incurring too many violations of their constraint PARSE-INTO-F, a subpart of the PARSE-INTO-X family of constraints, for which see Section 4.3 (Ito & Mester 2009:186). Since metrical feet seem to have no status in Armenian, this objection may be moot. For our purposes, what is important is that both of the clitics attach outside the semisyllable and the minimal prosodic word. I leave clitic ordering in Classical Armenian as an open question.

5.1 Further Directions

This discussion has been based almost exclusively on data from Indo-European languages, especially Armenian and Romance, with brief mention of data from non-Indo-European

languages such as Korean and various varieties of Arabic. It is my intent to build a general theory of extraprosodicity and prosodic structure, but without meaningful examination of non-Indo-European languages I cannot exclude the possibility that the generalizations I have relied on apply only to Indo-European. It is, of course, possible that the structures above are all inherited from the proto-language. Since Sonority Sequencing Principle violations were tolerated in Proto-Indo-European onsets, the semisyllables found in Romance and Armenian for sibilant-stop clusters must be independent innovations. However, because there were extraprosodic segments in Proto-Indo-European (recall **pstēn* ‘breast,’ see Section 3.1), the structure as a whole could have been inherited into the daughter languages. It is necessary to revisit these arguments with further data from non-Indo-European languages to be certain whether the semisyllable structures I am advocating for here are universal or Indo-European specific.

List of Optimality Theory Constraints

1. STRICT LAYER HYPOTHESIS: “a prosodic constituent of level C^i [should] immediately dominate only constituents of the next level down in the prosodic hierarchy, C^{i-1} ” (Selkirk 1995, updating Selkirk 1981 for implementation in Optimality Theory).
2. SONORITY SEQUENCING PRINCIPLE: Segments in complex onsets should rise in sonority towards the nucleus, and in complex codas they should fall in sonority away from the nucleus. Abbreviated SSP.
3. MAX: Do not delete segments.
4. SYLLABLE CONTACT LAW: Do not allow adjacent [-syllabic] segments to rise in sonority across a syllable boundary.
5. *#CC: A word may not begin with two consonants. Revised: a maximal prosodic word may not begin with two consonants.
6. CONTIGUITY: If two segments are adjacent in the input, they must remain adjacent in the output.
7. LINEARITY: If two segments are adjacent in the input, they must remain in the same order in the output (i.e., no metathesis).
8. DEP: Do not epenthesize.
9. P/ó: Do not stress schwa.

10. ALIGN(PWD, R, HD- $\acute{\sigma}$, R): The right edge of every word must be aligned with a primary stressed syllable. Abbreviated ALIGN-1R.
11. ALIGN(PWD, L, $\acute{\sigma}$, L): The left edge of every word must be aligned with a stressed syllable. Abbreviated ALIGN-2L.
12. IDENT(V): Do not change vowel features.
13. *CLASH: Do not allow stress clash.
14. ROOTEDNESS: "There is exactly one node that dominates every other node."
15. LINEAR ORDER: "The nodes immediately dominated by a node are linearly ordered from left to right."
16. NO TANGLING: "For any nodes x and y, if x precedes y, then all nodes dominated by x precede all nodes dominated by y. This excludes both line crossing and improper bracketing (since nodes do not precede themselves)."
17. LABELING: "Each node bears a label, an element of the ordered set PH = { $v > \iota > \phi > \omega > f > \sigma > \mu$ }, the *prosodic hierarchy*, whose elements stand in a relation of containment, as indicated."
18. CONTAINMENT: "Each immediate dominance relation respects the containment structure of the prosodic hierarchy, in the sense that lower ranked elements do not immediately dominate higher-ranked elements."
19. HEADEDNESS: "Every (non-terminal) prosodic category dominates a *head*, a prosodic category at the next lower level in the prosodic hierarchy."
20. NO-RECURSION: "An element is parsed only once into a given category. Assign one violation mark for each additional parse of an element into the same category" (Ito & Mester 2009:145).

21. PARSE-INTO-X: "Every element of the terminal string is parsed at the X-level" (Ito & Mester 2009:139).
22. FAITH: "Do not modify lexically built prosodic structure" (Peperkamp 1997:189).

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