

# The role of heads and cyclicity in bracketing paradoxes in Armenian compounds

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## Abstract

It is often argued that words have complex internal structure in terms of their morphology, phonology, and semantics. On the surface, Armenian compounds present a bracketing paradox between their morphological and phonological structure. I argue that this bracketing paradox simultaneously references endocentricity, strata, and prosody. I use Armenian as a case study to argue for the use of cyclic approaches to bracketing paradoxes over the more common counter-cyclic approaches. I analyze the bracketing paradox using cyclic Head-Operations (Hoeksema 1984) and Prosodic Phonology (Nespor and Vogel 1986), specifically the Prosodic Stem (Downing 1999a). I argue that the interaction between the bracketing paradox and the rest of compound phonology requires the use of stratal levels and cyclicity. I argue that counter-cyclic approaches like Morphological Merger (Marantz 1988) or Morphological Rebracketing (Sproat 1985) are inadequate because they make incorrect predictions about Armenian phonology.

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## 1 Introduction

A common idea in generative linguistics is that words have both morphosyntactic and prosodic structure (Booij and Lieber 1993). However, these structures can be non-isomorphic, mismatching, or paradoxical, i.e., a bracketing paradox (Pesetsky 1979; Williams 1981). Armenian compounds present one such bracketing paradox which simultaneously references endocentricity, strata, and prosody. I use Armenian as a case study to argue for the use of cyclic approaches to bracketing paradoxes over the more common counter-cyclic approaches. I analyze the bracketing paradox using cyclic Head-Operations (Hoeksema 1984) and Prosodic Phonology (Nespor and Vogel 1986), specifically the Prosodic Stem (Downing 1999a). I argue that the interaction between the bracketing paradox and the rest of compound phonology requires the use of stratal levels and cyclicity. I argue that counter-cyclic approaches like Morphological Merger (Marantz 1988) and Morphological Rebracketing (Sproat 1985) are inadequate because they make incorrect predictions about Armenian phonology.

Armenian is an Indo-European isolate. Armenian has two standard dialects: Western and Eastern Armenian. The bracketing paradox is virtually the same in both dialects. I transcribe the data based on Western Armenian pronunciation.<sup>1</sup> I give a brief preview of the data. In simplex nouns, the plural suffix is *-er* after monosyllabic bases (1a-i), *-ner* after polysyllabic bases (1a-ii). But plural formation creates a bracketing paradox in compounds. Compounds are formed by concatenating two stems, STEM1 and STEM2, normally with a linking vowel *-a-*. In some cases, the plural counts the number of syllables in the entire polysyllabic compound and surfaces as *-ner* (1b-ii). But in other compounds, the plural only counts the number of syllables in the monosyllabic *second stem* and surfaces as *-er* (1b-i). I underline the domain of syllable counting.

- |     |    |    |                            |                |     |                         |                       |
|-----|----|----|----------------------------|----------------|-----|-------------------------|-----------------------|
| (1) | a. | i. | pág                        | ‘yard, lot’    | ii. | panág                   | ‘army’                |
|     |    |    | <u>pag</u> -ér             | ‘yards, lots’  |     | <u>panag</u> -nér       | ‘armies’              |
|     | b. | i. | antsrév + tǰúr             | ‘rain + water’ | ii. | tǰár + sírd             | ‘evil + heart’        |
|     |    |    | antsrev-a-tǰúr             | ‘rain-water’   |     | tǰar-a-sírd             | ‘evil-hearted’        |
|     |    |    | antsrev-a- <u>tǰur</u> -ér | ‘rain-waters’  |     | <u>tǰar-a-sird</u> -nér | ‘evil-hearted people’ |

For the compounds in (1b-i), the plural counts the number of syllables in a morphological subconstituent of the base. This constitutes a bracketing paradox. In this paper, I show that it is largely due to endocentricity. The plural counts the number of syllables in the *semantic head*. If the compound is exocentric, it counts the number of syllables in the entire compound (1b-ii); while if the compound is endocentric, it counts the number of syllables in the head: the second stem (1b-i).<sup>2</sup>

In §2, I go over theories and types of bracketing paradoxes, with a focus on morphology-phonology paradoxes. In §3, I discuss the basic Armenian data. I show that compounds largely match simplex stems in their phonology. They form a single prosodic word and undergo stem-level rules. The only bracketing paradox is how endocentric compounds are pluralized. In §4, I show that the bracketing paradox is productive and

<sup>1</sup>Data is collected from the various sources cited in the bibliography, Wiktionary, and my own native (Western) judgments. Glosses are taken from Armenian-English dictionaries if available, otherwise my own translation. Data is transcribed in IPA. For Western Armenian, aspiration is not contrastive and is not marked. I transcribe the tap as <ɾ>, uvular fricatives /χ, ʁ/ as <x, ɣ>, and the lax mid-vowels /ɛ, ɔ/ are transcribed as <e, o>. Armenian citations are Romanized based on the ISO 9985 transliteration system.

<sup>2</sup>Endocentric compounds are right-headed in Armenian; left-headed compounds are judged as ungrammatical (Karapetyan 2016:36).

based on endocentricity. This signals that Armenian inflection is head-marking. I formalize the bracketing paradox in §5, and I argue for using cyclic Head-Operations and against the use of counter-cyclic approaches like Morphological Merger. In §6, I discuss prosodically-conditioned variation in pluralizing endocentric compounds. This variation requires combining cyclic Head-Operations with Prosodic Phonology. I argue that the head of compounds maps to a prosodic constituent *p*. This constituent is not a foot or recursive PWord, but a Prosodic Stem (Downing 1999a). I conclude in §7. In the appendix, I identify problems with alternative counter-cyclic analyses.

## 2 Bracketing paradoxes in morphophonology

Given some word, a **bracketing paradox** is when the word has two or more contradictory constituency structures. I focus on cases where the mismatch is between the phonology and morphology, e.g., the English comparative: *happier* ~ *unhappier*. I first provide a classification of theories for bracketing paradoxes, and I set up different subtypes of phonology-morphology paradoxes.<sup>3</sup>

### 2.1 Theories and tools for bracketing paradoxes

Since Pesetsky (1979), there have been different theories for modeling bracketing paradoxes (Newell 2019) and debates over the validity of these paradoxes (Kitagawa 1986; Light 1991; Sproat 1992; Kang 1993). Here, I go over some classifications for these theories.

One common classification is based on what constituency is posited as primary vs. derived (Sproat 1985). Most approaches treat the morphological structure as primary, while the phonological representation is derived. Theories which do this include Morphological Rebracketing (Sproat 1985, 1988), Morphological Merger (Marantz 1988), Prosodic Phonology (Aronoff and Sridhar 1983; Nespor and Vogel 1986; Cohn 1989; Booij and Lieber 1993), and Local Dislocation (Embick and Noyer 2001; Haugen and Harley 2013; Deal 2016). A less frequent approach is to let the phonological representation be primary while the morphological representation is derived; this includes theories like Affix Raising (Pesetsky 1985; Hoeksema 1987) and Morphological Reanalysis (Kiparsky 1983). A third set of approaches assumes that the morphological and phonological representations are always identical but they utilize additional tools to let the paradox emerge, such as counter-cyclicity or the ability of an affix to look inside its base. This set includes Late Adjunction (Newell 2005, 2008), Paradigm Function Morphology (Stump 1995b,a, 2001), Head Operations (Hoeksema 1984), and autosegmental planes (Halle and Vergnaud 1987a,b; Falk 1991).

To facilitate the application of the above types of theories to Armenian, I reclassify them in terms of the cyclicity vs. counter-cyclicity of the phonological representation. Some theories assume that the *temporal* order in which both the morphological and phonological structures are generated *matches* the order in which the word's meaning (semantics) is interpreted, i.e., cyclically. This includes theories such as Head-Operations and Prosodic Phonology. In contrast, in counter-cyclic theories, the phonological representation

<sup>3</sup>For space, I don't discuss some solutions that developed in non-Chomskyan frameworks, e.g., Autolexical Theory (Chelliah 1995), CG (Chae 1990, 1993), CCG (Bozsahin 1999), HPSG (Crysmann 1999; Müller 2003), LFG (Kim 1991, 1992), Dependency Grammars (Gross 2011a,b), a.o. I also don't discuss work that focuses on paradoxes between the morphological, syntactic, and semantic representations, such as in the phrases *transformational grammarian* and *beautiful dancer* (Williams 1981; Strauss 1982; Sadock 1985; Spencer 1988; Beard 1991; Becker 1993; Fukushima 1999, 2015, 2014; Ackema and Neeleman 2004; Belk 2019).

(morpheme spell-out) is generated in a temporal order which does *not match* the semantic order. Depending on the theory, the morphological representation can be generated in a temporal order that either does or doesn't match the semantics. Most theories for bracketing paradoxes are counter-cyclic, including Morphological Merger, Morphological Rebracketing, Late Adjunction, among others.

(2) *Cyclicity-based classification for theories in bracketing paradoxes*

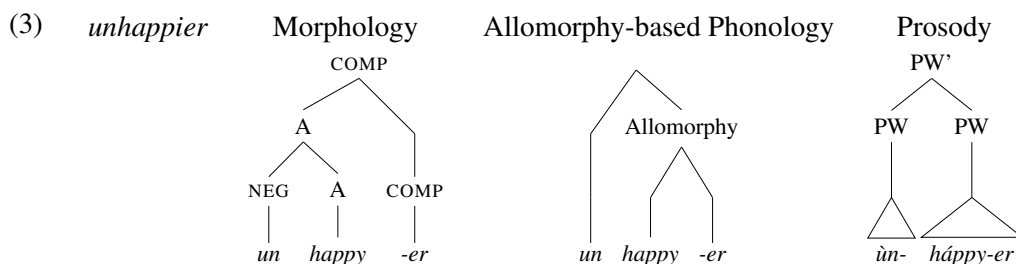
Counter-cyclic	Cyclic
Morphological Rebracketing (Sproat 1985), Morphological Merger (Marantz 1988), Paradigm Functions (Stump 2001), Linear Dislocation (Embick and Noyer 2001), Late Adjunction (Newell 2005) , ...	Head-Operations (Hoeksema 1984), Prosodic Phonology (Nespor and Vogel 1986), Autosegmental Planes (Halle and Vergnaud 1987a)

To illustrate, Prosodic Phonology is a cyclic model. Even though the prosodic and morphological structures don't match, the morphemes are spelled-out in the temporal order that matches the semantics (cf. Booij and Rubach 1984; Cohn 1989; Inkelas 1989). For example in *un-(happi-er)<sub>w</sub>*, the prefix *un-* is spelled-out as outside the root's PWord temporally before the suffix *-er* is added. In contrast, Morphological Merger is countercyclic. The morphological structure is first generated in the right semantic order, but it is later modified. The morphemes are phonologically-spelled out based on this modified representation. For *unhappier*, the suffix forms a constituent with the root in the modified representation [*un[happy-COMP]*], and it spelled out as *-er* temporarily before the prefix *un-* is phonologically spelled-out.

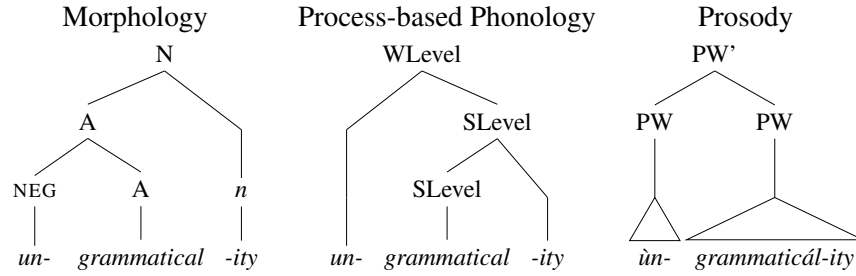
## 2.2 Definition and types of bracketing paradoxes

Having set a cyclicity-based classification for the above theories, I now refine the types of representations that are involved in morphology-phonology paradoxes. I classify paradoxes into allomorphy-based vs. process-based bracketing paradoxes based on the source of the phonological representation.

A bracketing paradox is **allomorphy-based** if the paradox between the morphological constituency and the phonological constituency is based on the allomorphy of a morpheme. There is such a contradiction in *unhappier* because the comparative counts the syllables of the root 'happy' instead of the base 'unhappy'.



In contrast, a **process-based** bracketing paradox occurs for the word *ungrammaticality* because morphological constituency contradicts the phonological constituency that's based on phonological rule domains. Morphologically, the adjective *grammatical* forms a constituent with the prefix *un-*, not the suffix *-ity*. But, the domain of stem-level (SLevel) or Level 1 stress assignment includes the suffix *-ity*, not the prefix *un-*. The entire construction is the domain of word-level (WLevel) processes.

(4) *ungrammaticality*

Cross-linguistically for most bracketing paradoxes, the allomorphy-based and process-based representations tend to be the same and they tend to match prosodic structure. In English, both types of phonological representations loosely match the prosody, e.g., *un-* forms its own PWord. Because of this tendency, most work in morphology-phonology bracketing paradoxes conflates these two types of phonological constituencies.

In Armenian compounds, I argue that these two phonological representations are not identical. In contrast, the morphological representation matches the domain-based representation, the domain-based representation does *not* match the allomorphy-based representation, and the allomorphy-based representation matches the prosodic representation. Because of this split in which representations match, Armenian is a useful case study to evaluate different tools for analyzing bracketing paradoxes. In the next section, I go over the data and I later argue that the Armenian data works best with cyclic theories, not counter-cyclic theories.

### 3 Constituencies in Armenian compounds

In this section, I set up the morphological, phonological, and prosodic structure for Armenian simplex words and compound words. Compound words tend to show isomorphic representations (§3.1), and the only bracketing paradox is present in compound pluralization (§3.2).

#### 3.1 Matching constituencies in compounds

In terms of morphology, Armenian is primarily suffixing and agglutinative. A root can take on derivational (5a-ii) and inflectional suffixes (5a-iii). Compounds are formed by combining two stems (STEM1 & STEM2), normally with a linking vowel *-a-* (5b-ii).<sup>4</sup> A compound can itself take a suffix (5b-iii).<sup>5</sup>

- |     |    |      |                |           |    |      |                    |                |
|-----|----|------|----------------|-----------|----|------|--------------------|----------------|
| (5) | a. | i.   | kórdz          | ‘work’    | b. | i.   | háts + kórdz       | ‘bread + work’ |
|     |    | ii.  | kórdz-avór     | ‘worker’  |    | ii.  | hats-a-kórdz       | ‘baker’        |
|     |    | iii. | kórdz-avor-nér | ‘workers’ |    | iii. | hats-a-kórdz-utjún | ‘bakery’       |

In terms of prosody, compounds and simplex words are similar. Primary stress is on the rightmost full vowel

<sup>4</sup>Most compounds consist of only two stems but there are compounds which have three or more stems: *manər + lujs + nəgar* ‘small + light + picture’ → *manr-a-lus-a-nəgar* ‘micro-photograph’. A linking vowel is used between each stem. These large compounds are rarely used and mostly restricted to higher registers. Data on their phonology is limited and I do not discuss them.

<sup>5</sup>In 5b-iii, the derivational suffix modifies the meaning of the entire compound, not just the second stem. In fact, there is no free-standing word *\*kórdz-utjun*.

of the word, whether on a root (5a-i) or a suffix (5a-iii). Final schwas are unstressed (6iii). Clitics are word-external and are not stressed (6iv). Based on stress, both simplex and compounds form a single prosodic word. Armenian is thus like Greek in that compounds form a single PWord, contra the cross-linguistic tendency for compounds to form two PWords (Nespor and Vogel 1986; Nespor 1999; Vogel 2010).

(6)	a.	i.	kordz-avór	‘a worker’	b.	i.	hats-a-kórdz	‘a bakery’
		ii.	kordz-avor-nér	‘workers’		ii.	hats-a-kordz-nér	‘bakeries’
		iii.	kordz-avor-nér-ə	‘the workers’		iii.	hats-a-kordz-nér-ə	‘the bakeries’
		iv.	kordz-avor-nér al	‘also workers’		iv.	hats-a-kordz-nér al	‘also bakeries’

Besides stress, there are phonological processes which apply differently between derivational and inflectional morphology (Dolatian 2019a,b, 2020). For example, there is a process of Destressed High Vowel Reduction (DHR) whereby destressed high vowels are deleted (7a), or reduced to a schwa (7b) if deletion would create an unsyllabifiable consonant cluster (Khanjian 2009). Similarly, Armenian has a rule of Destressed Diphthong *uj*-Reduction (DDR) whereby a destressed *uj* is reduced to *u* (7c). Both types of reduction apply before derivational suffixes (7ii), compounding (7iii) but not inflectional suffixes (7iv).<sup>6</sup>

(7)	a. <i>DHR via deletion</i>		b. <i>DHR to schwa</i>		c. <i>DDR</i>	
i.	ḍzayíg	‘flower’	t̪úr	‘water’	húj̥n	‘a Greek’
ii.	ḍzayg-avéd	‘flowery’	t̪ər-ajín	‘watery’	hun-agán	‘Greek (adj.)’
iii.	tért	‘paper’	pós	‘hole’	háj	‘Armenian’
	ḍzayg-a-tért	‘flower-petal’	t̪ər-a-pós	‘water-hole’	hun-a-háj	‘Greek-Armenian’
iv.	ḍzayig-óv	‘flower-INST’	t̪ur-óv	‘water-INST’	huj̥n-óv	‘Greek-INST’

Following Dolatian (2020), I analyze these processes in terms of lexical strata or cophonologies. Derivational morphology forms morphological stems (MStems) and triggers the stem-level phonology, while informational morphology forms morphological words and triggers the word-level phonology. The reduction processes are stem-level processes, not word-level. Morphologically, compounds form a single MStem and undergo the same set of stem-level rules as simplex stems.

Vowel-hiatus repairs likewise shows stratal distinctions. Before derivational suffixes, vowel hiatus with a base final *i* is commonly repaired by deletion (8a-ii); other possible repairs are coalescence (8b-ii, /-agan/). Similarly for base-final *u*, hiatus is commonly repaired by glide fortition to *v* (8c-ii). Compounding behaves the same way and triggers the same set of stem-level rules (8iii). But before inflectional affixes, hiatus is generally repaired by glide epenthesis (8iv).<sup>7</sup>

<sup>6</sup>In Eastern Armenian, V-initial inflection can cause the overapplication of destressed high vowel reduction: *t̂ər-ér* ‘waters’. I argue this is because of prosodic misalignment (Dolatian 2020, forthcoming). The same behavior extends to compounds, especially endocentric compounds: *and̂zrev-a-d̂zər-er* ‘rain-waters’. The derivation above is just for Western Armenian. There are also fossilized rules of destressed *e*-to-*i* reduction and destressed *ja*-to-*e* reduction. These rules apply in some derivatives: *sér* ‘love’ vs. *sir-agan* ‘affectionate’, *arakjál* ‘apostle’ vs. *arakel-agán* ‘apostolic’. They do not apply in not inflection: *ser-óv* ‘love-INST’, *arakjal-óv* ‘apostle-INST’. Both rules apply in compounding: *túxt* for *sir-a-túxt* ‘love-letter’, *gérb* ‘manner’ for *arakel-a-gérb* ‘apostle-like’.

<sup>7</sup>Before derivational suffixes, some rare repair rules are glide formation for *i* (*i*→*j*), glide epenthesis for *i* and *u*, and vowel deletion for *u*. Before inflectional suffixes, Eastern Armenian allows vowel deletion for *i* and glide fortition for *u*. But these rules are much less common than glide epenthesis.



- (8)
- |                                |                        |                               |
|--------------------------------|------------------------|-------------------------------|
| a. <i>Deletion</i>             | b. <i>Coalescence</i>  | c. <i>Fortition</i>           |
| i. aʃavní ‘pigeon’             | kiní ‘wine’            | lezú ‘language’               |
| ii. aʃavn-óts ‘pigeon-coop’    | kin-egán ‘vinic’       | lezv-agán ‘linguistic’        |
| iii. dún ‘house’               | dún ‘house’            | xúmp ‘group’                  |
| aʃavn-a-dún ‘pigeon-coop’      | kin-e-pós ‘wine-shop’  | lezv-a-xúmp ‘language-family’ |
| iv. aʃavni[j]-óv ‘pigeon-INST’ | kini[j]-óv ‘wine-INST’ | lezu[j]-óv ‘language-INST’    |

### 3.2 Paradoxical constituency in compounds

So far, I have not shown a bracketing paradox for compounds. However, a bracketing paradox occurs in pluralization. For simplex words, the plural has two phonologically-conditioned allomorphs: *-er* after monosyllabic bases (9a-i), *-ner* after polysyllabic bases (9a-ii,9a-iii) (Vaux 2003; Dum-Tragut 2009). I use the realization rules in (9b). They will be later revised.

- (9)
- |                      |                    |                    |
|----------------------|--------------------|--------------------|
| i. pág ‘yard, lot’   | ii. panág ‘army’   | iii. akarág ‘farm’ |
| pag-ér ‘yards, lots’ | panag-nér ‘armies’ | akarag-nér ‘farms’ |
- b. PL: *counting syllables* (Version 1)
- PL → *-er* / #σ \_
- PL → *-ner* / elsewhere

In simplex stems, the allomorphy is a simple case of syllable-counting.<sup>8</sup> I show its simple distribution below. The allomorphy is insensitive to stress: both the input singular form and output plural form have final stress. The choice of allomorph does not affect final stress. The allomorphy is also not based on the number of feet; both bi- and trisyllabic words are pluralized the same. And, the allomorphy is insensitive to the syllable structure of the final syllable, e.g. the suffix *-ner* is added to a polysyllabic base even if the base ends in a consonant cluster. Likewise, *-er* is added to V-final monosyllabic bases; vowel hiatus is repaired by epenthesis.

#### (10) Distribution of the plural in simplex nouns

	Syllable count								
Final $\sigma$	$\sigma$	$\sigma$ -er		$\sigma\sigma$	$\sigma\sigma$ -ner		$\sigma\sigma\sigma$	$\sigma\sigma\sigma$ -ner	
CV	tsí	tsi[j]-ér	‘horses’	fugá	fuga-nér	‘stores’	mekená	mekena-nér	‘machines’
CVC	pát	pat-ér	‘ducks’	d̥ʒagád	d̥ʒagad-nér	‘foreheads’	kaʃapár	kaʃapar-nér	‘concepts’
CVCC	pánd	pand-ér	‘prisons’	dayánt	dayant-nér	‘talents’	aʃxadánk	aʃxadank-nér	‘works’
CVCCC	bártk	bartk-ér	‘debts’	lusántsk	lusantsk-nér	‘margins’	alabást(ə)r	alabastər-nér	‘alabasters’

Compounds are always polysyllabic, thus we expect them to always be pluralized with *-ner*. This is the case for compounds where STEM2 is polysyllabic; these compounds are always pluralized with *-ner*.

<sup>8</sup>The allomorphy does not optimize phonological well-formedness. The only trace of optimization are CVCC bases which end in a rising-sonority cluster (Vaux 2003; Macak 2016). These clusters optionally take an excrescent or epenthetic schwa: *man(ə)r* ‘small’. Their plural can be bisyllabic with *-er*: *manr-er*, or trisyllabic with *-ner*: *manər-ner*. The choice varies by dialect, speaker, and item. I put these cases aside. A few other morphemes also show suppletion based on syllable count, e.g. the indicative prefix (Vaux 1998) and possessive plurals (Arregi et al. 2013; Wolf 2013). None of these processes reference stress-assignment. Macak (2016) argues that they reference unstressed feet.

- (11) a.  $\widehat{\text{gárdz}} + \widehat{\text{haság}}$  ‘short + height’  
 $\widehat{\text{gárdz-a}} + \widehat{\text{haság}}$  ‘short’  
 $\widehat{\text{gárdz-a}} + \widehat{\text{hasag-nér}}$  ‘short (people)’
- b.  $\widehat{\text{kórdz}} + \widehat{\text{seyán}}$  ‘work + table’  
 $\widehat{\text{kórdz-a}} + \widehat{\text{seyán}}$  ‘work-bench’  
 $\widehat{\text{kórdz-a}} + \widehat{\text{seyan-nér}}$  ‘work-benches’

But, pluralization exhibits a bracketing paradox in compounds when STEM2 is monosyllabic. In this situation, some compounds are pluralized with *-ner* (12a), but some are pluralized with *-er* (12b). As a mnemonic, I say that compounds of the first type are transparently pluralized with *-ner*, while compounds of the second type are paradoxically pluralized with *-er*. I underline the syllables which are counted.

- (12) a.  $\widehat{\text{tjár}} + \widehat{\text{sírd}}$  ‘evil + heart’  
 $\widehat{\text{tjár-a}} + \widehat{\text{sírd}}$  ‘evil-hearted’  
 $\widehat{\text{tjár-a-sírd-ner}}$  ‘evil-hearted (people)’
- b.  $\widehat{\text{antsrév}} + \widehat{\text{tjár}}$  ‘rain + water’  
 $\widehat{\text{antsrev-a-tjár}}$  ‘rain-water’  
 $\widehat{\text{antsrev-a-tjár-er}}$  ‘rain-waters’

In (13), I show the different types of constituencies for the transparent vs. paradoxical compound plurals. The compounds are identical in their morphological constituency, process-based phonological constituency, and stress-based prosodic constituency. Here, the compound stems form a stem-level constituent that excludes the word-level plural suffix.<sup>9</sup> Crucially, the compounds differ in their allomorphy-based representation. The allomorphy-based representation of the transparent plural matches the morphology, while that of the paradoxical plural does not. In the transparent case, the compound takes a suffix *-ner* because the plural counts the number of syllables in the compound. But in the paradoxical case, the plural counts the syllables in STEM2, meaning that STEM2+PL form an allomorphy-based constituent to the exclusion of STEM1.

(13) *Constituencies in compound plurals with monosyllabic STEM2*

	Morphology	Process-based Phonology	Allomorphy-based Phonology	Prosody
$\widehat{\text{tjár-a-sírd-ner}}$				
$\widehat{\text{antsrev-a-tjár-er}}$				

<sup>9</sup>I assume a simple morphological model for compounds (Selkirk 1982). In the morphological representation, I omit the linking vowel. I assume it is a semantically empty morph (Aronoff 1994; Ralli 2008) which is added during phonological spell-out in PF as a dissociated morpheme (Oltra-Massuet 1999; Tat 2013; Embick 2015). In the prosodic representation, I omit feet. In §6, I show that two types of compounds have different prosodic constituencies below the PWord-level.

The bracketing paradox is found for compound pluralization, but not for the rest of the compound phonology. Visually, the paradoxical plural's two different phonological representations do not match. The compound undergoes the same stem-level processes as the transparent plural. I discuss this further in §5. In the next section, I show that this bracketing paradox is robust and that it is triggered by endocentricity.

## 4 Endocentricity and Head-marking in Armenian compounds

Having explained how compound plurals form a bracketing paradox, I provide a simple analysis for the paradox based on endocentricity: only endocentric compounds like ‘rain-water’ can trigger a paradoxical plural. It is cross-linguistically common for headedness to affect compound structure and phonology (Williams 1981; Zwicky 1985; Hoeksema 1984, 1988, 1992; Di Sciullo and Williams 1987; Stump 1995b; Revithiadou 1999; Scalise et al. 2009; Scalise and Fábregas 2010; Moskal and Smith 2019). For Armenian, the role of endocentricity is not a novel claim, but it is an established fact in Armenian linguistics (Vaux 1998; Dum-Tragut 2009).

Because the paradox is largely unfamiliar in generative linguistics, I go through a representative sample of compound plurals (§4.1). I show that across different types of compounds, the single most common predictor for pluralization is endocentricity. The bracketing paradox is insensitive to other factors such as the part of speech of the compound members or the semantic relationship between these members. I show that the bracketing paradox is productive (§4.2). I show that inflection displays head-marking in endocentric compounds (§4.3), including the percolation of irregular inflection.

The examples in this section are my native Western judgments. My judgments match the prescriptive and descriptive generalizations that are found across grammars on Armenian (Sowk'iasyan 2004:232; Ezekyan 2007:248; Sevak 2009:152; Dum-Tragut 2009:670-5, a.o.) and philological research on Armenian compounds (Mkrtčyan 1972, 1973, 1977, 1980; Sargsyan 1979, 1987; Donabédian 2004; Xaçatryan 2009a,b; Karapetyan 2016). For English sources on compound morphology, see Dum-Tragut (2009).

### 4.1 Distribution of the bracketing paradox

Informally, a compound is endocentric if it is hyponymic, i.e., if it is interpreted as a subtype of STEM2 (Allen 1979).<sup>10</sup> In this case, STEM2 acts as the semantic head *h* of the compound. In this section, I go through a taxonomy of compounds. The three most common constructions are nominal, possessive, and deverbal compounds. Nominal compounds are endocentric, while possessive and deverbal compounds are exocentric. I show that only endocentric compounds trigger the bracketing paradox. To emphasize how wide-spread the bracketing paradox is, I provide corpus estimates from Donabédian (2004).

For example, the word *dun* can form the STEM2 of either an endocentric nominal or exocentric possessive compound. The exocentric one is transparently pluralized with *-ner* (14a), while the endocentric one is paradoxically pluralized with *-er* (14b). (For the rest of this section, I do not provide separate glosses for plural forms.)

<sup>10</sup>For space, I do not use more technical formalizations of hyponymy and endocentricity (Lieber 2004; Andreou 2014).

- |      |    |                        |                  |    |                         |                  |
|------|----|------------------------|------------------|----|-------------------------|------------------|
| (14) | a. | médz + dún             | ‘big + house’    | b. | ayavní + dún            | ‘pigeon + house’ |
|      |    | medz-a-dún             | ‘opulent’        |    | ayavn-a-dún             | ‘pigeon-coop’    |
|      |    | <u>medz-a-dun</u> -nér | ‘opulent people’ |    | ayavn-a- <u>dun</u> -ér | ‘pigeon-coops’   |

#### 4.1.1 Bracketing paradox in endocentric nominal compounds: X-N=N

In a nominal compound, both STEM2 and the compound are nouns (X-N=N). These are estimated to constitute around 30% of Armenian compounds (Donabédian 2004). These compounds are endocentric and are paradoxically pluralized with *-er*.

- |      |                        |                  |                        |              |                             |                |
|------|------------------------|------------------|------------------------|--------------|-----------------------------|----------------|
| (15) | dón + dzár             | ‘holiday + tree’ | adzúx + hór            | ‘coal + pit’ | pərúntsk + márd             | ‘fist + fight’ |
|      | don-a-dzár             | ‘Christmas tree’ | adzx-a-hór             | ‘coal-pit’   | pərəntsk-a-márd             | ‘fist-fight’   |
|      | don-a- <u>dzar</u> -ér |                  | adzx-a- <u>hor</u> -ér |              | pərəntsk-a- <u>mard</u> -ér |                |

Semantically, STEM1 acts as an adjunct modifier for STEM2. The specific semantic relationship between the two stems is wide-ranging and unpredictable, but it does not affect the bracketing paradox. As long as the compound is hyponymic, it is paradoxically pluralized.

Furthermore, STEM1 is usually a noun as in the above examples, but it can range over different parts of speech, such as an adjective, infinitival verb, or verbal root.<sup>11</sup> Again, the category of STEM1 does not matter for the bracketing paradox; the compound is still endocentric and paradoxically pluralized.

- |      |    |                              |                     |                            |                       |
|------|----|------------------------------|---------------------|----------------------------|-----------------------|
| (16) | a. | mán(ə)r + véb                | ‘small + novel’     | náx + hájr                 | ‘first + father’      |
|      |    | manr-a-véb                   | ‘novella’           | nax-a-hájr                 | ‘forefather’          |
|      |    | manr-a- <u>veb</u> -ér       |                     | nax-a- <u>hajr</u> -ér     |                       |
|      | b. | kordz-é-l + gérb             | ‘to work + manner’  | kər-é-l + tsév             | ‘to write + manner’   |
|      |    | kordz-e-l-a-gérb             | ‘strategy’          | kər-e-l-a-tsév             | ‘writing style’       |
|      |    | kordz-e-l-a- <u>gerb</u> -ér |                     | kər-e-l-a- <u>tsev</u> -ér |                       |
|      | c. | afxad-í-l + vártš            | ‘to work + payment’ | marz-é-l + táft            | ‘to exercise + field’ |
|      |    | afxad-a-vártš                | ‘wage’              | marz-a-táft                | ‘sports field’        |
|      |    | afxad-a- <u>varts</u> -ér    |                     | marz-a- <u>taft</u> -ér    |                       |

#### 4.1.2 No bracketing paradox in possessive compounds: X-N=A

Exocentric possessive compounds are compounds where STEM2 is a noun but the compound is an adjective (X-N=A). These compounds are interpreted as metonymic or possessive compounds, whereby the compound *possesses* STEM2. They constitute 5% of common Armenian compounds (Donabédian 2004). They are analogous to English *bahuvrihi* compounds (*blue-eyed*) except that there is no overt suffix on STEM2. As adjectives, they can be substantivized and take nominal inflection. These compounds are non-hyponymic and exocentric: an evil-hearted person is not a type of heart. They are transparently pluralized with *-ner*.

<sup>11</sup>Free-standing verbs consist of a root followed a theme vowel *-e, -i, -a* and tense/agreement marking such as the infinitival *-l*: *afxad-i-l* ‘to work’. STEM1 can be an infinitival verb or bound verbal root. In these compounds, STEM1 is verbal because the compound is interpreted as involving the activity of STEM1. These compounds can be translated with English gerunds.

- (17)  $\widehat{tj\acute{a}r} + \acute{s}ird$  ‘evil + heart’     $\widehat{ardz\acute{a}t} + \acute{v}\acute{a}rs$  ‘silver + locks’     $\acute{t}\acute{a}ng + \acute{k}\acute{i}n$  ‘costly + price’  
 $\widehat{tj\acute{a}r-sird}$  ‘evil-hearted’     $\widehat{ardz\acute{a}t-a-v\acute{a}rs}$  ‘silver-locked’     $\acute{t}\acute{a}ng-a-\acute{k}\acute{i}n$  ‘valuable’  
 $\widehat{tj\acute{a}r-a-sird-n\acute{e}r}$      $\widehat{ardz\acute{a}t-a-vars-n\acute{e}r}$      $\acute{t}\acute{a}ng-a-kin-n\acute{e}r$

STEM1 is usually an adjective (18a). STEM1 can range over other parts of speech such as a noun (18b) or verbal root (18c). But regardless of what STEM1 is, possessive compounds are always transparently pluralized.

- (18) a.  $\acute{t}et\acute{e}v + \acute{k}\acute{a}jl$  ‘light + footstep’     $\acute{z}\acute{e}v\acute{a}rt + \widehat{ts\acute{a}j\acute{n}}$  ‘cheerful + voice’  
 $\acute{t}et\acute{e}v-a-\acute{k}\acute{a}jl$  ‘light-footed’     $\acute{z}\acute{e}v\acute{a}rt-a-\widehat{ts\acute{a}j\acute{n}}$  ‘cheerful-voiced’  
 $\acute{t}et\acute{e}v-a-kajl-n\acute{e}r$      $\acute{z}\acute{e}v\acute{a}rt-a-tsajn-n\acute{e}r$   
b.  $\acute{a}rjun + \acute{k}\acute{u}j\acute{n}$  ‘blood + color’     $\widehat{tsj\acute{u}n} + \acute{p}\acute{a}jl$  ‘snow + brightness’  
 $\acute{a}rjun-a-\acute{k}\acute{u}j\acute{n}$  ‘blood-colored’     $\widehat{tsj\acute{u}n} + \acute{p}\acute{a}jl$  ‘snow-white’  
 $\acute{a}rjun-a-kujn-n\acute{e}r$      $\widehat{tsjun-a-pajl-n\acute{e}r}$   
c.  $\acute{x}\acute{e}y\acute{t}-e-l + \widehat{ts\acute{a}j\acute{n}}$  ‘to strangle + voice’     $\acute{x}\acute{e}y\acute{t}-e-l + \acute{m}\acute{a}h$  ‘to strangle + death’  
 $\acute{x}\acute{e}y\acute{t}-a-\widehat{ts\acute{a}j\acute{n}}$  ‘strangled-voiced’     $\acute{x}\acute{e}y\acute{t}-a-\acute{m}\acute{a}h$  ‘asphyxiated’  
 $\acute{x}\acute{e}y\acute{t}-a-tsajn-n\acute{e}r$      $\acute{x}\acute{e}y\acute{t}-a-mah-n\acute{e}r$

#### 4.1.3 No bracketing paradox in deverbal compounds: $X-V_{Root}=N/A$

Finally, the most common types of compounds are deverbal compounds which are estimated to form at least 48.6% of Armenian compounds (Donabédian 2004).<sup>12</sup> In these compounds, STEM2 is derived from a verb while the entire compound is a noun or adjective. Because of this mismatch in their parts of speech, deverbal compounds are non-hyponymic and exocentric. They are transparently pluralized.

- (19)  $\acute{g}o\acute{f}j\acute{g} + \acute{g}\acute{a}r-\acute{e}-l$  ‘show + to sew’     $\acute{g}\acute{e}r\acute{a}g + \acute{b}\acute{a}f\acute{t}-\acute{e}-l$  ‘fire + to worship’  
 $\acute{g}o\acute{f}g-a-\acute{g}\acute{a}r$  ‘shoe-maker’     $\acute{g}\acute{e}r\acute{a}g-a-\acute{b}\acute{a}f\acute{t}$  ‘fire-worshipper’  
 $\acute{g}o\acute{f}g-a-gar-n\acute{e}r$      $\acute{g}\acute{e}r\acute{a}g-a-baft-n\acute{e}r$

Armenian deverbal compounds have clear argument structure with STEM2 acting as a verb. They are analogous to English synthetic compounds like *truck driver*. But unlike in English, these compounds lack an overt nominalizing suffix on STEM2. Traditionally in Armenian linguistics, STEM2 is called a verbal root ( $V_{root}$ ),<sup>13</sup> because STEM2 lacks the corresponding verb’s theme vowel and tense/agreement suffixes.

Semantically, the verbal root STEM2 is salient in these compounds because it assigns a thematic role to STEM1. The verbal root is thus not a light verb, but it has lexical content. In most cases, like those in (19), STEM2 is the root of a transitive verb. STEM1 acts as the internal argument of the verbal root while the entire compound is interpreted as the external argument. As an internal argument, STEM1 can be a noun (20a), adjective (20b) or even another verbal root (20c). But in pluralization, STEM1’s category does not matter and the compound is transparently pluralized with *-ner*.

<sup>12</sup>This figure is for deverbal compounds where STEM1 is a noun. This figure is larger if we include other categories for STEM1.

<sup>13</sup>The Armenian term is /pajagan armad/ ‘verbal root’, or the compound /paj-armad/ ‘verb-root’ (Sowk’iasyan 2004:251; Karapetyan 2016:77, a.o.).

- (20) a. manúg + varǵ-é-l ‘child + to instruct’      3oyovúrt + var-é-l ‘populace + to lead’  
          mang-a-várǵ ‘school-teacher’      3oyovərt-a-vár ‘demagogue’  
          mang-a-varǵ-nér      3oyovərt-a-var-nér
- b. zazír + xos-í-l ‘filthy + to speak’      lāv + des-n-é-l ‘good + to see’  
          zazr-a-xós ‘lewd, coarse’      lav-a-dés ‘optimist’  
          zazr-a-xos-nér      lav-a-des-nér
- c. ənterts-an-é-l + sir-é-l ‘to read + love’<sup>14</sup>      hajhoj-é-l + sir-é-l ‘to swear + to love’  
          ənterts-a-sér ‘lover of reading’      hajhoj-a-sér ‘lover of swearing’  
          ənterts-a-ser-nér      hajhoj-a-ser-nér

Other argument structures also don’t trigger the bracketing paradox. In some compounds, STEM2 is the root of an intransitive verb (21a) or a passive verb (21b). These are exocentric and transparently pluralized.

- (21) a. jergár + dev-é-l ‘long + to last’      kedín + soy-á-l ‘ground + to creep’  
          jergar-a-dév ‘long-lasting’      kedn-a-sóy ‘ground-crawler’  
          jergar-a-dev-nér      kedn-a-soy-nér
- b. tév + har-v-í-l ‘demon + to be beaten’      aváz + bad-v-í-l ‘sand + to be enclosed’  
          tiv-a-hár ‘demon-possessed’      avaz-a-bád ‘enclosed with sand’  
          tiv-a-har-nér      dzar-a-zart-nér

In sum, when STEM2 is a verbal root, the bracketing paradox is not triggered. It doesn’t matter whether STEM1 is an argument, an adjunct, a noun, or another category. Deverbal compounds are non-hyponymic, exocentric, and transparently pluralized as polysyllabic bases with *-ner*. As for possessive compounds, they are also non-hyponymic, exocentric, and transparently pluralized. The ONLY compounds which trigger the bracketing paradox are *endocentric* compounds, such as nominal compounds.

## 4.2 Productivity of the bracketing paradox

In the previous section, I argued that endocentricity is the most common denominator in predicting the bracketing paradox. In this section, I extend the argument by showing that the bracketing paradox is productive in new types of compounds and for morphologically ambiguous compounds.

The most common compound constructions are nominal, possessive, and deverbal compounds (~90% of existing compounds (Donabédian 2004). But the bracketing paradox is not restricted to nominal compounds. It is slowly extending to *new* endocentric compound constructions, such as *adjectival* compounds where both STEM2 and the compound are adjectives (Karapetyan 2016:73ff).

- (22) a. derév + xíd ‘leaf + dense’      b. márt + fád ‘man + many’  
          derev-a-xíd ‘dense with leaves’      mart-a-fád ‘populous’  
          derev-a-xid-ér ‘ones dense with leaves’      mart-a-fad-ér ‘ones that are populous’

These compounds are very rare in Armenian (Donabédian 2004). Their pluralized forms are rarely if ever found online, in corpora, grammars, or philological works (cf. Karapetyan 2016:75). But in my own judg-

ments, these plurals are paradoxically pluralized because they're hyponymic and endocentric.<sup>15</sup>

The second piece of evidence comes from ambiguity. In principle, some identical pairs of stems are ambiguous between hyponymic and non-hyponymic readings. For example, some compounds can alternate between an endocentric nominal and exocentric possessive reading (23a), or between an endocentric nominal and exocentric deverbal reading (23b). In the latter case, STEM2 can be morphologically parsed as either a noun or a verbal root. But regardless, the endocentric reading is paradoxically pluralized with *-er* while the exocentric one is transparently pluralized with *-ner*.

(23)	a.	garmír + tév	red + wing'	méym + tsájn	'mild + voice'
		garmr-a-tév	'red-winged (est.)'; 'a red wing'	meym-a-tsájn	'mild-voiced (est.)'; 'a mild voice'
		<u>garmr-a-tev</u> -nér	'red-winged things'	<u>meym-a-tsajn</u> -nér	'mild-voiced people'
		garmr-a- <u>tev</u> -ér	red wings'	meym-a- <u>tsajn</u> -ér	'mild voices'
	b.	pájd + hád	'wood + piece'	márkarid + hád	'pearl + piece'
		pájd + had-é-l	'wood + to cut'	márkarid + had-é-l	'pearl + to cut'
		pajd-a-hád	'wood-cutter (est.)'; 'piece of wood'	markard-a-hád	'piece of pearl (est.)'; 'pearl-cutter'
		<u>pajd-a-had</u> -nér	'wood-cutters'	<u>markard-a-had</u> -nér	'pearl-cutters'
		pajd-a- <u>had</u> -ér	'pieces of wood'	markard-a- <u>had</u> -ér	'pieces of pearl'

For these potentially ambiguous compounds, one reading is the *established* reading (est.) which is listed in dictionaries. For *garmr-a-tev*, the default reading is the exocentric 'red-winged'. This meaning is transparently pluralized: *garmr-a-tev-ner* 'red-winged things'. But if a speaker encounters this compound with a paradoxical plural, then the speaker is forced to reinterpret it as a endocentric nominal compound: *garmr-a-tev-er* 'red wings'.<sup>16</sup>

To summarize, the bracketing paradox is productive and ultimately driven by endocentricity. The bracketing paradox is slowly extending from nominal compounds to adjectival compounds. Furthermore, speakers can alternate their interpretation of a plural compound based on the shape of the plural suffix.

### 4.3 Endocentricity and percolation of irregular inflection

The analysis so far is that pluralization is a form of head-marking whereby we count the number of syllables in the semantic head: STEM2 or the entire compound. Further evidence for the role of headedness comes nouns which form irregular plurals (24a). Their irregular plural is inherited in endocentric compounds (24b). However, Armenian irregular inflection has been leveling out (Sargsyan 1984). Some endocentric compounds with an irregular head can optionally take a regular plural (24c) (Sargsyan 1987:212).<sup>17</sup>

<sup>15</sup>Speaker judgments vary on how to pluralize these compounds. I speculate that morphological ambiguity may play a role. In many of these adjectival compounds, STEM2 could be parsed an adjective or a verbal root: *xid* 'dense' vs. */xid-/* '*√dense*' in *xəd-an-a-l* 'to be dense'. An adjectival reading would make the compound hyponymic and take a paradoxical plural: *derev-a-xid-er*, while a verbal parse would make the compound be non-hyponymic and take a transparent plural: *derev-a-xid-ner*. Here, the verb would be interpreted as an intransitive inchoative. I suspect that the deverbal reading is generally dominant.

<sup>16</sup>These judgments are my own and those of other Armenian speakers consulted.

<sup>17</sup>I could not find an exocentric compound where STEM2 is *mart* 'man'.

<sup>18</sup>There is evidence that compounds in Classical Armenian likewise displayed head-marking inflection. Classical Armenian did not have phonologically-conditioned suppletion for the plural, but it had many declension classes. These classes used different case suffixes. Compounds tended to inherit the class of their head STEM2 when endocentric (Olsen 2011).



morphology. The two stems are first phonologically realized in Cycle 1. In Cycle 2, they are concatenated and the linking vowel is added. We determine that the semantic head  $h$  of the exocentric compound is the entire compound (in brackets), while that of the endocentric compound is STEM2. The plural suffix is then spelled-out in Cycle 3. The plural allomorphy is determined by a head-operation. The realization rule for plural (27b) counts the number of syllables in the semantic head  $h$ .<sup>19</sup> The bracketing paradox thus emerges.

(27) a. *Deriving the bracketing paradox with Head-Operations*

		Exocentric 'evil-hearted (people)'	Endocentric 'rain-waters'
	UR	$\widehat{tj\text{ar}} + \text{sird} + \text{PL}$	$\widehat{\text{antsrev}} + \widehat{tj\text{ur}} + \text{PL}$
	Morphology	$[ [\widehat{[tj\text{ar}]}[\text{sird}]] \text{ PL } ]$	$[ [\widehat{[\text{antsrev}]}][\widehat{tj\text{ur}}]] \text{ PL } ]$
Cycle 1	Spell-out stems	$\widehat{tj\text{ar}} \quad \text{sird}$	$\widehat{\text{antsrev}} \quad \widehat{tj\text{ur}}$
Cycle 2	Concatenate stems	$\widehat{tj\text{ar-a-sird}}$	$\widehat{\text{antsrev-a-tj\text{ur}}}$
	Determine $h$	$[\widehat{tj\text{ar-a-sird}}]_h$	$\widehat{\text{antsrev-a-}}[\widehat{tj\text{ur}}]_h$
Cycle 3	Spell-out PL	$\widehat{tj\text{ar-a-sird-ner}}$	$\widehat{\text{antsrev-a-tj\text{ur-er}}}$

b. PL: *counting syllables in the semantic head (h)* (Version 2)

PL  $\rightarrow$  -er /  $[ \sigma ]_h \_$

PL  $\rightarrow$  -ner / elsewhere

In contrast to Head-Operations, a countercyclic approach like Morphological Merger (Marantz 1988) posits that the order in which morphemes are phonologically spelled-out does not match the underlying morphology. In the morphology, the stems first form a constituent under the scope of the plural. A rebracketing operation then applies whereby the semantic head of the compound is merged with the plural suffix. This operation is vacuous for exocentric compounds, but is crucial for endocentric compounds because now STEM2 forms a constituent with the plural. With this modified constituency, we apply bottom-up spell-out. The two compounds are spelled-out in two different orders and thus the paradox emerges.

(28) *Deriving the bracketing paradox with Morphological Merger*

		Exocentric 'evil-hearted (people)'	Endocentric 'rain-waters'
	UR	$\widehat{tj\text{ar}} + \text{sird} + \text{PL}$	$\widehat{\text{antsrev}} + \widehat{tj\text{ur}} + \text{PL}$
	Morphology	$[ [\widehat{[tj\text{ar}]}[\text{sird}]] \text{ PL } ]$	$[ [\widehat{[\text{antsrev}]}][\widehat{tj\text{ur}}]] \text{ PL } ]$
	Rebracketing		$[ [\widehat{\text{antsrev}}] [\widehat{[tj\text{ur}}]\text{PL}]]$
Cycle 1	Spell-out stems	$\widehat{tj\text{ar}} \quad \text{sird}$	Spell-out stems $\widehat{\text{antsrev}} \quad \widehat{tj\text{ur}}$
Cycle 2	Concatenate stems	$\widehat{tj\text{ar-a-sird}}$	Spell-out PL $\widehat{\text{antsrev}} \quad \widehat{tj\text{ur-er}}$
Cycle 3	Spell-out PL	$\widehat{tj\text{ar-a-sird-ner}}$	Concatenate stems $\widehat{\text{antsrev-a-tj\text{ur-er}}}$

So far, both cyclic and counter-cyclic approaches can describe the bracketing paradox. In fact, Vaux (1998:57) formalizes the bracketing paradox in Armenian using Morphological Merger, specifically in the form of head-to-head movement. Conceptually though, rebracketing is more redundant than head-operations because both reference the semantic head but the former also uses rebracketing.

<sup>19</sup>I have reformulated the realization rule (27b) so that it can encode the intuition behind a head-operation. Formally, in Categorical Morphology (Hoeksema 1984), an inflectional process  $F$  is a head-operation if when given a morphologically complex input  $W = XY$  where  $Y$  is the head of  $W$ , then the output of  $F(Z)$  is  $XF(Y)$ .

However, I argue that counter-cyclic approaches are inadequate once we contrast the bracketing paradox with the rest of compound phonology. Recall from §2.2 that I distinguish between process-based vs. allomorphy-based bracketing paradoxes. The former occurs in examples like English stress assignment in *ungrammaticality*, while the latter occurs in the English comparative *unhappier*. The two types of paradoxes involve the contradiction between the morphological structure vs. the process-based and allomorphy-based representations respectively. The above counter-cyclic approaches assume that in any bracketing paradox, the allomorphy-based and process-based representations are the same and that they both contradict the morphological representation. This is where counter-cyclic analyses fall short in Armenian.

In a counter-cyclic analysis like Morphological Merger, we incorrectly predict that the second member and the plural form a single domain-based constituent, and that the first member is phonologically non-cohering. This is not borne out. Both exocentric and endocentric compounds undergo the same set of stem-level rules between their stems. As explained in §3.1, the stem-level rule of destressed high vowel reduction applies in derivation, but not inflection. It applies in both exocentric (29a) and endocentric compounds (29b).

- (29) a. *aznív + sírd* ‘sincere + heart’      b. *jergír + kúnt* ‘earth + sphere’  
       *aznəv-a-sírd* ‘sincere-hearted’      *jerg-a-kúnt* ‘globe’  
       *aznəv-a-sird-ner* ‘sincere-hearted (people)’      *jerg-r-a-kunt-er* ‘globes’

The two stems form a domain for the application of stem-level rules such as high vowel reduction, among other rules. The compound forms a larger word-level domain with the plural suffix. Visually, the process-based representations for endocentric and exocentric compounds are the same, and they match the morphological representation. The allomorphy-based representation for an endocentric compound matches neither of them. In the morphology, I show the stems in their underlying form without the linking vowel.

(30) *Constituencies in compound plurals with monosyllabic STEM2 and vowel reduction*

	Morphology	Phonology	Phonology	Prosody
	PL /Compound/ /STEM1/ /STEM2/ PL /azniv/ /sird/ -ner	WLevel /SLevel/ /SLevel/ /aznəv-a- sird -nér	Allomorphy /aznəv-a-sird -ner	PW /aznəv-a-sird-ner
<i>aznəv-a-sird-ner</i>				
	PL /Compound/ /STEM1/ /STEM2/ PL /jergir/ /kunt/ -er	WLevel /SLevel/ /SLevel/ /jerg-r-a- kunt -er	Allomorphy /jerg-r-a- kunt -er	PW /jerg-r-a-kunt-er
<i>jerg-r-a-kunt-er</i>				

When combined with stratal phonology, cyclic head-operations can account for the matching process-based

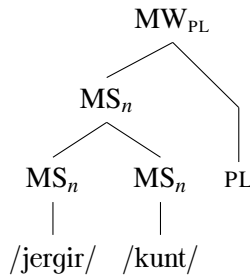
representation and the mismatching allomorphy-based representation. In Cycle 1, the two stems are first spelled-out and undergo the stem-level (SLevel) phonology to get stressed. They are then concatenated into an MStem and their heads are determined. Both concatenations undergo the same stem-level rules of reduction. The plural suffix is then added and counts the number of syllables in the head. Destressed high vowels are marked by the diacritic *ĩ,ũ*.

(31) *Deriving the bracketing paradox with Head-Operations and strata*

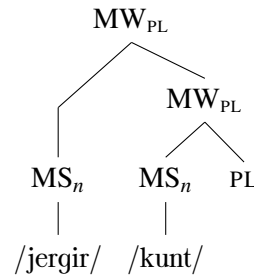
		Exocentric 'sincere-hearted (people)'	Endocentric 'globes'
	UR Morphology	/aznĩv + sird + PL/ [ [[aznĩv][sird]] PL ]	/jergir + kunt + PL/ [ [[jergir][kunt]] PL ]
Cycle 1	Spell-out stems	aznĩv sird	jergir kunt
	SLevel: stress	aznĩv sird	jergĩr kũnt
	SLevel: reduction		
Cycle 2	Concatenate stems	aznĩv-a-sird	jergĩr-a-kũnt
	Determine <i>h</i>	[aznĩv-a-sird] <sub>h</sub>	jergĩr-a-[kũnt] <sub>h</sub>
	SLevel: stress	[aznĩv-a-sird] <sub>h</sub>	jergĩr-a-[kũnt] <sub>h</sub>
	SLevel: reduction	[aznəv-a-sird] <sub>h</sub>	jergr-a-[kũnt] <sub>h</sub>
Cycle 3	Spell-out PL	aznəv-a-sird-ner	jergr-a-kũnt-er
	WLevel: stress	aznəv-a-sird-nér	jergr-a-kũnt-ér

In contrast, a derivation using Morphological Merger and strata does not work. In the original morphological structure of an endocentric compound, the two stems form a larger MStem which then merges with the PL to form an MWord. But in the rebracketed version, STEM2 and the plural form a constituent, an inflected MWord. When concatenated with STEM1, this stem-word compound forms a larger MWord. Cross-linguistically, MStems generally can't dominate MWords; stem-word compounds tend to show prosodic differences from simple stem-stem compounds (cf. stem-word compounds in Greek: Nespor and Ralli 1996; Nespor 1999; Ralli 2012; Nikolou 2009). Below, I show the original and modified morphological structure for an endocentric compound.

(32) a. *Original*



b. *Rebracketed*



The two stems are spelled out and undergo the stem-level rules to get stressed. In the exocentric case, the two stems are concatenated, undergo the stem-level rules, and get pluralized. But in the endocentric case, the second stem had formed an MWord with the plural. In Cycle 2, we spell-out the plural suffix and trigger the word-level phonology. Then at Cycle 3, we concatenate STEM1 with the MWord to form a larger MWord. But, as an MWord, stem-level rules are blocked and we get the incorrect output without reduction.

(33) *Failed derivation of the bracketing paradox with Morphological Merger and strata*

		Exocentric 'evil-hearted (people)'		Endocentric 'globes'
	UR	/azniv + sird + PL/		/jergir + kunt + PL/
	Morphology	[ [[azniv]][sird]] PL ]		[ [[jergir]][kunt]] PL ]
	Rebracketing			[ [jergir] [[kunt]PL] ]
Cycle 1	Spell-out stems	azniv sird	Spell-out stems	jergir kunt
	SLevel: stress	aznív sírd	SLevel: stress	jergír kúnt
	SLevel: reduction		SLevel: reduction	
Cycle 2	Concatenate stems	aznív-a-sird	Spell-out PL	jergír kúnt-er
	SLevel: stress	aznív-a-sírd	WLevel: stress PL	jergír kúnt-ér
	SLevel: reduction	aznəv-a-sírd		
Cycle 3	Spell-out PL	aznəv-a-sírd-ner	Concatenate stems	jergír-a-kúnt-ér
	WLevel: stress	aznəv-a-sird-nér	WLevel: stress	jergír-a-kúnt-ér
Output: <i>expect</i>		✓ aznəv-a-sird-ner		✗ *jergir-a-kunt-er jergir-a-kunt-er

To summarize, counter-cyclic analyses can work for the compound plurals, but they cause inconsistencies with the rest of compound phonology. In endocentric compounds, these analyses require that STEM2 and the plural form a single domain-based constituent, while STEM1 is excluded from this constituent and treated as a phonologically non-cohering element. This requirement is inconsistent with the fact that STEM1 *is* phonologically cohering and that it forms a stem-level domain with STEM2. Faced with this inconsistency, we either need to abandon counter-cyclic analyses or to abandon lexical strata. In this paper, I chose the former approach and I settle on using cyclic Head-Operations. I show in the appendix that there are problems when replacing strata with phases (Newell 2008) or with the free interleaving of cyclic and non-cyclic phonology (Halle and Vergnaud 1987b), also known as selective spell-out (Scheer 2011:9).

## 6 Prosodic variation

In this paper, I focused on the general rules in pluralizing compounds. In the previous section, I developed a cyclic analysis for the bracketing paradox in compounds by using Head-Operations. The Head-Operations analysis can adequately describe cases where endocentric compounds are paradoxically pluralized as monosyllabic, as well as cases where they inherit irregular inflection from their head. For these cases, another cyclic analysis like Prosodic Phonology (Nespor and Vogel 1986) is by itself inadequate.<sup>20</sup> A prosodic analysis would be unsuited for the percolation of irregular inflection.

In this section, I discuss a type of prosodically-determined variation which cannot be analyzed with Head-Operations, but requires prosodic constituents like the Prosodic Stem (Downing 1999a).<sup>21</sup> I argue that we need both Head-Operations and Prosodic Phonology in order to describe the full extent of the bracketing

<sup>20</sup>Using cyclically created autosegmental planes (Halle and Vergnaud 1987a) is also inadequate because it would not distinguish exocentric and endocentric compounds because both are cyclically formed and have identical stress planes (cf. a similar problem noted by Cohn 1989). Though in the appendix, I show that counter-cyclically created planes don't have this problem.

<sup>21</sup>In this paper, I only discuss prosodically-conditioned variation. There is limited variation based on generation, dialect, semantic shift, semantic opacity, metaphoricity, animacy, loanwords, grammaticalization, lexicalization, and frequency (Sargsyan 1979, 1987; Marowt'yan 2003; Avetisyan 2007:43). All relevant data and research are unfortunately only available in Armenian.

paradox. Head-Operations handle both the norm and irregular inflection, while Prosodic Phonology handles the norm and the variation.

## 6.1 Prosodic heads and bisyllabic minimality

In general, compounds are at least trisyllabic because they surface with the linking vowel *-a-*. But, some compounds *arbitrarily* lack a linking vowel. I call such compounds ‘unlinked’. These unlinked compounds are less common than linked compounds. They arose from collocations, dialectal borrowings, or sporadic diachronic syncope of the linking vowel. They are estimated at fewer than 100 compounds (Ėloyan 1972).

(34)	a.	$\widehat{xatf} + k\acute{a}r$	‘cross + stone’	b.	$k\acute{a}r + da\check{f}\text{-}el$	‘stone, to carve’
		$xat\check{f}\text{-}k\acute{a}r$	‘cross-stone (ornament)’		$kar\text{-}d\acute{a}\check{f}$	‘stone carver, mason’
		$xat\check{f}\text{-}\underline{\underline{kar}}\text{-}\acute{e}r$	‘cross-stones’		$*kar\text{-}da\check{f}\text{-}\acute{e}r$	‘stone carvers, masons’
		$\underline{\underline{xat\check{f}\text{-}kar}}\text{-}\acute{e}r$			$\underline{\underline{kar\text{-}da\check{f}}}\text{-}\acute{e}r$	

Because the linking-vowel is absent, the above compounds are bisyllabic. Unsurprisingly, exocentric bisyllabic compounds are transparently pluralized with *-ner* (34b). But bisyllabic endocentric compounds are variably pluralized as transparent or paradoxical (34a). Judgements for bisyllabic compounds vary by speaker, dialect, and era. For the endocentric unlinked compound  $\widehat{xatf}\text{-}kar$  (34a), the paradoxical plural with *-er* is prescriptive and considered standard in Eastern Armenian. Some consider the transparent plural as obsolete (Sargsyan 1979:39, Sargsyan 1987:206, Marowt’yan 2003:57). But in my judgments of Western Armenian, the transparent plural is more common and sounds more natural.

The above variation indicates an emergent minimality effect. In §6.2, I provide more examples in order to understand the extent of the variation. I first formalize this variation using prosodic constituents (35). The semantic head *h* is mapped to a prosodic constituent *p* (the prosodic head). *p* is optionally restructured when it is monosyllabic and follows an unparsed word-initial syllable. I discuss the identity of *p* in §6.3. I argue that the most likely label is the *Prosodic Stem* (Downing 1999a).

### (35) Prosodic mapping (Version 1)

a. Mapping the semantic head *h* to the prosodic head *p*

$$[\dots]_h \rightarrow (\dots)_p$$

b. Optional restructuring the prosodic head *p* in a bisyllabic compound

$$\# \sigma (\sigma)_p \rightarrow (\sigma \sigma)_p$$

I show the prosodic structure of these bisyllabic compounds, before parsing the suffix.

- (36) a. Exocentric                      b. Endocentric & Paradoxical                      c. Endocentric & Transparent
- PW

|

*p*

△

kar-daʃ + -ner

kar-daʃ-ner ‘stone carvers’

PW

△

|      *p*

xatʃ -kar + -er

xatʃ-kar-er ‘cross-stones’

PW

|

*p*

△

xatʃ-kar + -ner

xatʃ-kar-ner ‘cross-stones’

Inflectional processes are sensitive to both the semantic head *h* and its prosodic head *p*. For the plural, if the *h* has any irregular inflection features, then the plural is spelled-out as an irregular plural. Otherwise, when *h* is regular, the plural counts the number of syllables in both *h* and *p*. If both *h* and *p* are monosyllabic, then the allomorph *-er* is chosen. Otherwise, we use the allomorph *-ner*. In the latter case, *h* can be monosyllabic while its *p* is polysyllabic; this still triggers the allomorph *-ner*

- (37) PL: *counting syllables in semantics and prosodic heads* (Version 3)

PL → *-ig* / [+IRREGULAR]<sub>h</sub>  
 PL → *-er* / [(σ)<sub>p</sub>]<sub>h</sub> –  
 PL → *-ner* / elsewhere

Below, I show a partial derivation for bisyllabic and trisyllabic compounds. After the stems are concatenated, the semantic head *h* is determined in Cycle 2. *h* is parsed into *p*. *p* is optionally restructured in the bisyllabic endocentric compound (b), while *p* and *h* stay isomorphic for exocentric and trisyllabic compounds (a,c,d). In Cycle 3, The plural is then spelled-out and counts the syllables in the heads. The optional restructuring creates two possible plurals for *xatʃ-kar*. I omit the application of stem-level and word-level rules.

- (38) *Deriving optionality in the bracketing paradox*

		<i>Bisyllabic Compound</i>		<i>Trisyllabic Compound</i>	
		a. Exocentric ‘stone carvers’	b. Endocentric ‘cross-stones’	c. Exocentric ‘evil-hearted (PL)’	d. Endocentric ‘rain-waters’
UR Morphology		/kar + daʃ + PL/ [ [[kar][daʃ]] PL ]	/xatʃ + kar + PL/ [ [[xatʃ][kar]] PL ]	/tʃar + sird + PL/ [ [[tʃar][sird]] PL ]	/antsrev + tʃur + PL/ [ [[antsrev][tʃur]] PL ]
Cycle 1	Spell-out stems	kar daʃ	xatʃ kar	tʃar sird	antsrev tʃur
Cycle 2	Concatenate stems	kar-daʃ	xatʃ-kar	tʃar-a-sird	antsrev-a-tʃur
	Determine <i>h</i>	[kar-daʃ] <sub>h</sub>	xatʃ-[kar] <sub>h</sub>	[tʃar-a-sird] <sub>h</sub>	antsrev-a-[tʃur] <sub>h</sub>
	Map <i>p</i>	(kar-daʃ) <sub>p</sub>	xatʃ-(kar) <sub>p</sub>	(tʃar-a-sird) <sub>p</sub>	antsrev-a-(tʃur) <sub>p</sub>
	Restructure <i>p</i>		xatʃ-(kar) <sub>p</sub> , (xatʃ-kar) <sub>p</sub>		
Cycle 3	Spell-out PL	kar-daʃ-ner	xatʃ- <u>kar</u> -er, xatʃ-kar-ner	tʃar-a-sird-ner	antsrev-a-tʃur-er

## 6.2 Prosodic minimality across bisyllabic compounds

As said, unlinked compounds are rare (Ēloyan 1972). Thus, endocentric bisyllabic ones are rarer. Fortunately, another source for bisyllabic compounds comes from cases where STEM2 is monosyllabic and

V-initial. When STEM2 is V-initial, no linking vowel is used and the two stems are syllabified together. If the compound is endocentric and at least trisyllabic, then it is paradoxically pluralized (39a). But if the compound is bisyllabic, then it can be paradoxically or *transparently* pluralized (39b).<sup>22</sup>

- |      |    |                    |                    |    |                |                  |
|------|----|--------------------|--------------------|----|----------------|------------------|
| (39) | a. | godʒág + ántsk     | ‘button + passage’ | b. | kít + ántsk    | ‘nose + passage’ |
|      |    | godʒa.g-ántsk      | ‘water canal’      |    | kə.t-ántsk     | ‘nasal cavity’   |
|      |    | godʒa.g-ántsk-ér   | ‘water canals’     |    | kə.t-ántsk-ér  | ‘nasal cavities’ |
|      |    | *godʒa.g-ántsk-nér |                    |    | kə.t-ántsk-nér |                  |

Optional prosodic restructuring is widespread among endocentric bisyllabic compounds which lack a linking vowel, either arbitrarily (40a) or because of vowel hiatus (40b). They take either a transparent or paradoxical plural. Judgments are taken from Sargsyan (1979:39, 1987:205-6) based on Eastern Armenian.

- |      |    |              |                     |              |                 |
|------|----|--------------|---------------------|--------------|-----------------|
| (40) | a. | tsár + xód   | ‘horsehair + grass’ | tfúr + hór   | ‘water + well’  |
|      |    | tsar-xód     | ‘fern’              | tfər-hór     | ‘well’          |
|      |    | tsar-xod-ér  | ‘ferns’             | tfər-hor-ér  | ‘wells’         |
|      |    | tsar-xod-nér |                     | tfər-hor-nér |                 |
|      | b. | mah + azt    | ‘death + notice’    | kéd + áp     | ‘river + coast’ |
|      |    | ma.h-ázt     | ‘death notice’      | ke.d-áp      | ‘river-bank’    |
|      |    | ma.h-azt-ér  | ‘death-notices’     | ke.d-ap-ér   | ‘river-banks’   |
|      |    | ma.h-azt-nér |                     | ke.d-ap-nér  |                 |

However, for some endocentric bisyllabic compounds, prosodic restructuring is obligatory. For bisyllabic compounds where STEM2 is the V-initial morpheme *ántsk* ‘passage’, some of them only accept the transparent plural (41a), others accept both (41b). Bisyllabic unlinked compounds where STEM2 is *gáb* ‘tie, knot’ behave the same (41c,d). Additionally, compounds with *gab* can optionally appear with the linking vowel *-a-* and become trisyllabic. When they do, only the paradoxical plural is grammatical.

- |      |    |                  |               |                 |                  |
|------|----|------------------|---------------|-----------------|------------------|
| (41) | a. | lújs + ántsk     | ‘light + ...’ | tfúr + ántsk    | ‘water + ...’    |
|      |    | lu.s-ántsk       | ‘margin’      | tfə.r-ántsk     | ‘canal’          |
|      |    | lu.s-ántsk-nér   | ‘margins’     | tfə.r-ántsk-nér | ‘canals’         |
|      | b. | hértš + ántsk    | ‘leaf + ...’  | soy-á-l + ántsk | ‘to creep + ...’ |
|      |    | her.ts-ántsk     | ‘leaf-vein’   | so.y-ántsk      | ‘loophole’       |
|      |    | her.ts-ántsk-ér  | ‘leaf-veins’  | so.y-ántsk-ér   | ‘loopholes’      |
|      |    | her.ts-ántsk-nér |               | so.y-ántsk-nér  |                  |
|      | c. | víz + gáb        | ‘neck + ...’  | póɣ + gáb       | ‘neck + ...’     |
|      |    | vəz-gáb          | ‘necktie’     | poɣ-gáb         | poɣ-a-gáb        |
|      |    | vəz-gab-nér      | ‘neckties’    | poɣ-gab-ér      | poɣ-a-gab-ér     |
|      | d. | kár + gáb        | ‘stone + ...’ | tév + gáb       | ‘arm + ...’      |

<sup>22</sup> Although the linking vowel is generally absent before V-initial second-stems, there are some exceptions in recent borrowings and calques (Ėloyan 1972:81). Another common exception is the superlative prefix *amen-a-* which usually takes the linking-vowel even before V-initial bases: *artar* ‘just’ vs. *amen-a-artar* ‘most just’ (Ėloyan 1972:80; Xačatryan 1988:68; among others).

kar-gáb	kar-a-gáb	‘gorge’	tev-gáb	tev-a-gáb	‘cuff’
kar-gab-ér	kar-a-gab-ér	‘gorges’	tev-gab-ér	tev-a-gab-ér	‘cuffs’
<u>kar-gab</u> -nér			<u>tev-gab</u> -nér		

Given an endocentric bisyllabic compound, it is unpredictable whether it can be pluralized transparently, paradoxically, or both. Sargsyan (1979, 1987) speculates that the choice is diachronic, while Marowt’yan (2003) speculates that the choice depends on the degree of semantic bleaching and lexicalization. Two open questions are thus 1) the probabilistic distribution of these different plurals and 2) the additional factors which determine this distribution. Corpus resources on Armenian are too limited to answer these questions.<sup>23</sup> In this paper, I am agnostic over what determines the rate of prosodic restructuring in bisyllabic compounds. I focus on the simpler problem of formalizing the prosodic process itself.

### 6.3 Identity of the prosodic head

To summarize, I repeat below the prosodic structure for trisyllabic and bisyllabic compounds. They all form a single PWord based on stress. For now, I omit feet and syllables. The constituent *p* is isomorphic with the semantic head *h* in most cases, but it can optionally mismatch in endocentric bisyllabic compounds. In the previous section, I did not give a label to the prosodic constituent involved in prosodic restructuring. In this section, I discuss the identity of the prosodic head *p*. I argue that it is unlikely to be a foot or PWord, but is likely a *Prosodic Stem*.<sup>24</sup>

#### (42) Prosodic structure of different compounds

Trisyllabic		Bisyllabic	
Exocentric	Endocentric	Exocentric	Endocentric
‘evil-hearted (PL)’	‘rain-waters’	stone carvers’	‘cross-stones’

Cross-linguistically, there is evidence that the presence of semantic heads can affect stress placement or accent placement, whether in simplex words, compounds (Revithiadou 1999; Roon 2005; Gouskova and Roon 2008; Gouskova 2010), or blends (Shaw 2013; Shaw et al. 2014; Broad 2015; Broad et al. 2016; Moreton et al. 2017). Armenian thus presents additional evidence for the role of heads in prosody. But in contrast to other languages, the prosodic head *p* affects prosodically-conditioned allomorphy in Armenian, not stress placement. Stress stays final in all compounds.

<sup>23</sup>Dolatian (2020) notes the emergence of a new bracketing paradox in endocentric compounds based on traces of schwa prothesis in sibilant-initial STEM2. See Dolatian (2020) for more information.

<sup>24</sup>An alternative is to let *p* stay unlabelled, i.e., the morphological structure is cyclically mapped to unlabelled prosodic constituents. Unlabelled prosodic constituents have been proposed before for the *recursive* mapping of phrasal cycles to *gradient* and relative prosodic structure (Wagner 2005, 2010). However, this alternative only recapitulates the problem of not having a label for *p*.



### 6.3.1 Feet as prosodic heads

One strategy is to argue that the semantic head *h* is aligned with foot. In this analysis, degenerate feet are optionally restructured in bisyllabic compounds, and the plural counts the number of syllables in the rightmost foot.

(43) *Deriving optionality in the bracketing paradox with feet*

UR		Exocentric 'stone carvers' /kar + daʃ + PL/	Endocentric 'cross-stones' /xatʃ + kar + PL/
Cycle 1	...		
Cycle 2	Concatenating stems	kar-dáʃ	xatʃ-kar
	Determine <i>h</i>	[kar-dáʃ] <sub>h</sub>	xatʃ-[kar] <sub>h</sub>
	Map <i>f</i>	(kar-dáʃ) <sub>f</sub>	xatʃ-(kár) <sub>f</sub>
	Restructure <i>f</i>		xatʃ-(kár) <sub>f</sub> , (xatʃ-kár) <sub>f</sub>
Cycle 3	Spell-out PL	kar-daʃ-nér	xatʃ-kar-ér, xatʃ-kar-nér

Treating *p* as a foot would work for modeling *just* the bracketing paradox. However, this analysis is inconsistent with secondary stress assignment. Secondary stress is assigned on the first syllable, both in simplex (44a) and compound words (44b) (Abeġyan 1933:20; Sowk'iasyan 2004:29).<sup>25</sup> Armenian stress is a hammock system: we need feet at both word edges (Vaux 1998; Gordon 2002; DeLisi 2015, 2018).

- (44) a. bàdasxán 'answer'      b. tsév 'shape, manner'  
       bàdasxan-avór 'responsible'      bàdasxan-a-tsév 'style of answering'  
       bàdasxan-avor-óv 'responsible-INST'      bàdasxan-a-tsev-óv 'style of answering (INST)'  
       (bàd.as)xa.na(vo.róv)      (bàd.as)xa.na(tse.vóv)

The feet required for secondary stress contradict the feet that we need from equating *p* with feet. For example, the bisyllabic simplex words in (45) have initial secondary stress and final primary stress, and thus have two feet. Secondary stress is weakly perceivable in the free-standing roots in (45a), but it is highly perceivable for words with the negative prefix *an-* (Ġaragyowlyan 1974:133, T'oxmaxyan 1975:179). This prefix can be category-changing (45b) or category-preserving (45c). All of these words are transparently pluralized.

- (45) a. àntám 'member'      àndár 'forest'      ànkám 'time'  
       àntam-nér 'members'      àndar-nér 'forests'      ànkam-nér 'time'  
       b. hám 'taste'      vax 'fear'      xélk 'mind'  
       àn-hám 'tasteless'      àn-vax 'fearless'      àn-xélk 'mindless'  
       àn-ham-nér 'tasteless (PL)'      àn-vax-nér 'fearless (PL)'      àn-xelk-nér 'mindless (PL)'

<sup>25</sup>In compounds, there are conflicting *impressionistic* reports of secondary stress on the linking vowel (Margaryan 1997:76): *ot-à-nav-a-gaján* 'air-ship-station (=airport)', or the first syllable of STEM2 (T'oxmaxyan 1971:63, 1983:74). These reports are restricted to mostly tri-stem compounds, and are not acoustically supported (Toparlak 2019).

c.	gěydẑ	‘false’	kój	‘existent’	hájd	‘evident’
	àn-gěydẑ	‘sincere’	àn-kój	‘non-existent’	àn-hájd	‘non-evident’
	àn-gěydẑ-nér	‘sincere (PL)’	àn-koj-nér	‘non-existent (PL)’	àn-hajd-nér	‘non-evident (PL)’

Prosodically, these bisyllabic words form two degenerate feet, one foot for each level of stress. If we define the constituent *p* as the foot, then we *incorrectly* predict that these words should be paradoxically pluralized with *-er* because they end in a monosyllabic degenerate foot, as shown below. This shows that *p* cannot be a foot, and that *p* must be larger than a foot.<sup>26</sup>

(46) *Foot structure and plural formation for bisyllabic non-compounds*

	‘member’	‘sincere’	‘tasteless’
	antam	an-geydẑ	an-ham
Primary and Secondary Stress	àntám	àn-gěydẑ	àn-hám
Foot-structure for stress	(àn)(tám)	(àn)-(gěydẑ)	(àn)-(hám)
Predicted plural if <i>p</i> is foot	* (àn)( <u>tam</u> -ér)	* (àn)-(geydẑ-ér)	* (àn)-(h <u>am</u> -ér)
Correct plural	àntam-nér	àn-geydẑ-nér	àn-ham-nér

### 6.3.2 Recursive prosodic words as prosodic heads

Alternatively, we could treat *p* as a recursive minor PWord (Selkirk 1996; Peperkamp 1997; Ito and Mester 2009; Macak 2016). Exocentric compounds form a single PWord, while endocentric ones consist of two PWord layers. Bisyllabic endocentric compounds optionally fuse to a single PWord. The plural counts the number of syllables in the rightmost PWord. This analysis would work for the paradox, but it contradicts the stratal phonology of Armenian. Stem-level rules like destressed high vowel reduction apply in derivation, not inflection (47a). They also apply across the compound boundary to STEM1. These rules apply in endocentric compounds, both trisyllabic (47b) and bisyllabic (47c).

(47)	a.	t̪úr	‘water’	b.	jergír + kúnt	‘earth + sphere’	c.	t̪úr + hór	‘water + well’
		t̪ər-ajín	‘aquatic’		jergir-a-kúnt	‘globe’		t̪ər-hór	‘well’
		t̪ur-óv	‘water-INST’		jergir-a-kunt-er	‘globes’		t̪ər-hor-ér	‘wells’
								t̪ər-hor-nér	

By equating the compound boundary with a PWord-boundary, it is surprising that stem-level rules can apply in this context. Because endocentric compounds have an internal PWord-boundary, we incorrectly predict that stem-level rules like reduction won’t apply to STEM1.

<sup>26</sup>Besides the empirical problem of secondary stress, there is relatively little positive evidence for feet in Armenian. Primary stress in Armenian is final, cued by pitch (Athanasopoulou et al. 2017), non-iterative, and shows a hammock pattern with initial secondary stress. Because of these properties, Armenian has been argued to be footless (DeLisi 2015); its prosody has been modeled with just the metrical grid (Gordon 2002). French and Turkish have similar stress patterns, and they have also been argued to be footless (Özcelik 2017).

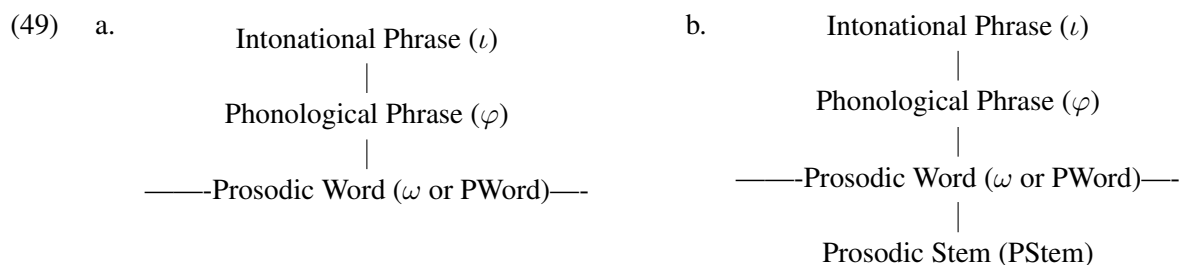
(48) *Inconsistencies between strata and recursive PWords in endocentric compounds*

	Bisyllabic 'wells'	Trisyllabic 'globes'
UR	/tʃur + hor + PL/	/jergir + kunt + PL/
Cycle 1 ...		
Cycle 2 Concatenating stems	tʃúr-hór	jergír-a-kúnt
Determine <i>h</i>	tʃúr-[hor] <sub>h</sub>	jergír-a-[kúnt] <sub>h</sub>
Map PWords	(tʃúr-(hor) <sub>w</sub> ) <sub>w</sub>	(jergír-a-(kúnt) <sub>w</sub> ) <sub>w</sub>
Restructure PWords	(tʃúr-(hor) <sub>w</sub> ) <sub>w</sub>	(tʃúr-hor) <sub>w</sub>
SLevel: stress*		(tʃúr-hór) <sub>w</sub>
SLevel: reduction*		(tʃər-hór) <sub>w</sub>
*blocked across PWords		
Cycle 3 Spell-out PL	tʃúr- <u>hór</u> -er,	tʃər- <u>hór</u> -ner
WLevel: stress	tʃúr- <u>hor</u> -ér,	tʃər- <u>hor</u> -nér
Output: <i>expect</i>	✗ tʃúr- <u>hor</u> -ér tʃər- <u>hor</u> -ér	✓ tʃər- <u>hor</u> -nér ✗ jergir-a- <u>kunt</u> -ér jergir-a- <u>kunt</u> -ér

This stratal problem is aggravated by the lack of explicit consensus on the behavior of recursive prosodic constituents. There is debate over whether recursive constituents can trigger categorically different processes vs. gradually different processes (Ladd 1986; Ito and Mester 2009, 2012, 2013; Wagner 2010; Frota and Vigário 2013; Elfner 2015), whether they can block or trigger lexical processes (Szpyra 1989; Booij 1996; Peperkamp 1997; Raffelsiefen 2005; Kabak and Revithiadou 2009; Bennett 2018), whether they are restricted to the post-lexical phonology of clitics (Inkelas 1989; Booij 1996; Selkirk 1996; Zec 2005; Tyler 2019), and whether they act as diacritics for behaviorally different constituents (Vogel 2009, 2012, 2016; Vigário 2010; Guzzo 2018, Downing and Kadenge forthcoming; Miller 2018; 2020).

## 6.3.3 Prosodic stems in as prosodic heads

Faced with these problems, I argue that *p* is actually a Prosodic Stem. The traditional prosodic hierarchy assumes only three levels of morphosyntactically derived constituents: the prosodic word, the prosodic phrase, and the intonational phrase (49a). However, there is cross-linguistic work on agglutinative and polysynthetic languages which argues for a more enriched hierarchy that includes at least one constituent below the PWord: the Prosodic Stem (49b).



For Armenian, there is conceptual evidence for labelling *p* as the PStem. Cross-linguistically, there are

correlations between 1) morphosemantic heads and the prosodic stem, 2) minimality and PStems, and 3) morphological stems and prosodic stems. All three correlations are intermingled. To illustrate, Aronoff (1988) analyzes reduplication in KiHehe as a head-operation which targets the head of the word (in italics). Reduplication in KiHehe linearly occurs between prefixes and stems (50a) (Odden and Odden 1985). The reduplicant (underlined) generally copies only stem segments but it semantically scopes over the entire word. Furthermore, when the stem is V-initial, prefix-final consonants are overcopied with the stem because of syllabification (50b).

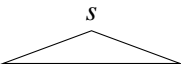
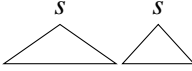
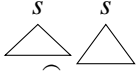
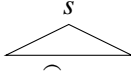
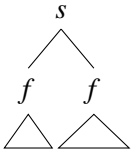
- (50) a. ku-*haata* ‘to ferment’                      b. kw-*iita* ‘to pour’  
       ku-haata~*haata* ‘to start fermenting’        kw-iita~kw-*iita* ‘to start pouring’

Aronoff analyzes the reduplication as a head-operation which is attached to the morphological head of the word: the stem. To explain prefix-copying in V-initial stems, he discusses reduplication as also targeting a *prosodic head* but does not formalize this concept. Downing (1998b) reanalyzes KiHehe and formalizes the prosodic head as the *Prosodic Stem* (PStem). The PStem is a prosodic constituent which is mapped from the morphological stem, analogous to the mapping of prosodic words from morphological words. The bulk of the evidence for the PStems comes from morphologically complex languages (Downing 1999a; Czaykowska-Higgins 1997). Dolatian (2020, forthcoming) argues for the role of the PStem as the domain of appendix incorporation and for dialectal variation in vowel reduction.

As a constituent, the PStem can be the target of reduplication, tone, vowel harmony, minimality, and other sublexical processes (Downing 1998a, 1999a,b). It shows misalignment from the MStem based on syllabification. Further evidence for the PStem as a domain for phonological rules comes from cross-linguistic work on reduplication (Fitzpatrick-Cole 1994; Inkelas and Zoll 2005; Shaw 2005), prefix-suffix asymmetries (Hyman 2008), minimality (Downing 2005, 2006), strata (Inkelas 1989, 1993), and even bracketing paradoxes in **compounds** (Han 1995). For more cross-linguistic evidence for the PStem, see Downing (2006, 2016), Downing and Kadenge (to appear).

I argue that the constituent *p* is the PStem *s*. I illustrate a possible geometry below for singular compounds. For completeness, I show the foot and PStem structure for a bisyllabic prefixed word *àn-hám* from (§6.3.1).

- (51) *Prosodic structure of different types of compounds and prefixed-words where p is the PStem*

	Exocentric	Endocentric Trisyllabic	Endocentric Bisyllabic	Endocentric Bisyllabic Restructured	Prefixed Bisyllabic
Singular					
Plural	àznəv -a- sírd ( <u>aznəv-a-sird</u> ) <sub>s</sub> -nér	jérgr -a- kúnt (jérgr-a)- <u>(kunt)</u> <sub>s</sub> -ér	xàtʃ kár (x-atʃ) <sub>s</sub> - <u>(kar)</u> <sub>s</sub> -ér	xàtʃ - kár (xatʃ-kar) <sub>s</sub> -nér	àn hám ( <u>àn-ham</u> ) <sub>s</sub> -nér

The semantic head of the compound is mapped to a PStem *s* (52a). In simplex words, the entire input stem is the head and is mapped to a PStem. A sequence of two monosyllabic PStems is optionally restructured to form a single PStem (52b). The plural counts the number of syllables in the rightmost PStem (52c).

(52) *Prosodic mapping (Final Version)*a. *Mapping the semantic head h to a Prosodic Stem s*

$$[... ]_h \rightarrow (...)_s$$

b. *Optional restructuring the Prosodic Stem s in a bisyllabic compound*

$$\#(\sigma)_s (\sigma)_s \rightarrow (\sigma \sigma)_s$$

c. *PL: counting syllables in the semantic head h and rightmost PStem s (Final Version)*

$$PL \rightarrow -ig / [+IRREGULAR]_h$$

$$PL \rightarrow -er / [(\sigma)_s]_h \_$$

$$PL \rightarrow -ner / \text{elsewhere}$$

By using a PStem in our cyclic derivation, there is no inconsistency with secondary stress assignment for feet, nor with the stem-level phonology. I don't show secondary stress in the below examples.<sup>27</sup>

(53) *Deriving optionality in the bracketing paradox with PStems in endocentric compounds*

	Bisyllabic 'wells'	Trisyllabic 'globes'
UR	/tʃur + hor + PL/	/jergir + kunt + PL/
Cycle 1 ...		
Cycle 2 Concatenating stems	tʃúr-hór	jergír-akúnt
Determine <i>h</i>	tʃúr-[hor] <sub>h</sub>	jergír-a-[kúnt] <sub>h</sub>
Map PStem	tʃúr-(hor) <sub>s</sub>	jergír-a-(kúnt) <sub>s</sub>
Restructure PStem		(tʃúr-hor) <sub>s</sub>
SLevel: stress	tʃúr-(hór) <sub>s</sub>	(tʃúr-hór) <sub>s</sub>
SLevel: reduction	tʃər-(hór) <sub>s</sub>	(tʃər-hór) <sub>s</sub>
Cycle 3 Spell-out PL	tʃər-hór-er,	tʃər-hór-ner
WLevel: stress	tʃər-hór-ér,	tʃər-hór-nér
		jergir-a-kunt-er
		jergir-a-kunt-ér

## 7 Conclusion

Many linguistic theories argue that words have complex internal structure in terms of their morphology and phonology. Bracketing paradoxes arise when the morphological structure of the word contradicts its phonological structure. This phonological structure is required by the domain of phonological processes or required by the domain of affix allomorphy.

In Armenian, the morphological structure of a compound is isomorphic to its process-based phonological structure, i.e., its stratal phonology. However, the plural form shows a bracketing paradox between its morphological structure and its allomorphy-based phonological structure. The plural suffix has two allomorphs

<sup>27</sup>The above derivation is serial, however the prosodic mapping can be equivalently formalized with parallel constraints, such as by adapting constraints from MATCH theory (Selkirk 2011) and WRAP theory (Truckenbrodt 1999) for stems. We would need a specialized constraint MATCHENDO that requires that semantic heads are parsed to PStems. The output constraint  $*(\sigma)_s(\sigma)_s$  bans a string of a monosyllabic PStems. Recursive structures would be blocked by a constraint NONREC. I do not flesh out these constraints.

based on syllable count: *-er* after monosyllabic bases, *-ner* after polysyllabic bases. Endocentric compounds paradoxically surface with *-er* if the second stem is monosyllabic.

This bracketing paradox signals a type of head-marking inflection. I argue that the bracketing paradox is resolved by using a combination of two cyclic tools: as Head-Operations and Prosodic Phonology. A cyclic approach like Head-Operations can derive the paradoxical allomorphy-based phonological structure, and it can also derive the non-paradoxical process-based phonological structure. Counter-cyclic approaches like Morphological Merger cannot do both. I also argued that the existence of prosodically-conditioned variation in some compounds means that Head-Operations are not enough. We also need sublexical prosodic constituents such as the Prosodic Stem in order to fully capture the bracketing paradox. The end result is a demonstration that bracketing paradoxes are cross-modular, and that different tools for bracketing paradoxes can contradict different aspects of the larger phonological system.

## A Counter-cyclicity with alternatives to stratal phonology

Setting aside prosodic variation, I showed that counter-cyclic approaches like Morphological Merger are partially adequate for modeling the bracketing paradox but they contradict the stratal phonology of Armenian. I instead argued that the bracketing paradox required a cyclic approach like head-operation which did not contradict the stratal phonology. In this appendix, I sketch out two alternative analyses that combine counter-cyclic approaches with two alternative to stratal phonology: phase-based phonology and Halle and Vergnaud (1987a)'s free interleaving of cyclic and non-cyclic phonology. I argue that these alternatives have problems in modelling the entirety of compound phonology and morphology.

### A.1 Empirical problems with phase-based phonology

Phonological Derivation by Phase (PDb) is a conceptual offshoot of lexical phonology (Marvin 2002; Newell 2008; Samuels 2011, 2012). While several theoretical assumptions of PDbP are still being debated (Matushansky and Marantz 2013; Siddiqi and Harley 2016; Newell et al. 2017), the following discussion refers to the more commonly held assumptions. I argue that when combined with Morphological Merger, PDbP can model the bracketing paradox and the application of stem-level rules in endocentric compounds. But it has problems in the application of stem-level rules in exocentric compounds.

PDbP assumes that words are cyclically derived where cycles are defined in terms of phase head  $n$ ,  $v$ ,  $a$  (= derivational suffixes). Non-phase heads (= inflectional suffixes) cannot trigger spell-out and thus do not trigger any cycles. They are not just post-cyclic, but they are part of the same cycle as derivation (Embick 2010). PDbP generally assumes that there is only one cophonology (= no stem vs. word strata) and that there are no prosodic constituents (Scheer 2011, 2012). Cyclic derivations generally respect the phonological structure created on previous cycles, whether by the Phase Impenetrability Condition (Marvin 2002), Phonological Persistence (Newell and Piggott 2014), phase-based faithfulness (McPherson and Hayes 2016), or the use of cophonologies (Sande et al. 2020).

Recall that destressed high vowel reduction (DHR) applies in derivation, but not inflection. It applies in both endocentric and exocentric compounds.

- |      |    |    |  |   |     |  |  |
|------|----|----|--|---|-----|--|--|
| (54) | a. | i. | $\widehat{tj}ur$<br>$\widehat{tj}ar-ajin$<br>$\widehat{tj}ur-ov$ | 'water'<br>'aquatic'<br>'water-INST'    | ii. | $azniv$<br>$aznav-utjun$<br>$azniv-ov$                 | 'sincere'<br>'sincerity'<br>'sincere-INST'                       |
|      | b. | i. | $jergir + kunt$<br>$jegr-a-kunt$<br>$jegr-a-kunt-er$             | 'earth + sphere'<br>'globe'<br>'globes' | ii. | $azniv + sird$<br>$aznav-a-sird$<br>$aznav-a-sird-ner$ | 'sincere + heart'<br>'sincere-hearted'<br>'sincere-hearted (PL)' |

First, without strata, PDbP cannot directly capture the fact that inflection can trigger some but not all stem-level processes. The null hypothesis is that inflection cannot trigger its own cycle because inflection is a non-phase head. Instead, inflection is incorporated into the same phase-cycle as the previous (covert or overt) derivational suffix (Embick 2010). For simplex stems, this would allow inflection to trigger stress shift but not DHR.

(55) *Phase-based derivation for vowel reduction*

		Base 'water'	Derivation 'aquatic'	Inflection 'water-INST'
Cycle 1	Spell-out Stress Reduction	tʃur - ∅ tʃúr	tʃur - ∅ tʃúr	tʃur - ∅ - ov tʃur-óv
Cycle 2	Spell-out Stress Reduction		tʃúr - ajin tʃúr-ajin tʃər-ajin	
Output		tʃúr	tʃər-ajin	tʃur-óv

When combined with Morphological Merger, PDbP can model the bracketing paradox. Destressed high vowel reduction correctly applies in endocentric compounds, but not in exocentric compounds. I assume the following morphological structure for endocentric and exocentric compounds. These structures are adapted from conventions in Distributed Morphology (Harley 2009; Harðarson 2016, 2017, 2018). Each stem is made up of a root and covert category affix. In the endocentric compound, STEM1 is adjoined to STEM2, as indicated by the different indexes for *n*. In exocentric compounds, STEM1 is also adjoined to STEM2. The entire compound takes a covert adjectivizer *a* (Steddy 2019). As before, I assume that linking vowels are generated in phonological spell-out in the PF component as dissociated morphemes (Embick 2015).

(56) *DM-based morphology for compounds*

Exocentric possessive 'sincere-hearted (people)'	Endocentric nominal 'globes'	Endocentric nominal (rebracketed)

I go through a derivation below. Following morphological rebracketing, the PL forms a constituent with STEM2 in endocentric compounds. The PL is spelled-out as *-er* in the first cycle with STEM2. The two stems are concatenated in Cycle 2 and reduction correction applies.



## (57) Deriving compounds with phases &amp; Morphological Merger

Morphology	Input Rebracketed	Endocentric 'globe'	Exocentric 'evil-hearted (PL)'
		$[[ [ \text{jergir} - \emptyset ]_{n1} [ \text{kunt} - \emptyset ]_{n2} ]_{n2} - \text{PL}]_{\text{PL}}$ $[ [ \text{jergir} - \emptyset ]_{n1} [ [ \text{kunt} - \emptyset ]_{n2} - \text{PL} ]_{\text{PL}} ]_{\text{PL}}$	$[ [ [ \text{azniv} - \emptyset ]_a [ \text{sird} - \emptyset ]_n ]_n - \emptyset ]_a - \text{PL}]_{\text{PL}}$
Cycle 1	Spell-out	jergir - $\emptyset$ kunt - $\emptyset$ - er	azniv - $\emptyset$ sird - $\emptyset$
	Stress	jergír    kunt-ér	aznív    sírd
	Reduction		
Cycle 2	Spell-out	jergír-a-kunt-ér	aznív-a-sírd
	Stress	jergír-a-kunt-ér	aznív-a-sírd
	Reduction	jergr-a-kunt-ér	aznəv-a-sírd
Cycle 3	Spell-out		aznəv-a-sírd - $\emptyset$ - ner
	Stress		aznəv-a-sírd-nér
	Reduction		aznəv-a-sərd-nér
Output <i>expect</i>		✓ jergr-a-kunt-ér	✗ aznəv-a-sərd-nér aznəv-a-sird-nér

But, reduction is incorrectly predicted to apply to STEM2 in exocentric compounds. In the first two cycles, each stem is spelled-out and then concatenated. By the second cycle, the compound has undergone stress shift to STEM2 and reduction on STEM1: *aznəv-a-sírd*. At this stage, the singular compound is an endocentric noun, but it must be reinterpreted as an exocentric possessive by taking a covert adjectivizer *a* (Steddy 2019). But this causes a problem for the phonology. In Cycle 3, the *a* category-node for the compound is spelled-out alongside the PL. Although the correct plural is generated, the monostratal phase-based phonology must apply stress shift to PL and reduction on STEM2: \**aznəv-a-sərd-nér*.

An additional conceptual problem is that the above PDbP system contradicts Phonological Persistence. Phonological Persistence (Newell and Piggott 2014) predicts that structure-changing processes (reduction) should be possible within the same phase. By being in the same phase-cycle as the root, inflection would not be blocked from changing any structure: reduction would be incorrectly predicted to be preferred. In contrast, derivation would be incorrectly predicted to only trigger structure-building processes (no reduction) because it is in a separate phase.

In order to get the right reduction patterns, the simplest solution is to allow inflection to trigger its own cycles (Bobaljik and Wurmbrand 2013).<sup>28</sup> Phonological Persistence would then block inflection from triggering DHR. However, this implies an informal stratification of phonological processes. Furthermore, we still need a separate mechanism that allows derivation to trigger structure-changing processes like reduction.

To handle Armenian, PDbP can be tweaked to include strata via final vs. non-final phases (Lochbihler 2017), separation of phonological and morphosyntactic cycles (Embick 2014; d'Alessandro and Scheer 2015), and allowing inflection to trigger its own cycles (Bobaljik and Wurmbrand 2013; Shwayder 2015; Kilborne-Ceron et al. 2016). Doing so reduces the differences between PDbP vs. Stratal/Lexical Phonology. This brings us back into the original problem of how Morphological Merger contradicts stratal phonology.

<sup>28</sup>Morphological evidence for the separation of inflection from a root's phase-cycle is that regular inflection does not trigger root suppletion. The closest case of suppletion is irregular inflection which also triggers reduction (Dolatian 2020).

## A.2 Conceptual problems in the free interleaving of cyclic and non-cyclic phonology

Phase-based phonology assumes that it is morphosyntactically predictable if a given morpheme will trigger a cycle or not. In contrast, the model of phonological cyclicity in Halle and Vergnaud (1987a,b) removes this predictability. Here, where an affix can trigger cyclic rules or not is diacritically determined. There are also no constraints on the ordering of cyclic and non-cyclic affixes. Scheer (2011:9) calls this system "selective spell-out". Furthermore, PDbP assumes a single cophonology or set of rules. In contrast, Halle and Vergnaud (1987a,b) assume two cophonologies: cyclic vs. noncyclic rules. Whether a phonological process is cyclic or not is diacritically determined. I show that this lack of constraints makes it possible for Halle and Vergnaud (1987a) to model the Armenian data. However, this model does not find independent evidence elsewhere in Armenian.<sup>29</sup>

Consider again the application of destressed high vowel reduction in non-compounds. To make the comparison easier, I decompose stress shift into two processes: rightmost stress assignment and destressing. Informally, Rightmost Stress Assignment places stress on the rightmost full vowel; Destressing removes stress from a stressed vowel which is not the rightmost stressed vowel.

In my analysis, reduction is a stem-level rule which applies in derivation (the MStem) but not inflection (the MWord). Stress-assignment and destressing are both stem-level and word-level rules. In Halle and Vergnaud (1987a,b)'s system, stem-level rules are called cyclic rules while word-level rules are noncyclic. All derivational and inflectional suffixes are diacritically marked as triggering cyclic (*c*) and noncyclic (*nc*) rules respectively. The concept of MStems vs. MWords is not relevant.

### (58) Deriving vowel reduction in simplex words with Halle and Vergnaud (1987a)'s system

		Base 'water'	Derivation 'aquatic'	Inflection 'water-INST'
			$A_c$	$INST_{nc}$
		$N_c$	$N_c$ $A_c$	$N_c$ $INST_n$
		$\hat{t}f\hat{u}r$	$\hat{t}f\hat{u}r$ -a $j\hat{i}n$	$\hat{t}f\hat{u}r$ -ov
Cycle 1	Spell-out Rightmost Stress Assignment Destressing Reduction	$\hat{t}f\hat{u}r_c$ $\hat{t}f\acute{u}r$	$\hat{t}f\hat{u}r_c$ $\hat{t}f\acute{u}r$	$\hat{t}f\hat{u}r_c$ $\hat{t}f\acute{u}r$
Cycle 2	Spell-out Rightmost Stress Assignment Destressing Reduction		$\hat{t}f\acute{u}r$ - a $j\hat{i}n_c$ $\hat{t}f\acute{u}r$ -a $j\hat{i}n$ $\hat{t}f\ddot{u}r$ -a $j\hat{i}n$ $\hat{t}f\ddot{e}r$ -a $j\hat{i}n$	$\hat{t}f\acute{u}r$ - ov $_{nc}$
Noncyclic Cycle	Rightmost Stress Assignment Destressing	$\hat{t}f\acute{u}r$	$\hat{t}f\ddot{e}r$ -a $j\hat{i}n$	$\hat{t}f\acute{u}r$ -ov $\hat{t}f\ddot{u}r$ -ov
Output		$\hat{t}f\acute{u}r$	$\hat{t}f\ddot{e}r$ -a $j\hat{i}n$	$\hat{t}f\ddot{u}r$ -ov

<sup>29</sup>Halle and Vergnaud (1987a) assume a non-interactionist system whereby all morphological processes precede phonological processes. This means that they have problems in defining phonologically-conditioned allomorphy (Hargus 1993), e.g., the Armenian plural suffix. I set this problem aside for illustration.

To match the representations used in Halle and Vergnaud (1987a), I do not assume covert category suffixes on roots. In Cycle 1, the noun is spelled-out. Because the noun has a cyclic diacritic, it triggers the cyclic rules of stress and (vacuous) reduction to form  $t\hat{f}úr$ . In Cycle 2, the derivational suffix *-ajin* is spelled out and triggers the cyclic rules of stress and reduction:  $t\hat{f}ər-ajín$ . But, in Cycle 2, we also spell-out the noncyclic inflectional suffix *-ov*. Halle and Vergnaud (1987a,b) argue that non-cyclic affixes can't trigger cyclic rules. They also can't trigger non-cyclic rules. Thus, no rules apply at all. Finally, all the words undergo a final noncyclic cycle where only noncyclic rules apply. This gets us final stress in  $t\hat{f}ur-óv$ .

For compounding, I assume that the compound's category is not due to adjunction (Selkirk 1982). When combined with Morphological Merger or any other rebracketing process, Halle and Vergnaud (1987a)'s model can handle the bracketing paradox. It can also *arguably* trigger the right cyclic rules. The problem is that they rely on the Strict Cyclicity Condition (Mascaró 1976), a debunked principle (Kiparsky 1993).

(59) *Deriving compounds with Morphological Merger and Halle and Vergnaud (1987a)'s system*

Morphology	Input	Endocentric 'globe'	Exocentric 'evil-hearted (PL)'
		$  \begin{array}{c}  PL_{nc} \\  \swarrow \quad \searrow \\  N_{3,c} \quad \quad PL_{nc} \\  \swarrow \quad \searrow \\  N_{1,c} \quad N_{2,c} \\    \quad \quad   \\  jergir \quad kunt  \end{array}  $	$  \begin{array}{c}  PL_{nc} \\  \swarrow \quad \searrow \\  A_{2,c} \quad \quad PL_{nc} \\  \swarrow \quad \searrow \\  A_{1,c} \quad N_c \\    \quad \quad   \\  azniv \quad sird  \end{array}  $
	Rebracketed	$  \begin{array}{c}  N_{3,c} \\  \swarrow \quad \searrow \\  N_{1,c} \quad PL_{nc} \\    \quad \quad   \\  jergir \quad kunt \quad PL_{nc}  \end{array}  $	
Cycle 1	Spell-out Rightmost Stress Assignment Destressing Reduction	$jergir_c \quad kunt_c$ $jergír \quad kúnt$	$azniv_c \quad sird_c$ $aznív \quad sírd$
Cycle 2	Spell-out Rightmost Stress Assignment Destressing Reduction	$jergír \quad kúnt-er_{nc}$ <div style="background-color: #cccccc; height: 20px; width: 100%;"></div>	$aznív-a-sírd$ $aznív-a-sírd$ $aznív-a-sírd$ $aznəv-a-sírd$
Cycle 3	Spell-out Rightmost Stress Assignment Destressing Reduction	$\{jergír-a-kúnt-er\}_c$ $jergír-a-kúnt-er$ $jegr-a-kúnt-er$	$aznəv-a-sírd - ner_{nc}$ <div style="background-color: #cccccc; height: 20px; width: 100%;"></div>
Noncyclic Cycle	Rightmost Stress Assignment Destressing	$jegr-a-kúnt-ér$ $jegr-a-künt-ér$	$aznəv-a-sírd-nér$ $aznəv-a-sírd-nér$
Output		$jegr-a-kunt-ér$	$aznəv-a-sird-nér$

The exocentric plural has a straightforward derivation. In Cycle 1, the two stems undergo the cyclic rules and get stressed. In Cycle 2, they are concatenated and undergo the cyclic rules of stress and reduction. Note that Rightmost Stress Assignment does not remove primary stress from STEM1. Removal is done by Destressing. In Cycle 3, the plural suffix is added. Because the suffix is non-cyclic, it does not trigger cyclic stress shift and reduction. The word eventually undergoes the non-cyclic stratum and gets final stress.

For the endocentric plural, the first two cycles are straightforward. In Cycle 1, the stems are stressed. In Cycle 2, the second stem gets the plural suffix *-er*. Because the suffix is non-cyclic, then no rules apply. In Cycle 3, the stems are concatenated. The suffix does not get any stress because of the Strict Cyclicity Condition (SCC). SCC blocks rightmost stress assignment on the suffix *-er* because the substring *er* was created in the previous cycle. We still get destressing and reduction on STEM1's *u* because concatenation made *u* no longer a final vowel. In the final noncyclic cycle, the compound undergoes the noncyclic rules to get final stress.

As shown, Halle and Vergnaud (1987a)'s system can work for Armenian. However, it has three conceptual problems. First, the derivation mainly worked because of the SCC. In Cycle 3, the input was *jergír-a-kúnt-er* and the output was *jegr-a-kúnt-er* with reduction on STEM1. In this cycle, the SCC blocked stress shift to the suffix *-er*, which itself blocked destressing and reduction in *\*jegr-a-kənt-ér*. Current incarnations of Halle and Vergnaud (1987a)'s system still assume that the SCC plays some role (Halle and Nevins 2009). However, the SCC is a dubious principle and has been debunked (Kiparsky 1993). An alternative blocking systems like the Phrase Impenetrability Condition are likewise dubious (Embick 2014; Newell 2017).<sup>30</sup> See Scheer (2011) for a historical overview on the development and failures of the SCC.

Second, Halle and Vergnaud (1987a)'s assumes it is arbitrary and unpredictable whether an affix is cyclic or not. This misses the fact that in Armenian all cyclic and non-cyclic affixes are respectively derivational and inflectional morphology. Third, Halle and Vergnaud (1987a)'s system allows cyclic and noncyclic affixes to linearly precede and follow each other, e.g., English *patent-abl-ity* where *-able* is Level 2, while *-ity* is Level 1 (Halle and Kenstowicz 1991; also in Salishan: Czaykowska-Higgins 1993). It is then surprising that these ordering paradoxes are not found in Armenian. All noncyclic affixes are inflectional, and they follow all other derivational morphology.

<sup>30</sup>It is possible that the SCC could be replaced with Shwayder (2015)'s 'phonocyclic buffer'. The phonocyclic buffer is a diacritically determined linear span of morphemes for cyclic phonological processes. When combined with Morphological Merger, the plural suffix would get counter-cyclically spelled-out but it would not enter the buffer. The plural would latter undergo the post-cyclic rule of stress shift. In this way, the buffer lets us separate between the domain of cyclic processes and the domain of allomorphy (cf. §2.2). I leave exploring the use of this phonocyclic buffer to future work.

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