Relativized locality: Phases and tiers in long-distance allomorphy in Armenian

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Abstract

Linguistic processes tend to respect locality constraints cross-linguistically. In this paper, we analyze the distribution of conjugation classes in Armenian verbs. We analyze a type of Tense/agreement allomorphy which applies across these classes. On the surface, we show that this allomorphy is long-distant. Specifically, it is sensitive to the interaction of multiple morphemes that are neither linearly nor structurally adjacent. However, we argue that this allomorphy respects 'relativized adjacency' (Toosarvandani 2016) or tier-based locality (Aksënova et al. 2016). While not surface-local, the interaction in Armenian verbs is local on a tier projected from morphological features. This formal property of tier-based locality is substantively manifested as phase-based locality in Armenian (cf. Marvin 2002). In addition to being well-studied computationally, tier-based locality allows us to capture superficially non-local morphological processes while respecting the cross-linguistic tendency of locality. We speculate that tier-based locality is a cross-linguistic tendency in long-distance allomorphy, while phase-based locality is not necessarily so.

keywords: phase, theme vowel, tier, allomorphy, locality, morphologically-conditioned allomorphy, phase-based locality, tier-based locality, locality domains, long-distance allomorphy.

1 Introduction

It is a cross-linguistic tendency that morphologically-conditioned allomorphy is conditioned by local or adjacent triggers (Siegel 1974; Allen 1979). Because of this tendency, most theories of allomorphy assume that local conditioning is the default or norm, and that any apparent case of non-locally triggered allomorphy requires special mechanisms. However, non-local allomorphy is typologically attested (Bobaljik 2000). In order to incorporate these cases, a wealth of disparate

and elaborated theoretical machinery has been proposed. Finding the right theoretical treatment for non-local allomorphy is an active area of research and dispute (Gribanova and Shih 2017; Newell et al. 2017).

In this paper, we contribute to this debate from two angles: empirical and computational. On the empirical side, we provide data on long-distance allomorphy in Armenian. Armenian is an understudied isolate within Indo-European with two standard dialects: Western and Eastern Armenian. We focus on Western Armenian. There are several descriptive grammars of Armenian verbal paradigms, the most complete of which is Boyacioglu (2010); but there are only few partial theoretical treatments (Baronian 2002, 2004, 2006; Khanjian 2013).[1]

Simple regular verbs are broken down into two 3 conjugation classes based on the choice of theme vowel: *-e-, -i-, -a-*. The choice of class and theme vowel is root-dependent. Regular verbs display long-distance allomorphy in the past perfective (also called the aorist). I-Class verbs use one set of tense-agreement suffixes that start with *-a*, while the E-Class and A-Class use another set of suffixes that start with *-i*. The root and the tense suffix are not linearly adjacent but separated by both the theme vowel and the perfective (aorist) suffix *-t͡s-*.

(1)

	Infinitival		Past Perfective 3PL	
E-Class	*ker-e-l*	'to scratch'	*ker-e-t͡s-i-n*	'they scratched'
I-Class	*xos-i-l*	'to speak'	*xos-e-t͡s-a-n*	'they spoke'
A-Class	*gart-a-l*	'to read'	*gart-a-t͡s-i-n*	'they read'
	$\sqrt{}$-TH-INF		$\sqrt{}$-TH-AOR-T-AGR	

We analyze the tense-agreement allomorphy (henceforth T-Agr allomorphy or *aorist agreement*) as a type of long-distance allomorphy between class features and Tense. In the case of simple verbs, these class features are found on the root. In complex verbs, i.e., verbs with valency morphology, class features are found on little *v*. Complex verbs, including causatives, passives, and inchoatives, display similar but non-identical distributions of theme vowels and aorist allomorphy.[2]

Aorist allomorphy is long-distant and does not obey strict adjacency, either linearly or structurally. However, it displays regularities in terms of blocking and licensing. In words that have multiple morphemes with class features, only the rightmost morpheme determines the class and aorist allomorphy of the entire verb. To analyze these facts, we utilize the computational concept of tiers, similar to how autosegmental structure is used in long-distance phonotactics (Goldsmith

[1] Data was elicited by the native Western-speaking authors. Data was double-checked with paradigms from multiple descriptive grammars and teaching grammars (Gulian 1902; Fairbanks 1948; Kogian 1949; Johnson 1954; Bardakjian and Thomson 1977; Kozintseva 1995; Bardakjian and Vaux 1999; Andonian 1999; Sakayan 2000, 2007; Bardakjian and Vaux 2001; Dum-Tragut 2009; Hagopian 2005; Boyacioglu 2010). We do not mark aspiration on consonants, and we transcribe the segments /ɑ,ɛ,ɔ,ɾ,χ,ʁ/ as *a,e,o,r,x,ɣ*.

[2] We analyze the data in a realizational piece-based framework like Distributed Morphology (Halle and Marantz 1993), but our tier-based analysis can be equivalently expressed in process-based approaches (Aronoff 1976; Anderson 1992; Stump 2001) or non-realizational piece-based models (Lieber 1980; Selkirk 1982). We're not sure if it can be easily expressed in a word-and-paradigm approach (Blevins 2006).

1976). Class-bearing morphemes are projected onto a tier that is used to compute the allomorphy. These regularities then formally constitute a type of tier-based strict locality or relativized adjacency.

Substantively, the computational concept of tier-based locality is reminiscent of multiple theoretical concepts such as root-outwards cyclicity (Bobaljik 2000), relativized adjacency (Toosarvandani 2016), and closest triggers in allomorphy (Choi and Harley 2019). And interestingly, we show that the formal locality of tier-based locality is substantively manifested in Armenian as phase-based locality Marvin (2002). The nodes which participate in the allomorphy are all involved in phasal computation: little *v* and categorized roots (i.e., a root plus little *v*). We speculate that tier-based locality is a generalized formal property of long-distance allomorphy, based on a brief cross-linguistic survey. In the case of Armenian, this formal property is substantively manifested as phase-based locality. However in other langauges, there are attested cases of long-distance allomorphy that are formally tier-based local but not substantively phase-based locality.

This paper is organized as follows. In §2, we first go over the different conjugation classes in Armenian. We first go over simple verbs and determine their structure (§2.1). We argue that the theme vowels correlate with transitivity but cannot be reduced to a transitivity marker (§2.2); rather, theme vowels must be determined by the class features of a root. We then move on to complex verbs that contain valency-changing morphology (§2.3). Only the rightmost class-bearing morpheme triggers the class of the verb. In §3, we generalize on the behavior of class assignment and theme-vowel selection. In terms of linearity (§3.1), the overt trigger for class (root or little *v*) is overtly adjacent to the theme vowel. This linearity underscores a general pattern of blocking and licensing in words with multiple class-bearing morphemes. In §3.2, we argue that this blocking behavior is a form of phase-based locality. Formally, the blocking behavior constitutes a simple type of tier-based locality.

In §4, we go over long-distance allomorphy in the past perfective, i.e., in aorist agreement. For simple verbs, we show that there is a non-local dependency between the class-bearing morpheme and tense (§4.1). We analyze this dependency using arbitrary morphological features (§4.2). We find similar non-local dependencies in complex verbs (§4.3). What unifies these patterns is that they display tier-based locality over phase heads. In §5, we elaborate on our data and analysis within a larger theoretical framework. We argue that the long-distance allomorphy between class and tense cannot be reduced to any (arguably local) conditioning on transitivity. Inchoatives showcase this issue (§5.1), as they have the opposite pattern of transitivity, theme vowel selection, and aorist agreement from other verbs in Armenian. In §5.2, we elaborate on the role of tier-based computation. In §5.3, we elaborate on the connection between the formal property of tier-based locality and the substantive property of phase-based locality. Conclusions are in §6

2 Local assignment of conjugation class

This section goes through the conjugation classes of regular verbs. These classes are distinguished by two factors: the verb's theme vowel and whether the verb contains a valency-changing suffix. For both simple and complex verbs, class assignment is a strictly local process between the class-bearing morpheme and the theme vowel. We first go over simple verbs, those without a valency-changing suffix (§2.1). We discuss the morphosemantic value of the theme vowel, and show that it cannot be equated with transitivity (§2.2). We then discuss complex verbs, which have valency-changing morphology (§2.3): the causative (§2.3.1) and the passive (§2.3.2)

2.1 Structure of simple verbs

In simple regular verbs, stems consist of a root and a theme, without any valency-changing morphology. The theme vowel can be *-e-*, *-i-*, or *-a-*. In citation form, the stem is followed by the infinitival suffix *-l*.

(2) a. E-Class *ker-e-l* 'to scratch'
b. I-Class *xos-i-l* 'to speak'
c. A-Class *gart-a-l* 'to read'

In descriptive grammars, the 3 classes are often called Conjugation I, II, and III (Kogian 1949). In this paper, we use the mnemonic names E-Class, I-Class, and A-Class. The E-Class is considered default since the majority of verbs belong to this class.[3]

For a given simple verb, the choice of theme vowel is arbitrary. For a given root, there is no morphosyntactic or phonological property that determines what theme vowel is used. There are however some tendencies that involve transitivity or voice. Among the 3 classes, the E-Class mostly has transitive verbs, while the I-Class and A-Class mostly have intransitive verbs (Daniel and Khurshudian 2015:486). This is a tendency and not a strict rule because we do find transitive and intransitive verbs in all 3 classes ((3); see also (6) below).

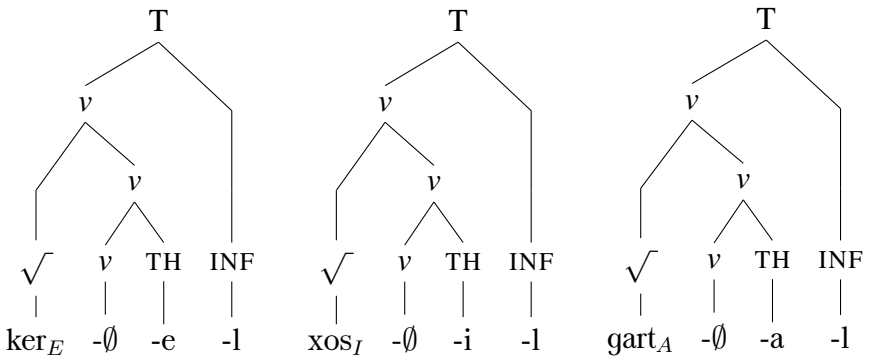
(3) *Conjugation classes by transitivity*

	E-Class		I-Class		A-Class	
Transitive	*azad-e-l*	'to free'	*naj-i-l*	'to look at'	*aɣ-a-l*	'to grind'
	ned-e-l	'to throw'	*sorv-i-l*	'to learn'	*havad-a-l*	'to believe'
Intransitive	*hamper-e-l*	'to be patient'	*barg-i-l*	'to lie down'	*bor-a-l*	'to shout'
	pampas-e-l	'to gossip'	*məs-i-l*	'to feel cold'	*mən-a-l*	'to remain'

[3]There is a fourth obsolete class where the theme vowel is *u*. This class is mentioned in some early grammars (cf. references in Boyacioglu 2010:66), but it does not exist in contemporary Armenian. In Eastern Armenian, there is no longer a theme vowel *-i-*. All Western I-Class verbs are instead E-Class or A-Class: *xos-i-l* to *xos-e-l* 'to speak', and *ʒəbd-i-l* to *ʒəpt-a-l* 'to smile'.

Thus for simple verbs, the morphosyntactic role or position of the theme vowel is not obvious. Cross-linguistically, theme vowels are often treated as meaningless morphs that are structurally adjoined to a little *v* head (Oltra-Massuet 1999a,b; Oltra-Massuet and Arregi 2005). They are variably called empty morphs (Aronoff 1994), ornamental morphemes (Embick and Noyer 2007), or dissociated morphemes (Embick 1998, 2015). But one could argue that theme vowels are exponents of little *v* (Julien 2015; Spyropoulos et al. 2015). For simple verbs, there is no unambiguous evidence either way. For illustration, we take the adjunction approach and we place class features on roots. The choice of structure doesn't affect our later analyses. However, we later find that for complex verbs, the theme vowel must be separate from little *v*.[4]

(4) *Structure of simple verbs*



Because the choice of theme vowel is not predictable from transitivity, we treat it as conditioned by roots, not conditioned by little *v* (cf. Acquaviva 2009). The realization rules in (5) will select a theme vowel for a verb based on the class features of the root. We label these morphological features as E-CLASS, I-CLASS, and A-CLASS. For simplicity, we treat them as privative, not binary, though nothing in our analysis hinges on this choice.

(5) *Selecting theme vowels after a class marker*

TH → *-e-* / [E-CLASS] ⌢ *v* ⌢ _
-i- / [I-CLASS] ⌢ *v* ⌢ _
-a- / [A-CLASS] ⌢ *v* ⌢ _

2.2 Transitivity and equipollence

For simple verbs, we analyze the choice of theme vowel as morphologically idiosyncratic and conditioned by the root. However, there are imperfect correlations between the choice of theme vowel and transitivity. Briefly put, the *-e-* theme vowel tends to appear in transitive verbs, while *-i-, -a-* in intransitives. However, the correlation is not bidirectional: while transitives do tend to appear with the *-e-* theme vowel, intransitives appear frequently with all three theme vowels.

[4]There is no evidence of separate *v* heads and VOICE heads (Harley 2009, 2013). We treat *v* and VOICE as a fused zero morph (Harley 2017). Whether these nodes are covertly fused or not does not affect our main analysis.

To showcase the statistical tendency, the following table shows the number and proportion of transitive and intransitive verbs for the 3 classes. The numbers are calculated over Boyacioglu and Dolatian (2020)'s database of nearly 3,258 verbs, of which 2,239 are simple regular verbs. Ditransitives are subsumed under transitives. A minority of verbs can be used as either intransitives or transitives ('Both'); we set them aside.

(6) *Distribution of regular simple verbs across class and transitivity*

Class	Transitivity							
	Intransitive		Transitive		Both		Total	
E-Class	191	(12%)	1435	(87%)	27	(2%)	1653	(74%)
I-Class	414	(91%)	32	(7%)	9	(2%)	455	(20%)
A-Class	98	(75%)	30	(23%)	3	(2%)	131	(6%)
Total	703	(31%)	1497	(67%)	39	(2%)	2239	

The E-Class is the most populated class at 74% of all regular verbs; the E-Class' default status is due to its preponderance. The E-Class mainly has transitive verbs (87%) with a significant number of intransitives (12%). The I-Class is the second-most populated at 20% of simple verbs. The class is mostly intransitives (91%) with some transitives (7%). The A-Class is the smallest class at 6%, a sizable majority of which are intransitives (75%).

Based on just the theme vowel of a simple verb, a speaker cannot predict whether it is transitive or not with certainty. While there is a relatively high chance of guessing the right transitivity value, 87% for E-Class, 91% for I-Class, and 75% for A-Class, it's not close to a perfect prediction. 253 (11%) of the verbs in the database have the "wrong" transitivity value (putting aside ambitransitive verbs). And in the opposite direction, given an intransitive verb, its theme vowel is completely unpredictable: E-Class (191, 27%), I-Class (414, 59%), or A-Class (98, 14%). Therefore, theme vowel classes cannot be reduced to (in)transitivity.

The above statistical tendency is grammaticalized in a subset of Armenian verbs as a form of equipollence. There are verbs which alternate in the choice of theme vowel based on transitivity: *-e-* for transitive, *-i-* for intransitive (medio-passive).[5]

(7) *jep-e-l* 'to cook X' *ajr-e-l* 'to burn X' *mar-e-l* 'to extinguish X'
jep-i-l 'to be cooked' *ajr-i-l* 'to be burned' *mar-i-l* 'to be extinguished'

Donabédian (1997:328) estimates that there around 160 verbs which show the above equipollence pattern. In the Boyacioglu and Dolatian (2020) database, we find 180 such verbs, meaning we find 90 roots which are transitives with *-e-* and intransitive with *-i-*.

[5]In the Armenian literature, these verbs are variably called equipollent verbs (Haspelmath 1993), labile verbs (Daniel and Khurshudian 2015), ambitransitive verbs (Dum-Tragut 2009), or diathesis verbs (Donabédian 1997). Because Eastern Armenian lacks the *-i-* theme vowel, many of the equipollent intransitive forms are passive verbs in Eastern Armenian, e.g., 'to be burned' is *ajr-i-l* '$\sqrt{}$-TH-INF' in Western but *ajr-v-e-l* '$\sqrt{}$-PASS-TH-INF' in Eastern. See §2.3.2 on the structure of passive verbs.

For these equipollent verbs, an economic analysis is to posit that the roots lack any class features. Instead, the transitivity value of little *v* (or VOICE) determines the class of the root, which in turn specifies the theme vowel. The following feature-insertion rules insert the E-CLASS feature for a transitive root, and I-CLASS for an intransitive root. For simplicity, we assume that the class feature is inserted in the root and not in little *v*, though our analysis does not rely on this assumption.

(8) *Inserting class features for equipollent verbs*

$$\emptyset \rightarrow \text{E-CLASS} \;/\; \sqrt{\_} \frown v[\text{+TRNS}]$$
$$\text{I-CLASS} \;/\; \sqrt{\_} \frown v[\text{-TRNS}]$$

But this equipollence isn't perfect. Besides the above *e-i* equipollent verbs, there are roots which can take either *-e-,-i-* and still be intransitive (9a). Some roots show voicing equipollence of *-e-* with *-a-*, instead of with *-i-* (9b). Some roots are intransitives with *-a-* or *-i-* (9c). One root is transitive with either *-a-* or *-e-* (9d). And, one root shows equipollence with all 3 theme vowels (9e).

(9)	a.	*kajt-e-l*	'to slip (intr.)'	*kajt-i-l*	'to slip (intr.)'
	b.	*d͡zəx-a-l*	'to emit smoke (intr.)'	*d͡zəx-e-l*	'to smoke (tr.)'
	c.	*sarsər-i-l*	'to shudder (intr.)'	*sarsər-a-l*	'to shudder (intr.)'
	d.	*xet-a-l*	'to look at enviously (tr.)'	*xet-e-l*	'to look at enviously (tr.)'
	e.	*xələrd-a-l*	'to move (intr.)'	*xələrd-e-l*	'to move (tr.)'
		xələrd-i-l	'to be moved (intr.)'		

For such verbs, the class-insertion rules based on little *v* above cannot work. The end-result is that, although there are correlations between theme vowels and voice, the choice of theme vowel is on the whole unpredictable, especially for intransitive verbs. Instead, for most verbs, the theme vowel must be memorized as a class feature on the root.

2.3 Local assignment in complex verbs

Evidence for the finer decomposition of verbs comes from productive valency-changing morphology (Daniel and Khurshudian 2015:489). The causative, passive, and inchoative are marked by both their own exponent and their own theme vowel. These three valency affixes are respectively E-Class, I-Class, and A-Class.[6] The causative and inchoative suffixes are usually preceded by a vowel, while the passive suffix is not.

[6]The theme vowels for valency affixes indicate a cline of transitivity: E-CLASS > A-CLASS > I-CLASS. The causative (E-CLASS) adds an argument, while the passive (I-CLASS) deletes an argument. There is a similar transitivity cline in simple verbs, though this is a tendency rather than being categorical (3).

(10) *Conjugation classes in simple and complex verbs*

	E-Class	I-Class	A-Class
Simple verb	*ker-e-l* 'to scratch'	*xos-i-l* 'to speak'	*gart-a-l* 'to read'
Complex verb	Causative *ker-e-t͡sən-e-l* 'to make scratch'	Passive *xos-v-i-l* 'to be spoken'	Inchoative *urax-a-n-a-l* 'to be happy'

In this section, we discuss causatives and passives. We postpone inchoatives until much later, in section §5.1. For complex verbs, we show that theme vowel selection is locally computed between the theme vowel and the immediately preceding little *v* morpheme.

2.3.1 Causative

A causative verb consists of a base, a causative suffix *-t͡sən-*, and a theme vowel *-e-*. Causatives are derived by adding the causative suffix onto either a verbal or non-verbal stem. When a verb is causativized, the causative suffix generally appears after the base verb's theme vowel.

(11) *Deriving causative verbs*

	Simple verb		Causativized	
E-Class	*ker-e-l*	'to scratch'	*ker-e-t͡sən-e-l*	'to make scratch'
I-Class	*xos-i-l*	'to speak'	*xos-e-t͡sən-e-l*	'to make speak'
A-Class	*gart-a-l*	'to read'	*gart-a-t͡sən-e-l*	'to make read'
	$\sqrt{}$-TH-INF		$\sqrt{}$-TH-CAUS-TH-INF	
Adjective	*hivant*	'sick'	*hivant-a-t͡sən-e-l*	'to make sick'
Noun	*badger*	'picture'	*badger-a-t͡sən-e-l*	'to portray'

In general, the original verb's theme vowel is maintained before the causative, but with some exceptions. Before the causative suffix, the *-i-* theme vowel is replaced by *-e-* for independent reasons. Because this vowel change is a quite general morphological process in Armenian, we set it aside.[7] In some causativized verbs, the root's theme vowel is deleted. The deleted form is more common in Eastern Armenian than in Western Armenian. When derived from a non-verb, the pre-causative vowel can be *-e-* in addition to *-a-*. For this paper, we are agnostic over what triggers the breadth of variation in the pre-causative vowels.

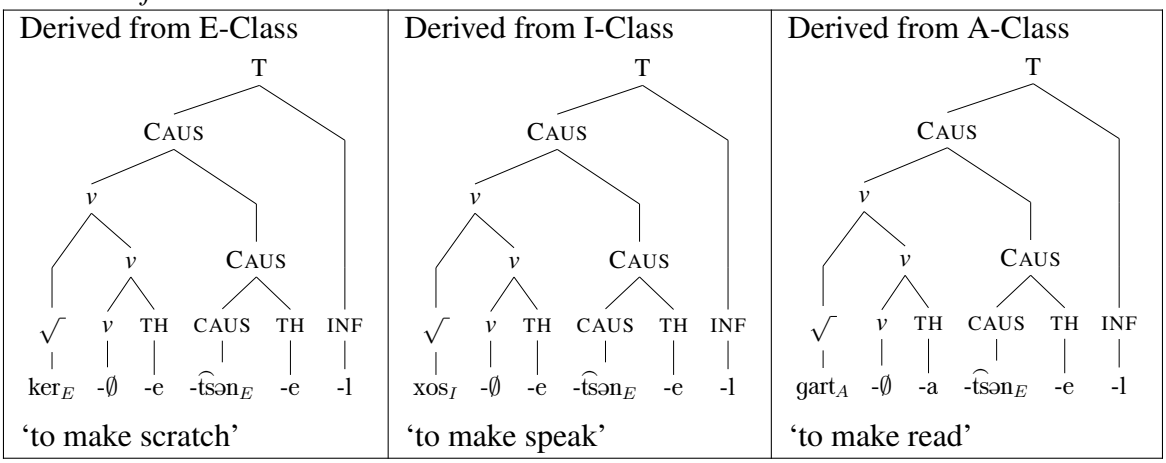
(12) *Variation in the pre-causative theme vowel*

Base		Causative		
xaɣ-a-l	'to play'	*xaɣ-a-t͡sən-e-l*	*xaɣ-t͡sən-e-l*	'to make to play'
vax	'fear'	*vax-e-t͡sən-e-l*	*vax-t͡sən-e-l*	'to scare someone'

[7] Briefly put, Armenian has final stress. Unstressed *-i-* theme vowels are replaced with *-e-* as a morpheme-specific operation.

Causative verbs are always E-Class, with an *-e-* theme vowel. Structurally, the causative suffix is a flavor of little *v* which we represent as CAUS (potentially fused with VOICE), while the *-e-* is an adjunct. The causative is placed on top of the base verb's little *v* layer. The E-Class feature is part of the causative suffix.[8]

(13) *Structure of causatives*



2.3.2 Passive

Alongside causitivization, Armenian verbs are passivized with the suffix *-v-*. The passive suffix takes its own theme vowel *-i-*. Unlike with the causative, when the passive suffix follows an E-Class or I-Class verb root, the root's chosen theme vowel does not surface.[9]

(14) *Partial paradigm of passive verbs*

	Simple verb		Passive verb		
E-Class	*ker-e-l*	'to scratch'	*ker-v-i-l*	'to be scratched'	√-PASS-TH-INF
I-Class	*xos-i-l*	'to speak'	*xos-v-i-l*	'to be spoken'	√-PASS-TH-INF
A-Class	*gart-a-l*	'to read'	*gart-a-t͡s-v-i-l*	'to be read'	√-TH-?-PASS-TH-INF

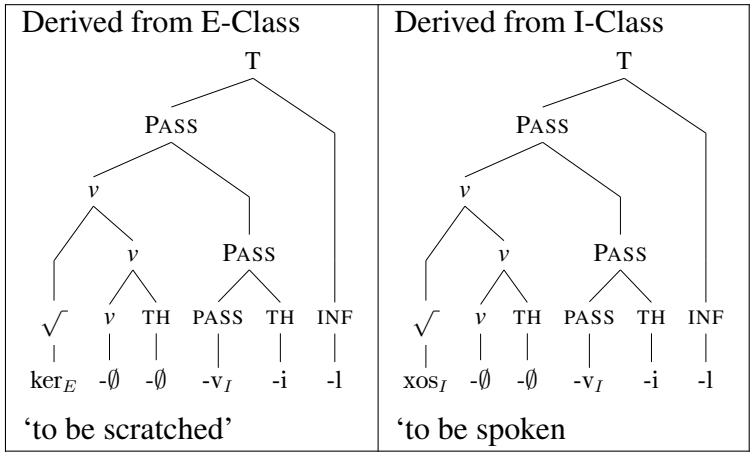
We don't discuss passivized A-Class verbs. Their derivation is complicated by the presence of morphomic or empty morphs, specifically the use of a morphomic aorist stem *gart-a-t͡s-*. We set this issue aside because it doesn't affect our data or generalizations.

Structurally, we assume that the passive is analogous to the causative. The passive suffix *-v-* is an additional layer of little *v* on top of the base verb's own little *v* layer (cf. Bruening 2013). The passive little *v* has an I-Class feature which selects the *-i-* theme vowel.

[8]Hypothetically, the presence of two overt theme vowels in causatives could be connected to the existence of two events. But this is problematic because Megerdoomian (2005) provides evidence that causatives are semantically a single event (monoclausal).

[9]Because Eastern Armenian lacks the I-Class, the passive is an E-Class verb: Western *ker-v-i-l* vs. Eastern *k^{h}er-v-e-l* 'to be scratched'.

(15) *Structure of passives*



Although there is no overt morphological evidence for the continued presence of the base's little *v*, there is syntactic-semantic evidence that it is present.[10] Briefly put, the passive consistently removes an external argument from the base verb (Haig 1982:163). The removal can manifest in the form of passivization, reflexivization, reciprocalization, or anti-causativization (Dum-Tragut 2009:177). All these types of argument demotion can be expressed with the passive suffix *-v-* which is uniformly I-Class in Western Armenian (Boyacioglu 2010:18).

But, regardless of the structure of the verb underneath the passive, the passive suffix always takes the *-i-* theme vowel. Passive verbs are I-Class verbs, and the I-Class feature is on the passive suffix.

3 Determining conjugation class: locality and phases

So far, we have seen which types of morphemes can carry class features: verb roots and valency-changing suffixes. The class of the verb is manifested by the theme vowel of the last class-bearing morpheme: either the rightmost suffix, or the root in the absence of any suffix. In this section, we give the generalization that class-bearing morphemes are involved in phasal computation.

For causatives and passives, the class of the verb (= theme selection) is determined by the corresponding valency suffix in little *v* (CAUS or PASS). The valency suffix carries either the E-Class or I-Class feature. For simple verbs, little *v* does not carry any class features. Instead, the root determines the class. For many equipollent verbs, the root is underspecified and the class features are governed by insertion rules that involves transitivity.

There are two characteristics which unify the above different constructions: linear adjacency (§3.1) and phasal status (§3.2). The first characteristic has computational correlates, while the

[10]There is likewise some phonological evidence in the form of syllabification and vowel reduction patterns, which we set aside.

latter characteristic has theoretical consequences. Furthermore, the two properties of locality and phasehood can be further unified in the form of tier-based locality. In 5.2, we demonstrate the usefulness of tier-based locality to morphology. It is computationally well-studied, it unifies different substantive conditions, and it retains the importance of locality in linguistic processes while capturing non-local behaviors.

3.1 Linear adjacency

The first characteristic of determining conjugation class is LINEAR ADJACENCY. The overt determinant of the theme vowel is linearly adjacent to the theme vowel, whether as a root or as an additional layer of little *v*. This is clear in complex verbs where the E-Class causative or I-Class passive determine the verb's theme vowel, regardless of the class features of the root.

(16) *Local selection of theme vowels in causatives and passives*

	Simple verb		Causative verb		Passive verb	
E-Class	*kɛr-ɛ-l*	'to scratch'	*kɛr-ɛ-t͡sən-ɛ-l*	'to make scratch'	*kɛr-v-i-l*	'to be scratched'
I-Class	*xos-i-l*	'to speak'	*xos-ɛ-t͡sən-ɛ-l*	'to make speak'	*xos-v-i-l*	'to be spoken'
A-Class	*gart-a-l*	'to read'	*gart-a-t͡sən-ɛ-l*	'to make read'	*gart-a-t͡s-v-i-l*	'to be read'
	√-TH-INF		√-TH-CAUS-TH-INF		√(-TH-?)-PASS-TH-INF	

The role of linear adjacency is underlined by the case of verbs with multiple valency suffixes: passivized causatives and causativized passives. Cross-linguistically, we expect that each suffix will cyclically alter the verb's conjugation class (cf. Svenonius 2008). This expectation is borne out: Only the last valency-changing suffix determines the conjugation class of the entire verb.

Consider passivized causatives. Causatives are E-Class verbs. But when they are passivized, they become I-Class verbs. These have the morpheme order CAUS-PASS, and their meaning follows the Mirror Principle: The passive scopes over the causative (Baker 1985).

(17) *Formation of passivized causatives*

Base	Causative	Passivized Causative
	√-TH-CAUS-TH-INF	√-TH-CAUS-PASS-TH-INF
jɛr-a-l	*jɛr-a-t͡sən-ɛ-l*	*jɛr-a-t͡s-v-i-l*
'to boil (intr.)	'to boil (tr.)	'to be boiled by someone'
sar-i-l	*sar-ɛ-t͡sən-ɛ-l*	*sar-ɛ-t͡s-v-i-l*
'to freeze (intr.)'	'to freeze (tr.)'	'to be frozen by someone'

The causative suffix *-t͡sən-* is replaced by a special reduced allomorph *-t͡s-*. Like the simple passives, passivized causatives belong to the I-Class and have the *-i-* theme vowel. The passive affix deletes the causative's theme vowel, just like it does in simple verbs (§2.3.2).

Passivized causatives are common in Armenian, while causativized passives are vanishingly rare. These would have the morpheme order PASS-CAUS, whereby the causative scopes over the passive. Such orders are so rare that some argue that they don't exist (Daniel and Khurshudian 2015:491). We've found only one causativized passive from the Eastern Armenian National Corpus. This verb is conjugated as E-Class just like any other causative. Note that the passive displays high vowel reduction on the root (*kiʒ* → *kəʒ*; cf. Dolatian 2020b).[11]

(18) *Formation of causativized passives*

Base	Passive √-PASS-TH-INF	Causative of Passive √-PASS-TH-CAUS-TH-INF	cf. Causative of E-Class √-TH-CAUS-TH-INF
kiʒ 'lunatic'	*kəʒ-v-i-l* 'to go mad'	*kəʒ-v-e-t͡sən-e-l* 'to make s.o. go mad'	*ker-e-t͡sən-e-l* 'to make scratch'

Based on surface distribution, this relationship between the class determiner and theme vowels is strictly local over overt morphs. Specifically, the theme vowel is determined by the morpheme immediately to its left. Computationally, strict locality is a common aspect of concatenative morphology and allomorphy (Chandlee 2014, 2017; Dolatian 2020a). Within the theoretical literature, locality or strict adjacency is likewise seen as the norm (Embick 2010).

3.2 Phases and tier-based locality

The second unifying property of class determinants is that they are involved in phasal computation. This in turn means that the locality of class assignment is essentially phase-based locality.

In Distributed Morphology, derivational suffixes are typically analyzed as categorizer nodes (little *n, a, v*) that constitute phase heads (Marvin 2002; Marantz 2007; Newell 2008; Embick 2010, 2015; Samuels 2011, 2012). These phase heads block any allomorphy processes which operate across them. That is, a morpheme cannot undergo allomorphy if its trigger is found across a phase head (references above, as well as Guekguezian 2020). In the case of Armenian, simple verbs contain a single word-internal phase created by the little *v* node that merges with the root. Because little *v* is a sister to the root (or head-adjoined: Marantz 2013; Kastner 2016), the root percolates its class features over the covert little *v*. Unlike complements of higher phase heads, roots can interact with morphemes across the root-merged categorizers (Marantz 2007; Embick 2010). Thus, the categorized root (= root + *v*) determines the class of the verb. We illustrate this interplay in the figures below. We mark phases with a right parenthesis, and successful theme-selections are shown with arrows.

[11] We have found a handful more from Armenian Wiktionary (`hy.wiktionary.org/`) as of December 2020.

(19) *Phase-based locality of theme-vowel selection in simple verbs*

E-Class 'to scratch'	I-Class 'to speak'	A-Class 'to read'
ker_E -∅) -e -l √ *v*) TH INF	xos_I -∅) -i -l √ *v*) TH INF	gart_A -∅) -a -l √ *v*) TH INF

In complex verbs, we find that higher phases block the transmission of class features. Consider causatives first. There are two layers of little *v*: one over the root, and the other the causative. Morphological evidence for two layers comes from the overt presence of theme vowels for each layer. Syntactic evidence comes from how causatives can add an extra argument (causer), and then license the appropriate accusative/dative case-marking (Megerdoomian 2005, 2009; Dum-Tragut 2009; Khanjian 2013). Phasal locality is shown by the fact that the causative's little *v* determines the class of the entire verb. Even though the root has its own class features inside the first little *v* layer, the causative acts as a barrier for the propagation or percolation of the root's class features. In addition to determining theme vowels, the class of the entire verb also determines tense/agreement allomorphy (see §4). As we show later, the phasal barrier of the causative little *v* prevents the root from determining agreement.

(20) *Phase-based locality of theme-vowel selection in causative verbs*

From E-Class 'to make scratch'	From A-Class 'to make read'
ker_E -∅) -e -$\widehat{\text{ts}}\text{ən}_E$) -e -l √ *v*) TH CAUS) TH INF	gart_A -∅) -a -$\widehat{\text{ts}}\text{ən}_E$) -e -l √ *v*) TH CAUS) TH INF

Similarly, the passive little *v* layer is a phase head and I-Class. The intervening passive phase head blocks the root from selecting the verb's theme vowel and determining tense/agreement allomorphy. The disappearance of the pre-passive theme vowel is an interesting phenomenon, but it is beyond the scope of this paper.

(21) *Phase-based locality of theme-vowel selection in passive verbs*

From E-Class 'to be scratched'	From I-Class 'to be spoken'
ker_E -∅) -∅ -v_I) -i -l √ *v*) TH PASS) TH INF	xos_I -∅) -∅ -v_I) -i -l √ *v*) TH PASS) TH INF

Metaphorically, the multiple phase heads are in competition with each other as each try to determine the conjugation class and theme vowel of the entire verb. Each phase head acts as a blocker

for the preceding node. This metaphorical competition is often found in the phonological literature in the form of the autosegmental structure and tier-based competition in long-distance phonotactics (Goldsmith 1976). For example, in a hypothetical vowel harmony system of progressive ATR harmony, a word can be made up of vowels that are specified for [+/-ATR], and vowels that are unspecified [0ATR]. +ATR vowels will spread their +ATR feature onto all following underspecified [0ATR] vowels (22a), while -ATR will spread [-ATR] (22b). In the case of disharmony (22c), a word-medial specified [-ATR] vowel will block the further spread of a preceding [+ATR] vowel.

(22) *Toy cases of progressive ATR harmony*

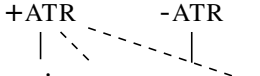
a. From initial +ATR vowel: /pitUkImO/ → [pitukimo]

b. From initial -ATR vowel: /pɪtUkImO/ → [pɪtʊkɪmɔ]

c. Disharmony: /pitUkɪmO/ → [pitukɪmɔ]

To visualize the role of propagation and blocking, consider the following autosegmental structure for disharmonic words. The autosegmental arcs indicate the spread of the right vowel features. The NO CROSSING CONSTRAINT blocks the spread of +ATR over a -ATR vowel (Coleman and Local 1991).

(23) *Autosegmental structure of a hypothetical disharmonic word*

Input /pitUkɪmO/	Output [pitukɪmɔ]	Ungrammatical *[pitukɪmo]
		

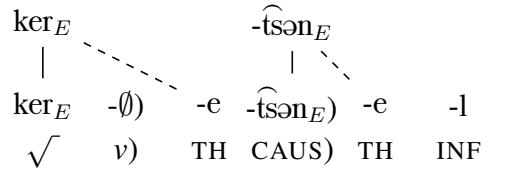
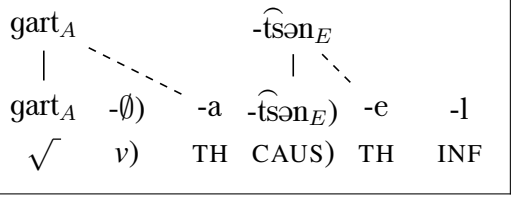
In the computational literature, this interplay of autosegmental spreading and blocking has inspired a class of formal grammars called tier-based strictly-local grammars (TSL) (Heinz et al. 2011). In morphology, such grammars have been used to model morphotactics (Aksënova et al. 2016), and have appeared under non-computational guises such as 'relativized adjacency' (Toosarvandani 2016). These grammars can operate as acceptors over stringsets, or as transducers over functions. We focus on TSL grammars as functions.

Intuitively, the autosegmental elements are formalized as members of a projected tier of elements. For vowel harmony over a linear string, underlyingly specified vowels are projected onto a tier of ATR-specified vowels. When the string is traversed left-to-right, the ATR feature of an underspecified vowel is determined by examining the ATR feature of the most recently projected tier-element. For the 2nd /U/ vowel in /pitUkɪmO/, the most recently projected tier-element is +ATR /i/, thus it licenses the spread of +ATR. As for the 4th vowel /O/, the most recently projected element is -ATR /ɪ/ and thus -ATR is spread.

Tying this back to the Armenian data, the strict-locality of class assignment is manifested a form of blocking that is likewise TSL. The elements that determine the conjugation class and theme

vowels of the verb are phase heads, which all have class features: verbalized roots and additional little *v* nodes (causatives and passives). Within a conventional tree-based representation, the role of blocking is often visually shown with circular edges. Over a tier-based grammar, this intuition would be modeled by projecting the phase heads onto a specially designated tier of phases. The type of theme vowel is selected based on examining the most-recently projected tier-element. We illustrate below for causatives.

(24) *Tier-based locality of theme-vowel selection in causative verbs*

From E-Class 'to make scratch'	From A-Class 'to make read'
	

The reader should note that TSL grammars are often used for phonological processes that are *long-distant*, such as vowel harmony. For the local case of Armenian class selection and theme vowel selection, the use of a TSL grammar looks too powerful. However, in the next section, we analyze a long-distance allomorphy process which operates over the same phasal tier. This allomorphy is non-local in terms of linearity, but is local in terms of phases and tiers.

4 Non-locality in aorist agreement

All previous examples involved the citation form of Armenian verbs, i.e., their infinitival form. In this section, we show how conjugation classes have differences in their agreement morphology for the past perfective (§4.1). We argue that these differences are a form of long-distance allomorphy that is conditioned by class features (§4.2). We find tier-based competition in complex verbs between multiple class-feature-bearing morphemes (§4.3).

4.1 Aorist agreement in simple verbs

Armenian has three primary synthetic forms: the present, past imperfective, and past perfective. The first two don't show any class-conditioned allomorphy, while the latter displays long-distance allomorphy that's triggered by class features.

In citation form, the infinitival suffix occurs directly after the verb's theme vowel. When a verb is inflected, the infinitival suffix is replaced by the appropriate tense and agreement morphology. For example, in the present tense, the post-thematic element varies by person and number agreement

with the subject. These suffixes are the same for all 3 classes, and they are arguably a fused T/Agr node. The theme vowels stay constant.

(25) *Present tense for simple verbs*

	E-Class	I-Class	A-Class	*Template*
INF	*ker-e-l* 'to scratch'	*xos-i-l* 'to speak'	*gart-a-l* 'to read'	$\sqrt{}$-TH-INF
1SG	*ker-e-m* 'I scratch'	*xos-i-m* 'I speak'	*gart-a-m* 'I read'	$\sqrt{}$-TH-T/AGR
2SG	*ker-e-s*	*xos-i-s*	*gart-a-s*	
3SG	*ker-e-*	*xos-i-*	*gart-a-*	
1PL	*ker-e-nk*	*xos-i-nk*	*gart-a-nk*	
2PL	*ker-e-k*	*xos-i-k*	*gart-a-k*	
3PL	*ker-e-n*	*xos-i-n*	*gart-a-n*	

Similarly in the past imperfective (also called 'past imperfect' or 'imperfect'), the post-thematic elements designate tense and agreement. The affixes are the same for the 3 classes, and the can be decomposed to separate T and Agr nodes. These nodes show syncretism in the 2SG and 3SG forms, and the T morph is an overt *-i-* for all but the 3SG. Like in the present tense, the only difference among the 3 classes is the choice of theme vowel.[12]

(26) *Past imperfective of simple verbs*

	E-Class	I-Class	A-Class	
INF	*ker-e-l* 'to scratch'	*xos-í-l* 'to speak'	*gart-a-l* 'to read'	$\sqrt{}$-TH-INF
1SG	*ker-e-i* 'I was scratching'	*xos-e-i* 'I was speaking'	*gart-a-i* 'I was reading'	$\sqrt{}$-TH-T-AGR
2SG	*ker-e-i-r*	*xos-e-i-r*	*gart-a-i-r*	
3SG	*ker-e -r*	*xos-e -r*	*gart-a -r*	
1PL	*ker-e-i-nk*	*xos-e-i-nk*	*gart-a-i-nk*	
2PL	*ker-e-i-k*	*xos-e-i-k*	*gart-a-i-k*	
3PL	*ker-e-i-n*	*xos-e-i-n*	*gart-a-i-n*	

We see class-based allomorphy only in the past perfective. Here, the perfective suffix *-t͡s-* is added after the theme vowel. The perfective is often called the aorist in the literature, which we follow for ease of comparison with other work on Armenian.

[12]The *-i-* theme vowel is neutralized to *-e-* because of an arbitrary morphological rule, which we set aside. We omit the glide that is inserted between the theme vowel and T: *ker-e-[j]-i* 'I was scratching'.

(27) *Past perfective or aorist form of simple verbs*

	E-Class	I-Class	A-Class	Template
INF	*ker-e-l* 'to scratch'	*xos-i-l* 'to speak'	*gart-a-l* 'to read'	$\sqrt{}$-TH-INF
1SG	*ker-e-t͡s-i* 'I scratched'	*xos-e-t͡s-a* 'I spoke'	*gart-a-t͡s-i* 'I read'	$\sqrt{}$-TH-AOR-T-AGR
2SG	*ker-e-t͡s-i-r*	*xos-e-t͡s-a-r*	*gart-a-t͡s-i-r*	
3SG	*ker-e-t͡s-*	*xos-e-t͡s-a-v*	*gart-a-t͡s*	
1PL	*ker-e-t͡s-i-nk*	*xos-e-t͡s-a-nk*	*gart-a-t͡s-i-nk*	
2PL	*ker-e-t͡s-i-k*	*xos-e-t͡s-a-k*	*gart-a-t͡s-i-k*	
3PL	*ker-e-t͡s-i-n*	*xos-e-t͡s-a-n*	*gart-a-t͡s-i-n*	

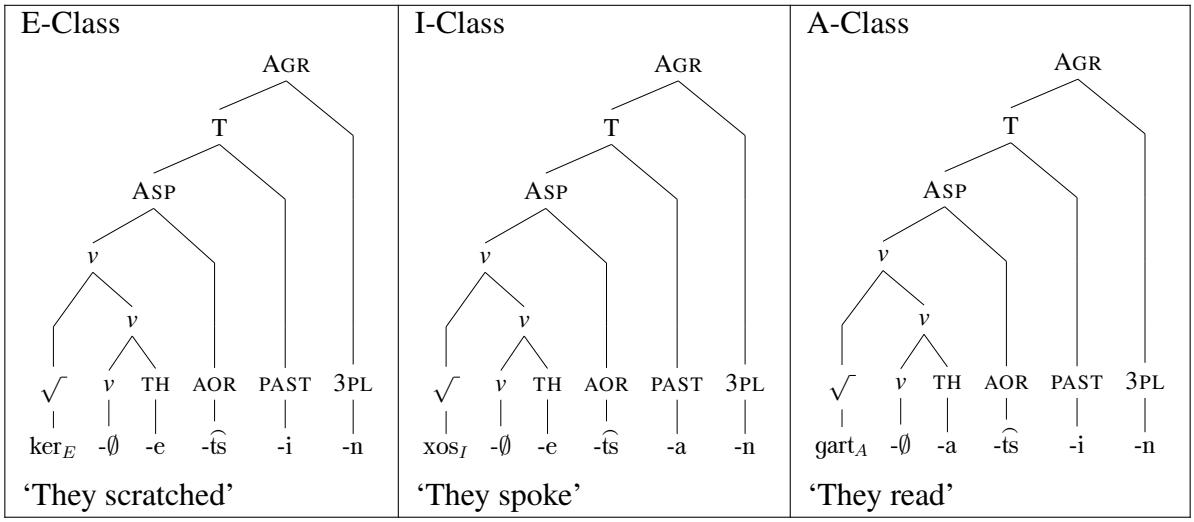
The aorist suffix is followed by a set of T and Agr suffixes. In the E-Class and A-Class, the T and Agr suffixes are largely the same as in the past imperfective. These suffixes all start with *-i* or are zero: *-i, -i-r, ∅, -i-nk, -i-k, -i-n*. We call this set the *primary agreement* set for two reasons. First, this set occurs in two of the three classes, including the default E-class. Second, it shares the same endings as the past imperfective (except in the 3SG). Thus, we treat the primary agreement set as the default agreement set.

But in the I-Class, the T suffix is a special allomorph *-a-*, and the 3SG Agr is a special allomorph *-v*. Thus, these suffixes all start with the segment *-a-*: *-a, -a-r, -a-v, -a-nk, -a-k, -a-n*. We call this set the *secondary agreement* set for the simple reason that, among regular verbs, this agreement is only found in the aorist of I-class verbs.[13]

Below, we show the tree structure of the 3PL aorist from each of the 3 classes. We treat the aorist suffix *-t͡s-* as the realization of perfective aspect (Donabédian 2016). Note again that the *-i-* theme vowel is changed to *-e-* because of an independent and Armenian-general morphophonological process (see footnote 7).

[13]In Eastern Armenian, I-Class verbs are either E-Class or A-Class verbs: *xos-e-l* 'to speak'. Thus, they do not trigger secondary aorist agreement: *xos-e-t͡sʰ-i* 'I spoke'. Secondary agreement is restricted to inchoatives (§5.1) and irregular verbs (footnote 14).

(28) *Structure of aorist 3PL*



In this paper, we don't focus on the exact realization rules needed for the different T and Agr morphemes across the different synthetic tenses (for that, see Karakaş et al. prep). Instead, we focus on what conditions the allomorphy displayed on T-Agr in the past perfective or aorist forms. That is, we focus on the choice of primary agreement vs. secondary agreement. We argue that secondary agreement is the marked set of allomorphs, while primary agreement is elsewhere (occurs in 2 of 3 classes, including the default class, and is shared with the past imperfective).

4.2 Determining aorist allomorphy

Based on just the surface distributions, there are two primary determinants of T-Agr allomorphy in the past perfective. Briefly put, the aorist suffix *licenses* the T-Agr suffixes, while the class features *pick* the T-Agr allomorphs, either the primary or secondary set.

To illustrate the subsequent discussion, we repeat below the linear structure of the 3PL past perfective of E-Class and I-Class verbs. As before, parentheses mark phases. The arrows show the dependency between class features and T-Agr.

(29) *Long-distance allomorphy of aorist agreement in simple verbs*

E-Class 'they scratched'	I-Class 'they spoke'
ker$_E$ -∅) -e -t͡s- -i -n √ v) TH AOR PAST 3PL	xos$_I$ -∅) -e -t͡s- -a -n √ v) TH AOR PAST 3PL

First, the aorist suffix licenses the use of the past perfective T-Agr suffixes. This set is similar but not identical to the set that is used in the past imperfective. For example, 3SG past imperfective of

E-Class *ker-e-l* 'to scratch' is *ker-e-r*, while past perfective is *ker-e-t͡s*. For non-3SG form of the past imperfective, nonetheless, primary aorist agreement is identical to past imperfective agreement. Similarly, the marked agreement set is only used in the past perfective, not past imperfective: I-Class *xos-e-i-n* 'they were speaking' vs. *xos-e-t͡s-a-n* 'they spoke'.

Second, for the past perfective, the set of T-Agr suffixes is divided into the primary agreement set (mostly starting with *-i*), and the secondary agreement set (starting with *-a*). For simple verbs, the morphological features which determine the choice of agreement set is the class features of the root. For regular simple verbs, only the I-Class triggers the marked secondary agreement set. We analyze this dependence by using a privative morphological feature [SECONDARY]. Simple E-Class and A-Class verbs are unmarked without [SECONDARY], while I-Class verbs are marked with [SECONDARY]. The distribution of this feature is controlled by insertion rules (30). Representationally, this feature is a property of the I-Class feature in a form of feature geometry (cf. Trommer 2008). We assume that only morphemes with class features can undergo this rule.[14] For aorist agreement, it doesn't matter if this feature is privative or binary.

(30) *Insertion rules for the* SECONDARY *feature* (To be revised)
$\emptyset \rightarrow$ [SECONDARY] / [I-CLASS, _] (Simple I-Class verbs)

Thus for simple verbs, secondary agreement is triggered by the presence of [SECONDARY] feature on the closest class-bearing morpheme (the root), while primary agreement is used elsewhere (31). Thus, in simple verbs at least, the root is the determinant of the T-Agr suffixes. Over a linear string, the root and the T-Agr suffixes are not adjacent: they are separated by the theme vowel and the aorist suffix. Thus on the surface, the T-Agr allomorphy is long-distance. The following rule showcases this. For illustration, the following rule only handles the allomorphy of the T node, and not that of the Agr node.[15]

(31) *Realization rules for past perfective or aorist agreement*
T[PAST] $\rightarrow$ *-a* / [αCLASS, SECONDARY] ... ASP[AOR] $\frown$ _
-i / elsewhere

[14]The rule is incomplete. In this paper, we focus on the patterns of aorist agreement for regular verbs, both simplex and complex. Irregular verbs show some deviations on the expected use of aorist agreement (Plungian 2018). In brief, irregulars with the *-i-* theme vowel take secondary agreement as expected: *təbt͡ʃ-i-l* 'to touch' vs. *təb-a-n* 'they touched'. But there are some irregulars with *-e-* or *-a-* that arbitrarily take secondary agreement: *jell-e-l* 'to rise' vs. *jel-a-n* 'they rose', *kədn-e-l* 'to find' vs. *kəd-a-n* 'they found'. Some irregulars take primary agreement in all but the 3SG, meaning they are heteroclitic (Stump 2006): *per-e-l* 'to bring' vs. *per-i-n* 'they brought' vs. *per-a-v* 'I brought'. All these irregulars are likewise accompanied by an additional morphological irregularity, such as dropping the aorist suffix, dropping a meaningless infix *-t͡ʃ-* or *-n-* that occurs in non-aorist forms, dropping the theme vowel, or using root suppletion. For these irregulars, the trigger for secondary agreement is the irregular feature of the root. The fact that secondary agreement is common with irregulars is further evidence that secondary agreement is a form of marked allomorphy. We set aside irregular verbs.

[15]We do not give complete realization rules for all 6 T-Agr values for the 2 agreement sets. For non-3SG forms, the agreement morph is identical between the two sets. The 3SG is convoluted to formalize because of the effects of syncretism, impoverishment, and zero morphology. These complications are tangential to our purposes. For complete rules, see Karakaş et al. (prep).

The rule in (30) references ASP locally and the class-features non-locally. The aorist suffix licenses the presence of aorist agreement, while the closest class-bearing morpheme determines the actual choice of exponents. In terms of directionality, aorist agreement is inwardly-sensitive and depends on the morphological class-features of a previously spelled out morpheme. Thus, cyclic spell-out cannot erase morphological features (cf. Bobaljik 2000).

Even if we were to assume that the class features are on the covert little *v* instead of the root (Acquaviva 2009), the covert little *v* is not adjacent to the T-Agr suffixes because of an intervening (adjoined) Theme and a (non-adjoined) Aspect. Furthermore, although we could use spans (Merchant 2015) that stretch from the root to the T-Agr suffixes, the intervening aorist suffix doesn't affect the choice between primary agreement vs. secondary agreement. The use of spans would obfuscate the fact that the aorist suffix itself does not affect the choice of agreement set, but only licenses the use of either set. In fact, the invisibility of theme vowels and the non-active role of the aorist suffix act as conceptual evidence for the use of tiers (Jardine 2016:250; Paster 2019:26), which we argue for in the next section.[16]

The fact that class determines the T/Agr allomorphy is visible in equipollent verbs. Recall from §2.2, that for most equipollent verbs, the *-e-* theme vowel is used for the transitive form, while *-i-* is used in the intransitive form. In this case, the root lacks an underlying class feature. Instead, the class features are inserted based on the transitivity value of little *v*. As expected, the E-Class transitive forms take primary agreement, while the I-Class intransitives take secondary agreement.

(32) *Aorist agreement for equipollent verbs*

	E-Class		I-Class	
Infinitival	*ajr-e-l*	'to burn X'	*ajr-i-l*	'to be burnt'
Past Perf. 3PL	*ajr-e-t͡s-i-n*	'they burned X'	*ajr-e-t͡s-a-n*	'they burned'

Note that we can't reduce the choice of allomorphy to just transitivity. The A-Class verbs are largely intransitives but they take primary agreement (33a). Furthermore, there are a handful of equipollent verbs which alternate in transitivity via the theme vowels *-e-* and *-a-*, and they both take primary agreement (33b). There are likewise verbs which alternate between *-i-* and other theme vowels with identical transitivity values, but take non-identical aorist agreement (33c). Regardless of transitivity, the choice of the aorist agreement set correlates with the choice of theme vowel.

(33)	a.	*toɣ-a-l*	'to tremble (intr.)'	*loɣ-a-l*	'to swim (intr.)'
		toɣ-a-t͡s-i-n	'they trembled'	*loɣ-a-t͡s-i-n*	'they swam'
	b.	*d͡zəx-a-l*	'to emit smoke (intr.)'	*d͡zəx-e-l*	'to smoke (tr.)'
		d͡zəx-a-t͡s-i-n	'they emitted smoke'	*d͡zəx-e-t͡s-i-n*	'they smoked'
	c.	*sarsər-i-l*	'to shudder (intr.)'	*sarsər-a-l*	'to shudder (intr.)'
		sarsər-e-t͡s-a-n	'they shuddered'	*sarsər-a-t͡s-i-n*	'they shuddered'

[16]Without using a tier, the allomorphy would be strictly local with a window of size k=4 (the root, little *v* or theme vowel, aorist, and T). This window is still larger than most cross-linguistically morphological and phonological processes, which are often around k=*2* (Chandlee 2017; Chandlee and Heinz 2018).

In sum, past perfectives show a type of long-distance allomorphy that's conditioned by the class features of the root in simple verbs. For simple regular verbs, the I-Class triggers secondary agreement, while the E-Class and A-Class trigger (elsewhere) primary agreement.

4.3 Non-locality in complex verbs

In this section, we show that underneath the surface long-distance allomorphy, we again find tier-based locality. As before, this tier-based locality is manifested as phase-based locality. The role of long-distance and tier-based locality is likewise found between causatives and passives.

Recall that causatives are formed with the *-t͡sən-* suffix. They are E-Class verbs and take the *-e-* theme vowel following the causative suffix. In the past perfective, the causative suffix uses a special allomorph *-t͡su-* without a theme vowel (we assume they are fused, though nothing in our argument hinges on this). The causative precedes the aorist suffix *-t͡s-*. As expected, the causative triggers primary agreement because of its E-Class feature. The root's class features don't matter. The causative triggers primary agreement even if is derived from an I-Class verb.[17]

(34) *Aorist form of causative verbs*

	E-Class	I-Class	A-Class	*Template*
	'to scratch'	'to speak'	'to read'	
Simple INF	*ker-e-l*	*xos-i-l*	*gart-a-l*	√-TH-INF
Past Perf. 3PL	*ker-e-t͡s-i-n*	*xos-e-t͡s-a-n*	*gart-a-t͡s-i-n*	√-TH-AOR-T-AGR
Causative INF	*ker-e-t͡sən-e-l*	*xos-e-t͡sən-e-l*	*gart-a-t͡sən-e-l*	√-TH-CAUS-TH-INF
Past Perf. 3PL	*ker-e-t͡su-t͡s-i-n*	*xos-e-t͡su-t͡s-i-n*	*gart-a-t͡su-t͡s-i-n*	√-TH-CAUS-AOR-T-AGR

Conversely for passives, recall that passives are I-Class verbs with the *-i-* theme vowel. Like any other I-Class verb, passives trigger secondary agreement. It doesn't matter if the passive is derived from an E-Class verb or not.

(35) *Aorist form of passive verbs*

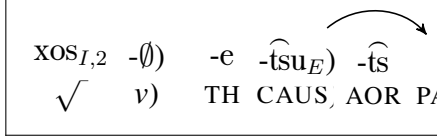
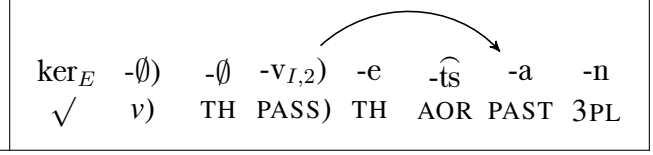
	E-Class	I-Class	*Template*
	'to scratch'	'to speak'	
Simple INF	*ker-e-l*	*xos-i-l*	√-TH-INF
Past Perf. 3PL	*ker-e-t͡s-i-n*	*xos-e-t͡s-a-n*	√-TH-AOR-T-AGR
Passive INF	*ker-v-i-l*	*xos-v-i-l*	√-PASS-TH-INF
Past Perf. 3PL	*ker-v-e-t͡s-a-n*	*xos-v-e-t͡s-a-n*	√-PASS-TH-AOR-T-AGR

For causatives and passives, the determinant class features are on the overt little *v*. We illustrate this below; the subscript 2 marks the SECONDARY feature. As in the case of roots in simple

[17] In Eastern Armenian, the causative's past allomorph is *-t͡sʰr-*. The theme vowel and aorist suffix are optional: *kʰer-e-t͡sʰr-e-t͡sʰ-i-n* or *kʰer-e-t͡sʰr-i-n* 'They caused to scratch' (Hagopian 2005:358; Dum-Tragut 2009:208).

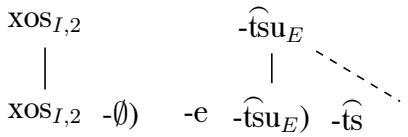
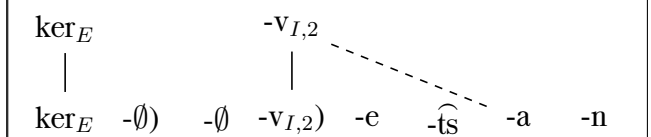
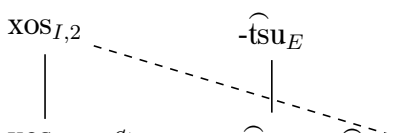
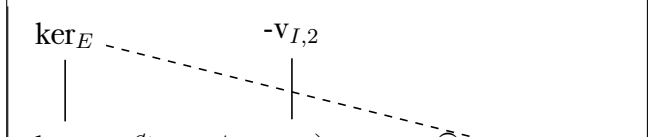
verbs, the causative and passive suffixes are not linearly adjacent to the T-Agr suffixes. They are separated by at least one overt morph: the theme vowel (for passives) and the aorist suffix (for both). Although one could argue that the theme vowels are invisible to local conditioning because they are adjuncts, the aorist suffix forms a separate non-adjoined head that intervenes between little *v* and T-Agr. Thus, aorist agreement is truly long-distance.

(36) *Long-distance allomorphy of aorist agreement in complex verbs verbs*

Causative of I-Class 'they made speak'	Passive of E-Class 'they were scratched'
	

Although aorist agreement is long-distance, it displays the same type of relativized or tier-based locality that was shown in theme vowel selection. In a verb with multiple morphemes that have class features, only the rightmost class feature determines the type of aorist agreement. Consider the case of causatives and passives again. Autosegmentally, it is as if the rightmost class feature spreads its [SECONDARY] feature onto the T-Agr suffixes. Over a tier-based grammar, this is captured by projecting all the class-bearing morphemes onto the corresponding tier. When the word is spelled-out, only the most recently projected tier-element will determine the right T-Agr suffixes. It would be ungrammatical if the deeper-embedded root were to determine aorist agreement. Like with the choice of the verb's theme vowel, phasal locality determines which class-feature-bearing morpheme determines aorist agreement. Again, in Armenian, tier locality is the same as phasal locality.

(37) *Tier-based locality of aorist agreement in causatives and passives*

Causative of I-Class	Passive of E-Class
xos-e-t͡su-t͡s-i-n 'they made speak' 	*ker-v-e-t͡s-a-n* 'they were scratched' 
**xos-e-t͡su-t͡s-a-n* 	**ker-v-e-t͡s-i-n* 

The interaction of spreading and blocking is likewise visible in verbs with multiple valency

features, i.e., causativized passives and passivized causatives. With multiple layers of little *v*, only the topmost layer determines the T-Agr allomorphy. That is, only the linearly rightmost class-morpheme (valency suffix) determines aorist agreement.[18]

(38) *Aorist of causativized passive and passivized causative*

Passive	*kəʒ-v-i-l* √-PASS-TH-INF 'to go mad (intr.)'	Causative	*jer-a-t͡sən-e-l* √-TH-CAUS-TH-INF 'to cause to boil (tr.)'
Causativized	*kəʒ-v-e-t͡sən-e-l* √-PASS-TH-CAUS-TH-INF 'to make s.o. go mad'	Passivized	*jer-a-t͡s-v-i-l* √-TH-CAUS-PASS-TH-INF 'to be boiled by s.o.'
Past Perf 3PL	*kəʒ-v-e-t͡su-t͡s-i-n* **kəʒ-v-e-t͡su-t͡s-a-n* √-PASS-TH-CAUS-AOR-T-AGR		*jer-a-t͡s-v-e-t͡s-a-n* **jer-a-t͡s-v-e-t͡s-i-n* √-TH-CAUS-PASS-TH-AOR-T-AGR

Thus, as with simple verbs, these complex verbs show that aorist agreement is long-distance but displays relativized adjacency. In brief, the rightmost class-bearing morpheme determines the type of aorist T-Agr allomorphy. Formally, this constitutes a type of tier-based locality over a tier of class morphemes. Theoretically, these class-bearing morphemes demarcate phases, making tier-based locality manifest as phase-based locality in Armenian.

5 Primacy of phases and locality

As an interim summary, the data and discussion so far suggest the following generalizations:

(39) *Generalizations on Armenian classes*

a. **Class features**: (verbalized) roots and little *v* have class features.

b. **Local and long-distance allomorphy**: morphemes with class features affect the choice of theme vowels (in a linearly-adjacent local fashion) and the choice of T-Agr allomorphs (in a long-distant fashion).

c. **Blocking**: In a word with multiple class morphemes, each class morpheme can *only* affect the allomorphy of morphemes that come between it and the next class morpheme.

d. **Tier-based locality**: The combination of long-distance conditioning and blocking is a form of relativized or tier-based locality.

e. **Phasal connection**: The morphemes which have class features and which participate in tier-based locality are either little *v* phase heads themselves (causative, passive) or head-adjoined to little *v* (roots).

[18]The passive verb *kəʒ-v-i-l* is derived from an adjective *kíʒ* 'lunatic' with vowel reduction. We omit the covert adjectivizer (little *a*) between the root and *v*.

For the first generalization, we first elaborated the role of class features in §2 on the selection of theme vowels. For the second generalization, only the class features provide a unified treatment on what conditions long-distance allomorphy in aorist agreement. Other morphosyntactic correlates like transitivity cannot explain the entire range of data. We re-emphasize this point in the subsequent section on inchoatives (§5.1).

However, the long-distant nature of the allomorphy does not mean that the machinery that needed to describe this pattern is un-restrictively powerful. The third generalization is that class-conditioned allomorphy displays a form of relativized adjacency and blocking, such that only the linearly closest and most-recently spelled-out class morpheme can determine aorist agreement. This type of blocking is commonly seen in long-distance phonotactics, which gave rise to theories of autosegmental phonology in the literature on theoretical phonology. It has simultaneously inspired a class of computational formal grammars that utilize tiers. The role of tiers and computation is further emphasized in section (§5.2).

As a final generalization, it is interesting that the class morphemes which trigger long-distant allomorphy are the same morphemes that are argued to demarcate phases in Distributed Morphology. Even if this just a coincidence, it provides an interesting case of convergence between the empirical formal properties of Armenian morphology and cross-linguistic debates on the role of phases. We discuss this in section (§5.3).

5.1 Inchoatives and transitivity

For regular simple verbs, we have seen that there are 3 conjugation classes based on 3 theme vowels. Of these classes, only the I-Class triggers secondary agreement. As for complex verbs, the causatives and passives are E-Class and I-Class respectively, and again, it is the I-Class passives that trigger secondary agreement. In this section, we discuss a third type of valency morphology: inchoativization. We show that inchoatives are A-Class verbs, but they idiosyncratically trigger secondary agreement. This agreement pattern shows that aorist agreement cannot be reduced to either transitivity or just class features.

In terms of transitivity, causatives are always transitive while passives are always intransitive.[19] E-Class simple verbs are often transitive while I-Class simple verbs are often intransitive. Based on this dichotomy of voicing, one could argue that perhaps intransitivity is what essentially triggers secondary agreement. This is however false for multiple reasons. The first reason, discussed before in §2.2, is that E-Class and I-Class verbs have both transitive and intransitive verbs. For the E-Class, the number of intransitives is significant. The second reason is that for simple verbs, the A-Class is largely intransitive but triggers primary agreement (§3.1).

The third reason that we provide comes from inchoatives. Virtually any noun or adjective can be turned into an inchoative verb by adding the inchoative suffix *-n-* followed by the *-a-* theme vowel.

[19] In Boyacioglu and Dolatian (2020)'s database, all 339 causative verbs are transitive, and all 268 passives are intransitive.

(40) *Paradigm of inchoative verbs*

	Base		Inchoative	
Noun	*kar*	‘rock’	*kar-a-n-a-l*	‘to be petrified’
	ənger	‘friend’	*ənger-a-n-a-l*	‘to become friends’
Adjective	*urax*	‘happy’	*urax-a-n-a-l*	‘to become happy’
	t͡ʃerm	‘warm’	*t͡ʃerm-a-n-a-l*	‘to grow warm’

The inchoative suffix is often preceded by another vowel *-a-*, less often by *-e-* or by nothing at all. We assume that the pre-nasal vowel is the same meaningless linking vowel that is used in compounding (Donabédian 2004; Dolatian 2021), and not another theme vowel. Regardless of the identity of the pre-inchoative vowel, the inchoative verb is A-Class and takes the *-a-* theme vowel.

(41) *Inchoatives without a pre-nasal theme vowel* -a-

Vowel	Base		Inchoative		
-e-	*mod*	‘near’	*mod-e-n-a-l*		‘to come near’
	mert͡s	‘close’	*mert͡s-e-n-a-l*		‘to come near’
∅	*ker*	‘fat’	*ker-a-n-a-l*	*ker-n-al*	‘to become fat’
	sɛv	‘black’	*sɛv-a-n-a-l*	*sɛv-n-a-l*	‘to become black’

Inchoative verbs are largely intransitive. There is, however, a small number of transitive verbs that have inchoative morphology. In these cases, the inchoative suffix *-n-* retains only its roles as a verbalizing *v*, without the aspectual semantics of inchoativity. The pre-nasal vowel is variably deleted, more often in Western Armenian than in Eastern Armenian. In some cases, the verb is derived from an unclear base.

(42) *Transitive verbs with inchoative morphology*

With pre-nasal vowel	Without pre-nasal vowel		Base
koɣ-a-n-a-l	*koɣ-n-a-l*	‘to rob’	from *koɣ* ‘robber’
mor-a-n-a-l	*mor-n-a-l*	‘to forget’	
əst-a-n-a-l		‘to receive’	

Inchoative verbs show a complex form of allomorphy in the past perfective or aorist. First, the nasal affix and its theme vowel are deleted, leaving only the aorist suffix *-ts-* itself. Second, the A-Class inchoative takes secondary agreement, unlike simple A-Class verbs. Thus, inchoatives share properties with both A-Class and I-Class verbs, Like A-Class verbs, inchoatives have the same *-a-* theme vowel in infinitivals; like I-Class verbs, inchoatives take secondary agreement in the aorist.

(43) *Aorist formation in inchoative verbs vs. simple A-Class and I-Class verbs*

	I-Class	Inchoative	A-Class
INF	*xos-i-l* $\sqrt{}$-TH-INF 'to speak'	*urax-a-n-a-l* $\sqrt{}$-LV-INCH-TH-INF 'to become happy'	*gart-a-l* $\sqrt{}$-TH-INF 'to read'
Past Perf 3PL	*xos-e-t͡s-a-n* $\sqrt{}$-TH-AOR-T-AGR 'they spoke'	*urax-a-t͡s-a-n* $\sqrt{}$-LV-AOR-T-AGR 'they became happy'	*gart-a-t͡s-i-n* $\sqrt{}$-TH-AOR-T-AGR 'they read'

In the past perfective, it is the post-nasal theme vowel *-a-* that's deleted and not the pre-nasal vowel *-a-*. Evidence comes from inchoatives where the pre-nasal segment is not *-a-*.

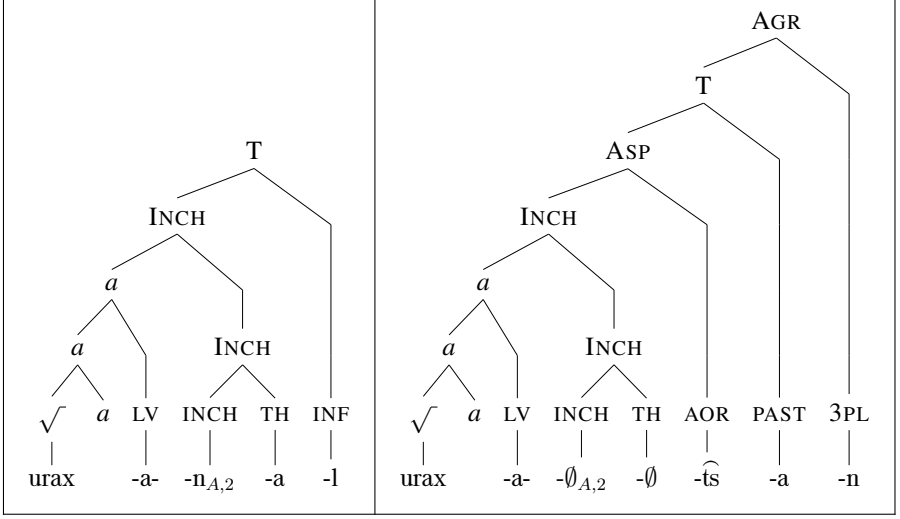
(44) *Aorist of inchoatives without a pre-nasal theme vowel* -a-

Vowel	Base		Inchoative		Past Perf. 3PL	
-e-	*mod*	'near'	*mod-e-n-a-l*	'to come near'	*mod-e-t͡s-a-n*	'they came near'
∅	*ker*	'fat'	*ker-n-al*	'to become fat'	*ker-t͡s-a-n*	'they became fat'

Structurally, we treat the inchoative suffix *-n-* as a flavor of little *v*. It has both the A-Class feature and a [SECONDARY] feature. We treat the post-nasal vowel as an adjunct theme vowel. We show below a deadjectival inchoative. Here, there are two phase heads: first, a root-merged or -adjoined *a* for the adjectival stem, and second, a little *v* (in INCH) for the verbalized stem. In the past perfective, the inchoative suffix is covert but still present. The covert inchoative little *v* us necessary to provide inchoative semantics, and to trigger secondary agreement. The morphological activity of a covert inchoative is analogous to how covert affixes in exocentric compounds can block the inheritance of irregular morphology (Kiparsky 1982; Ackema and Neeleman 2004; Steddy 2019; Dolatian 2021) and how covert morphology can trigger nativization in loanwords (Jurgec and Bjorkman 2018). Note that a meaningless linking vowel LV is adjoined to the adjectival base.

(45) *Structure of inchoative in infinitivals and in aorist form*

Infinitival	Past perfective 3PL
'to become happy'	'they became happy'



The split behavior of inchoative verbs is evidence for the minute division of morphological features. On the one hand, we have features which select theme vowels: E-CLASS, I-CLASS, and A-CLASS. On the other hand, we have a separate feature for aorist agreement: [SECONDARY]. Causatives and passives are respectively E-Class and I-Class verbs; of these two, only the passive takes [SECONDARY] from the insertion rules in (46), revised from (30). In contrast, inchoatives are A-Class but exceptionally take [SECONDARY]. Thus, our use of [SECONDARY] is a shorthand for the disjunction-based distribution in (46).[20]

(46) *Insertion rules for the* SECONDARY *feature* (Final)

∅	→	[SECONDARY]	/ [I-CLASS, _]	(I-Class verbs, including passives)
	→	[SECONDARY]	/ [INCH, _]	(Inchoatives)
	→	no insertion	/ elsewhere	(Simple E-Class and A-Class, causatives)

For morphologically inchoative verbs, it is not semantic inchoativity or syntactic intransitivity that trigger secondary agreement. There are two reasons for this. First, both inchoatives and simple A-Class verbs use the *-a-* theme vowel: *gart-a-l* 'to read' vs. *urax-a-n-a-l* 'to become happy'. They are likewise both mainly intransitive classes. But, only inchoatives trigger secondary agreement. We provide allow calculations on the number of A-Class and inchoatives from Boyacioglu and Dolatian (2020).

[20] As suggested by a reviewer, a more economical system is to have only two morphological features: A-CLASS and SECONDARY. In this analysis, E-Class verbs have no features, I-Class verbs have only SECONDARY, A-Class verbs have A-CLASS, and inchoatives have A-CLASS and SECONDARY. Via default insertion rules, a sole SECONDARY feature results in the *-i-* theme vowel, while the lack of features results in an elsewhere *-e-* theme vowel. This analysis would work for regular verbs, but not for irregulars or suppletive verbs, which can have both the *-e-* theme vowel and secondary agreement: *jell-e-l* 'to rise' and *jel-a-n* 'they rose'. See footnote 14.

(47) *Distribution of inchoatives and simple A-Class verbs by transitivity*

Class	Transitivity							
	Intransitive		Transitive		Both		Total	
Simple A-Class	98	(75%)	30	(23%)	3	(2%)	131	(31%)
Inchoative	274	(92%)	21	(7%)	2	(1%)	297	(69%)
Total	372	(87%)	51	(12%)	5	(1%)	428	

Second, semantically-bleached inchoatives have inchoative morphology without any inchoative aspectual semantics; for these verbs, the inchoative is just a verbalizer. These transitive 'inchoatives' constitute around 7% of morphological inchoatives, yet they take secondary agreement, just like a typical inchoative verb.[21]

(48) *Aorist of transitive verbs with inchoative morphology*

	With pre-nasal vowel		Without pre-nasal vowel	
	Infinitival	Past Perf. 3PL	Infinitival	Past Perf. 3PL
'to rob'	*koɣ-a-n-a-l*	*koɣ-a-t͡s-a-n*	*koɣ-n-a-l*	*koɣ-t͡s-a-n*
'to forget'	*mor-a-n-a-l*	*mor-a-t͡s-a-n*	*mor-n-a-l*	*mor-t͡s-a-n*
'to receive'	*ǝst-a-n-a-l*	*ǝst-a-t͡s-a-n*		

In sum, we argue that aorist agreement is long-distant and conditioned by a [SECONDARY] feature on class-bearing morphemes, not by transitivity.

[21] A reviewer makes an interesting alternative analysis based on deponency (Grestenberger 2019). Briefly put, they suggest that perhaps the trigger for secondary agreement is the transitivity value of little *v* in conjunction with the theme vowel. Essentially, transitives would take primary agreement while intransitives would take secondary agreement. The dependence between transitivity values on *v* and T-Agr could be modeled as some type of feature chain (cf. Elordieta 1997). The E-Class and I-Class are marked as default transitives and intransitives respectively; any cases of intransitive E-Class and transitive I-Class are morphologically deponent. There would thus be a mismatch between the semantic intransitivity and morphological transitivity of an intransitive E-Class verb. The problem with this approach is that it recapitulates our own analysis and makes unclear explanations for A-Class and inchoative verbs. First, instead of placing arbitrary class features on roots, this analysis would place arbitrary features on little *v*, such that these arbitrary features would often line up with transitivity but would be free to diverge from transitivity. But, because any analysis of Armenian conjugation classes requires arbitariness anyway, it's unclear what is gained from the connection with transitivity and then the permitted mismatches. Second, this analysis would posit many deponent intransitive E-Class (191) and transitive I-Class (32) verbs, at around 223 out of Boyacioglu and Dolatian (2020) 2,108 E-Class and I-Class verbs (1̃0%). Third, the deponency analysis wouldn't explain why simple A-Class verbs are mainly intransitives (75% out of 131 verbs) and they all take primary agreement, while inchoatives A-Class verbs are mainly intransitive (92% out of 297) but take secondary agreement. Four, the intervening aorist suffix would still make this deponency analysis require long-distance conditioning. We suspect that this deponency analysis may be more viable in Classical Armenian, which had stronger correlations between transitivity, theme vowels, and agreement (Olsen 2017). Replicating our analysis from Modern to Classical Armenian is an open future research question.

5.2 Tiers and non-locality

In terms of empirical generalizations, this paper has shown that theme vowel selection is a local process that operates over linear adjacency, while aorist agreement is a long-distance process that operates over multiple overt interveners. In this section, we go over the status of locality in the morphological literature and place Armenian within this discussion.

There is a wide range of work that argues that morphologically-conditioned allomorphy obeys strict adjacency (Siegel 1974; Allen 1979). The need for adjacency can manifest in terms of linear adjacency (Ostrove 2018, 2020), structural adjacency (Siegel 1978; Gribanova 2015), or cyclic locality (Embick 2003, 2010). Local conditioning can operate over concatenative or non-concatenative morphology (Arad 2003; Embick 2013; Kastner 2019). Locality can be used as a diagnostic to distinguish different types of morphological or phonological processes Embick and Shwayder (2018).

Thus, Armenian theme-vowel selection conforms to this cross-linguistic tendency, while long-distance aorist agreement does *not*. The literature on attested cases of non-local allomorphy is small but has been growing in recent years (Bruening 2018; Deal 2018; Lee and Amato 2018; Wu 2018). Oftentimes, each individual case of long-distant allomorphy has been accompanied with a separate theoretical apparatus. An incomplete list of strategies include feature percolation (Lieber 1989), c-command (Chung 2007, 2009), phase-based locality (Marvin 2002; Marantz 2007, 2013; Embick 2010; Guekguezian 2020), domain suspension (Bobaljik and Wurmbrand 2013), accessibility domains (Moskal 2015b,a), linear spans (Merchant 2015; Guekguezian 2020), morphological fusion and re-bracketing (Christopoulos and Petrosino 2017), rules with multiple conditioning triggers (Moskal and Smith 2016), bounded windows or stacks (Božič 2019), parameterizing the phase-status of morphemes (Kilbourn-Ceron et al. 2016), structural adjacency with articulated tree structures (Bobaljik 2012; Gribanova 2015), or assumptions on the elsewhere-status of morphs (Ganenkov 2020).

Thus based on the choice of theoretical devices, it seems that there is little in common among the many reported cases of long-distance allomorphy. In this paper however, we identified a formal property of Armenian long-distance allomorphy which is theory-agnostic: tier-based locality. We speculate that tier-based locality may be a cross-linguistic tendency in long-distance allomorphy. Tier-based locality could unify the variation in long-distance allomorphy that has prompted different types of theoretical machinery.

Tier-based locality is mostly reported in the phonological literature, such as in the case of consonant harmony (McMullin 2016; McMullin and Hansson 2016; De Santo 2018), vowel harmony (Aksënova and Deshmukh 2018; Mayer and Major 2018), and stress (Hao and Andersson 2019; Baek 2018; Hao 2020). Despite the many theories of vowel harmony and consonant harmony, tier-based locality seems to be a unifying property across most of the typology (Aksënova et al. forthcoming). Most of the typology can be modeled with a TSL grammar that uses a single tier. Languages that utilize multiple harmony patterns often require a refinement of TSL grammars that utilize multiple tiers, i.e., Multi-TSL grammars or MTSL (McMullin and Hansson 2019; Burness

and McMullin 2020; Aksënova 2020).[22] Furthermore, tier-based locality has appeared in non-computational guises such as relativized minimality in Search&Copy theory (Nevins 2010), which is formally tier-based (Andersson et al. 2020).

In morphology, tier-based formalisms have also been used to model morphological processes. Within computational morphology, they have been used to model the interdependence between prefixes and suffixes, such as in circumfixal patterns (Aksënova et al. 2016; Aksënova and De Santo 2019; Moradi et al. 2019). But in the theoretical literature, most cases of essentially tier-based formalisms have not used the term 'tier' *per se*. For example, tiers were proposed early on in the form of autosegmental structure for Semitic morphology (McCarthy 1981). They were most recently proposed in the form of relativized adjacency in Toosarvandani (2016) for Northern Paiute. In Northern Paiute, verbs show suppletion based on the number feature of the closest noun, whether it is is an object, subject, or applicative (cf. with more stringent locality requirements in similar languages: Bobaljik and Harley 2017; Harley et al. 2017; Duncan 2019).[23] Crucially, intervening adverbs are ignored. In a tier-based formalization, the tier for suppletion computation includes all nouns but excludes adverbs.

To our knowledge, we are the first in the literature on theoretical morphology to explicitly state the connection between tier-based locality (as used in computational morphology) and relativized locality (as used in theoretical morphology). Making this connection, however, requires that we distinguish between the formal and substantive aspects of tier-based locality.

5.3 Phases vs. tiers

The paper so far has made dual generalizations over how aorist agreement is tier-based strictly-local, and simultaneously phase-based local. In this section, we discuss the connection between the two generalizations. In brief, tier-based locality is a formal generalization, while phase-based locality is a substantive generalization and a substantive manifestation of tier-based locality.

Within phonology, it is often noted that there are both formal and substantive constraints that shape the typology of phonological processes (Moreton 2008). The formal properties come from work in computational phonology (Heinz 2018). For example, the formal property of being finite-state or regular imposes strict upper limits on phonological expressivity (Kaplan and Kay 1994). Other formal properties like strict locality are properties which push down the expressivity of most

[22]Our gratitude to Phillip Burness for discussing this section. Of course, there are some cases of vowel harmony which are beyond the power of simple TSL or MTSL grammars. Attested cases of bidirectional harmony are strictly more expressive than (M)TSL because they require both infinite lookback and infinite lookahead (Heinz and Lai 2013). Likewise, attested cases of sour-grapes like pattern are also above (M)TSL (McCollum et al. 2020). But regardless of these cases, tier-based locality is significantly common in vowel harmony systems.

[23]Though see Thornton (2019) who re-analyzes these data as due to syntactic agreement affecting a word-internal number morpheme. In this reanalysis, the ultimate trigger of allomorphy is still long-distant, but it is analyzed as tier-based *syntactic* agreement (for work on tiers in syntax, see: Vu 2018, 2019; Vu et al. 2019; Graf and Shafiei 2019). The relevant properties of the word-external trigger is then recapitulated into a word-internal morpheme which then locally triggers the suppletion.

phonological processes (Chandlee 2014; Chandlee and Heinz 2018; Chandlee et al. 2018). In contrast, substantive constraints from articulation and diachrony affect what types of processes are cross-linguistically common (Blevins 2004; Kiparsky 2006).

As a formal process, Armenian allomorphy displays tier-based locality. Computationally, the brunt of the work in creating a tier-based analysis is to determine the elements of the tier. But, formally, the choice of tier elements is ultimately arbitrary and phenomenon-dependent. For the computation of Armenian, class features are stipulated to be the tier elements simply because they are the elements that affect the computation. The same type of formal stipulation is involved in vowel harmony and consonant harmony. Vowels are formally stipulated to be part of a tier for vowel harmony.

But, alongside the formal stipulation of tier elements, there are likewise substantive explanations. For example, for the computation of vowel harmony, it is a formally arbitrary fact that vowels are part of the projected tier. But, typologically and phonologically, it is expected that vowels should be projected onto a tier for vowel harmony because of various substantive factors, such as co-articulation and diachrony. Similarly for Armenian, it is formally arbitrary that the tier elements for allomorphy are class features on roots and little *v*. But, substantively, these tier elements are phase heads.

For Armenian, we argue that tier-based locality is a formal property of aorist allomorphy. This formal property is then substantively manifested in the choice of phase heads as tier elements. However, this does not mean that tier-based locality is the same as phase-based locality. Furthermore, this does not mean that all cross-linguistic cases of long-distance allomorphy likewise operate over phases. Instead, at a more abstract level, we speculate that tier-based locality is a generalized property of cross-linguistic cases of long-distance allomorphy. On a language-by-language basis, this tier-based property will manifest in terms of what counts as the elements of the corresponding tier. For Armenian, the manifestation is in the form of phase heads, meaning that the tier-based locality is manifested as phase-based locality. As phase heads determine cyclic computation of form and meaning, they do seem to be a natural choice to be the elements of the tier.[24]

But there is evidence that in other languages with long-distance allomorphy, those languages display tier-based locality but not over phase heads. An illustrative case comes from Korean (Choi and Harley 2019). In Korean, there are two root suppletion patterns in verbs: one based on negation, the other on honorifics. When the verb contains both types of triggers, only the structurally closest trigger will trigger allomorphy. For Korean, this is the honorific. Choi and Harley (2019) analyze the data and argue for a model of spell-out which is bottom-up, such that the root will supplete by searching for the structurally closest allomorphy trigger. Substantively, this process of root-outwards search does not involve phases. But formally, this analysis displays tier-based locality. Korean suppletion simply uses a tier made up of the honorific and negation. The root suppletes

[24]We are the first to propose an *explicit* connection between phases and tier-based locality, but the literature does have implicit cases. Some argue that phases are "universal interveners" to every possible process (Abels 2003). They are interveners because they carry all possible features. In formal terms, this amounts to saying that phase morphemes are present on all possible tiers. We thank Omer Preminger for bringing this to our attention.

based on the tier-local trigger. Japanese shows virtually the same set of suppletion patterns (Oseki and Tagawa 2019). The main difference is that Japanese has tier-based competition among 3 sets of triggers: object honorific, potential, and subject honorific (in that order).

In sum, as a long-distance process, Armenian agreement displays both tier-based locality and phase-based locality. The tier-based locality is a formal generalization that likely unifies Armenian with other cross-linguistic cases of long-distance allomorphy. It is a language-specific fact that the tier-based locality is manifested as phase-based locality in Armenian, but without phases in some other languages. An open research question is discovering the cross-linguistic frequency of having tier-based locality be manifested as phase-based locality. It is possible that tier-based locality is manifested as other substantive kinds of locality, besides phases.

6 Conclusion

Western Armenian verbal morphology shows several dependencies that are relevant to models of locality in morphological allomorphy. We discussed two patterns: class-assignment and aorist agreement. Class-assignment is a fully local process that respects strict adjacency. In contrast, aorist agreement displays long-distant morphologically-triggered allomorphy. This allomorphy is simultaneously tier-based strictly local as a formal property and phase-based local as a substantive property.

For aorist agreement, the target of allomorphy is tense (and agreement) in the past perfective. The trigger of allomorphy is the closest verbalized root or valency affix (i.e., phase head). The target and trigger are not adjacent. The allomorphy pattern is sensitive to the class features of the trigger. This feature must be part of the categorized root or of a valency suffix (little *v* phase head), and not on any closer morpheme.

This pattern is not amenable to an account of locality which is defined by morpheme position (either linearly or structurally). However, we propose that this pattern does indeed obey locality in a tier-based framework. Over a tier of phase heads, we retain local interaction among the trigger and target of allomorphy. We suspect that tiers are also able to account for apparent cases of non-local morphologically-conditioned allomorphy in other languages.

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