Allomorphy in Greek verbal inflection as result of phonological computation

One of the most controversial debates in current morphological theory concerns *root allomorphy*, which is either analyzed in terms of *suppletion* and *stem-listing* (e.g., Booij 1997; Inkelas & Zoll 2005; Bermúdez-Otero 2013, 2016) or it is argued to be determined by *context-sensitive rules* (e.g., Halle & Marantz 1993; Embick & Halle 2005; Harley & Tubino Blanco 2013; Arregi & Nevins 2014; Embick 2016). The main difference between the two approaches is that in the former the root allomorphs are arguably listed as separately stored stems that share a common semantic core, whereas in the latter a single root is assumed, whose specific realizations are conditioned by morpheme-specific phonological rules (aka *Readjustment Rules* in *Distributed Morphology*; Halle & Marantz 1993; Embick & Halle 2005). In this paper we argue in favour of the latter approach but, crucially, we depart from the traditional readjustment analysis, putting more emphasis on the exact phonological operations that give rise to allomorphic phenomena. In particular, we examine root allomorphy in Greek verbal inflection and show that most of the attested alternations result from the competition between phonological segments that belong to the vocabulary items that materialize the terminal nodes of the root and the relevant functional heads (Voice/Aspect, T).

Although Greek verbal morphology is predominantly concatenative, in the sense that inflectional forms result from the linear combination of a root with overt or zero exponents that realize the morphosyntactic structure (the result of head movement) given in (1) (Philippaki–Warburton 1998; Merchant 2015):

(1) $[_{T(Agr)}\ [_{Asp}\ [_{Voice}\ [_{v}\ \sqrt{}\ v\ ]\ Voice\ ]\ Asp\ ]\ T\ Agr]]$,

for a considerable number of verbs, the realization of certain functional categories affects the phonological shape of the root. In most cases, this reshaping exhibits systematic patterns, including vowel alternations, omission/addition of consonants or syllables and consonantal changes:

(2) Systematic patterns of C- and V-alternations

		[–pass, –pfv]	[+pass, −pfv]	[–pass, +pfv, +pst]	[+pass, +pfv, +pst]
Regular roots	a.	aníɣ-o	aníɣ-ome	ánik-s-a (/ɣs/→ks)	aníx-θ-ik-a
Roots with V-alternations	b.	vr**é**x-o	vr**é**x-ome	é-vrek-s-a (/xs/→ks)	vr**á**x-ik-a
	c.	s**é**r**n**-o	s**é**r**n**-ome	é-s**i**r-a (–PST: s**í**r-o)	s**í**r-θ-ik-a
	d.	ɣð**é**r**n**-o	ɣð**é**r**n**-ome	é-ɣð**a**r-a (–PST: ɣð**á**r-o)	ɣð**á**r-θ-ik-a
	e.	p**é**r**n**-o	p**é**r**n**-ome	p**í**r-a (–PST: p**á**r-o)	p**á**r-θ-ik-a
Roots with C-alternations	f.	psáx**n**-o	psáx**n**-ome	é-psak-s-a	psáx-θ-ik-a
	g.	kalíp**t**-o	kalíp**t**-ome	kálip-s-a	kalíf-θ-ik-a
	h.	alá**z**-o	alá**z**-ome	ála**k**-s-a	alá**x**-θ-ik-a

(a) *aníɣo* 'I open', (b) *vréxo* 'I wet', (c) *sérno* 'I drag', (d) *ɣðérno* 'I scratch', (e) *pérno* 'I take', (f) *psáxno* 'I search', (g) *kalípto* 'I cover', (h) *alázo* 'I change'

The data in (2) reveal some very interesting patterns. In vowel alternation cases (2b-e), the root vowel of the imperfective forms is always /e/ and the root may be followed by a coronal /n/ (2c-e), which disappears in the environment of perfective. In passive perfective forms, either the root vowel turns to /a/ (2b), in which case the root is followed by the Tense exponent /-ik/, or what emerges is the underlying /i/ (2c) or /a/ (2d-e) (cf. the nominalizations *s**í**r-sim-o* 'dragging', *ɣð**á**r-sim-o* 'scratch', *p**á**r-sim-o* 'taking') and the root is followed by the Voice/Aspect exponent /-θ/. To make things more complex, in a subset of these verbs, past tense in active voice changes the root vowel in /i/ (2e). These facts indicate that, for certain Greek verbs, the exponence of Voice/Aspect and Tense is associated with root vowel alternations. In technical terms, this means that the exponent of these functional categories may be construed as a floating vowel (i.e. a vowel with no association with the CV tier) that docks in the vowel slot position of the root (for non-linear affixation see, among others, Trommer 2011; Bermúdez-Otero 2012; Bye & Svenonius 2012; Trommer & Zimmermann 2014). Crucially, the interaction of the exponent with the preceding phonological material takes effect in a local manner. For instance, the docking of the vowel /i/ of past tense is blocked in passive past perfective, because of the intervention of the affix /-θ/, *párθika* and not **pírθa* or **pírθika* (cf. the active perfective past *píra*). Moreover, in verbs with an overt verbalizer, vowel alternations triggered by Voice/Aspect affect the intervening verbalizing exponent of *v* and not the root, e.g. IMPFV *θerm-én-o* vs. PFV *θerm-án-o* 'I make s.o./sth warm', IMPFV *vaθ-én-o* vs. PFV *vaθ-ín-o* 'I make s.o./sth deep'.

Interestingly, these patterns of vowel alternations interact in complex ways with the suffixal realizations of the relevant functional heads, resulting in a gradient system of root/suffix allomorphy:

(3) a. No root/suffix allomorphy - affixal exponents in all cases (2a)
b. Allomorphy in PASS PFV - affixal exponents elsewhere (2b)
c. Allomorphy in IMPFV - affixal exponents elsewhere (2c-d)
d. Allomorphy in IMPFV & PST ACT PFV - affixal exponent in PST PASS PFV (2e)

This gradient system of allomorphy reveals in turn a gradient system of selection of the relevant exponents: the stronger (in phonological terms) the root is, the more immune it is to any alternations; reversely, the weaker the root is, the more probable the emergence of floating exponents (and hence allomorphy) is. Put differently, the selectional pattern here is not lexically conditioned but is rather governed by the phonological strength (strong vs. deficient) of the vocabulary items that materialize the terminal nodes of the root and the functional categories.

A similar, albeit simpler, picture is found in consonant alternations, which emerge in the environment of imperfective. While regular verbs exhibit a null Voice/Aspect exponent (e.g. *aníɣ-Ø-o*), certain verbs require the presence of an extra coronal consonant between the root and the ending (2c-h). Building on Borer's (2013) notion of *phonological index*, we propose that the imperfective exponent of these verbs is a partially specified coronal consonant $C_{[COR]}$, which may have various manifestations, i.e. [n] (2c-f), [t] (2g) or even [z] as a result of fusion with the final root consonant (2h), depending on the phonological environment in each case. Again, what conditions the selection between the two exponents (Ø or $C_{[COR]}$) is not some sort of lexical specification, but the phonological make-up of the root: weak roots need more phonological material and therefore combine with the exponent /$C_{[COR]}$/, whereas strong roots do not need phonological support and thus select for Ø.

A question that arises at this point is what makes a root strong or weak. To answer this question, we employ Smolensky & Goldrick's (2016) *Gradient Symbolic Representations* theory, under which phonological representations consist of entities that have a numerical value, called *Activity Level* (AL), which basically encodes their relative strength (see also Rosen 2016; Faust & Smolensky 2017; Zimmermann 2018). Only elements with output AL 1 are pronounced; deficient segments with AL lower than 1 (e.g. 0.8) will not be realized, unless they are provided with epenthetic activity. We will show that this "ghost behavior" of certain root segments and exponents is what gives rise to the allomorphic phenomena at hand: the floating vocalic exponents /e/ (IMPFV), /i/ (PST ACT PFV) and /a/ (PASS PFV) and the consonantal exponent /$C_{[COR]}$/ (IMPFV), which are all deficient in nature and, thus, only partially active, are more likely to be preferred over the fully active suffixal manifestations of the relevant functional heads when combined with weak roots, because in that case they optimally complement the low strength value of the deficient root segments. Thus, the various allomorphic patterns result from the phonological profile of the root, on the one hand, and the phonological properties of the exponents, on the other: from all available exponents of a given functional head, the one that optimally complements the strength value of the vocabulary item of a given root will eventually surface, including zero manifestation (*conspiratory null exponence*; Trommer 2012). The proposed analysis offers a phonologically grounded explanation for the described complex patterns of allomorphy (root reshaping, suffixal and zero exponence and their interaction) without having to resort to any form of lexical conditioning (diacritics on vocabulary items or environment listing in vocabulary insertion rules) or to extensive stem/span listing and the application of phonologically unrestricted readjustment rules. Most importantly, it allows us to treat allomorphy as simply the result of the phonological computation of the phonological makeup of the vocabulary items that materialize adjacent terminal nodes.

Selected references: (1) Bermúdez-Otero, R. 2012. The architecture of grammar and the division of labour in exponence. In J. Trommer (ed.), *The Morphology and Phonology of Exponence*. 8–83. Oxford: OUP. (2) Smolensky, P. & M. Goldrick. 2016. Gradient symbolic representations in grammar: The case of French liaison. ROA-1286. (3) Borer, H. 2013. *Taking Form: Structuring Sense Volume III.* Oxford: OUP. (4) Halle, M. & A. Marantz. 1993. Distributed Morphology and the pieces of inflection. In K. Hale & S. J. Keyser (eds.), *The View from Building 20: Essays in Linguistics in Honor of Sylvain Bromberger*. 111–176. Cambridge, MA: MIT Press. (5) Philippaki-Warburton, I. 1998. Functional categories and Modern Greek syntax. *The Linguistic Review* 15: 158–186.