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Beyond unpredictability: A GHG analysis of Greek noun stress

Upon initial examination, Greek stress assignment seems unpredictable, given that any of the last three syllables of a phonological word is a potential stress location, e.g., [ˈsi.zi.ɣos] 'spouse', [zo.ˈɣra.fos] 'painter', [o.ði.ˈɣos] 'driver' (Drachman & Malikouti–Drachman 1999; XX 1999, 2007, etc.). Nevertheless, experimental studies (XX 2012; XX & XX 2016; XX 2018) have called this unpredictability into question, bringing to light important regularities driven by lexical frequency. More specifically, in experiments involving pseudo-nouns, adult speakers demonstrate a general tendency towards PU stress, but also a distinct preference for APU in pseudo-nouns ending in particular suffixes. U stress, on the other hand, is the least preferred option overall. Interestingly, these observed tendencies align with the skewed patterns identified in lexical resources such as Anastassiadis–Symeonidis' (2002) *Reverse Dictionary* and the *A(nnotated)-Clean* corpus (XX 2018, based on Protopapas et al. 2012).

These findings suggest that each stress position (APU, PU, U) has a different probability of hosting stress, primarily determined by the specific inflectional suffix involved. With three potential grammatical stress outputs for a given input, each with a different probability of occurrence, an analysis that simply distinguishes between well-formed and ill-formed structures is not adequate. Instead, a model is needed that ranks possible outputs based on their likelihood of occurrence.

In principle, this task could be undertaken by analytical frameworks built upon stochastic grammars, such as *Noisy Harmonic Grammar* (NHG; Boersma & Pater 2016; Hayes 2017). In such a model, the computation of each candidate's probability of occurrence is determined exclusively by the constraint system; specifically, by the constraint weights, which are adjusted at each 'evaluation time' by the addition of a *noise* value. For instance, the preference for APU stress can be captured via the assignment of a high noise value to the weights of the constraints that are violated by outputs with PU or U stress. However, a problem arising with such an analysis is that it erroneously predicts a general preference for APU stress across noun categories. This prediction contradicts the experimental results, which reveal a distinct association between stress preferences and specific inflectional suffixes. In light of this challenge, we shift our focus from the phonological constraints to the phonological input and adopt Smolensky & Goldrick's (2016) *Gradient Harmonic Grammar* (GHG), a framework that emphasizes the nature of the representations (*Gradient Symbolic Representations / GSR*) that are manipulated by the phonological grammar.

Expanding upon the premise that, in the adult speakers' internalized lexicon, the underlying representation of suffixes includes inherent stress properties (XX 1999, 2007), we put forth that, in Greek, noun class markers have an input lexical accent that yields APU surface stress ($^{\leftarrow\leftarrow}$*). The strength of this accent differs among various noun classes, resulting in diverse stress patterns across these classes. In GSR terms, this level of strength is formalized by means of a numerical value called *activity level* (AL), ranging from 0 to 1. AL correlates with the likelihood of an underlying element to be realized: elements with a low AL are less likely to be pronounced, as their realization necessitates epenthetic activity, rendering them more "expensive" for the grammar. Consequently, when the input features suffixes with a strong lexical accent, APU stress is the most probable option. Conversely, APU stress stemming from a weak lexical accent demands significantly more epenthetic activity and eventually loses to a more harmonic candidate of another stress pattern, i.e., PU and, secondarily, U.

To illustrate, for the suffixes -*o*, -*a,* and -*is*, which have been linked to varying stress preferences (XX 2018), we propose the following AL values:

(1)	*Infl. suffix*	*Preferred stress patterns*	*AL of lexical accent* ($^{\leftarrow\leftarrow}$*)
a.	-*o*	**APU** > PU > U	0.9
b.	-*a*	PU > **APU** > U	0.4
c.	-*is*	PU > U > **APU**	0.1

Tableaux (2), (3), and (4) demonstrate the relevant phonological computations triggered by the presence of /-$^{\leftarrow\leftarrow *0.9}$o/, /-$^{\leftarrow\leftarrow *0.4}$a/ and /-$^{\leftarrow\leftarrow *0.1}$is/ in the input (in all three tableaux the suffix combines with the pseudo-stem *lerif-*). To begin with /-$^{\leftarrow\leftarrow *0.9}$o/, considering the strong inherent accent, the output with APU stress in (2a) necessitates only a small amount of epenthetic activity (0.1, which translates into a –0.1 violation of DEP). This violation is multiplied by the weight of the constraint (i.e., 2), yielding a total penalty of –0.1 × 2 = –0.2. Despite this penalty and the additional violation of ALIGN-R (since the trochaic foot is not aligned with the right edge of the word), the output [ˈlerifo] has a higher harmony compared to candidates with PU (2b) or U (2c) stress, since both the latter patterns necessitate the utmost degree of additional activity (i.e., 1), thereby incurring a substantial penalty of DEP (i.e., –1 × 2 = –2). Moreover, the candidates in (2b–c) leave the AL of the underlying accent unpronounced, thus entailing the violation of MAX by 0.9 and a consequent penalty equal to –0.9 × 3 = –2.7.

(2)

	/lerif- $^{\leftarrow\leftarrow*0.9}$o/	DEP *2*	MAX *3*	TROCHEE *2*	ALIGN-R *3*	**H**
a.	ˈlerifo	–0.2			–3	–3.2
b.	leˈrifo	–2	–2.7			–4.7
c.	leriˈfo	–2	–2.7	–2		–6.7

In /-$^{\leftarrow\leftarrow*0.4}$a/, the underlying AL of the input accent is lower, calling for a larger amount of epenthetic AL (0.6 instead of 0.1; compare 3a with 2a). At the same time, the penalty for violating MAX in outputs featuring PU or U stress decreases (compare 2b–c with 3b–c). As a result, the probability of APU stress to surface gets demoted and PU stress becomes the most likely pattern to emerge.

(3)

	/lerif- $^{\leftarrow\leftarrow*0.4}$a/	DEP *2*	MAX *3*	TROCHEE *2*	ALIGN-R *3*	**H**
a.	ˈlerifa	–1.2			–3	–4.2
b.	leˈrifa	–2	–1.2			–3.2
c.	leriˈfa	–2	–1.2	–2		–5.2

Finally, in suffixes bearing a stress property with extremely low AL, like /-$^{\leftarrow\leftarrow*0.1}$is/, the demand for epenthetic activity is so high that the candidate with APU stress (4a) ends up having lower harmony not just compared to PU (4b) but even compared to U (4c).

(4)

	/lerif- $^{\leftarrow\leftarrow*0.1}$is/	DEP *2*	MAX *3*	TROCHEE *2*	ALIGN-R *3*	**H**
a.	ˈlerifis	–1.8			–3	–4.8
b.	leˈrifis	–2	–0.3			–2.3
c.	leriˈfis	–2	–0.3	–2		–4.3

To conclude, we present a GHG account of stress assignment in Greek nouns that models the probability of each possible stress pattern to emerge. Importantly, we achieve this not by selectively adjusting the constraint system (as done in alternative stochastic frameworks) but by positing input elements (i.e., inherent accents associated with specific noun class markers) with varying levels of strength. These elements play a crucial role in regulating accentual patterns within and across different noun classes. The gist of our analysis is summarized in Figure 1.

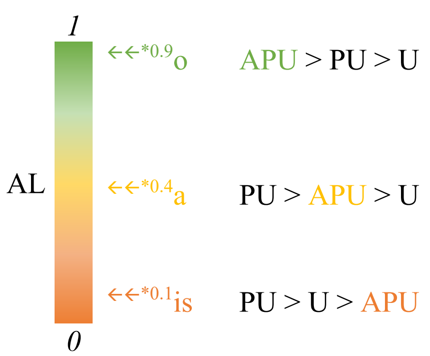

Figure 1.

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