Vowel reduction and the representation of openness

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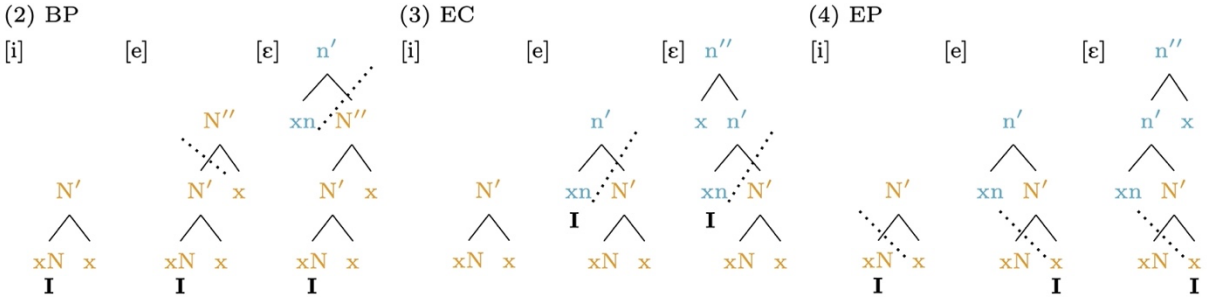
Problem. Brazilian Portuguese (BP; Santana 2018, Silva 1992), European Portuguese (EP; Carvalho 2011), and Eastern Catalan (EC; Wheeler 2005) have seemingly identical 7-vowel systems, which, however, reduce differently in unstressed position (1). Government Phonology (GP; Kaye, Lowenstamm & Vergnaud 1985, 1990) models most cases of vowel reduction as the loss of elements (Harris 2005, Harris & Lindsey 1995), where elements are the privative building blocks of melody. (Roughly **I** = frontness, **U** = roundness, **A** = openness. Elements stand alone or combine, e.g. [o] contains **A** and **U** etc.) This straightforwardly expresses the BP merger of [e]/[i] as [i]: In [e] the element **I** is head and **A** non-head, i.e. **({A}I)**, while in [i] the sole element **I** is head, i.e. **({}I)**. The merger is effected by loss of **A**. However, it remains unclear how a merger of BP [e]/[ɛ] as [e] is achieved: Two interpretations are conceivable for [ɛ], **({I}A)** or **({I,A}_)**, the latter having no head. In order to go from one of the those two possibilities to [e], i.e. **({A}I)**, a rearrangement of elements is necessary, but no element is lost. **Problem 1 (P1):** What is the formal expression of reduction? Why should *loss* and *rearrangement* of elements both "count" as the same? (Nevins 2012 simply assumes headless combinations to be weaker, which fails in reduction to [e], **({A}I)**, with **I** the head.) Relatedly (**P2**), it is not clear which rearrangements should count as reduction and which not. Lastly (**P3**), why do BP [i/e/ɛ] merge as [i] in parallel to [u/o/ɔ] as [u], while EC has an asymmetry with front [e/ɛ] going to [ə] but back [o/ɔ] going to [u]? (Similarly EP [e/ɛ] vs. [u/o/ɔ].) Here I address all three problems in one fell swoop.

(1)

tonic	i	e	ɛ	a	ɔ	o	u
Brazilian Portuguese							
pre-tonic	i	e		a	o		u
post-tonic/ final	i			ə	u		
Eastern Catalan							
atonic	i	ə		u			
European Portuguese							
atonic	i	ɨ		ə	u		

Proposal. GP 2.0 (Pöchtrager 2006, 2018, 2020, 2021, Pöchtrager & Kaye 2013, Živanovič & Pöchtrager 2010), a further development of classic GP, reinterprets as structural certain properties commonly assumed to be melodic. This includes the element **A**, motivated by recurrent interaction between **A** and (constituent) structure. Consequently, aperture (one role of old **A**) is expressed structurally, and treated as scalar. BP illustrates this: Stressed [ɛ] reduces to [e] when unstressed, and further to [i] in final unstressed position. (Leaving aside additional height harmony in certain varieties; Segundo 1993.) This can be analysed as the successive removal of layers of structure in progressively more unfavourable prosodic positions.

GP 2.0 assumes a bipartite structure with *up to* two heads (xn and xN) for vowels, with xn on top of xN (if both are present). Each head projects maximally twice (xN/N′/N″, xn/n′/n″). The more open a vowel, the more empty positions it has. There is some leeway in internal composition and the position of melody (**I**, **U**) to model crosslinguistic differences in behavior. (2–4) contrasts the representations of front vowels in BP/EC/EP (colours for readability).



BP [ɛ] to [e] involves the loss of a layer of structure, [e] to [i] that of yet another one (dotted lines). EC simply combines both steps in one. (xN roughly corresponds to stress; hence the difference in internal structure.) **P1**–**2** are addressed: reduction is uniformly expressible as the

loss of structure. Also, assume that **I** sits higher up in EC (3), while **I** sits in a lower position in BP (2). If tree pruning starts from the top, then EC **I** will be lost immediately, as the branch it sits on is cut off first. BP **I**, being low, is safe. We derive the asymmetry in reduction patterns (**P3**). (2) also sheds light on alveolar palatalisation (absent from EC/EP, alas): BP [t/d] go to [tʃ/dʒ] before [i], but not before [e/ɛ]. All three vowels contain **I**, but in [e/ɛ] it is buried deep and thus has no effect on what precedes. **I** in [i] is not shielded off by structure in the same way. Lastly, EP (4) shows the most "dramatic" reduction, where only the lowest head remains. (The position of **I** in EP is supported by reduction in onsetless syllables, skipped here.)

Further issues. The proposal goes beyond the microvariation between BP/EP/EC: **1.** Russian [i] consistently palatalises preceding consonants (Timberlake 2004), unlike [e]. This follows if **I** in Russian [e] is shielded off by empty structure like in BP. We (correctly) predict that [e] reduces to [i] when unstressed, as **I** is buried deep, hence safe from tree-pruning. Also, Russian [o] reduces to [ə/ʌ], i.e. **U** (but not **I**) is lost, the reverse of BP/EC/EP. **U** is low in the latter three languages, thus rounding survives reduction in both, unlike in Russian, where it is high. **2.** (Old) **A** has been claimed to underlie alveolars, too (Broadbent 1991). If **A** is replaced by more empty structure, then alveolars must be bigger than consonants of other places of articulation and should be more susceptible to lenition. This explains why *d/t* are lenited in English (tapping) rather than velars/labials. **3.** The last point raises the more general question whether *all* lenition is about structure. In GP 2.0, **A** is replaced by structure, as are the old elements **ʔ** (stopness) and **H** (voicelessness), albeit by different types of structure. Certainly stopness is a lenition target (Spanish: Harris 1969, Catalan: Wheeler 2005, Danish: Basbøll 2005), as is voicelessness (Danish: Basbøll 2005).

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