English vowel reduction is conditioned by duration, not stress

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Vowel reduction is one of the most pervasive phonological processes of English, and many arguments since *The Sound Pattern of English* (Chomsky and Halle 1968) have rested on a simple assumption: stressless short vowels reduce. Chomsky and Halle noted that reduction is more limited in certain contexts (especially, prevocalic vowels and final non-low vowels), but the SPE grammar is generally designed to ensure that unreduced short vowels bear some degree of stress, either on the surface or at some earlier derivational stage. In this study, I demonstrate an additional restriction: vowels in absolute word-initial position show a more limited and complex pattern of reduction, maintaining a two-way height distinction in stressless syllables: ɪ/ɛ vs. ə in light syllables, and ɪ vs. ɛ/æ in heavy syllables. I argue that the occurrence of non-ə vowels cannot be attributed to stress, but instead the slightly longer duration of absolute initial position.

The pattern of reduction for short front vowels is shown in (1). As is well known, reduction depends on speech rate, frequency, foreignness, and morphologically related forms. Controlling for these, the distribution in (1) holds phrase-initially in careful speech for familiar words. It is well-known that reduced vowels vary between higher (ɪ-like) and lower (ə-like) vowels. However, there is more to be said: in fact, a limited height contrast is maintained in absolute initial position. The restriction to absolute initial position is important for (1a–d), which show reduction to [ə] word-medially ([ɛ]stónia vs. b[ə]stów) and phrase-medially (*an* [ə]*gregious error*). Of particular interest is the (previously unreported) possibility for some speakers of partially reduced [ɛ] in words like *advance* in careful speech, which creates a chain shift: æ → ɛ → ɪ.

(1) Partial contrasts maintained in absolute-initial position

		/ɪ/		/ɛ/		/æ/	
a.	/__ CV	ɪ/i	illícit, imáginary	ɪ/i	emótion, evólve	ə	allége, aphásia
b.	/__ TRV	ɪ/i	igúana, Iglésias	ɪ/i	equálity, eclípse	ə	acquíre, acrópolis
c.	/__ SCV	ɪ	Islámic, Iscáriot	ɪ/ə	estáte, escápe	ə	astónish
d.	/__ TCV	ɪ	igníte, ignóble	ɛ/ɪ	eccéntric, exíst	æ/ɛ	accéntuate, admíre
e.	/__ RCV	ɪ	impárt	ɛ	Elmíra	æ	alpáca, ambássador

Aside from the possibility of partial reduction of /æ/ to [ɛ] in certain contexts for some speakers, the facts in (1) are easily observed in sources such as Kenyon and Knott (1953) and dictionaries. However, as far as I can tell, they have not been systematically analyzed. Some of these facts have been attributed to special properties of prefixes (Liberman and Prince 1977), but monomorphemic items also fail to reduce: [ɪ]*náctive*, [ɪ]*mélda*. The effect of a following cluster is often attributed to secondary stress, but this would require a stress rule that (1) depends on the absence of an onset, (2) stresses /æ/ in a subset of contexts as /ɛ/ (counter to sonority), and (3) still cannot account for the difference between partial reduction (/ɛ/→[ɪ]) and full reduction ([ɛ]→[ə]). I argue that what distinguishes the contexts in (1) is not stress, but rhyme duration.

All of the factors that inhibit reduction are associated with greater duration: careful citation speech, low frequency items, stressed syllables, low vowels, and vowels in absolute initial position. I analyze the link to duration with a family of constraints *VDur(≥x)/RhymeDur(≤y), which penalize vowels of long intrinsic duration in rhymes with short duration. Schematically, we assume that rhymes in stressless open CV have duration 1, and acquire extra duration with coda obstruents (+2) or sonorants (+3), lacking an onset (+4), or stress (+10). This yields a set of rhyme durations as in (2).

(2) Contextual rhyme durations, and intrinsic vowel durations

a.

	Stressless		Stressed	
	/C__	/#__	/C__	/#__
Open syllable	1	5	11	15
Closed by obstruent	2	6	12	16
Closed by sonorant	3	7	13	17

b.

"schwa"	1
ɪ	2
ɛ	3
æ	4

The constraints in (3) suffice to characterize contexts where reduction is compelled in English.

(3) Markedness: *VDur(≥x) / RhymeDur(≤y)

- *VDur(≥æ) / RhymeDur(≤6) : Tolerates [æ] in all stressed syllables, and stressless onsetless initial syllables with sonorant codas, but nothing shorter
- *VDur(≥ɛ) / RhymeDur(≤5) : Tolerates [ɛ] in all stressed syllables, and stressless onsetless initial syllables with obstruent codas

To capture the chain shift, I assume scalar faithfulness (Kirchner 1996, Gnanadesikan 1997), which penalizes reduction of low /æ/ to high [ɪ], and favors the lower vowel [ə]. The ranking that yields a chain shift of partial reduction in the dialect with /æ/ → [ɛ] is illustrated in (4).

(4) a. [ɛ]dmit, [ə]ppear

/ædˈmɪt/	*VDur(≥æ) /RDur(≤6)	*VDur(≥ɛ) /RDur(≤5)	Ident(V≥3)	Ident(V≥2)	Ident(V≥1)
a. ædˈmɪt	*!				
☞ b. ɛdˈmɪt					*!
c. ədˈmɪt				*!	*
d. ɪdˈmɪt			*!	*	*

/æˈpɹɪ/	*VDur(≥æ) /RDur(≤6)	*VDur(≥ɛ) /RDur(≤5)	Ident(V≥3)	Ident(V≥2)	Ident(V≥1)
a. æˈpɹɪ	*!	*			
b. ɛˈpɹɪ		*!			*
☞ c. əˈpɹɪ				*	*
d. ɪˈpɹɪ			*!	*	*

b. [ɛ]xist, [ɪ]bullience

/ɛgˈzɪst/	*VDur(≥æ) /RDur(≤6)	*VDur(≥ɛ) /RDur(≤5)	Ident(V≥3)	Ident(V≥2)	Ident(V≥1)
a. ægˈzɪst	*!				*
☞ b. ɛgˈzɪst					
c. əgˈzɪst				*	*
d. ɪgˈzɪst					*

/ɛˈbʊlɪɛnt/	*VDur(≥æ) /RDur(≤6)	*VDur(≥ɛ) /RDur(≤5)	Ident(V≥3)	Ident(V≥2)	Ident(V≥1)
a. æˈbʊlɪənt	*!	*			*
b. ɛˈbʊlɪənt		*!			
c. əˈbʊlɪənt				*!	*
☞ d. ɪˈbʊlɪənt					*