Reduction, frequency and morphology in Singaporean English prosody

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Abstract

Several factors coincide to make the interaction of frequency, morphology and prosody particularly visible in Singaporean English (SgEng). Segmentation of prosodic words (pwords) is unusually explicit: glottal stops consistently appear at vowel-initial pword left edges, while surface tone assignment is both stress-dependent and sensitive to pword right edges. At the same time, other aspects of SgEng prosody are much obscured by the acoustic non-salience of stress and its inertness in phonological processes such as stress shift.

Here I propose that variation in surface tone can be used to infer destressing and hence primary/secondary stress distinctions. Combined with rich evidence for pword edges, this permits us to infer recursive pword structures which are sensitive to destressing processes. SgEng initialisms such as *MRT* (Mass Rapid Transit) allow us to examine the interaction of multiple stems within high-frequency lexical items, demonstrating that lexical frequency is correlated with reductions in both stress and pword structure.

Acknowledgments

I would like to thank those who helped me in this project; of course only I should be blamed for its shortcomings.

- Darya Kavitskaya and Matt Wolf for coming to the rescue;
- Stephen Anderson, Bob Frank, Jelena Krivokapić, Maria Pinãngo, Wee Lian Hee, Pasha Siraj, Erich Round, Arto Anttila, Diana Apoussidou, Uri Tadmor and K. P. Mohanan for insightful suggestions;
- Participants in the Prosodic Alignment workshop at Mannheim (2008);
- Raffles Junior College for the use of their music facilities;
- Nick Huang (Zhipeng), Lim Tse Yang and Gilbert Oh for sensitive judgments and unfailing interest;
- My informants, and all others I have omitted by request.

1. Introduction

Much variation in natural speech arises from alternation between full and reduced forms, e.g. *going to ~ gonna ~ gon'* in English. It is well-established that high lexical frequency favours greater phonetic reduction, and several mechanisms for this interaction have been proposed. So far, however, none of them have been applied to frequency-linked processes in phonology. This paper draws on findings in psycholinguistics, phonetics and phonology to provide a unified analysis of prosodic word parsing in Singaporean English content words, using constraints indexed to speed of lexical access instead of lexical frequency as in previous phonological accounts.

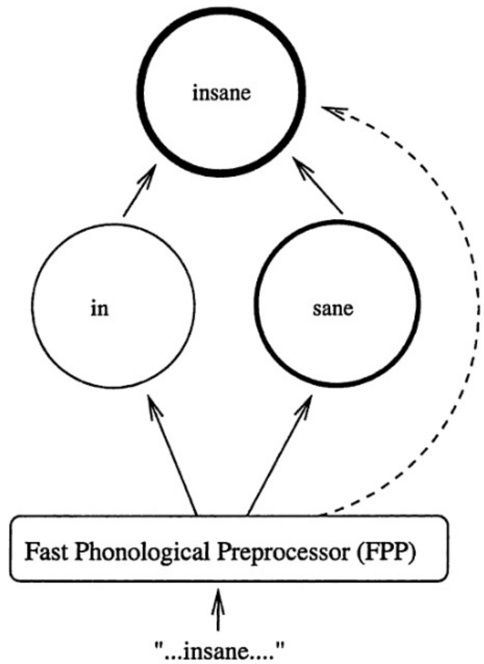
Several factors coincide to make the interaction of frequency, morphology and prosody particularly visible in Singaporean English (SgEng). Segmentation of prosodic words (pwords) is unusually explicit: glottal stops or creaky voice are consistently found at vowel-initial pword left edges, while surface tone assignment is stress-dependent and sensitive to pword right edges. These diagnostics allow us to observe interesting conflicts attendant upon SgEng's fondness for initialisms. In forms like *NRIC* (National Registration Identity Card), for instance, we see four stems competing to project their own stresses, within a whole-word unit whose high lexical frequency forces destressing, within a grammar which demands faithfulness to stem stress.

In the rest of this section, I will review relevant theoretical proposals (§1.1) and the methods used in this study (§1.2), after which I turn to SgEng glottalisation (§2), tone (§3), stress (§4), and frequency (§5) in turn. Each of these sections comprises a subsection justifying the diagnostic or metric in question, a second subsection describing the SgEng data, and a concluding subsection on the necessary Optimality Theory analysis. All constraints and tableaux are recapitulated in the appendix.

1.1. Background

Morphology and lexical access. Psycholinguistic studies of priming have shown that high-frequency words tend to be lexically accessed as single whole-word units, low-frequency words as decomposed morphemes (e.g. Baayen 1992; Hay 2003: ch. 4). This dual-route access model is illustrated in **Figure 1** below with dotted and solid arrows respectively.

Figure 1: Whole-word vs. decomposed access (Hay 2003: 13)



There is increasing evidence that not just one, but both access routes can succeed (e.g. Baayen & Schreuder 1999; McCormick, Brysbaert & Rastle 2009). This gives us three possible types of lexical access illustrated in (1) below. Note that since all results of access count as accessed lexical units, I will use the term *grammatical word* to refer to the whole-word unit, and *stem* to refer to any constituent which can appear as an independent grammatical word, including the whole-word unit itself.

(1) *Mixed-route lexical access model*

a.	Whole-word-only access	*insane* (grammatical word)
b.	Decomposed-only access	*in-* (affix) *sane* (stem)
c.	Mixed access	*insane* (grammatical word) *in-* (affix) *sane* (stem)

Phonology only 'sees' the units returned by lexical access, so whole-word-only access makes it impossible for Align constraints to target internal stem boundaries. This is only possible with decomposed-only access or mixed access. SgEng phonology provides support for the mixed-route access model because it is sensitive to properties of the whole-word unit (frequency) while also respecting stems (pword alignment).

Phonology and the prosodic hierarchy. The focus of this study is the prosodic word or the phonological word. The *pword*, as I shall refer to it for brevity, is the member of the prosodic hierarchy (Selkirk 1984; Nespor & Vogel 1986) which is of roughly the same size as a grammatical word, although crucially not isometric with it (Hall 1999: 2). By definition it is also the lowest-level member of the prosodic hierarchy which is sensitive to morphology and in fact must be aligned with morphosyntactic units (Raffelsiefen 1999: 133). Extensive cross-linguistic evidence supports the existence of recursive pwords (Inkelas 1989; McCarthy & Prince 1993: A1; Selkirk 1995; Peperkamp 1997), which I will assume in cases of mismatched pword edges, e.g. (prefix(stem) implies (prefix(stem)). This analysis also assumes that no pword can contain two identical levels of secondary stress, i.e. stress is strictly hierarchical (Liberman & Prince 1977; Hayes 1995: 25), though this prohibition is almost certainly a highly-ranked constraint in SgEng rather than a linguistic universal (Nespor & Vogel 1986: §3.2.1). The restriction also applies to recursive pwords: ((σ́)σ̀σ) or ((σ̀)σ́σ) are possible representations, whereas ((σ́)σ́σ) is not.

1.2. Methods and notation

Methods. The data are chiefly drawn from a series of recordings made in 2008-9. Five speakers read the main script (238 test items), while three others read a supplementary script (160 test items) from which little data was drawn for this study except for compound numbers; not all of these recordings have been transcribed yet. Almost all sentences in the script used question-and-answer pairs such as (2) below to promote natural speech. Subjects were instructed to pretend that the target word was a common brand such as Colgate.

(2) *Experimenter:* Can order ah?
Subject: NEVER order Differentiation from Katong lah.

In order to draw focus away from the target word, the initial focused word was varied between *CANNOT, NEVER, BETTER* and *ALWAYS*, and the place name was varied between *Jurong, Katong* and *Punggol*. Sentence-final *ah* and *lah* were included because they are the most common interrogative and declarative discourse particles respectively (Gupta 1992), and could therefore promote natural and authentic SgEng speech while remaining as pragmatically neutral as possible. Supplementary data comes from a combination of eavesdropping and consulting others' native-speaker intuitions on unattested forms and correct transcriptions.

Tone. Because tone is a crucial diagnostic and has only been studied for ethnically Chinese SgEng speakers, non-Chinese Singaporeans have been excluded from this study. All tones were labelled impressionistically based on my intuitions in Min Chinese, the subfamily of Chinese which has had the greatest influence on the formation of SgEng (Gupta 1998). As I consider myself only a semi-native speaker of either language, tone transcriptions such as HHMH and HMMH were confirmed by checking with another semi-native speaker and two native speakers of SgEng and Min Chinese.

Notation. The following conventions are used in this paper.

(3) *Notation*

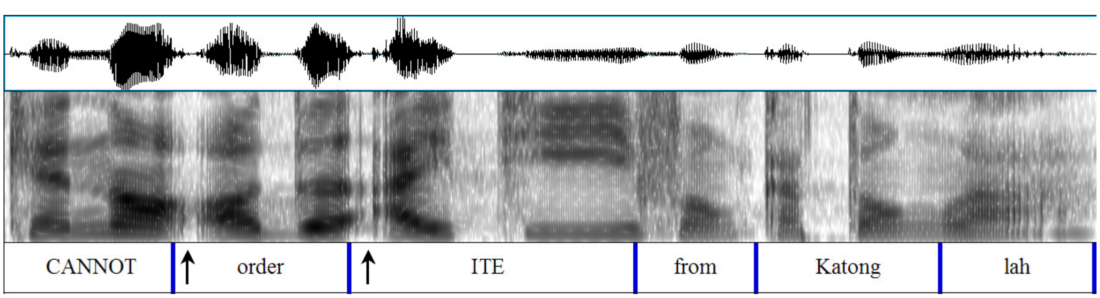
a. Square brackets indicate [[stem]-s] in inputs to tableaux.
b. Round brackets indicate (p)(word) (structure) unless otherwise labelled.
c. *Initialisms* refer to lexical items like *CIA*. *Acronyms* refer to forms like *CIA* and *NASA* collectively.
d. L, M and H refer to low, mid and high tone.

2. Glottalisation

2.1. Diagnostic for pword left edges

SgEng often strikes non-speakers as 'choppy' or 'staccato' (Brown 1988), probably because liaison is rare even in contexts such as *An apple a day* (Tongue 1979: 38). Vowel-initial grammatical words are almost always marked with a glottal stop or creaky voice, which I will refer to as glottalisation collectively. This may be observed in **Figure 2** below.

Figure 2: Glottalisation in *ITE* (Institute of Technical Education)



In other varieties of English, word-initial glottalisation is a variable phonetic effect rather than a categorical pword marker (Umeda 1978; Pierrehumbert & Talkin 1992; Redi & Shattuck-Hufnagel 2001). It varies greatly by speaker and is favoured at phrase boundaries, slow speech rates, rare words and low vowels, but disfavoured before unstressed syllables or function words. In SgEng, however, my recordings show that nearly all speakers have glottalisation not only in stressed syllables (4a), but also in unstressed syllables (4b), function words (4c) and phrase-medially (4d).

(4) *Glottalisation word-initially*

a.	*no ˈ**a**pple*	[no ˈ**ʔ**æpəɯ]	b.	***a**ˈnnoy ˈme*	[**ʔ**əˈnɔɪ ˈmi]
c.	***I** ˈsee*	[**ʔ**aɪ ˈsi]	d.	*ˈgo **a**ˈway*	[ˈgo **ʔ**əˈweɪ]

Glottalisation is not only practically categorical word-initially, but forbidden word-medially. Onsets are created by glide insertion if a high vowel is present. In cases of hiatus between two low vowels, as in the name of Singaporean poet Alfian bin Sa'at (5c), most speakers attempt no repair at all.

(5) *Glide insertion word-medially*

a.	*iron*	[aɪ**j**ən], *[aɪ**ʔ**ən]	b.	*wire*	[waɪjə], *[waɪ**ʔ**e]
c.	*Sa'at*	[sa**Ø**at], *rarely* [sa**ʔ**at]			

Similar glottalisation facts apply in Indonesian (Pater 2001), Bulgarian (Rubach 2000), Northern Arapo and Gufang Ifugao (Smith 2002: 127ff), Guaraní, Hausa, Squamish, Wolof and numerous other languages (Flack 2007: 56ff).

Based on the definition of the pword given in section 1.1 above, a monomorphemic grammatical word will typically be contained by a pword. As such we can treat glottalisation as a diagnostic of pword left edges.

(6) ***Diagnostic: Pword left edge***
Any site where glottalisation is typically possible signals a pword left edge.

We are now equipped to check for pword left edges at morphological boundaries in prefixed, suffixed and compound words respectively.

2.2. Glottalisation in morphologically complex words

Prefixes. Whereas glottalisation was strictly forbidden word-medially in morphologically simple words, in prefixed words it is normally found at the prefix-stem boundary, as in (7) below.

(7) *Prefixes: Glottalisation at the prefix-stem boundary*

a. *mis-understand* [misʔɑndəstæn] b. *dis-honest* [disʔɔnəs]
c. *re-install* [riʔinstɔɯ] d. *re-order* [riʔɔdə]
e. *re-allocate* [riʔæloket] f. *un-important* [ʔɑnʔimpɔten]
g. *un-install* [ʔɑnʔinstɔɯ] g. *un-afraid* [ʔɑnʔəfret]

The presence of medial glottalisation indicates that in prefixed words, stem left edges induce a pword left edge.

Suffixes. In contrast, the stem-suffix boundary never allows glottalisation; instead, vowel-initial suffixes receive an onset from the stem-final consonant.

(8) *Suffixes: Syllabification, no glottalisation across stem-suffix boundary*

a. *magic-al* [mædʒikØəɯ] b. *psycho-logi-cal-ly* [saɪkɔØlɔdʒiØkəli]
d. *do-able* [duØəbəɯ] d. *remove-able* [rimuvØəbəɯ]
e. *hissing* [hissØiŋ] f. *eat-ing* [ittØiŋ][1]

As the absence of medial glottalisation indicates, SgEng does not require stem *right* edges to coincide with a pword left edge. This kind of prefix-suffix asymmetry is common: in many languages prefixes tend to form a separate prosodic word while suffixes cohere to the stem (Peperkamp 1997: 55; Zuraw 2007).

Compounds. I did not test enough compounds with vowel-initial stems to determine a typical glottalisation pattern conclusively, but those that I did record behaved like prefixed forms, permitting medial glottalisation to mark internal stem left edges.

(9) *Compounds: Glottalisation at stem-stem boundary*

a. *century egg* [sɛntʃri ʔek] b. *stopover* [stɔp ʔovə]

The presence of medial glottalisation implies that in compounds as well as prefixes, each stem left edge induces a pword left edge.

[1] According to Wee (2008), words with *-ing* do not resyllabify across the stem-suffix boundary in order to create onsets as in most other suffixed words, but instead trigger gemination. However medial glottal stop epenthesis is still forbidden, so our diagnostic for pword left edges (6) remains intact.

Summary. Our current findings are summarised in (10) below.

(10) *Identified pword edges*

	Prefixes		*Suffixes*		*Compounds*
a.	(prefix-(stem	b.	(stem-suffix	c.	(stem-(stem

The generalisation which covers all three word types is that stem left edges induce a pword left edge. This site is word-medial in prefixed forms but non-word-medial in suffixed forms, explaining the prefix-suffix asymmetry. Exceptions to (10) do exist, but always in the direction of losing glottalisation at stem boundaries, e.g. *ˌdis-aˈgree* ((ˌH)LˈH), *ˌmis-ˈinterpret* ((ˌH)ˈMMH). Such cases will be accounted for in section 5 on lexical frequency.

2.3. Optimality Theory analysis

To capture the generalisation that stem left edges induce a corresponding pword left edge, all we need is the familiar constraint ALIGN (STEM, L, PWD, L), which has also been used to analyse Romance pwords (Peperkamp 1997: 78ff). As we are concerned chiefly with footing and pword structure, ALIGN violations will be counted per syllable. Hence glottal stop epenthesis can be disregarded in tableaux as it causes misalignment by only one segment.[2]

(11) **ALIGN (STEM, L, PWD, L)** **Short form: $_{\text{PW}}$[STEM**
A stem left edge must coincide with a pword left edge.
One violation per stem per syllable otherwise.

Speakers must be willing to indicate stem edges with pword edges even when this means creating more pword structure; on the other hand, needless recursivity must be penalised. An ECONOMISE constraint captures this conflict:[3]

[2] The paradox of strict stem-pword alignment and glottalisation-induced misalignment has been analysed by Pater (2001) for Malay. Following Cohn & McCarthy (1994), he assumes that alternative repairs such as glide insertion require feature spreading to an empty onset, which is forbidden across pword boundaries. This prohibition is captured by ranking Itô and Mester's (1999) CRISPEDGE(PWD) over gradient ALIGN (STEM, L, PWD, L), which achieves the desired one-segment misalignment. As Pater observes, categorical ANCHOR (McCarthy 2003) would be inadequate here.

[3] Most studies of the pword rule out unnecessary pword structure with NONRECURSIVITY, which would state that no pword can dominate another pword (e.g. Selkirk 1995). But it is not clear whether NONRECURSIVITY can decide between the ((prefix)stem) and ((prefix)(stem)) structures that we will encounter in SgEng, so this analysis applies ECONOMISE instead.

(12) **Economise** **Short form: Econ**
Do not create unnecessary pword structures. One violation per pword used.

We have yet to encounter diagnostics for the pword right edge, but section 3.2 will show that the winner in (13) below has recursive pword structure. This demonstrates the ranking $_{PW}$[Stem ≫ Economise.

(13) *Prefix-stem boundary creates pword left edges*

un-[install]	$_{PW}$[Stem	Econ
☞ a. (un-(install))		**
b. (un-install)	W*	L*

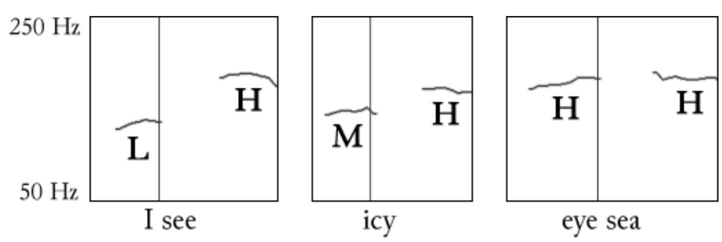
We have now accounted for typical pword left edge alignment. The next section discusses surface tone assignment, which will be our main diagnostic for pword right edges and stress.

3. Tone

3.1. Diagnostic for pword right edge and stress

SgEng gives the acoustic impression of being a tone language (Killingley 1972: 547-8). Recent proposals (Wee 2008; Ng 2008a, 2009; Siraj 2008) have distinguished low, mid and high surface tones as illustrated in **Figure 3** below.

Figure 3: CSE low, mid and high tones



Ng's (2009) analysis, which reconciles the abovementioned proposals, states that the assignment of SgEng surface tones is sensitive to stress and grammatical word edges. This is demonstrated by the typical tone patterns of morphologically simple words (14) and the generalisations given in (15).

(14) *Tone in simplex words*

a.	*ˈsee*	ˈH	e.	*maˈchine*	LˈH
b.	*ˈapple*	ˈMH	f.	*hiˈbiscus*	LˈMH
c.	*ˈelephant*	ˈMMH	g.	*Aˈmerica*	LˈMMH
d.	*ˈIndoˌnesia*	ˈMMˌMH	h.	*ˈKilimanˌjaro*	ˈMMMˌMH

(15) *Tone assignment generalisations*

a. High tone is assigned to the final syllable of the pword.
b. Low tone is assigned to initial unstressed syllables.
c. Mid tone is assigned to all remaining syllables, starting with the first stress.

It is also possible for unstressed syllables to remain unspecified for tone (Ng 2009), but as this phenomenon is not accessible to native speaker intuitions and does not affect our diagnostics for prosodic structure, it can be omitted from this analysis without loss of generalisation.

As with glottalisation, we will assume that each monomorphemic grammatical word corresponds to a pword. If so, surface tone indicates pword right edges as well as stress. These two diagnostics are illustrated in (16) and (17) below with the sentence *So I can still see Peter tomorrow* (ˈH) (L L (ˈH)) (ˈH) (ˈMH) (LˈMH).

(16) ***Diagnostic: Pword right edge***
High tone indicates the final syllable of a pword, e.g. **H**) L L **H**) **H**) M**H**) LM**H**).
Conversely, lack of high tone indicates a non-pword-final syllable.

(17) ***Diagnostic: Stress***

a. Low tone indicates pword-initial unstressed syllables,
e.g. ˈH (**L L** ˈH ˈH ˈMH (**L**ˈMH.
b. Mid tone after any other tone indicates stress, e.g. ˈH L L ˈH ˈH ˈ**M**H Lˈ**M**H.
But note that stressed final syllables will not be detected by this diagnostic.
c. High tone not preceded by mid tone indicates stress,
e.g. ˈ**H** L L ˈ**H** ˈ**H** ˈMH LˈMH.

For present purposes (16) above is probably the most helpful to keep in mind because pword right edge alignment is the main focus of this section.

3.2. Tone in morphologically complex words

In the transcriptions below, all structure inferred from the diagnostics for pword right edges (16) and stress (17) has been indicated along with surface tones. In order to keep transcriptions consistent across the paper, primary and secondary stress have been marked based on diagnostics presented in section 4 on stress.

Prefixes. For prefixed words two patterns are equally common. This section accounts only for the first (18); we will return to the second (19) in section 4 on stress.

(18) *Prefix high tone (stressed)*

a.	*ˌun-inˈstall*	(ˌH)-(LˈH)	b.	*ˌir-ˈrational*	(ˌH)-(ˈMMH)
c.	*ˌanti-ˈEnglish*	(ˌMH)-(ˈMH)	d.	*ˌmono-ˌun-ˈsaturated*	(ˌMH)-(ˌH)-(ˈMMMH)

(19) *Prefix low tone (unstressed)*

a.	*un-inˈstall*	(L-(LˈH))	b.	*ir-ˈrational*	(L-(ˈMMH))

Based on diagnostic (17), we can see that prefixes with high tone (18) are stressed. Since both medial glottalisation and multiple high tones are present, we can infer the pword structure (ˌprefix)(ˈstem).

Suffixes. Typical suffixed words resemble monomorphemes in surface tone rather than prefixed words. Note that secondary stress is probably present in (20b) but cannot be inferred directly from our diagnostics.

(20) *Tone in typical suffixed words*

a.	*magic-al*	(ˈMMH)	b.	*psycho-logi-cal-ly*	LˈMMMMH)
d.	*do-able*	(ˈMMH)	d.	*remove-able*	LˈMMH)
e.	*blind-ness*	ˈMH)	f.	*duck-ling*	MH)
g.	*come-ing*	ˈMH)	h.	*eat-ing*	(ˈMH)

Given that the suffixed words in (20) above permit only one high tone and forbid medial glottalisation, we can infer that the typical suffixed structure is (stem-suffix).[4]

[4] Siraj (2008) reports that three out of four of his informants had a foot-final high tone in addition to the pword-final high tone in my recordings. My informants generally accept these pronunciations, e.g. *ˈmodifiˌcation* ˈMMHˌMH, but one of them rejected *ˈKilimanˌjaro* ˈMHˌLMH. This opens up the possibility that Siraj's informants have an Align (Stem, R, PWd, R) constraint and had morphologically reanalysed the multi-footed words he tested, rather than a true foot-final high.

Compounds. Most compounds (21) behave like words with stressed prefixes (18).

(21) *Tone in typical compounds*

a. *century egg* (ˈMH)ˌH) b. *stopover* (ˈH)ˌMH)

c. *moneylender* (ˈMH)ˌMH) d. *mouthwash* (ˈH)ˌH)

I recorded no low tones in compounds, but this should be attributed to an accidental gap in the script, which tested no compounds with stem-initial unstressed syllables. Based on the multiple high tones and sites of glottalisation in compounds (21), we can infer that compounds typically have a straightforward (stem)-(stem) structure.

Summary. Our current findings are summarised in (22) below.

(22) *Identified pword edges*

	Stressed prefixes		*Suffixes*		*Compounds*
a.	(ˌprefix)-(ˈstem)	b.	(stem-suffix)	c.	(stem)-(stem)

We can hypothesise that stem left edges induce not only pword left edges but also pword right edges.

3.3. Optimality Theory analysis

To capture the generalisation that stem left edges induce a pword right edge, we can take advantage of the flexible definition of the Align constraint, which allows us to make reference to different edges of the two relevant morphological constituents. In the categorical Anchor framework this would also be possible using the D-Anchor constraint family (McCarthy 2003).

(23) **Align (Stem, L, PWd, R)** **Short form: $_{\text{PW}}$]Stem**

A stem left edge must coincide with a pword right edge.

One violation per stem per syllable otherwise.[5]

(24) *Compounds create pword right edges (preview of tableau (50) on p. 26)*

[century] [egg]	$_{\text{PW}}$]Stem	$_{\text{PW}}$[Stem	Econ
☞ a. (ˈcentury)(ˌegg)			**
b. (ˈcentury (ˌegg))	W*		**

[5] The alignment constraints used in this paper assume, leniently, that word-initial stems are preceded by a pword right edge belonging to another grammatical word, e.g. *…)(century)(egg).

This stem alignment constraint enforces multiple pword right edges for compounds and stressed prefixes. At this stage there is no evidence for the correct ranking of $_{\text{PW}}$]Stem; this will be supplied in tableau (50) in section 4.3, at which point we will be able to evaluate pword structures visible only with further stress diagnostics.

Next, a straightforward Wrap constraint (Truckenbrodt 1999) is needed to ensure that no suffix material goes unparsed.

(25) **Wrap (GWd, PWd)** **Short form: Wrap**
Each grammatical word is contained in a pword. One violation per grammatical word otherwise.

(26) *Suffixes do not induce separate pwords*

[[[[**psycho**]-**logi**]-**cal**]-**ly**]	**Wrap**
☞ a. (psyˈchologiˌcally)	
b. (psyˈchologiˌcal)ly	W*

Note that this analysis differs from Zuraw's (2007) analysis of frequency effects on a similar prefix-suffix asymmetry in Tagalog. Whereas most Tagalog prefixes induce a separate pword, high-frequency prefixed words cohere into a single pword. Zuraw's Align constraint achieves this by targeting all accessed lexical units, not just stems:

(27) **Align (Accessed Unit, L, PWd, L)**
The left edge of any accessed lexical unit must coincide with the left edge of some prosodic word.

The disadvantage of this constraint is that it also demands independent pwords for suffixes. In Tagalog this can be prevented by the addition of a minimality constraint stating that every pword must contain at least one foot of two syllables. But this will not work for SgEng, where *psycho-logi-cal-ly* has enough suffix material to form an independent pword. My analysis therefore makes use of the conventional distinction between stems and affixes, while stipulating that stem alignment constraints such as (11) can target both decomposed and whole-word units returned by lexical access.

4. Stress

4.1. Diagnostics for stress

4.1.1. Phonetics and phonology of SgEng stress

Much stress-related phonology is lacking in SgEng; for instance, there is no evidence for stress shift of any kind. Part-of-speech distinctions which rely on stress are rare (Bao 1998: 170):

(28) *Lack of part-of-speech distinctions in stress*

BrEng	*inˈcrease* (v.)	*ˈincrease* (n.)	*proˈject* (v.)	*ˈproject* (n.)
SgEng	*inˈcrease* (v.)	*inˈcrease* (n.)	*proˈject* (v.)	*proˈject* (n.)

Affix-driven stress shift is blocked in favour of stem faithfulness (Bao 1998: 171):

(29) *Impotence of stress-shifting affixes*

BrEng	*ˌecoˈnomic*	*ˌtechnoˈlogical*	*ˌacaˈdemic*	*ˌpsychoˈlogical*
SgEng	*eˈconomic*	*techˈnological*	*aˈcademic*	*psyˈchological*

My recordings have also failed to find clash-driven phrasal stress shift, e.g. *thirˈteen ˈmen* > *ˈthirteen ˈmen* (Liberman & Prince 1977). In a young contact variety of English it is not entirely surprising that faithfulness should be ranked high for ease of word recognition, but since clash and lapse processes are key to the hierarchical nature of stress (Hayes 1995: 25), their absence raises the question of whether SgEng has underlying tone rather than stress.

Certainly SgEng stress is not acoustically salient, though again this is not surprising because two out of three of the traditional correlates of stress are much obscured. Pitch is governed by categorical tone distinctions instead of pitch accent; duration differences are minimised by syllable timing (Low 1998; Deterding 2007: 31ff) and masked by utterance-final lengthening (Low 1998). Furthermore, vowels often fail to reduce in unstressed contexts, and schwa is acceptable in stressed contexts (Low, Grabe & Nolan 2000; Deterding 2005; Deterding 2007: 28ff). However, intensity is a significant phonetic cue for SgEng stress even when tone is not controlled for (Tan 2002). I have conducted my own mini-study of 41 syllable pairs among three speakers, controlling for tone, vowel, syllable type, non-word-finality and speech rate, and tagging stress by the tonal diagnostics described in (17) above. Under these conditions both duration and intensity turn out to be significant correlates of stress ($p < 0.005$)

(Ng 2008b). Phonetically, then, SgEng stress is present in the acoustic signal, though with reduced cues.

This may explain why trained linguists admit that some productions are difficult or impossible to code for stress (Bao 2006: fn.3; Deterding 2007: 33), but nonetheless show a high degree of agreement in transcriptions (Tongue 1979: 34ff; Tay 1982; Bao 1998; Deterding 2007: 32). For instance, one common observation is that stress appears further rightwards than in British English (Wells 2000):

(30) *Rightward stress shift in simplex words*

	BrEng	SgEng		BrEng	SgEng
a.	*ˈcolleague*	*coˈlleague*	b.	*ˈdiffer*	*diˈffer*
c.	*ˈvehicle*	*veˈhicle*	d.	*ˈcharacter*	*chaˈracter*

As we would hope, these previous stress transcriptions correctly predict variation in surface tones (Siraj 2008; Ng 2009), allowing for interference from British and American English mass media, prescriptivism and hypercorrection.

The differences between trained linguists' stress transcriptions are limited to fairly subtle distinctions, which are unfortunately crucial for our project. Most of these discrepancies cannot be distinguished by surface tone patterns, suggesting that linguists were subconsciously using tone as a cue for stress even before it was identified and analysed as stress-dependent.

(31) *Secondary stress vs. lack of stress: MMMH*

Bao (2006)	Frequent clash within stems, e.g. *ˌmoˌnoˈpoly.*
Tongue (1979: 33)	No clash transcribed, e.g. *socioˈlogy* (presumably *ˌso.cioˈlo.gy*).

(32) *Primary vs. secondary stress: MHMH*

Tongue (1979: 37)	Compounds are right-headed,[6] e.g. *ˌtable ˈtennis.*
Uri Tadmor (p.c. July 2008)	Compounds are double-headed, e.g. *ˈpocket ˈmoney*.

The confusion between secondary stress and lack of stress in (31) presumably arises because syllable-timing is likely to lend extra prominence to unstressed syllables, causing them to resemble secondary stress. But with compound stress (32) it is not so clear how phonetic implementation would bias stress perception, since final lengthening might suggest right-headedness, syllable timing double-headedness, and tonal

[6] In this paper, compound left- or right-headedness refers to prosodic prominence, not morphosyntactic structure.

downstep[7] left-headedness. Nor is it clear that we can resolve these questions by appealing to native speaker judgments: while untrained speakers can often distinguish between 'correct' and 'incorrect' pronunciations (Bao 2006), they find it extremely difficult to transcribe or produce them in terms of stress distinctions, in either British English or their own speech (Tay 1982).

However, thanks to syllable timing and the categorical nature of tone, Chinese SgEng speakers find surface tones salient and relatively easy to classify: one of my informants was transcribing it even before he learnt of my project. I propose that our discussion of stress should set aside conflicting impressionistic judgments, relying on surface tone and acoustic measures of duration and intensity instead. The main limitation of this approach is that tone assignment does not distinguish primary and secondary stress. However, there are cases of variation in tone assignment, and in the following discussion I will show how these can be related to variation in stress.

4.1.2. Destressing and variation in surface tone

Destressing is governed by a cross-linguistic constraint which can be summed up as follows: "if the two stresses are unequal in strength, it is always the weaker stress that is removed" (Hayes 1995: 37). This constraint has been formalised in terms of two principles in metrical grid theory:

(33) *Continuous Column Constraint (Hayes 1995: 34)*
A grid containing a column with a mark on layer $n + 1$ and no mark on layer n is ill-formed. Phonological rules are blocked when they would create such a configuration. (Do not create gaps in a grid column.)

(34) *Destressing in clash (Hayes 1995: 37)*
a. × → Ø / ____ ×
b. × → Ø / × ____
(Remove grid marks on the level where clash occurs.)

These principles predict different outcomes for left- and right-headed compound stress after destressing.

[7] Tonal downstep has not been formally described in SgEng, but Pasha Siraj (p.c. 17 November 2008) and Jeff Good (p.c. 8 Jan 2010) confirm my impression that it occurs in SgEng.

(35) *Destressing a left-headed compound*

```
   ×                   ×                   ×
   ×   ×               ×                       ×
   × × ×      →        × × ×               × × ×
a. ˈbutterˌfly      b. ˈbutterfly       c. *ˌbutterˌfly
```

(36) *Destressing a right-headed compound*

```
       ×                   ×                   ×
   ×   ×                   ×               ×
   × × ×      →        × × ×               × × ×
a. ˌbutterˈfly      b. butterˈfly       c. *ˌbutterˌfly
```

When surface tone is assigned based on the compound stress patterns listed in (35) and (36) above, we find different sets of possible tone patterns for left- and right-headed compounds after destressing (37), despite similar ones before.

(37) ***Diagnostic: Tone variation implies stress and pword structure***

		Left-headed	Right-headed
Before destressing	a.	(ˈMH)(ˌH)	(ˌMH)(ˈH)
After: Independent pwords	b.	*(ˈMH)(H)	*(MH)(ˈH)
After: Recursive pwords	c.	((ˈMH)H)	(L(LˈH))
After: Merged pwords	d.	(ˈMMH)	(LLˈH)

Both left- and right-headed compounds have independent pwords before destressing (37a), but these are not possible after destressing (37b) because a pword must contain at least one stress (Selkirk 1984; Nespor & Vogel 1986). Recursive structures (37c) may result if speakers simply cliticise the material that cannot form an independent pword, thus salvaging at least one pword edge to signal the morphological boundaries. But merged structures (37d) will be preferred if the cliticised structures happen to be prohibited.

In terms of our search for a diagnostic that can distinguish primary and secondary stress, the best case would be that the merged structures are possible, because they offer the best disambiguation of left- and right-headed compounds. However, note that the merged structure (37c) could result not only from destressing as described above, but also from whole-word-only access. We will only be able to rule out this possibility when we examine initialisms.

4.2. Stress in morphologically complex words

4.2.1. Prefixes

We are now in a position to revisit prefix variation as promised in section 3.2. Previous stress diagnostics (17) have already established that prefix high tone indicates stressed prefixes (38), while prefix low tone indicates unstressed prefixes (39). Note that prefix stress is evidently determined by factors other than clash (38b) or lapse (39a); these are probably pragmatic or semantic effects which fall beyond the scope of this analysis.[8]

(38) *Prefix high tone (stressed)*

a. *ˌun-inˈstall*	(ˌH)-(LˈH)	b. *ˌir-ˈrational*	(ˌH)-(ˈMMH)
c. *ˌanti-ˈEnglish*	(ˌMH)-(ˈMH)	d. *ˌmono-ˌun-ˈsaturated*	(ˌMH)-(ˌH)-(ˈMMMH)

(39) *Prefix low tone (unstressed)*

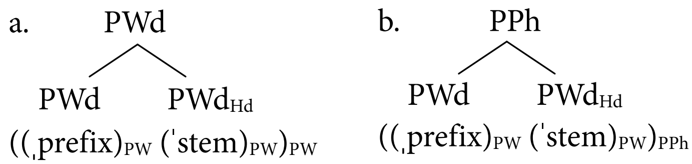
a. *un-inˈstall*	(L-(LˈH))	b. *ir-ˈrational*	(L-(ˈMMH))

Based purely on glottalisation and high tone diagnostics, we can see that the unstressed prefixes in (39) induce mismatched pword left and right edges. If we accept that the pword is a constituent rather than a set of edge markers, this mismatch must be interpreted as recursive pword structure (Inkelas 1989; McCarthy & Prince 1993: §A1; Selkirk 1995; Peperkamp 1997). Logically, a pword edge can only be masked if it coincides with another edge; thus it can be inferred that words with unstressed prefixes (39) have the recursive structure (prefix(ˈstem)), one of the logical results of destressing predicted in (37c) above.

We are now in a position to detect primary and secondary stress in prefixed forms based on the previous discussion of stress and tone variation. If prefix stress and tone variation is governed by the destressing principles identified previously, then it constitutes evidence that stressed prefixes form right-headed structures, i.e. primary stress on the stem, secondary stress on the prefix. This affix-stem asymmetry can only be enforced by designating the stem pword as the head of some larger prosodic unit containing both pwords. The remaining question is the identity of this larger unit.

[8] Certain types of destressing (especially in initialisms) are frequency-linked (§5). But these mechanisms cannot account for all types of destressing, because destressed initialisms lose all internal pword edges, whereas destressed prefixed forms can retain them (39). This is why I assume that prefix stress is determined by semantic or pragmatic factors, not frequency-linked factors as with initialisms.

(40) *Prosodic structure containing prefix and stem*



The question can be answered by the pword's definition as the largest prosodic unit which can be sensitive to morphology (Hall 1999). In order to consistently assign head status to the stem pword, the outermost prosodic unit in (40) must differentiate between stems and affixes, hence it can only be a pword. Completely nested structures like these were not used in Raffelsiefen's (1999) analysis of English prefixes, though the necessity is foreshadowed by her observation that the same (pword)(pword) structure corresponds to two different stress patterns in prefixed words and compound words (Raffelsiefen 1999: 142, fn11). Such structures have, however, been proposed for Portuguese stressed prefixes, stressed suffixes and compounds, which behave much like their SgEng counterparts (Vigário 2003: 222ff).

4.2.2. Suffixes

So far we have seen only merged pword structures for suffixed words, but there are exceptions, and they all belong to the class of suffixes which are stressed in British and American English. In all cases the suffix is homophonous with an independent grammatical word, though the semantic relationship is not necessarily transparent. Note that left pword edges are omitted from the following transcriptions when the glottalisation diagnostic is inapplicable due to consonant-initial morphemes.

(41) *Stressed suffixes*

		Independent/Recursive	*Merged*
a.	*ˈfriendˌship*	ˈH)ˌH)	ˈM(ˌ)H)
b.	*ˈscholarˌship*	ˈMH)H)	ˈMM(ˌ)H)
c.	*ˈchildˌhood*	ˈH)ˌH)	ˈM(ˌ)H)
d.	*ˈneighbourˌhood*	ˈMH)H)	ˈMM(ˌ)H)
e.	*ˈladyˌlike*	ˈMH)ˌH)	ˈMM(ˌ)H)
f.	*ˈbusinessˌlike*	ˈMH)ˌH)	ˈMM(ˌ)H)
g.	*ˈhandˌful*	ˈH)ˌH)	ˈM(ˌ)H)
h.	*ˈthankˌful*	ˈH)ˌH)	ˈM(ˌ)H)

I would suggest that for some speakers these are pseudo-compounds which decompose to two stems.[9] This reanalysis accounts for the prosodic structures in the first column of tone transcriptions, corresponding to independent or recursive pwords. The merged forms in the second column could be the result of correct analysis, left-headed destressing or whole-word-only lexical access.

The potential for reanalysis implies that stressed suffixes and compounds are potentially associated with similar stress patterns and pword structures. If we can determine that compound stress is typically left-headed and optionally recursive, then we will be able to infer a simple rule that that stems carry primary stress in both prefixed and suffixed forms. On the other hand, if compound stress is typically right-headed with obligatory independent pword structure, we would need a more complicated analysis; happily this will prove to be unnecessary.

4.2.3. Compounds

A few test items were typically pronounced like destressed left-headed compounds by most speakers. Their non-destressed pronunciations were rare, but speakers were often willing to accept them, if only marginally.

(42) *Left-headed destressing*

		Independent/Recursive	*Merged*
a.	*ˈdustˌbin*	? ˈH)ˌH)	ˈM(ˌ)H)
b.	*ˈiceˌcream*	? ˈH)ˌH)	ˈM(ˌ)H)
c.	*ˈbutterˌfly*	? ˈMH)ˌH)	ˈMM(ˌ)H)

These particular items lack semantic transparency and seem just as likely to be the result of whole-word-only access than destressing. However, there are indications that destressing-linked variation is possible beyond this small class of compounds. Among the speakers I have interviewed informally without recording, partly because they had been exposed to too much non-Singaporean English to be ideal subjects, there was one who never seemed to produce any destressed compounds, even the ones in (42) above, and another who produced nearly all tested compounds as if they had undergone left-headed destressing, e.g. *waterfall* (ˈMM(ˌ)H). This suggests that the bulk of compounds in SgEng are left-headed and can potentially undergo destressing.

[9] The stressed suffix –*aire* also forms pseudo-compounds. In my recordings *ˌmillionˈaire* always has the typical suffixed form (MMH), but I have heard *ˌbillionˈaire* (MH)(H) in a Singaporean production of *Boeing Boeing* (Wild Rice, 2010), and one of my informants confirms that ((MH)H) is also possible.

In contrast, I have found few destressed right-headed compounds in SgEng, all right-headed in British and American English, e.g. the place name *New York* (LˈH).

(43) *Greetings*

		Before destressing	*Right-headed destressing*
a.	*ˌgood ˈmorning*	? (ˌH)(ˈMH)	(L(ˈMH))
b.	*ˌgood ˈafternoon*	? (ˌH)(ˈMMH)	(L(ˈMMH))
c.	*ˌgood ˈevening*	? (ˌH)(ˈMMH)	(L(ˈMMH))
d.	*ˌgood ˈnight*	? (ˌH)(ˈH)	(L(ˈH))

Greetings may represent fossilised phrasal stress rather than true compound stress, but even if we accept them as examples of destressed right-headed compounds, they do not represent unambiguous proof that right-headed compound stress exists in SgEng. It is quite likely that they entered SgEng as already-destressed lexical items in their own right, since it is common to drop these secondary stresses in British and American English (Wells 2000), and the non-destressed SgEng pronunciations do not sound like greetings.

Additional complications arise with the second class of potentially right-headed compounds, the compound numbers from 21 to 99.

(44) *Destressed compound numbers 21-99*

		Before destressing	*Right-headed*	*Left-headed*
a.	*eighty-eight*	?? (MH)(ˈH)	(LL(ˈH)	(ˈMMH)
d.	*eighty-seven*	?? (MH)(ˈMH)	(LL(ˈMH)	(ˈMMMH)

While the un-destressed forms are highly unnatural, both the left-headed and right-headed destressed structures are possible. Again, these items have right-headed stress in British and American English, so it seems likely that they too entered SgEng in already destressed form, and that some speakers are replacing the exceptional stress pattern for this class of words with the stress pattern found more commonly in compounds. Alternatively, apparent left-headedness might result from whole-word-only access coupled with a non-destressed pronunciation.

Summary. We have seen that destressing and whole-word-only access often make similar predictions with respect to surface tone. We have also seen that variation between pre-destressed and post-destressed forms is often lacking, so that it is not clear whether destressing is productve in SgEng or only present in inherited forms. Furthermore, it has not always been possible to find cases of tonal variation which also allow us to diagnose pword left edges by providing the environment for glottalisation. For all these reasons we must turn to initialisms in order to clarify our analysis of stress and tone variation.

4.2.4. Initialisms

Harley (2004) has shown that English acronyms fall into two classes: some, like *NASA*, are pronounced like proper names and behave syntactically like them, whereas others like *CIA* are pronounced as distinct letters of the alphabet and behave syntactically like compounds. In SgEng *CIA*-like initialisms are by far the more common. Tonal patterns confirm that they behave like SgEng compounds (45); the only difference is that since more stems are possible, more tonal patterns are attested.[10]

(45) *2-letter initialisms:* Integrated Resort, Identity Card

		Least merger	*Most merger*
a.	*IR*	((ˈH)ˌH)	
b.	*IC*	((ˈH)ˌH)	(ˈMH)

(46) *3-letter initialisms:* National Day Parade, Ministry of Education, Mass Rapid Transit

		Least merger		*Most merger*
a.	*NDP*	(((ˈH)ˌH)ˌH)		
b.	*MOE*	(((ˈH)ˌH)ˌH)	((ˈH)ˌMH)	
c.	*MRT*	(((ˈH)ˌH)ˌH)	((ˈH)ˌMH)	(ˈMMH)

(47) *4-letter initialisms:*
Society for the Prevention of Cruelty to Animals, Anglo-Chinese Junior College, National Registration Identity Card, National Trade Unions Congress (supermarket)

		Least merger			*Most merger*
a.	*SPCA*	((((ˈH)ˌH)ˌH)ˌH)			
b.	*ACJC*	((((ˈH)ˌH)ˌH)ˌH)	(((ˈH)ˌH)ˌMH)		
c.	*NRIC*	((((ˈH)ˌH)ˌH)ˌH)	(((ˈH)ˌH)ˌMH)	((ˈH)ˌMMH)	
d.	*NTUC*	((((ˈH)ˌH)ˌH)ˌH)	(((ˈH)ˌH)ˌMH)	((ˈH)ˌMMH)	(ˈMMMH)

[10] HMH and HMMH were far more common than MMH, MMMH and HHMH, but all have been observed in at least one speaker and one initialism. This preference may arise because a two-way stress distinction is easy to maintain, giving little motivation for further destressing.

It is unlikely that this set of tonal patterns results from phonetic reduction of tones. Normal tonal reduction minimises pitch changes and narrows pitch range (e.g. Xu & Sun 2001; Kuo, Xu & Yip 2007), but here *more* pitch changes are created.

Nor can this variation in surface tone be explained in terms of a shift towards whole-word-only or less compositional lexical access, which then supplies fewer stems for pword alignment. This would predict only the first column (where all stem boundaries are respected) and the last column (where all stem boundaries are lost). Lexical access could only predict such a variety of forms if all attested pword parses lined up with potential stems; for instance the set of tone patterns attested for *NRIC* in (47c) would not be surprising if *IC, RIC* and *NRIC* were all meaningful initialisms. But while *IC* is a common SgEng initialism, *RIC* is not; nor are *TUC* or *UC* (47d). If lexically accessed units were really the key factor, then the tone pattern *[AC][JC]* (MH)(MH) should be quite common, since it eliminates all clash and reflects compositionality better (*AC* and *JC* are also common initialisms with the same meaning as in *ACJC*). It is also the case that most Singaporeans need to think a bit before they can recall what *NRIC* and *NTUC* stand for. Lexical access alone does not predict the directionality exhibited by the data. It is destressing that correctly predicts tonal variation and the consistent loss of internal pword left edges.[11]

Having established that tonal variation in initialisms can only be ascribed to stress variation, we can now distinguish different levels of stress by their susceptibility to destressing. From the last column we can infer that the leftmost stress is strongest, since it is the last to be lost. From the second-last column we can infer that the second stress is the next strongest, and so forth. Four levels of stress is quite a lot, but no more than Hayes (1995: 17) has argued for in English. These stress distinctions are confirmed by a preliminary phonetic analysis of adjacent syllable pairs in one speaker's initialisms. Intensity is greater on the first element for a significant proportion of pairs ($p < 0.05$); this also holds for duration ($p < 0.05$) except that the last syllable evidently undergoes final lengthening (visible in **Figure 3**), although this effect has previously been reported only for utterances (Low 1998). I conclude that acoustic measures confirm the relative prominence relations that have already been inferred from impressionistic transcriptions of surface tone.

[11] In my recordings, one informant was an exception to this rule: glottalisation occurred in every syllable of initialisms, though his surface tones were consistent with pword merger. Other informants felt that this sounded slightly unnatural except in extremely careful speech. I would suggest that his pronunciations can be explained by a different grammar, e.g. ONSET, CRISPEDGE(SYLLABLE) ≫ DEP.

4.2.5. Summary

Summing up, then, initialisms offer evidence that destressing is indeed productive in SgEng. This validates our tentative conclusions earlier in this section that affixes carry secondary stress (if stressed at all), stems carry primary stress (always assumed to be leftmost in this transcriptions for simplicity's sake), and that compound stress is normally left-headed. We have also seen that in some prefixed forms and initialisms, internal pword left edges are lost, though internal pword right edges are retained.

4.3. Optimality Theory analysis

In order to focus on the aspects of stress assignment relevant to pword parsing without a lengthy exposition of all constraints relevant to footing, I will use a cover constraint to enforce faithful stress:

(48) **Stress**
Cover constraint for stress. Requires faithfulness to lexically listed stem stress and prefix stress assigned according to non-phonological criteria. Supplies suffix stress by clash and lapse avoidance if necessary. One violation per accessed lexical unit which behaves otherwise.

This constraint allows prefixes to remain unstressed, even though stress would allow them to better satisfy $_{\text{PW}}$]Stem.

(49) *Prefixes can remain unstressed*

	un-[inˈstall]	**Stress**	$_{\text{PW}}$]**Stem**
☞	a. (un(inˈstall))		*
	b. ((ˌun)(inˈstall))	W*	L

Note that Economise cannot help *(un(inˈstall))* to defeat *((ˌun)(inˈstall))* in (49), because now that we have evidence of completely nested pwords, Economise must be ranked below both stem alignment constraints. Tableau (50) provides evidence for this ranking, which was previewed in tableau (24).

(50) *Compounds create pword right edges (previewed in tableau (24) on p. 13)*

[century] [egg]	PW]STEM	PW[STEM	ECON
☞ a. ((ˈcentury)(ˌegg))			***
b. (ˈcentury (ˌegg))	W*		L**
c. (ˈcentury ˌegg)	W*	W*	L*
d. ((ˈcentury) ˌegg)		W*	L**

Finally, a constraint is needed to enforce merged pwords in initialisms like *((ˈM)ˌOE)*, and to explain why recursive structures like *(((ˈM)ˌO)E)* do not are worse even though they have the same stresses, are equally good at avoiding independent pwords containing no stress, and satisfy PW]STEM better. This constraint must also allow certain other recursive structures like *(un(inˈstall))* to win. The key difference is that both desired winners have feet at pword right edges, whereas feet are not required at pword left edges.

(51) **ALIGN (PWD, R, FT, R)** **Short form: FT]PW**
A pword right edge must coincide with a foot right edge.
One violation per pword otherwise.

(52) *Pword merger after destressing*

[[ˈM][ˈO][ˈE]]	FT]PW	PW]STEM
☞ a. ((ˈM)ˌOE)		*
b. (((ˈM)ˌO)E)	W*	L

These constraints elegantly account for pword recursion and merger in destressed prefixed words and compounds, as well as initialisms and pseudo-compounds. However, they do not explain what drives destressing, and why initialisms are not all subject to the same degree of destressing. Nor do they motivate the loss of internal pword left edges from some prefixed forms and all initialisms. The next section seeks to answer these questions based on the well-established relationship between reduction and lexical frequency.

5. Frequency

5.1. Why frequency?

The obvious answer as to why some words might destress and lose internal pword structure is that they have high lexical frequency. This is known to speed up lexical access and/or speech rate, which in turn could affect phonology via the prosodic hierarchy. I will describe what is known about these interactions before I describe proposed mechanisms for frequency-linked effects which may be relevant to SgEng destressing.

The link between high lexical frequency and fast lexical access is one of the clearest empirical findings of psycholinguistics (e.g. Segui, Mehler, Frauenfelder & Morton 1982), such that we can consider measures of lexical frequency to be proxies for speed of lexical access. It is also well-established that high frequency predicts faster speech rates and shorter duration of lexical items (Aylett & Turk 2004; Pluymaekers, Ernestus & Baayen 2005; Fossler & Lussiera-Morgan 1999; Gahl 2008; Bell, Brenier, Gregory, Grand & Jurafsky 2009). In fact speed and the resulting overlap of articulatory gestures (Browman & Goldstein 1990) may well be responsible for some frquency-linked segmental reduction processes such as cluster *t/d* deletion in English; if so, this phenomenon may not have been correctly analysed as phonological by Coetzee (2009).

Fewer studies have delved into the more difficult question of whether high frequency also favours reduction defined in terms of the prosodic hierarchy. There is some evidence that it affects stress, because high-frequency Dutch words display reduced spectral tilt and duration (Van Son & Pols 2003). But apparently categorical prosodic realignment effects can turn out to be gradient upon closer inspection, as in Taiwanese syllable coalescence (Myers & Li 2009). On the other hand, potentially gradient effects such as Tagalog frequency-linked tapping (*d* > *r*) and nasal substitution (e.g. *mp* > *m*) turn out to be categorically conditioned by morphological word type (prefixed, suffixed, compound), hence they probably do belong in the phonology instead of phonetic implementation (Zuraw 2007). Similarly, secondary stress in low-frequency Russian compounds is unlikely to be an effect of slow speech rates alone, because it can be unfaithfully located owing to factors such as clash and vowel identity which are usually placed in the phonology (Gouskova & Roon, to appear). We can conclude that frequency does indeed have categorical effects on prosodic phonology; the next question is how.

There are three main proposals as to how frequency might be able to affect phonetics and phonology. Firstly, it is known that frequent items tend to be retrieved as whole-word lexical units rather than as decomposed constituents (e.g. Hay 2003; Zuraw 2007). If so, high-frequency complex words would tend to form flatter prosodic structure simply because they are usually retrieved via whole-word-only access; when the phonology receives only the whole grammatical word as input, the internal stems and affixes cannot be targeted by prosodic alignment constraints. The whole-word-only proposal is sufficient for Zuraw's (2007) analysis of Tagalog frequency-linked phonology; however, we have seen why it cannot explain SgEng forms like *NRIC* ((ˈH)ˌMMH), where some stems induce pword alignment and others do not. A second possibility comes from proposals that we store phonetic information for high-frequency items in the form of articulatory plans or fine-grained phonetic detail, resulting in faster but sometimes reduced execution (Bybee 2007; Pierrehumbert 2002). But these cannot explain the tonal patterns of SgEng initialisms either, because they predict wrongly that high-frequency words should display high phonetic fidelity to the original sequence of surface high tones, instead of introducing mid tones.

A third set of proposals suggests that the speed of lexical access itself facilitates or slows down articulatory planning, which in turn affects the speed of articulatory execution (Levelt 2002; Pierrehumbert 2002; Bell *et al.* 2009). One application of this prediction is based on the fact that high frequency would then result in shorter duration and faster speech rates. Since we know that different speech rates can require different constraint rankings for prosodic alignment (e.g. Yip 1999) and destressing (Hayes 1995: 96, 193), it would be possible to explain phonological peculiarities of high-frequency items by subjecting them to the constraint rankings necessary for fast speech. But this does not make the correct predictions, because each of the initialisms in (45)–(47) above is categorically limited to the set of tonal patterns listed: pronouncing *SPCA* with the highly merged pword structure ((ˈH)ˌMMH) would be very odd indeed, no matter how fast the speech rate. Besides, pword merger based on fast speech is not supported by the behaviour of SgEng monomorphemes, whose surface tones do not vary with speech rate. It appears that lexical access speed must be affecting phonology further 'upstream'.

One of these proposals (Bell, Brenier, Gregory, Girand and Jurafsky 2009) does in fact hypothesise that speed of lexical access has a direct impact on phonology:

(53) "… short-term coordination between the access of words and their articulation may increase the strength and/or duration of articulation when the progress of phonological encoding is slowed, but not so impaired to trigger overt disfluencies. While a detailed examination of any such mechanisms is beyond the scope of this paper and must be the subject of future work, initial evidence that such a lexical-access mechanism is involved would be to establish that a word's frequency affects its articulatory form, even after controlling for predictability." (Bell *et al.* 2009: 95)

Since this paper was published it has in fact been established that when speaker-centred ease of articulation conflicts with hearer-centred ease of disambiguation, i.e. predictability (Van Son & Pols 2003; Aylett & Turk 2004; Bell *et al.* 2009), ease of articulation wins in the case of near-homophone production (Yao 2010). Which mechanism is primarily responsible for the destressing in my SgEng recordings? We can assume that predictability effects were present to some extent, since my informants knew that I had lived in Singapore and hence my exposure to initialisms would be similar to theirs. However, predictability effects must have been minimal because the scripted frame sentences (2) used in my recordings bore no relation to the target words. If frequency had a significant impact on tone and stress in my data, most of the variation must therefore be ascribed to speaker-centred articulatory planning rather than hearer-centred predictability.

5.2. Frequency in SgEng initialisms

As lexical frequency is highly correlated with the speed of lexical access, the statistical analyses in this section rely on frequency counts to estimate access speeds. Frequency data is based on initialisms exclusively, firstly because they reflect SgEng destressing better than lexical items inherited from British English, and secondly because no other class of words is better controlled for syllable type and stem stress. It is also an advantage that letters of the alphabet are relatively well controlled for stem frequencies, since Hay (2003: ch. 4) argues convincingly for the significance of relative versus absolute frequency of the whole word compared to its stem.

The best frequency counts rely on large spoken corpora, but these are not available for SgEng. The best free substitute was to count Google hits. I used Google Singapore (20 March 2010) because it resulted in higher counts for nearly all items, restricting my search to Singaporean websites by appending `site:.sg` to the search terms. Of course, this method has its limitations. Firstly, written usage tends to be more formal than most speakers' lexicons; this probably explains why *NRIC* (National Registration Identity Card) had many more hits than *IC* (identity card) although any speaker can tell you that *NRIC* is far less common and is restricted to formal usage when disambiguation is desirable. Secondly, measuring frequency by Google hits naturally results in boosted counts for organizations with a strong Internet presence, such as *NUS* (National University of Singapore). Thirdly, homophones could not be disambiguated. Two-letter initialisms proved especially noisy[12] ($p = 0.851$ for fitted-line regression of hits and duration). As such two-letter initialisms were excluded from frequency analyses.

Frequency and tone. To check the hypothesis that lexical frequency predicts permitted degrees of destressing, I grouped initialisms into three ranked classes: (1) complete merger possible, (2) partial merger possible, (3) no merger possible. The initialisms were limited to the ones tested in my recordings, but class membership also took into account the forms I encountered in eavesdropping and elicitations; reclassification affected only *ACJC* and *MRT*. Note that *LMNO* and *LMN* have no significance in SgEng beyond their adjacency in the alphabet.

(54) *Classes of possible surface tones*

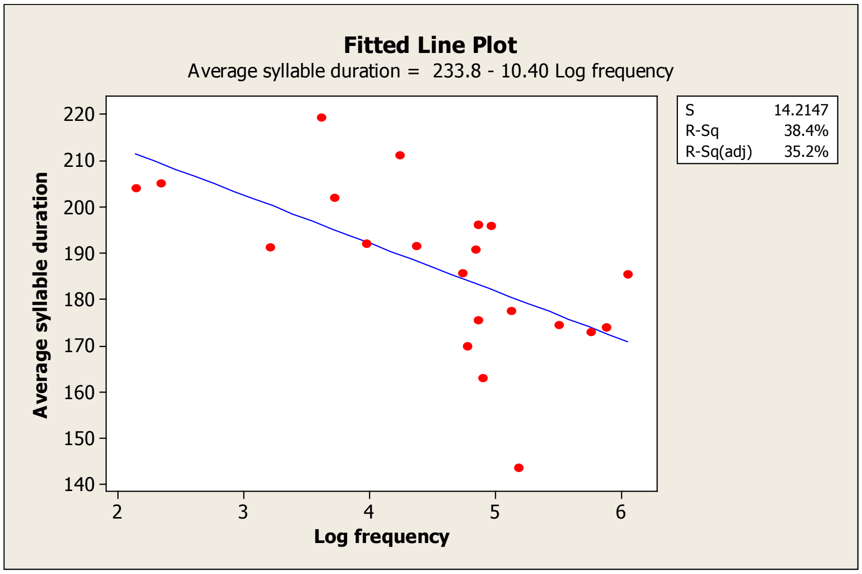
Class 1	*Complete merger:* (ˈMMH), (ˈMMMH)	*MRT, NTUC*
Class 2	*Partial merger:* ((ˈH)ˌMH), (((ˈH)ˌH)ˌMH), ((ˈH)ˌMMH)	*ACJC, NYP, CCA, NRIC, SMU, LRT,* *UOB, SIA, MOE, NTU, NUS*
Class 3	*No merger:* (((ˈH)ˌH)ˌH), ((((ˈH)ˌH)ˌH)ˌH)	*LMNO, LMN, SDU, RGS, NDP, ITE,* *CBD, GST*

Spearman's rank order correlation between Google hits and class membership (54) found a correlation of 0.560 ($p < 0.01$). This confirms that lexical frequency, which we can treat as a proxy for access speed, is a strong predictor of initialism destressing.

Frequency and duration. If highly frequent words are indeed more destressed, this should be evident not only in more merged pwords but also in shorter duration. A regression on log frequency and average syllable duration confirmed this ($R^2 = 35.2\%$, $p < 0.005$). The fitted-line plot appears in **Figure 4** below.

[12] It is possible that less widespread initialisms like *TP* had artificially boosted counts because they can have different uses in different contexts (Temasek Polytechnic, Toa Payoh, Traffic Police), whereas universally known initialisms like *IC* were less likely to be polysemous.

Figure 4: Frequency and duration



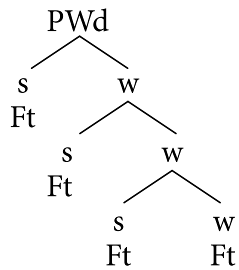
As predicted by the hypothesis, more frequent initialisms have shorter syllable durations. This provides additional confirmation that lexical frequency, and hence access speed, is a predictor of initialism destressing.

5.3. Optimality Theory analysis

There are at least two ways in which destressing might result from coordination between access speed and articulatory planning. If stress is strength of gestural activation (Tilsen, submitted) pure and simple, then high planning speeds may make it difficult to distinguish enough different activation strengths to create four, three or two levels of stress. This effect may be reinforced by the fact that SgEng stress is not strongly marked in the first place (§4.1.1). This account is attractively grounded in phonetics and the dispersion theory of contrast (Flemming 2004), but it is not clear that it would capture boundary effects or higher prosodic structure, which are also sensitive to speed (e.g. Jun 2003).

Alternatively, if the phonology is assumed to produce strictly hierarchical stress by constructing branching prosodic structures with strict binarity and headedness (55), then it may be that the grammar can only build at most (or at least) *x* prosodic units in *y* planning time.

(55) *Strictly hierarchical stress from headed binary branches (strong and weak)*



This account respects prosodic units as constituents rather than sets of markers for heads and boundaries. But note that some of the intermediate nodes required in (55) would not correspond to any members of the prosodic hierarchy (Selkirk 1984; Nespor & Vogel 1986), though they have a precedent in *SPE* (Chomsky & Halle 1968). As the correct formalisation of hierarchical stress is not the central concern of this analysis, and either possibility can account for SgEng destressing, I leave this issue to be settled in future studies.

The only previous analysis of frequency-linked compound stress (Gouskova & Roon, to appear) proposes the destressing constraint *StrongClash (56), which penalises all secondary stresses and is indexed to frequency-based word classes, .

(56) ***StrongClash (Gouskova & Roon, to appear)**
Assign a violation mark for every pair of adjacent columns of strong beats.

		×	word-level beat
×		×	foot-level beat
×	(×)	×	syllable-level beat

*StrongClash (56) reflects Hayes' (1995: 36) generalisation that destressing attacks weaker stresses rather than stronger ones. This single constraint is sufficient for Russian, where only one stress is allowed normally, two exceptionally. In SgEng, however, we have motivated four levels of stress which can be retained or lost, and three possible degrees of destressing. This calls for a constraint family indexed to four lexical speeds 1-4, from fastest to slowest.

(57) *STRONGCLASH (SPEED X) **Short form: *SCLASH$_S$**

A grammatical word accessed at speed *x* allows only *x* levels of stress at most, e.g. speed 3 allows only primary, secondary and tertiary stress.
One violation per grammatical word otherwise.

The appropriate lexical speed is indicated by input forms; e.g. [[M][O][E]]$_{S2}$ is accessed at speed 2, so it permits only two levels of stress in tableau (58) below.

(58) *Do not restore faithful stress to destressed initialisms*

[[M][O][E]]$_{S2}$	WRAP	*SCLASH$_S$	STRESS
☞ a. ((ˈM)ˌOE)			*
b. ((ˈM)ˌOˌE)		W*	L
c. ((ˈM)(ˌO)(ˌE))		W*	L
d. (ˈM)(ˈO)(ˈE)	W*		L

Although it is not obvious from the stress marks, candidates (58b) and (58c) incur violations under *STRONGCLASH$_{S2}$ because they contain three levels of stress, based on the assumption that a pword cannot contain identical levels of stress (§1.1). Candidate (58d) satisfies *STRONGCLASH$_{S2}$ and STRESS by assigning independent prosodic words, but fails to satisfy WRAP.

The last phenomenon remaining to be accounted for is that initialisms and some common prefixed forms lose their internal pword left edges (§4.2.4, §2.2). We cannot achieve this with the ranking $_{PW}$[STEM ≫ ECONOMISE which was established in section 2.3, because the desired winner *((ˈM)ˌOE)* would lose to *((ˈM)(ˌOE))*. However, it is known that fast speech tends to flatten out prosodic structure and eliminate internal boundaries, for instance in Mandarin Chinese foot structure (Shih 1997; Yip 1999).[13] High frequency words could compel a similar effect via fast lexical access and articulatory planning; this requires ECONOMISE to be ranked higher for frequent words.

(59) **ECONOMISE-HIGHSPEED(PWD)** **Short form: ECON$_S$**

Do not create unnecessary pword structures. One violation per pword used.
Applies only to grammatical words accessed at speeds 1, 2 and 3.

[13] Anttila (2006) reports a slightly different effect in Finnish; extrametricality increases with frequent words. This would be consistent with the SgEng analysis proposed here if the non-extrametrical structures were recursive in some way.

(60) *Do not restore faithful stress to destressed initialisms*

[[M][O][E]]$_{S2}$	**ECON**$_S$	$_{PW}$[**STEM**	**ECON**
☞ a. ((ˈM)ˌOE)	**	**	**
b. ((ˈM)(ˌOE))	W***	L*	W***

ECONOMISE$_S$ correctly eliminates completely nested pwords for high-frequency items, while permitting them in the rest of the vocabulary, e.g. *((ˌun)(inˈstall))*.

We can now confirm that whole-word and decomposed access can and must be simultaneously possible as proposed by the mixed-access models described in (1) above. In tableau (58) whole-word access was necessary for *STRONGCLASH$_S$ to access the frequency properties of the whole word, but the internal stems must also remain visible to $_{PW}$]STEM for *((ˈM)ˌOE)* to defeat *(ˈMˌOE)* in tableau (61) below.

(61) *Whole-word and decomposed access*

[[M][O][E]]$_{S2}$	$_{PW}$]**STEM**	**ECON**
☞ a. ((ˈM)ˌOE)	*	**
b. (ˈMˌOE)	W**	L*

Since both access routes succeed, this raises the question of whether SgEng phonology cares which one succeeds first. Given that all constraints in this section make reference to the high access speed of the whole-word unit rather than the stems, it seems likely that these constraints apply only when whole-word access succeeds first.

We have now concluded our analysis of SgEng pword parsing. All constraints and candidates are recapitulated with a combined tableau in the appendix.

6. Conclusion

This analysis has successfully accounted for the diverse pword parses possible in SgEng content words by expanding a previously proposed destressing constraint into the *STRONGCLASH constraint family. These constraints are indexed to access speeds instead of lexical frequency, bringing phonology in line with proposals from psycholinguistics and phonetics.

One obvious means of testing this proposal is to check whether pword parsing is affected by factors which are known to have an impact on stress and speed of lexical access. One of my informants suggested as much when he observed that he would say

NRIC (((ˈH)ˌH)ˌMH) in isolation, but (((ˈH)ˌMˌMH) in the script frame, implying more destressing in running speech.

As for effects on lexical access, this proposal predicts that destressing should follow from a change in access speed, which might be experimentally induced by repeated exposure. My intuition, however, is that the effects would not show up after heavy exposure in a single conversation, and that any such experiment would need to cover a longer period of time. There are two reasons why a null result in the single-conversation experiment would not necessarily explode the analysis presented here. Firstly, it is more than likely that speakers retain and reuse articulatory plans created from the first lexical access for short-term use, as Bybee (2007) has suggested they do for long-term use. Secondly, it is well-established that repetition causes low-frequency words to be accessed more quickly, but has a weaker impact on high-frequency words; this phenomenon is called the frequency attenuation effect on repetition priming (e.g. Forster & Davis 1984; Versace & Nevers 2003). We know that destressing affects a fairly small subset of SgEng lexical items, so the relevant access speeds may already be too high to change significantly over the course of one conversation.

The great advantage of indexing constraints to static frequencies instead of volatile access speeds would, of course, be to conflate speaker-centred articulatory planning effects and listener-centred predictability effects. As I have argued in this paper, however, it is legitimate and indeed necessary to separate the two.

Appendix

Constraints in rank order

(25) **Wrap (GWd, PWd)** **Short form: Wrap**
Each grammatical word is contained in a pword. One violation per grammatical word otherwise.

(57) ***StrongClash (Speed X)** **Short form: *SClash$_S$**
A grammatical word accessed at speed *x* allows only *x* levels of stress at most, e.g. speed 3 allows only primary, secondary and tertiary stress.
One violation per grammatical word otherwise.

(51) **Align (PWd, R, Ft, R)** **Short form: Ft]$_{PW}$**
A pword right edge must coincide with a foot right edge.
One violation per pword otherwise.

(48) **Stress**
Cover constraint for stress. Requires faithfulness to lexically listed stem stress and prefix stress assigned according to non-phonological criteria. Supplies suffix stress by clash and lapse avoidance if necessary. One violation per accessed lexical unit which behaves otherwise.

(23) **Align (Stem, L, PWd, R)** **Short form: $_{PW}$]Stem**
A stem left edge must coincide with a pword right edge.
One violation per stem per syllable otherwise.

(59) **Economise-HighSpeed(PWd)** **Short form: Econ$_S$**
Do not create unnecessary pword structures. One violation per pword used.
Applies only to grammatical words accessed at speeds 1, 2 and 3.

(11) **Align (Stem, L, PWd, L)** **Short form: $_{PW}$[Stem**
A stem left edge must coincide with a pword left edge.
One violation per stem per syllable otherwise.

(12) **Economise** **Short form: Econ**
Do not create unnecessary pword structures. One violation per pword used.

Tableau

SIMPLEX WORDS

1. **[announce]**	Wrap	Ft]$_{PW}$	*SClash$_{S}$	Stress	$_{PW}$]Stem	Econ$_{F}$	$_{PW}$[Stem	Econ
a. ☞ (aˈnnounce)	/	/	–	/	/	–	/	*
b. (a(ˈnnounce))	/	/	–	/	/	–	/	W**

2. **[Kilimanjaro]**	Wrap	Ft]$_{PW}$	*SClash$_{S}$	Stress	$_{PW}$]Stem	Econ$_{F}$	$_{PW}$[Stem	Econ
a. ☞ (ˈKilimanˌjaro)	/	/	–	/	/	–	/	*
b. (ˈKilimanjaro)	/	W*	–	W*	/	–	/	*
c. ((ˈKili)(manˌjaro))	/	/	–	/	/	–	/	W***
d. ((ˈKi)(limanˌjaro))	/	/	–	/	/	–	/	W***
e. ((ˈKiliman)(ˌjaro))	/	/	–	/	/	–	/	W***

PREFIXED FORMS

3. **un-[arm]**	Wrap	Ft]$_{PW}$	*SClash$_{S}$	Stress	$_{PW}$]Stem	Econ$_{F}$	$_{PW}$[Stem	Econ
a. ☞ (un(ˈarm))	/	/	–	/	*	–	/	**
b. (unˈarm)	/	/	–	/	*	–	W*	L*
c. un(ˈarm)	W*	/	–	/	*	–	/	L*
d. ((ˈun)(ˈarm))	/	/	–	W*	L	–	/	W***
e. (un)(ˈarm)	W*	W*	–	/	L	–	/	**

4. **[un-[install]]**	Wrap	Ft]$_{PW}$	*SClash$_{S}$	Stress	$_{PW}$]Stem	Econ$_{F}$	$_{PW}$[Stem	Econ
a. ☞ ((ˌun)(inˈstall))	/	/	–	/	/	–	/	***
b. (ˈun)(inˈstall)	W*	/	–	/	/	–	/	L**
c. ((ˌun)inˈstall)	/	/	–	/	/	–	W*	L**
d. (ˌuninˈstall)	/	/	–	/	W*	–	W*	L*
e. (ˌun(inˈstall))	/	/	–	/	W*	–	/	L**
f. (ˌunin)(ˈstall)	W*	/	–	/	W*	–	W*	L**

5. **anti-[English]**	Wrap	Ft]$_{PW}$	*SClash$_{S}$	Stress	$_{PW}$]Stem	Econ$_{F}$	$_{PW}$[Stem	Econ
a. ☞ ((ˌanti)-(ˈEnglish))	/	/	–	/	/	–	/	***
b. (ˈanti)-(ˈEnglish)	W*	/	–	/	/	–	/	L**
c. (ˌanti-ˈEnglish)	/	/	–	/	W**	–	W**	L*
d. (ˌanti-(ˈEnglish))	/	/	–	/	W**	–	/	L**
e. ((ˌanti)-ˈEnglish)	/	/	–	/	/	–	W**	L**

6. **[dis-[honest]]$_{S3}$**	Wrap	Ft]$_{PW}$	*SClash$_{S}$	Stress	$_{PW}$]Stem	Econ$_{F}$	$_{PW}$[Stem	Econ
a. ☞ (disˈhonest)	/	/	/	/	*	*	*	*
b. (dis(ˈhonest))	/	/	/	/	*	W**	*	W**
c. dis(ˈhonest)	W*	/	/	/	*	*	*	*
d. (ˈdis)(ˈhonest)	W*	/	/	W*	L	W**	*	W**

7. **[dis-[agree]]$_{S_3}$**	Wrap	Ft]$_{PW}$	*SClash$_S$	Stress	$_{PW}$]Stem	Econ$_F$	$_{PW}$[Stem	Econ
a. ☞ ((ˌdis)aˈgree)	/	/	/	/	/	*	*	*
b. (disaˈgree)	/	/	/	W*	W*	*	*	*
c. (ˌdisaˈgree)	/	/	/	/	W*	*	*	*
d. ((ˌdis)(aˈgree))	/	/	/	/	/	W***	L	W***
e. dis(aˈgree)	W*	/	/	W*	W*	*	*	*
f. (ˌdis(aˈgree))	/	/	/	/	W*	W**	L	W**

SUFFIXED FORMS

8. [[**order**]-ing]	Wrap	Ft]$_{PW}$	*SClash$_S$	Stress	$_{PW}$]Stem	Econ$_F$	$_{PW}$[Stem	Econ
a. ☞ (ˈordering)	/	/	–	/	/	–	/	*
b. (ˈorder)(ˈing)	/	W*	–	W*	/	–	/	W**
c. (ˈorder)ing	W*	/	–	/	/	–	/	*

9. [[**system**]-atic]	Wrap	Ft]$_{PW}$	*SClash$_S$	Stress	$_{PW}$]Stem	Econ$_F$	$_{PW}$[Stem	Econ
a. ☞ (ˈsysteˌmatic)	/	/	–	/	/	–	/	*
b. (ˈsystematic)	/	W*	–	W*	/	–	/	*
c. (ˈsystem)(ˈatic)	W*	/	–	/	/	–	/	W**
d. ((ˈsystem)ˌatic)	/	/	–	/	/	–	/	W**

10. [[[[**psycho**]-**logi**]-**cal**]-ly]	Wrap	Ft]$_{PW}$	*SClash$_S$	Stress	$_{PW}$]Stem	Econ$_F$	$_{PW}$[Stem	Econ
a. ☞ (psyˈchologiˌcally)	/	/	–	/	/	–	/	*
b. ((psyˈchologi)(ˌcally))	/	/	–	/	/	–	/	W***
c. (psyˈchologiˌcal)ly	W*	/	–	/	/	–	/	*
d. (ˌpsychoˈlogiˌcally)	/	W*	–	W*	/	–	/	*

Cranberry morph

11. [**grate-ful**]	Wrap	Ft]$_{PW}$	*SClash$_S$	Stress	$_{PW}$]Stem	Econ$_F$	$_{PW}$[Stem	Econ
a. ☞ (ˈgrateful)	/	/	–	/	/	–	/	*
b. ((ˈgrate)(ˌful))	/	W*	–	W*	/	–	/	W***
c. ((ˈgrate)ˌful)	/	/	–	/	/	–	/	W**
d. (ˈgrateˌful)	/	W*	–	W*	/	–	/	*

Pseudo-compound

12. [[**scholar**]-[**ship**]]	Wrap	Ft]$_{PW}$	*SClash$_S$	Stress	$_{PW}$]Stem	Econ$_F$	$_{PW}$[Stem	Econ
a. ☞ ((ˈscholar)ˌship)	/	/	–	/	/	–	/	**
b. (ˈscholarˌship)	/	/	–	/	W**	–	/	L*
c. ((ˈscholar)(ˌship))	/	/	–	/	/	–	/	W***
d. (ˈscholarˌship)	/	/	–	/	W**	–	/	*

COMPOUNDS

13. [L][M][N]	Wrap	Ft]$_{PW}$	*SClash$_S$	Stress	$_{PW}$]Stem	Econ$_F$	$_{PW}$[Stem	Econ
a. ☞ ((ˈL)(ˌM)(ˌN))	/	/	–	/	/	–	/	****
b. (ˈLˌMˌN)	/	/	–	/	W***	–	W***	L*
c. ((ˈL)ˌMˌN)	/	/	–	/	W**	–	W***	L**
d. (ˈL(ˌM(ˌN)))	/	/	–	/	W***	–	/	L***

14. [eye][sea]	Wrap	Ft]$_{PW}$	*SClash$_{S}$	Stress	$_{PW}$]Stem	Econ$_{F}$	$_{PW}$[Stem	Econ
a. ☞ ((ˈeye)(ˌsea))	/	/	–	/	/	–	/	***
b. ((ˈeye)ˌsea)	/	/	–	/	/	–	W*	L**
c. (ˈeyeˌsea)	/	/	–	/	W*	–	W*	L*
d. (ˈeye(ˌsea))	/	/	–	/	W*	–	/	L**

15. [[ice][cream]]$_{S1}$	Wrap	Ft]$_{PW}$	*SClash$_{S}$	Stress	$_{PW}$]Stem	Econ$_{F}$	$_{PW}$[Stem	Econ
a. ☞ (ˈice cream)	/	/	/	*	*	*	*	*
b. (ˈice ˌcream)	/	/	W*	L	*	*	*	*
c. ((ˈice) cream)	/	W*	/	*	L	W**	*	W**
d. ((ˈice) ˌcream)	/	/	W*	L	L	W**	*	W**
e. (ˈice) (ˌcream)	W*	/	W*	L	L	W**	L	W**
f. (ˈice (ˌcream))	/	/	W*	L	*	W**	L	W**

16. [[grand][father]]$_{S2}$	Wrap	Ft]$_{PW}$	*SClash$_{S}$	Stress	$_{PW}$]Stem	Econ$_{F}$	$_{PW}$[Stem	Econ
a. ☞ ((ˈgrand)ˌfather)	/	/	/	/	/	**	*	**
b. (ˈgrandˌfather)	/	/	/	/	W*	L*	*	L*
c. (ˈgrand)(ˈfather)	W*	/	/	/	/	**	L	**
d. (ˈgrand(ˌfather))	W*	/	/	/	W*	**	L	**

INITIALISMS

17. [[M][O][E]]$_{S2}$	Wrap	Ft]$_{PW}$	*SClash$_{S}$	Stress	$_{PW}$]Stem	Econ$_{F}$	$_{PW}$[Stem	Econ
a. ☞ ((ˈM)ˌOE)	/	/	/	*	*	**	***	**
b. ((ˈM)(ˌOE))	/	/	/	*	*	W***	L**	W***
c. (ˈM)(ˈOE)	W*	/	/	*	*	**	L**	**
d. ((ˈM)ˌOˌE)	/	/	W*	L	*	**	***	**
e. (ˈMˌOE)	/	/	/	*	W**	L*	***	L*
f. (ˈMˌOˌE)	/	/	W*	L	W**	L*	***	L*
g. (((ˈM)ˌO)E)	/	W*	/	*	L	W***	***	W***
h. (((ˈM)ˌO)ˌE)	/	/	W*	L	L	W***	***	W***
i. (ˈM)(ˈO)(ˈE)	W*	/	/	L	L	W***	L	W***
j. (ˈM(ˌO(ˌE)))	/	/	W*	L	W**	W***	L	W***
k. ((ˈM)(ˌO)(ˌE))	/	/	W*	L	L	W****	L	W****

18. [[N][R][I][C]]$_{S3}$	Wrap	Ft]$_{PW}$	*SClash$_{S}$	Stress	$_{PW}$]Stem	Econ$_{F}$	$_{PW}$[Stem	Econ$_{F}$
a. ☞ (((ˈN)ˌR)ˌIC)	/	/	/	*	*	***	******	***
b. (((ˈN)ˌR)ˌIˌC)	/	/	W*	L	*	***	******	***
c. (ˈN)(ˈR)(ˈI)(ˈC)	W*	/	/	L	L	W****	L	W****
d. (ˈN)(ˈR)(ˈIC)	W*	/	/	*	*	***	L***	***
e. (ˈN)(ˈR)(ˈIˌC)	W*	/	/	L	*	***	L***	***
f. ((ˈN)ˌRˌIˌC)	/	/	W*	*	W**	L**	******	L**

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