ENGLISH STRESS AND UNDERLYING REPRESENTATIONS

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Abstract

This paper addresses the issue of underlying representations (URs) from a Guierrian perspective and the necessity of taking into account certain orthographic elements which are associated with phonological behaviours related to English stress. We propose that underlying vowels should be represented as abstract phonological objects and that the inclusion of orthographic consonant geminates and final mute <e> into URs should be considered. Additionally, we argue that the phonology should have access to morphosyntactic information, which implies that the input to the phonology should be polystratal. Eventually, after arguing that vowel reduction should occur after stress assignment, we will report the results of studies on vowel reduction and "stress preservation" showing that reduction is not systematic in unstressed syllables and that non-reduction can, in some cases, be attributed to the existence of a full vowel in a morphologically-related word or to a high frequency of the latter.

1. Introduction

In most rule-based or constraint-based approaches in phonology, we are faced with the problem of URs and their content. In the approach introduced by Guierre, this problem has never been treated extensively even though the large corpus studies which have been conducted should allow us to address that problem within the approach itself, but also to bring elements of reflection with a more general reach. First, a presentation of the Guierrian School will be given along with an essential distinction to be made between studying individual speakers and studying a language. After giving the arguments in favour of the choice of the latter, a few problems in relation to the role of orthography in English phonology will be addressed along with two additional questions closely linked with English stress: the interface with morphology and vowel reduction.

2. The Guierrian School

The "Guierrian School" is an approach which was introduced in the seventies by the French researcher Lionel Guierre. During the sixties, Guierre computerised Daniel Jones's pronouncing dictionary and put together one of the largest corpora on English pronunciation at the time (35,000 words). He then studied it in its entirety. His PhD thesis (1979) was presented as an answer to Chomsky and Halle's *Sound Pattern of English* (1968, hereafter *SPE*), and his main critique regarding *SPE* was the absence of any empirical data backing up the rules formulated. Therefore, using this corpus, he tested the efficiency of the rules of stress placement and vowel pronunciation proposed in *SPE* and found that many rules were not very efficient when tested empirically.

However, Guierre never held that the rules he proposed were to be found in any given native speaker of English's phonology since his object of study was the English language.

Unlike *SPE*'s authors who quickly abandoned it, Guierre made an extensive use of the written form of words and included strictly orthographic elements such as consonant geminates, final mute <e> and vowel diagraphs in the parameters conditioning stress placement and vowel value. If Guierre had a few ideas on which of these elements were to be included in a lexical

(or underlying) representation, many of the researchers following his work (*e.g.* Deschamps, Fournier, Trevian) did not all agree on these. However, Deschamps (1983) argued that English orthography is phonological. However, all agree that English phonology is strongly influenced by morphology, and we should consider how to include morphological information in URs as well. To sum up, the Guierrian approach is mainly characterised by the study of pronouncing dictionaries' data and the use of orthography when necessary.

This paper is an attempt to present some of these elements and the arguments that may or may not lead to including them in URs. The notation used in this paper is the one used by all authors working within the approach introduced by Guierre, which is the following:

- Angle brackets are used for orthography (*e.g.* <original>)
- Square brackets are used for phonetics (*e.g.* [əˈrɪdʒɪnəl])
- Slashes are used for phonology (*e.g.* / ? /)

Before investigating the contents of URs, it is necessary to specify the object of study, and more precisely "whose" URs are treated here.

3. Speaker VS Language

When one studies a phenomenon like English stress, it seems appropriate to define what is being studied exactly and if the aim is to study the language or individual speakers, as the means of investigation will be defined accordingly. Both options present some problems, a few of which are laid down below:

Speaker:

- How can we pick an "ideal", "average" or "representative" speaker?
- What tests should be used in order to get quality data?
- How can we get enough data so that it can be considered representative of a given speaker's phonology?

Language:

- How can we define the English language and its boundaries?
- What data should be used?
- Should it take into account the relative stratification of the language (*e.g.* items' frequencies, specialised lexical fields, learned vocabulary)?

Although we can assume that some rules found in a given speaker's phonology may be found in the language, it may not necessarily be the case, so it does not seem reasonable to say that what we find to be true for a given speaker will hold for the language as well, and vice versa.

One of the main characteristics of the Guierrian School is, as mentioned above, to have chosen to study the language[1]. Even though defining the language might be difficult, we will follow Saussure's definition:

> "It is both a social product of the faculty of speech and a collection of necessary conventions that have been adopted by a social body to permit individuals to exercise that faculty." (1916: 25)

In order to try and study the language, the choice has been made to analyse pronouncing dictionaries like Jones's *Cambridge English Pronouncing Dictionary* (hereafter CEPD) or

[1] Even though the study of individual speakers is not excluded, it is just seen as distinct. Some Guierrian studies have already done tests on speakers (Martin, 2011) and more will most likely come.

Wells's *Longman Pronunciation Dictionary* (LPD). These dictionaries, even though not without some mistakes, allow us to access vast amounts of words that could be judged representative of the language[2]. The varieties described in these dictionaries are the standard ones (Received Pronunciation and General American), and the approach presented here does not claim that what is true for these varieties of English is true for all varieties. However, Martin (2011) conducted an intervarietal study of over 3,500 words known to be unstable in RP (*e.g.* with stress variants or belonging to classes which have numerous exceptions) and found that in over 90% of cases, the position of stress was the same in RP, GA and SAusE (Standard Australian English). Therefore, it seems that English, at least in Kachru's "Inner Circle" (1992), is very stable in its stress system.

Recent studies like Abasq et al. (2012) or Dabouis (2012) have also used frequency information from the *Corpus of Contemporary American English* to address the problem of rare or specialised vocabulary by excluding low-frequency items.

Thus, when one is using this methodology, it is possible to study a given class of words by analysing all the items of that class which can be found in the dictionaries. Then, it is possible to give the *productivity* of a class, the *efficiency* of the rule applying to it (if any) and the *list of exceptions* to the rule at stake. With such an inductive approach, formulating rules becomes a question of statistics as well as conventional analysis: a rule can only be called a rule if its efficiency is around 90%. If a phenomenon occurs in 70-90% of cases, we will be talking about a *tendency*, and under that figure we will be talking about chance. For example, Descloux et al (2010) looked at over 2,500 dissyllabic verbs and found the following stress patterns:

	Early Stress		**Late stress**		***Total***
	Nb	%	Nb	%	
Suffixed	177	74%	63	26%	*240*
Compounds	245	85%	44	15%	*289*
Prefixed	92	**7%**	1170	**93%**	*1262*
Bases	673	89%	85	11%	*758*
Total	*1187*	***47%***	*1362*	***53%***	*2549*

Table 1. Stress in dissyllabic verbs (from Descloux et al, 2010)

The figures in this table show that the usually assumed rule that dissyllabic verbs are stressed on their second syllable is not a rule at all as they are almost equally divided between early stress and late stress. However, the criterion which seems to be crucial here is prefixation, and we can formulate the rule "prefixed verbs are late-stressed" as it is the case in 93% of cases. Additionally, we could say there is a tendency for suffixed dissyllabic verbs to be early-stressed but, as English suffixes tend to have idiosyncratic properties, the latter should be studied individually and not only within this inventory.

When we choose to study the language, we have access to two forms: the phonetic and the orthographic forms. To determine the contents of URs, we can draw from both accessible forms and them only, as doing otherwise would imply including elements in the representation which cannot be justified but by the theory itself. This reproach was indeed often made to *SPE* in the case of words like *right* or *nightingale* which would present an

[2] Collie (2008) calls the language described in CEPD "an artificial idiolect of English".

underlying velar fricative /x/ never attested on the surface explaining the pronunciation of their stressed vowels.

Moreover, psycholinguistic concerns such as the balance between computation and lexical storage, sometimes called "the division of labour" (Bermúdez-Otero & McMahon, 2006), which are essential when one is trying to model individual speakers' phonologies, are irrelevant here. Obviously, the chosen form of representation is determined by the nature of the rules or constraints which will be applied in order to derive the surface representation. For that matter, the rules to keep in mind here are the ones described by Fournier (2007, 2010b), which could be adapted into rule-based or constraint-based models.

4. Sketching Empirically-Based Underlying Representations

In this section, we will start with a presentation of the proposed representation of vowels, with three main points:

- vowels can be grouped in series which relate to the same orthographic vowel;
- there can be more phonological vowels than there are phonetic vowels (in a word);
- we cannot ignore the behaviour of words with final mute <e>.

Then we will tackle the main problem between orthography, phonology and phonetics with regards to consonants: written consonant geminates (*e.g.* <bb>, <rr>, <mm>).

Eventually, we will deal with the question of the interface with morphosyntax, as several morphosyntactic elements are needed in the representation to derive stress.

One principle to keep in mind during the following paragraphs and that we will adopt here is what Guierre (1979: 33) called the "uniqueness of lexical forms" (in French: "unicité des formes lexicales"). According to that principle, having two possible pronunciations for a same lexical unit does not entail that we must have one lexical form for each of them. For Guierre, *controversy* ([ˈkɒntrəvɜːsi][3] ~ [kənˈtrɒvəsi]) or *albino* ([ælˈbiːnəʊ] (GB) ~ [ælˈbaɪnoʊ] (US)) have only a single lexical form, and the "least bad" known representation of that form is the orthography (*Ibid.*).

4.1. Vowels

4.1.1. Series and their Representation

If we have a look at the following table[4] taken from Fournier (2010b: 98), we can see that each written vowel can have:

- four[5] different *values* when it is a monograph (*e.g.* r-coloured, checked, free and r-coloured free);
- two different *values* when it is a diagraph (*e.g.* free and r-coloured free).

[3] All the phonemic transcriptions given in this paper are British pronunciations taken from LPD, unless indicated otherwise.
[4] This table concerns only stressed vowels, so it does not include reduced vowels.
[5] That does not include foreign vowels, see §4.1.2.

V^{r}	**V̌**	**Monographs**	**V̄**	**V̄^{r}**	**Diagraphs**
r-coloured vowel	checked vowel	**<V>**	free vowel	r-coloured free vowel	**<V̄V>**
[ɑː]	[æ]	<a>	[eɪ]	[eə]	<ai, ay / ei, ey>
[ɜː]	[e]	<e>	[iː]	[ɪə]	<ea, ee / ie**>
[ɜː]	[ɪ]	<i>	[aɪ]	[aɪə]	<ie*, ye>
[ɔː]	[ɒ]	<o>	[əʊ]	[ɔː]	<oa**, oe*>
[ɜː]	[ʌ (ʊ)]	<u>	[(j)uː]	[(j)ʊə]	<e(a)u, ew/ ue*>
			[ɔː]	[ɔː]	<au, aw>
			[uː]	[uː]	<oo>
			[ɔɪ]		<oi, oy>
			[aʊ]	[ɔː (aʊə)]	<ou, ow>

* : final ** : non-final

Table 2. Correspondences between orthography and phonetics for stressed vowels (after Fournier, 2010b: 98)

In Fournier's terminology, the vowels [ɑː], [æ], [eɪ], [eə] all have the same *quality*, *e.g.* they all derive from the same written vowel, they only differ in *value*. A set of very efficient rules[6] (summed up in Fournier 2010b: 141) determine which value a written vowel is going to have in a given context. If we take the orthography into account, it is easy to see that these vowels are related, but it does not mean that such a relationship has a phonological status[7].

However, morphologically-related pairs with vowel alternations seem to go in that direction:

(1)	V̄ ~ V̌	<divine> [dɪˈvaɪn]	~	<divinity> [dɪˈvɪnəti]
		<profane> [prəˈfeɪn]	~	<profanity> [prəˈfænəti]
		<serene> [səˈriːn]	~	<serenity> [səˈrenəti]
	V^{r} ~ V̌	<isobar> [ˈaɪsəʊbɑː]	~	<isobaric> [ˌaɪsəʊˈbærɪk]
		<fluor> [ˈfluːɔː]	~	<fluoric> [fluˈɒrɪk][8]
		<scar> [ˈskɑː]	~	<scarify> [ˈskærɪfaɪ]
	V̄^{r} ~ V̌	<barbarian> [bɑːˈbeəri‿ən]	~	<barbaric> [bɑːˈbærɪk]
		<empire> [ˈempaɪə]	~	<empiric> [ɪmˈpɪrɪk]
		<compare> [kəmˈpeə]	~	<comparative> [kəmˈpærətɪv]

It seems that these alternations have a status in the language independently of the orthography. Another type of alternation needs to be taken into account before we can formulate a proposition for the representation of vowels: the alternation between "foreign vowels" and "indigenous vowels".

[6] For example, the rule given in (10) or the rule associating words in *-ic* with a short vowel both have an efficiency of over 95%.

[7] As I am concerned here with the language, I will not argue for or against the reality of such vowels for English speakers. For a review on the study of vowel alternations, see Eddington (2001).

[8] This is the British pronunciation according to LPD. According to that same dictionary, American English has two possible pronunciations: [fluˈɔːrɪk] ~ [fluˈɑːrɪk], the first one respecting isomorphism with the base.

4.1.2. Foreign Vowels

Another of Guierre's arguments to postulate underlying vowels equivalent to orthographic vowels is the alternation between foreign[9] free vowels ($\bar{V}^e$) and indigenous[10] free vowels ($\bar{V}$). We can find three main foreign vowels:

	$\bar{V}$	$\bar{V}^e$
<a>	[eɪ]	[ɑː]
<e>	[iː]	[eɪ]
<i>	[aɪ]	[iː]

Table 3. Indigenous and foreign free vowels

Approaches which do not take into account the orthography usually do not have a concept of "foreign vowels", for phonetically the latter belong to the set of English vowels. What actually makes them "foreign" is precisely their relationship with the orthography, and following our proposition here, with their UR. When words containing these vowels get "naturalised" (*i.e.* adapted to the indigenous phonological system), the changes in pronunciation are highly predictable, especially the indigenous vowel which is going to be chosen, as in:

(2) <albino> [ælˈbiːn əʊ] (GB) ~ [ælˈbaɪnoʊ] (US)
<tomato> [təˈmɑːtəʊ] (GB) ~ [təˈmeɪţoʊ] (US)

In these examples, we can see that British English has preserved a "foreign" pronunciation whereas American English has adapted these words to its phonological system by adapting the vowels: [iː] → [aɪ] ; [ɑː] → [eɪ]. Of all the values they could take, the vowels change to the indigenous vowel corresponding to the same orthographic vowel. This could be seen as a simple influence of orthography, but Guierre argued that it was because the two values found in these words (foreign and indigenous) relate to the same underlying vowels, in the case of the words in (2), /i/ and /a/.

We will not go as far as claiming that it is so, for it would imply to attribute features to these vowels, and we would require synchronic rules for the Great Vowel Shift, such as the Vowel Shift Rule (discussed in McMahon, 2007). The idea is not to say that all values derive from the same underlying vowel through various alterations, but only to say that they are related, and that they share a common *quality*. Therefore, the representation for vowels proposed here is one that refers to abstract objects representing a series of surface vowels, and these abstract objects do not have any phonological content. It is only the context in which these objects occur which is going to determine which *value* is going to surface. We can find series of minimal pairs with vowels having the same value but only differing by their quality (*e.g. pat, pet, pit, pot, put* for checked vowels; *mate, mete, mite, mote, mute* for free vowels). As far as notation is concerned, the option favoured here is that of using the orthographic symbols for these abstract objects (*e.g.* /e/ would represent the series [ɜː], [e], [iː], [ɪə] (+ foreign [eɪ])) but we could very well adopt other notations (*e.g.* V_e). The choice of the representation is potentially debatable, but is of secondary importance here.

[9] "Foreign vowels" are the ones which imitate the pronunciation of these vowels in the language from which the words usually containing these vowels are borrowed.
[10] "Indigenous vowels" are regular English vowels as shown in Table 2.

4.1.3. Diagraphs

There are two environments in which vowels are usually short, unless they are represented by a diagraph:

- Before a consonant cluster or before the final consonant of a word:

(3) <auction> [ˈɔːkʃən] ~ <action> [ˈækʃən]
<seat> [ˈsiːt] ~ <sit> [ˈsɪt]

- When they are found in the antepenultimate syllable[11]:

(4) <speechify> [ˈspiːtʃɪfaɪ] ~ <specify> [ˈspesəfaɪ]

Diagraphs could be represented by their orthographic form as well to refer to the reduced series that they represent (free vowels and r-coloured free vowels; *e.g.* /ee/ would represent the series [iː], [ɪə]). Another to formalise their behaviour could be to say that they function as diacritics of length, as the vowels they represent are usually long.

4.1.4. Synaeresis

There are words for which the count of vowels (and thus syllables) is different between the orthographic and phonetic forms, as in *ocean* and *partial*, which both have three orthographic vowels but only two phonetic vowels, as two vowels got historically compressed and reduced into one under synaeresis. However, these words exhibit an interesting behaviour when derived:

(5) <ocean> [ˈəʊʃən] → <oceanic> [ˌəʊʃiˈænɪk]
<partial> [ˈpɑːʃəl] → <partiality> [ˌpɑːʃiˈæləti]

In their derivatives, *oceanic* and *partiality*, the two vowels that were compressed into one are distinct as the strong suffixes *-ic* and *-ity* entail the placement of primary stress on the second syllable of the two. This leads us to think that there are not two but in fact three phonological vowels in *ocean* and *partial*, and that it is a reduction phenomenon which causes the last two to be compressed into one. In general, we consider that there are as many syllables as there are orthographic vowels[12] except in two cases:

- Vowel diagraphs, as they represent only a single vowel (*e.g.* <ea>: *sea* ≠ *react*);
- Final mute <e>, which will be examined below.

4.1.5. Final Mute <e>

Final mute <e> is well-known by English native speakers, for they learn about its special behaviour with regards to the vowel preceding it, so that it is sometimes called “magic e” by teachers who teach reading and writing. It constitutes what Guierre called a “tensing context”,

[11] This phenomenon is usually known as Trisyllabic Shortening/Laxing, but Guierrian authors usually talk about “Luick’s rule” Luick (1898), who first described the phenomenon.
[12] However, syllabic consonants (as in words in <Cm#>, <Cle#>, <Cre#>) are never counted as a phonological syllable, even though they can constitute a phonetic syllable.

i.e. a context in which vowels are "tense"[13] when they are stressed or unreduced[14]. We could write down the rule for final mute <e> as follows.

(6) $V \rightarrow \bar{V} / \_\_C^1e$

Examples in (7) illustrate this behaviour under stress, those in (8) when the vowel is unstressed and unreduced, and those in (9) when reduction is optional.

(7) *fate* (≠ *fat*) ; *bite* (≠ *bit*) ; *cote* (≠ *cot*) ;

(8) ˈ*demonstrate ;* ˈ*anecdote ;* ˈ*dynamite ;*

(9) ˈ*composite* [aɪ ~ ɪ] *;* ˈ*advocate* [eɪ ~ ə]

Orthographically, this rule can be extended to all vowels in this context, and can be formulated as in (10). Examples illustrating that rule are listed in (11).

(10) $V \rightarrow \bar{V} / \_\_C^1V\#$

(11) *a* ˈ*roma,* ˈ*baby, bi* ˈ*kini,* ˈ*coma, ko* ˈ*ala,* ˈ*photo, tor* ˈ*pedo, vol* ˈ*cano, …*

In this context, final mute <e> functions as a vowel, which is not very surprising for it was once pronounced (Bermúdez-Otero, 1998, Duffell, 2008, Minkova, 1982, 1991) and the rule in (10) was not an orthographic rule at the time. However, it functions mostly as a diacritic.

It should be noted that it never counts as a syllable when it comes to stress assignment. This is shown by the stress patterns in non-derived words of three syllables or more[15], which are subject to the Normal Stress Rule (NSR), when they are not prefixed non-substantives[16].

(12) **Normal Stress Rule**[17]

Words of three syllables or more are stressed on their penultimate syllable.

As illustrated by the following examples, final mute <e> never counts as a syllable:

(13) ˈ*envelope ;* ˈ*paradise ;* (and not **en* ˈ*velope ;* **pa* ˈ*radise*)

Thus, final mute <e> seems to have a status in the language both through the phonological behaviours associated with its presence and simply through its existence in one of the two forms we have access to (in this case, the orthography). The question of its representation at the underlying level leaves two possible options. Either we can represent it:

- As the vowel /e/, which would have the same properties than other vowels overall but would have the specificity of being erased before stress assignment when found in final position. This could either be done by a deletion rule in a rule-based model or by a constraint forbidding its presence on the surface in a constraint-based model;

[13] Guierre considered all the values given in Table 2 except $\breve{V}$ to be "tense". However, in the case of final mute <e>, it concerns only $\bar{V}$, $\bar{V}^e$ and $\bar{V}^r$.

[14] Not all authors agree on the possibility for vowels to be unstressed and unreduced as they consider that vowel length is always associated to some level of stress (secondary or tertiary). For Guierre, this need not be the case, and he refuted the existence of stresses after primary stress (this view could be supported by the phonetic study by Plag & Kunter, 2011, who found that pre-tonic secondary stress was phonetically indistinguishable from primary stress, whereas it is not the case for post-tonic secondary stress).

[15] Here the syllable count does not include <e>.

[16] Indeed, prefixed non-substantives have a different behaviour: their prefixes are ignored when it comes to stress assignment (Fournier, 2007). An example of the behaviour can be seen in the study on verbs reported in Table 1.

[17] For the exact context of application of the NSR, see Fournier (2007, 2010a).

- As a diacritic, which has the advantage of not including an element in the representation that will need to be erased later in the derivation. However, in doing this we lose the parallelism between the behaviour of final mute <e> and that of other vowels.

As we leave this question open for now, let us turn to another element which presents similar problems: consonant geminates.

4.2. Consonant Geminantes

Consonant geminates are the main point of divergence between orthography, phonetics and phonology: they are represented orthographically by a consonant cluster; they behave like one phonologically but always surface as a single phonetic consonant. They are very efficient for the prediction of stress placement and vowel pronunciation:

(14) *Coˈlŏssus, vaˈnĭlla, ˌcigaˈrĕtte, ˈnŏbble* (≠ *ˈnōble*), *ˈtĭttle* (≠ *ˈtīt̄le*), *ˈmĭrror*

As pointed out by Deschamps (1982), they also explain the behaviour of <u>, usually long when stressed unless it is before a consonant cluster or in a final closed syllable, in words like those in (15) which parallel the behaviour before a consonant cluster, as in (16).

(15) *butter, mutter, rubber*

(16) *function, pustule, vulture*

However, like final mute <e#>, all we can observe is a phonological behaviour, not its cause, as they are never pronounced as geminates. Once again, we have two options:

- Represent them as underlying geminates and simplify them later in the derivation;
- Represent them with a diacritic indicating their specific behaviour.

4.3. Interface with Morphosyntax

In his thesis (1979), Guierre argued against the idea that syllable weight was central in the phonological system of English[18], especially with regards to vowel quality. Vowels are extremely variable according to the context in which they appear, and it seems unreasonable to attribute an underlying value to them[19]. He also warned against potential circular logic which could be derived from that concept, such as *SPE*'s argument that vowels are long because they are stressed and that they are stressed because they are long[20].

Guierre argued that if the relationship between vowel length and stress is to be oriented, stress should come first. In fact, he argued that vowel values are determined mostly by the context in which they appear, and that stress allows for the expression of these values whereas reduction – when it occurs – obscures them. Thus, for him vowel value and stress assignment could be processed in parallel, and independently[21]. Only reduction needs to occur afterwards.

However, stress has been shown to be morphologically-influenced, and according to Fournier (1998), more than what is usually assumed. A very well known phenomenon is that of "strong

[18] So did Fournier, 2010b.

[19] Except maybe in the case of vowels which are represented by diagraphs, which are almost always long.

[20] This logic is still found in more recent articles, as in Duanmu (2010), where we can read: "Stressed syllables are heavy/Heavy syllables are stressed".

[21] However, this view is not shared by all authors who worked after him. For Fournier, one can predict the value of a vowel efficiently only when that vowel is bearing stress. In other terms, vowel value comes only once stress assignment has taken place.

suffixes", more often called "Class I suffixes" (Spencer, 1991), as opposed to stress-neutral suffixes, "Class II suffixes"[22]. Here are a few examples:

(17) Class I: *-ion, -ity, -ic, -ate,…*
Class II: *-ness, -less, -hood, -ful, -ly,…*

This difference could be formally represented the way it is represented in Lexical Phonology (Kaisse & Shaw, 1985, Kiparsky, 1982) or, more recently, in Bermúdez-Otero's version of Stratal OT (2012), with Class I rules applying at the "stem-level" and Class II rules applying at the "word-level"[23], even though it would require some adaptations[24].

In the Guierrian approach, the main parameter conditioning English phonology is thought to be morphology, and semantically-defined morphological domains. Different morphological units behave differently phonologically, thus the notion of morphologically-defined phonological domain is definitely relevant.

URs should then include information relative to these morphologically-defined phonological domains, which we could represent with labelled brackets corresponding to the different strata, such as that which can be found in many generative works, like the following examples for *regarding* and *classifiable*:

(18)

$$[_{w}\,[_{s}\,\text{re+gard}]_{s}\,\text{iŋ}]_{w}$$
$$[_{w}\,[_{s}\,[_{s}\,\text{class}]_{s}\,\text{ifi}]_{s}\,\text{able}]_{w}$$

(W: word level; S: stem level)

Additionally, as illustrated by the rule concerning prefixed non-substantives, information about syntactical categories is necessary for stress assignment. Thus, we could use another labelled bracketing in order to display that information:

(19)

$$[_{V}\,[_{V}\,[_{P}\,\text{re}]_{P}\,[_{R}\,\text{gard}]_{R}\,]_{V}\,\text{iŋ}]_{V}$$
$$[_{A}\,[_{V}\,[_{N}\,\text{class}]_{N}\,\text{ifi}]_{V}\,\text{able}]_{A}$$

(P: prefix; V: verb; A: adjective; N: noun; R: root)

To sum up, when it comes to English phonology, we need information from other linguistic levels (or modules)[25], and that requires that the input to the phonology should contain all that information. Therefore, the input would have to be polystratal. The details concerning the contents or the number of these strata are, however, well beyond the scope of this paper.

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[22] Even though the definition Fournier gives of strong suffixes is not exactly equivalent to the common assumptions about Class I suffixes, for more details, see Fournier (1998).

[23] The assignment of a given suffix to a given level is seen as an idiosyncratic property of that suffix.

[24] For example, it seems problematic to include both non-derived words and words containing Class I suffixes in the stem-level when only the former are subject to the rule described in note 16. Additionally, the concept of "fake cyclicity" proposed by Collie (2008) after Bermúdez-Otero & McMahon (2006) and Bermúdez-Otero (in preparation) seems adapted to capture the relationships of isomorphism between morphologically-related words, especially the idea that the whole form of an embedded word is accessible to the phonology to derive the surface form of a related embedding word, which is an idea that is usually assumed by Guierrian authors.

[25] Which can itself be conditioned by yet other linguistic levels, as when semantics condition morphological boundaries (*e.g. reform ~ re-form* → one unit versus two units, semantic and morphological).

5. Vowel Reduction

If we consider vowel values to be predictable by the context in which vowels appear, we need to mention cases in which that value is not expressed, *e.g.* when reduction occurs[26]. Reduction is usually seen as the "norm" in unstressed syllables, especially those adjacent to primary stress. A recent PhD dissertation by Dahak (2011) showed that this was not the case, as the percentage of unreduced vowels varied considerably according to the syllabic position under scrutiny.

Syllabic rank	% of non-reduced vowels
1**0**0	3.4%
1**0**00	5.1%
-2**0**1-	22.2%
-1**0**	26.6%
1**0**	33.9%
-10**0**0	53.6%

Table 4. Percentage of non-reduction in unstressed syllables according to the syllabic rank[27]

As we can see in this table, the highest proportion of reduced vowels is found in post-tonic syllables which are adjacent to the primary-stressed syllable in three or four syllable words. However, the lowest proportion of reduction is found in the middle syllable of a final string of three unstressed syllables.

Some other recent studies (Collie 2007, Kraska-Szlenk, 2007) have shown what are often called "stress preservation"[28] effects. Indeed, they have showed that the relative frequency of a base and its derivative had an influence on stress preservation. Indeed, if the derivative is more frequent than the base, then reduction is more likely to occur, and vice versa, as evidenced in Table 5 below.

[26] Reduction is seen here as resulting from stress.

[27] The figures 1, 2 and 0 between slashes are commonly used by Guierrian authors to represent stress patterns: /1/ stands for primary stress, /2/ for secondary stress and /0/ for unstressed syllables. Therefore, the stress pattern of *ˌciga ˈrette* can be represented as /201/.

[28] However, within the framework presented here this phenomenon would be described in terms of non-reduction of unstressed vowels in related derivatives.

			(x per 10^6 words in spoken section of COCA)		
			base		derivative
a.	*cyclic stress*				
	cond[ɛ́] mn	còn**d**[ɛ̀] mn-ation	7.09	>	2.57
	imp[ɔ́]rt	ìmp[ɔ̀]rt-ation	5.15	>	0.62
b.	*variable stress*				
	cond[ɛ̀] nse	còn**d**[ɛ̀ ~ ə]ns-ation	0.28	≈	0.22
c.	*noncyclic stress*				
	cons[ɜ́]rve	còns[ə]rv-ation	1.65	<	9.11
	tràns**p**[ɔ́]rt	tràns**p**[ə]rt-ation	7.23	<	23.54

Table 5. Stress preservation and frequency (from Bermúdez-Otero, 2012: 32, after Kraska-Szlenk 2007: §8.1.2)

We found a similar effect in Abasq et al (2012) and showed that, in dissyllabic prefixed noun/verb pairs (*e.g. record, concern, process*), vowel reduction is less likely to occur if there exists a stress variant in which that vowel bears stress, *i.e.* there are more chances of having the noun *record* pronounced [ˈrekɔːd] than [ˈrekəd] because of the existence of the verb pronounced [riˈkɔːd]. Additionally, it was found that, for these words, reduction was more widespread in prefixes than in roots, hinting that different morphological units may have a different "resistance" to reduction, for instance that prefixes tend to reduce more than roots. This second finding is in line with a phenomenon Guierre described in his thesis (1979: 253): initial pretonic vowels followed by a consonant cluster tend to remain unreduced, except when they are monosyllabic prefixes, in which case they massively undergo reduction.

Eventually, one could ask what should be done about the representation of vowels which are always reduced. Precisely because they are always reduced, their quality can never be accessed phonetically. Guierre argued that if one should form a new word like **cymbalic*, it would most likely be pronounced [sɪmˈbælɪk], even though in *cymbal*, the second vowel is completely reduced. In that case, *-ic* predicts the position of stress and the value of the stressed vowel (checked), but it is the orthography which provides the vowel quality (<a>). Without the orthography, any checked vowel could be used, but the orthography determines which one is to be chosen[29].

6. Conclusion

We have argued in favour of an abstract UR of English vowels to account for a variety of surface alternations. The choice of such a representation raises the question of the abstractedness of URs. We believe that abstract forms can be justified if they can be supported by phonological or orthographic evidence and that they need not have any phonological content as long as they are distinctive.

Vowel diagraphs, consonant geminates and final mute <e> could all be formalised as diacritics or in a form close to orthography. However, the choice between these two options

[29] For this example, phonological priming would of course exclude [sɪmˈbɒlɪk] (i.e. *symbolic*), but not [sɪmˈbelɪk] nor even [sɪmˈbʌlɪk].

seems futile as both imply added lexical information. We would personally favour the second option, as it would be closer to one of the two accessible forms.

Furthermore, we have proposed that the input to the phonology should contain information from other linguistic levels and should therefore be polystratal.

Eventually, we discussed the issue of vowel reduction, the view that the latter obscures the quality of vowels and the idea that this quality could potentially be maintained by the existence of morphologically-related word in which it is not obscured.

To conclude, it seems difficult to study English phonology with no reference to orthography and the latter should probably be taken into account more often. Some arguments were presented to demonstrate an influence of orthography in the language, such an influence can also be found when studying individual speakers, as in Taft's psycholinguistic experiments (2006) seem to show.

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