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## English Phonology and the Literate Speaker Some Implications for Lexical Stress\*

Quentin Dabouis

### 0 Introduction

Reference to orthographic information is almost absent from phonological research, and one might ask why this should be. Is the question of the relationship between orthography and phonology considered as being 'solved' or is it simply ignored? Can phonology completely do away with orthographic information? This chapter argues that it should not and brings forward arguments which I hope will arouse interest for the links between these two representations of the 'signifiant'.

Interest in the relationship between orthography and phonology has come mainly from psycholinguistics and reading acquisition. Several experiments have shown that orthographic information can influence tasks which do not involve any visual stimuli, such as rhyme judgment, lexical decision or auditory word recognition (Chéreau et al. 2007; Peereman et al. 2009; Perre and Ziegler 2008; Perre et al. 2009; Seidenberg and Tanenhaus 1979; Taft and Hambly 1985; Taft 2006). Brewer (2008) also found that the number of letters representing word-final voiceless obstruents had a positive influence on the phonetic duration of these segments in both experimental conditions and in spontaneous speech.<sup>1</sup> Zamuner and Ohala (1999) who found orthographic effects on syllable segmentation in preliterate children, for example *cabin* [kæ] - [bɪn] vs. *cabbage* [kæb] - [bɪdʒ], although their experiment was replicated by Treiman et al. (2002), who did not confirm the results and only found orthographic effects in literate speakers. Significantly, an experiment on French speakers (Bürki et al. 2012) showed that a single orthographic presentation of a nonce-word is sufficient to induce a significant change in the phonological representation of that same nonce-word, which was constructed through 25 oral presentations of that word over several days. These results have been interpreted as signs that phonological knowledge is restructured when orthography is learned (Bürki et al. 2012; Ehri and Wilce 1980; Jaeger 1986; Perre and Ziegler 2008; Taft and Hambly 1985; Wang and Derwing 1986) and that this modification of the cognitive system is permanent. It might seem trivial to mention it but, as underlined by Jaeger (1986) and Laks (2005), learning how to read and how to write is a very long and tedious process and constitutes a powerful force to restructure phonological knowledge.

Recently, a number of studies in second language acquisition have looked at the relationship between orthography and phonology (see Bassetti et al. (2015) for an overview). Let us focus on a recent study to illustrate the sort of evidence that has been put forward. Mairano et al. (2018) study a group of Italian learners of English, who have to learn not to geminate consonants spelled with orthographic geminates (which I will represent as <C'C'>; for example *oppose*, *attacking*, *accuse*) and to increase their VOT for voiceless plosives. They report that the participants had a harder time avoiding gemination than adjusting their VOT. They see this difference as determined by orthography: gemination is represented in the spelling but not VOT. This shows that orthography can be a determining factor in the acquisition of the phonological properties of the target language. In a related field, a number of recent studies on

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1 Interestingly, she found that this effect did not extend to non-words, which suggests that the duration effect is linked to the lexical representation of words.

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loanword adaptation have shown how spelling can determine the pronunciation of borrowings (see Hamann and Colombo 2017, Neuman 2009: §5 and references therein).

Although there has been accumulating evidence that orthography can strongly influence the phonology, the relationship between the two has been largely ignored in phonological research on English<sup>2</sup> (and in phonological research in general), maybe except in the case of orthographic consonant geminates – which are discussed in various works and to which I will come back in section 4.3 – and the tentative proposal by Chomsky and Halle (1968: 49; thereafter *SPE*) that ‘English orthography, despite its often cited inconsistencies, comes remarkably close to being an optimal orthographic system for English’ when they note that the underlying representations which they propose often come to be very close to spelling. A few works in the generative literature have also dealt with this issue but it clearly remains marginal (Giegerich 1992, 1999; Hamann and Colombo 2017; Montgomery 2001, 2005).

According to Derwing (1992) and Giegerich (1992, 1999: 155), the reason for this scarcity of research integrating orthography is that early linguists such as Saussure and Bloomfield considered that ‘spoken forms alone constitute the object [of linguistic study]’ and that subsequent theorists have argued that all languages have a spoken form but not all have a written form.<sup>3</sup> However, as Giegerich points out, this ‘tells us nothing about the relationship between spoken and written form in languages that have both’ (ibid.). Guierre (2000) also suggested that this disinterest for orthography is due to the ‘trend’ of the quest of linguistic universals. He suggested that, as orthography is not a universal feature of natural languages, some may have deduced that it should not have any influence on phonology.

To my knowledge, the only strand of the literature in phonology which has always explicitly<sup>4</sup> taken orthography into consideration is the framework developed by the French linguist Lionel Guierre (1975, 1979), which can be described as a corpus-driven approach to English accentual and graphophonological patterns (see Chapter 2, this volume). In his thesis (1979), Guierre argued that out of four possible grammars (reader, writer, listener, speaker), the grammar of the reader is the most efficient to formulate generalisations on stress placement and on the realisation of vowels. Additionally, he argued that there are few orthographic differences which are not exploited or exploitable for distinctive purposes in the domain of derivation (ibid.: 179). This view has been pursued in subsequent works such as Deschamps (1994), Deschamps et al. (2004) and J.-M. Fournier (2007, 2010b). Large data-driven studies based on pronunciation dictionary data have led to the establishment of very efficient generalisations to derive the pronunciation of words from their spelling, against the assumption shared by many according to which ‘given that English orthography is opaque and allows for certain pronunciation variants, it is almost impossible to predict the actual pronunciation’ (Domahs et al. 2014: 68).<sup>5</sup> Although the different topics reviewed in the rest of this chapter are mostly based on research conducted within the Guierrian approach, several arguments will be taken from the generative literature.

In sum, there is accumulating evidence from a variety of strands of the literature that the relationship between orthography and phonology should be studied more closely than it has been so far. In the next section, I will lay out the research questions which I will seek to answer.

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2 It is probably mentioned more often for research on French, especially on *liaison* or word segmentation, even though these phenomena cannot be reduced to orthography (see Durand and Eychenne (2014) for discussion).

3 See also Neuman (2009: §0.8, §1.9) for a historical review of linguists’ views on orthography.

4 Carr (2000) opposes this approach to that of Chomsky and Halle (1968) which, arguably, makes implicit use of spelling.

5 See also Deschamps (1994) for a review of the « classical » arguments used to demonstrate that English spelling is highly irregular and cannot be used to predict the pronunciation of words (for example Shaw’s re-writing of *fish* into *ghoti*, Trenité’s poem *Chaos* or the words in *-ough*). As the author points out, none of these arguments is actually based on any sort of statistical approach.

I will then discuss aspects of the relationship between orthography and phonology, namely vowels (section 2), consonants (section 3) and orthographic diacritics (section 4). Then, I will discuss some of the consequences that the view developed in this chapter have on the analysis of English stress (section 5) before concluding on the place of orthography in a theory of grammar (section 6).

## 1 Aims of the Chapter

Generative linguistics postulates the abstract concept of an 'ideal speaker-hearer' (Chomsky 1986: 20). In the generative phonological literature, a great deal of attention has been paid to phenomena such as vowel alternations or stress shifts, which mostly occur in parts of the vocabulary which are probably known almost exclusively by literate speakers. Let us consider one such phenomenon, the 'Vowel Shift Rule', which accounts for the vowel alternations in (1).

(1)

*div*[aɪ]ne ~ *div*[ɪ]nity  
*m*[əʊ]de ~ *m*[ɒ]dify  
*prof*[eɪ]ne ~ *prof*[æ]nity  
*ser*[i:]ne ~ *ser*[e]nity<sup>6</sup>

*SPE* (1968: 187) argued that this rule, which has been widely discussed in the literature (for example Bermúdez-Otero and McMahon 2006; McMahon 2007; J. Myers 1999; S. Myers 1987), is 'without doubt the pivotal process of Modern English phonology'. However, it has been shown to be only marginally productive and to be the most productive for literate speakers, and only for alternations which are encoded in spelling with the same grapheme (Jaeger 1986; Wang and Derwing 1986).<sup>7</sup> In recent stratal models of phonology, this rule is usually placed on the first stratum, also called the 'stem-level' in Stratal Phonology (Bermúdez-Otero and McMahon 2006), even though classical Lexical Phonology placed it on the second stratum (see Halle and Mohanan 1985). Bermúdez-Otero (2012) claims that some aspects of the stem-level phonology may be acquired by some speakers, 'late, or not at all'. We could add that rules like the Vowel Shift Rule are even less likely to be ever acquired by illiterate speakers. Therefore, it seems necessary to define which phenomena can be accounted for (partially or completely) by orthography. Some phonologists may want to disregard such an enterprise because it does not have to do with 'pure' or 'real' phonology. A rather obvious answer to such an objection is precisely that the phenomena which I am going to discuss most likely have little to do with 'pure' or 'real' phonology.

Therefore, the main aim of this chapter is to provide a survey of those phenomena in English which require a reference to orthography to be accounted for. I will not seek to propose a formal model of phonology which integrates orthography, but I will seek to lay down the different empirical facts that such a theory would have to account for. I will then evaluate how integrating orthography might affect the analysis of stress placement in English. Finally, I will suggest some of the theoretical options which could be adopted in such a model in order to account for these phenomena.

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6 All phonemic transcriptions in this paper are British pronunciations taken from Wells (2008).

7 Interestingly, historical Great Vowel Shift alternations may not be productive (for example [ʌ] ~ [aʊ]), and alternations which did not come from the historical Vowel Shift can be productive (for example [ʌ] ~ [(j)u:]; McMahon 2007). This seriously weakens the view that the synchronic Vowel Shift Rule directly comes from the historical Vowel Shift. Clearly, there is something else involved, and that something else may very well be orthography.

## 2 Vowels: Series and Alternations

In this section, I discuss how orthography may be relevant in the analysis of the distribution of English vowels and the generalisations that govern this distribution. As will be discussed in section 5, this will be particularly relevant for the analysis of the stress system.

### 2.1 *The Limits of Phonology: Reduced – Full Alternations*

Certain alternations ‘breach the limits of what can be predicted on phonological grounds alone’ (Giegerich 1999: 5), especially those between reduced vowels and full vowels, as in (2).

(2) <atom> → <atomic> ; <symbol> → <symbolic>  
 [ˈætəm] [əˈtɒmɪk] [ˈsɪmbəl] [sɪmˈbɒlɪk]

Such alternations were not problematic for *SPE*, as surface schwas could be derived from underlying vowels, which means that surface full vowels could too. However, if we are to avoid free rides and avoid useless reduction rules, we have to posit that *atom* only has schwa in its second syllable. Therefore, if the alternation is to be predicted at all, the [ɒ] in these words has to come from somewhere. Giegerich (1992, 1999), Guierre (1979) and Montgomery (2001, 2005) argue that these alternations can only be driven by orthographic information. Indeed, in both these examples, the second vowel is reduced in the base and cannot provide any information as to what full vowel should appear in the corresponding derivative, in which that vowel is stressed. The vowel quality has to be retrieved from somewhere else than the (phonological) base and the most likely source of this information is orthography.

Giegerich (1992) notes that the link between [ə] and [ɒ] is completely arbitrary for an illiterate speaker but not for a literate speaker, who will establish a link between the base and the derivative through <o>, which is shared by both. Giegerich also rejects the alternative hypothesis of ‘re-structuring’ proposed by Anderson (1981), which consists in saying that *atom* has a melodically blank second vowel which is restructured at the underlying level when *atomic* is learned. The reason for rejecting this hypothesis, Giegerich argues, is that it cannot predict the generation of novel forms. A similar argument can be found in Guierre (1979), who proposes that spelling can restrict what full vowel is to be chosen in this type of derivation. For example, if a speaker wanted to form the *-ic* adjective of *cymbal* and has only access to phonological information, then they could derive [sɪmˈbu:lɪk], [sɪmˈbelɪk] or [sɪmˈbælɪk], because the schwa in the second syllable of *cymbal* can alternate with almost any vowel (for example *brutal* [ˈbru:təl] → *brutality* [bruˈtæləti], *totem* [ˈtəʊtəm] → *totemic* [təʊˈtemɪk], *autumn* [ˈɔ:təm] → *autumnal* [ɔːˈtʌmnəl], *atom* [ˈætəm] → *atomic* [əˈtɒmɪk] and, in American English, *hostile* [ˈhɑːstəl] → *hostility* [hɑːsˈtɪləti]; see Giegerich (1999: §5.1).<sup>8</sup> However, the knowledge of spelling would only predict [sɪmˈbælɪk].

Therefore, derivations such as these breach the limits of what can be achieved on phonological grounds alone and spelling simply cannot be ignored.<sup>9</sup> I believe, along with Bauer et al. (2013: 170) that an account that ‘makes crucial reference to the orthographic form’ seems to be ‘the most adequate’. However, there is one problem which I have not yet addressed with regards to these derivations. Following some of the authors which I have cited, I presented these cases as if the full vowel to be chosen was necessarily [ɒ]. However, this is only one of the

8 The specific vowels given here reflect what we would expect from the rules detailed in section 2.3, here short vowels, as is usual before *-ic* (unless the vowel is <u>). [sɪmˈbɒlɪk] would most likely not be a possibility, as it would be blocked by the existing *symbolic*.

9 This could predict that languages which do not have an orthographic system should not have such alternations, or that these alternations should be less stable in such languages than they are in languages which do have an orthographic system. This prediction remains to be explored.

possible realisations of <o>. What parameters determine which realisation of a given orthographic vowel is to be chosen? Why can *atomic* not be [ə'təʊmɪk]?

## 2.2 Vowel Series

As shown by the ‘Vowel Shift’ alternations presented in (1), or the additional examples in (3), a given orthographic vowel can have several realisations, which can occur in pairs of cognate words. Thereafter, we will call these different realisations ‘values’, following J.-M. (Fournier 2010b).

- |        |                           |   |                             |
|--------|---------------------------|---|-----------------------------|
| (3) a. | <divine> [dɪ'vɪn]         | ~ | <divinity> [dɪ'vɪnəti]      |
|        | <profane> [prə'feɪn]      | ~ | <profanity> [prə'fænəti]    |
|        | <serene> [sə'reɪn]        | ~ | <serenity> [sə'renəti]      |
| b.     | <isobar> [ˈaɪsəʊbɑ:]      | ~ | <isobaric> [ˈaɪsəʊ'bærɪk]   |
|        | <fluor> [ˈfluːɔ:]         | ~ | <fluoric> [flu'ɔrɪk]        |
|        | <scar> [ˈskɑ:]            | ~ | <scarify> [ˈskærɪfaɪ]       |
| c.     | <barbarian> [bɑ:'beəriən] | ~ | <barbaric> [bɑ:'bærɪk]      |
|        | <satire> [ˈsætəɪə]        | ~ | <satiric> [sə'tɪrɪk]        |
|        | <compare> [kəm'peə]       | ~ | <comparative> [kəm'pærətɪv] |

Alternations between different values have been the source of much debate on questions such as abstraction, learnability or free rides. Various formalisations of such alternations have been proposed. The three main ones are:

- Both vowels in a morphophonologically related pair are related to an abstract underlying vowel, and the context determines which surface vowel should appear (for example /I/ → [ɪ] or [aɪ]).<sup>10</sup>
- One vowel is derived from the other in a given context (for example [aɪ] → [ɪ] / X\_\_Y).
- No derivation occurs, they are simply related on the surface (for example ‘[aɪ] alternates with [ɪ]’).

However, with orthography, a fourth option (which could be related to the third option above) may be proposed. Indeed, if we follow Deschamps (1994), Deschamps et al. (2004), and J.-M. Fournier (2010b), vowels can be described as having a ‘quality’ and a ‘value’. The ‘quality’ represents a series of surface vowels (for example {[æ], [eɪ], [ɑ:], [eə]} or {[e], [i:], [ɜ:], [aɪə]}<sup>11</sup> which may alternate with each other in given contexts, taking different ‘values’ in different contexts.<sup>12</sup> Values represent series of vowels which appear in the same environments but also which, to an extent, form natural classes: in Received Pronunciation, r vowels are long monophthongs, checked vowels are short (or lax) vowels, free vowels are closing diphthongs<sup>13</sup> and r-coloured free vowels are mostly centring diphthongs or triphthongs. The different qualities and values for Received Pronunciation are shown in Table 4.1.

10 Green (2007: 174) underlines ‘the problem of determining what the underlying phonemes are whose allophones are [aɪ, ɪ], [i, e], [e, æ], [o, ɑ], because the surface allophones are featurally often more distinct from each other than they are from allophones of a different phoneme’.

11 Jaeger (1986) claims that children who learn how to spell unlearn phonetic groupings for vowels and learn to group them according to spelling, or Vowel Shift patterns, which would support the view defended here.

12 Considering vowel qualities as series is a view developed in Dabouis (2014).

13 Under the assumption that [i:] and [u:] are actually [ɪɪ] and [oʊ], respectively (see Wells (1982: 140, 147)).

Table 4.1 Table of correspondence for stressed vowels (taken from J.-M. Fournier 2010b: 98)<sup>14</sup>

$\bar{V}$ <sup>r</sup>	$\check{V}$	Monographs	$\bar{V}$	$\bar{V}^r$	Digraphs
r vowel	checked vowel	<V>	free vowel	r-coloured free vowel	< $\bar{V}\bar{V}$ >
[ɑ:]	[æ]	<a>	[eɪ]	[eə]	<ai, ay / ei, ey>
[ɜ:]	[e]	<e>	[i:]	[ɪə]	<ea, ee / ie**>
[ɜ:]	[ɪ]	<i>	[aɪ]	[aɪə]	<ie*, ye>
[ɔ:]	[ɒ]	<o>	[əʊ]	[ɔ:]	<oa**, oe*>
[ɜ:]	[ʌ (ʊ)]	<u>	[(j)u:]	[(j)ʊə]	<e(a)u, ew / ue*>
			[ɔ:]	[ɔ:]	<au, aw>
			[u:]	[ɔ:]	<oo>
			[ɔɪ]		<oi, oy>
			[aʊ]	[ɔ: (aʊə)]	<ou, ow>

\*: final    \*\*: non-final

One of the issues with the relationship between orthography and phonology concerns what restructuring of phonological knowledge could occur when spelling is learned. I propose that what learning how to spell does to the phonology is to link vowels into these series of values, which can alternate with each other in certain contexts. To answer the question at the end of the previous section, I will present the rules which determine which value is to be chosen in a given context in the following section.

### 2.3 The Rules to Determine Vowel Values

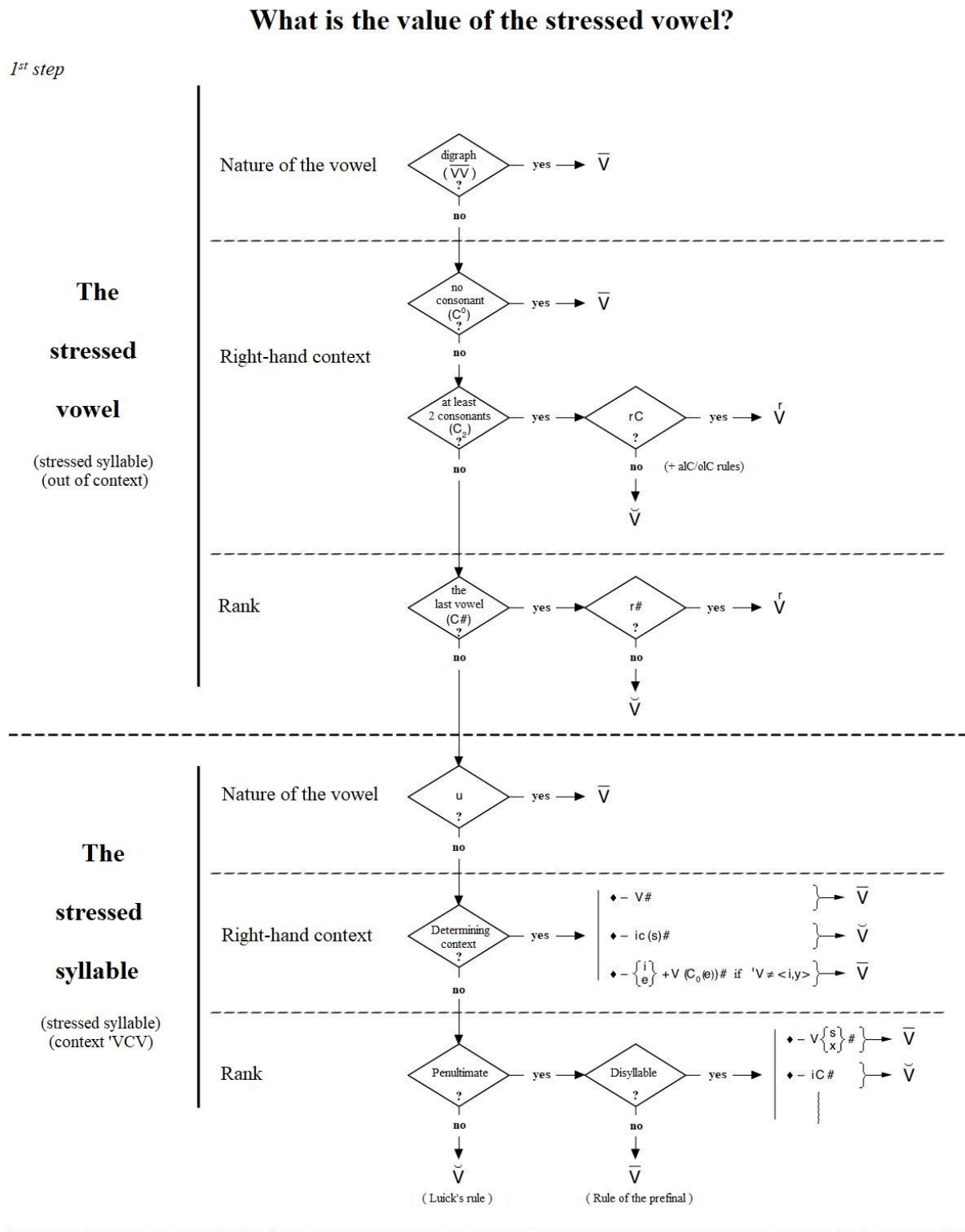
The value which a given orthographic vowel, if stressed, is most likely to have in a given context is regulated by a series of ordered generalisations, which have all been established using large empirical investigations based on pronouncing dictionaries. The main rules<sup>15</sup> found in J.-M. Fournier (2010b) are exposed below. They are hierarchically ordered, in the sense that if a given vowel meets the description of the first rule, that rule applies, but if it does not, the next rule is considered and so on until the last rule. The hierarchical organisation of the rules reflects the neutralisation of certain parameters at each step, along with the relative domination of certain parameters over others. For example, the first rule deals with all vowel digraphs, which means that the following rules deal only with vowel monographs. This means that the value ‘monograph’ for the variable ‘spelling of the vowel’ is neutral in the sense that it does not determine vowel values and that additional parameters (such as the right-hand context or the nature of the vowel) are required to determine those values. The whole system of rules is shown in Figure 4.1 and the individual rules are detailed in (4-15).

14 This table does not include reduced vowels and “foreign” vowels, which will be discussed below, such as:

- <a> → [ɑ:], <e> → [eɪ/eə], <i> → [i:/ɪə]: *fa, re, mi*
- French: <ou> → [u:/ʊə]: *bijou, courgette*; <eu> → [ɜ:]: *danseur/danseuse*; <(e)au> → [əʊ]: *auberge, chateau*; <oi, oy> → [wa:]: *boudoir*; <é(e), ê, è> → [eɪ/eə]: *négligée, déjà vu*
- ‘Classical’: <ae, oe> → [i:]: *Caesar, foetus*; <aa> → [ɑ:]: *bazaar*

15 There are additional subrules applying, for example <aIC> and <oIC> (*talk, old*), and ‘exceptional subclasses’, such as <ind#> words (*bind, blind, find*) or <Vste#> words (*chaste, paste, riposte*) which all have free vowels, contrary to the C2 rule in (6).

Figure 4.1 The system of spelling-to-sound rules for stressed vowels (after J.-M. Fournier 2010b: 141)





- (4)  $\overline{VV} \rightarrow \overline{V}$   
Vowels spelled with a digraph (for example <ow>, <ai>) are  $\overline{V}$  (for example *hydraulic*, *augment*, *sea*);
- (5)  $C^0 \rightarrow \overline{V}$   
If a vowel is followed by zero consonant (if it is followed by another vowel or is at the end of the word), it is a  $\overline{V}$  (for example *lion*, *chaos*, *me*);
- (6) If a vowel is followed by  $C_2$  (= a functional consonant cluster):<sup>16</sup>
- a.  $rC \rightarrow \overset{r}{V}$   
It is a  $\overset{r}{V}$  when the first consonant of that cluster is <r> (for example *person*, *fortunate*, *curtain*);
- b.  $C_2 \rightarrow \check{V}$   
It is a  $\check{V}$  for all other clusters (for example *nest*, *mystery*, *vanilla*);
- (7) If a vowel is followed by the final consonant of the word:
- c.  $r\# \rightarrow \overset{r}{V}$   
It is an  $\overset{r}{V}$  when that consonant is <r> (for example *car*, *sir*, *nor*);
- d.  $C\# \rightarrow \check{V}$   
It is a  $\check{V}$  for all other consonants (for example *cat*, *pet*, *permit*);
- (8)  $u \rightarrow \overline{V}$   
If the vowel is <u>, it is a  $\overline{V}$  (for example *acute*, *constitution*, *crucify*);
- (9)  $-V\# \rightarrow \overline{V}$   
In the context <-CV#>,<sup>17</sup> the vowel is a  $\overline{V}$  (for example *aroma*, *baby*, *cave*);
- (10)  $-ic(s)\# \rightarrow \check{V}$   
If a vowel is in the syllable preceding *-ic(s)#*, it is a  $\check{V}$  (for example *tonic*, *angelic*, *oceanic*);<sup>18</sup>
- (11)  $-C\left\{\begin{smallmatrix} i \\ e \end{smallmatrix}\right\} + VC_0(e)\#$  if 'V  $\neq$  <i, y>  $\rightarrow \overline{V}$   
If a vowel is followed by  $-C\left\{\begin{smallmatrix} i \\ e \end{smallmatrix}\right\} + VC_0(e)\#$ , and if it is not <i> or <y>, then it is a  $\overline{V}$  (for example *zodiac*, *appreciate*, *spontaneous*);

16 J.-M. Fournier (2010b: 38) defines a  $C_2$  as any group of two consonants (even orthographic ones) except <Ch>, <Cr>, <Cle#> and <Cre#>, but including <x>. The term ‘functional consonant cluster’ is used by Guierre (1979) to distinguish those referred to as  $C_2$  and ‘non-functional’ clusters, which phonologically behave like singletons for stress, vowel values and vowel reduction (although orthographic consonant geminates differ from other  $C_2$ s for vowel reduction, as discussed in section 4.3).

17 This context includes final mute <e>, which will be discussed in section 4.2.

18 J.-M. Fournier (1990) shows that this rule knows exceptions (sometimes as pronunciation variants) in the case of derivatives with free vowels in their base (for example *basic*, *cyclic*, *hydric*). He shows that the existence of a base with a long vowel is a necessary (but not sufficient) condition for an exceptional long vowel in the related *-ic* derivative.

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- (12) Luick<sup>19</sup> →  $\check{V}$   
 If the vowel is in the antepenultimate syllable (or further from the end), it is a  $\check{V}$  (for example *cylinder*, *austerity*, *ritual*);<sup>20</sup>
- (13) Prefinal →  $\bar{V}$   
 If the vowel is in the penultimate syllable in a word longer than two syllables, it is a  $\bar{V}$  (for example *neurosis*, *hiatus*, *horizon*);
- (14) The remaining dissyllables are mostly unregulated, apart from the two following subclasses (but see Deschamps (1994) for more details):
- Those ending in <s> or <x> have a  $\bar{V}$  (for example *crisis*, *motus*, *matrix*);
  - Those ending in <-iC#> have a  $\check{V}$  (for example *credit*, *solid*, *zenith*).

Additionally,  $\bar{V}$ s which are followed by <r> become  $\bar{V}^r$ s:

- (15) Digraphs: *their*, *beer*, *Europe*, ...  
 <u>: *curious*, *fury*, *obscurity*, ...  
 -VCV#: *aurora*, *era*, *vary*, ...  
 -C $\begin{cases} i \\ e \end{cases}$  + VC<sub>0</sub>(e)#: *auditorium*, *cafeteria*, *variance*, ...  
 Penultimate: *decorum*, *oxymoron*, *papyrus*, ...

The ordering of rules is based on the study of relevant cases, which are words for which two contradictory rules could apply (for example in *augment* (n.), the rules  $\bar{V}\bar{V} \rightarrow \bar{V}$  and  $C_2 \rightarrow \check{V}$  could both apply). If all the words for which two contradictory rules are in conflict behave uniformly, then we can determine which rule dominates the other (for example, virtually all digraphs followed by a consonant cluster are realised as free vowels, therefore the rule  $\bar{V}\bar{V} \rightarrow \bar{V}$  dominates the rule  $C_2 \rightarrow \check{V}$ ). If rules are not contradictory, transitivity can be used. For example, the rule  $C_2 \rightarrow \check{V}$  can be shown to dominate the rule  $u \rightarrow \bar{V}$ , as all vowels spelled <u> followed by a consonant cluster are checked vowels (for example *butter*, *function*, *mustard*) and rule  $u \rightarrow \bar{V}$  can be shown to dominate rule  $-ic(s)\# \rightarrow \check{V}$ , as all vowels spelled <u> followed by  $-ic(s)\#$  are free vowels (for example *cubic*, *mercuric*, *music*). Therefore, by transitivity, the rule  $C_2 \rightarrow \check{V}$  can be argued to dominate the rule  $-ic(s)\# \rightarrow \check{V}$ .

However, the application of these generalisations in suffixed words depends on the type of suffixation which is involved, and vowel shifts typically occur in words with Level I or Class I suffixes, usually called ‘strong suffixes’ in the Guierrian approach.

#### 2.4 ‘Level I’ Alternations and Stress Shifts

Most descriptions of English morphophonology agree on the fact that there are two types of suffixes, often called Class I and Class II (since Siegel 1974). Different theories have proposed different accounts of these two classes: +/# boundaries in *SPE*, strata in Lexical Phonology (Giegerich 1999; Kaisse and Shaw 1985; Kiparsky 1982, 1985) or Stratal Phonology (Bermúdez-Otero and McMahon 2006; Bermúdez-Otero 2012, 2018; Kiparsky 2000) or, more

<sup>19</sup> This rule is named after Luick (1898), who first described it.

<sup>20</sup> This rule, mostly known as Trisyllabic Shortening or Laxing in generative literature, is often questioned because it has many exceptions (for example *Oberon*, *obesity*) but it actually has an efficiency of over 92%, with 3632 out of 3930 words following that rule (Deschamps 1994). Building upon Prince’s (1991) reformulation of Trisyllabic Shortening as Trochaic Shortening, Dabouis (2018) proposes to reformulate this rule so as to include the penultimate syllable of verbs, which is generally checked (see also Dickerson (1980) on a similar claim, but another view is proposed by Nessly (1982)).

generally, what Scheer (2011) calls 'no look-back devices' which, in his model, is the Phase Impenetrability Condition. Fundamentally, the difference between the two classes can be boiled down to what J.-M. Fournier (1998) calls 'modes of computation'. 'Class I' suffixes trigger a 'direct computation' of the position of stress and of vowel values, whereas 'Class II' suffixes trigger a 'computation by reference', that is to say that the derivatives that they form preserve these properties from their bases. In other words, 'Class I' suffixes inhibit any reference to the base for the positioning of primary stress and the pronunciation of the primary stressed vowel<sup>21</sup> and trigger the direct application of normal rules (or suffix-specific rules in the case of suffixes such as *-ee*, *-ette* or *-ic*). Consequently, this 'direct computation' is the mechanism which is at the source of both vowel alternations and stress shifts, as in the examples in (16).

- (16) 'origin → o'riginal  
'rite [aɪ] → 'ritual [ɪ]

In Giegerich's (1992) view, there are no derivations from one vowel to another but rather spelling-to-sound generalisations which apply at Level I. I believe this view to be essentially correct. In the view presented in section 2.2, the different values in a given series are not derived from one another but are selected according to the environment in which the vowel appears. If this environment is modified by suffixation, rules will apply again if it is 'Class I' suffixation, but they will not apply again in the case of 'Class II' suffixation. In the former case, the rules apply transparently, but they are opaque in the latter (for example Luick's rule is opaque in *evasiveness*).

Interestingly, the spelling of words can be used to solve some apparent problems such as those in (17).

- (17) *ocean* ['əʊʃən] → *oceanic* [ˌəʊʃɪ'ænik]  
*partial* ['pɑːʃəl] → *partiality* [ˌpɑːʃɪ'æləti]

In these examples, the number of syllables in the derivative exceeds that of its base added to that of the suffix by one: *ocean* has two syllables, *-ic* has one and *oceanic* has four, as opposed to the expected three. In both of these cases, the mismatch is the result of a historical process of syneresis, a reduction process which leads sequences of two unstressed vowels to merge into a single vowel. One way to solve this kind of problem is to assume that the bases underlyingly have more syllables than what is actually pronounced. This is also reflected in the spelling of these words which clearly shows these underlying syllables. Therefore, directly using the spelling can account for cases like (17) but could also be used to predict what would happen in neologisms or nonce-words with a similar structure. For example, there are no common derivatives in *-ic* formed from words in *-ion*. We could expect most speakers to pronounce such words as [-i'ɒnik].<sup>22</sup>

## 2.5 Foreign Vowels

Many words such as those in (18) have irregular spelling-to-sound correspondences.

- (18) *armada*, *angina*, *banana*, *bikini*, *martini*, *mosquito*, *sake*, *tomato*, ...

---

21 Crucially, 'direct computation' concerns only primary stress, as secondary stress(es) is/are often inherited from their base (Collie 2007, 2008; J.-M. Fournier 2010b: 79-80; Kiparsky 1979 and many others).

22 The online *Oxford English Dictionary* only lists 2 words in *-ionic* (with the suffix *-ion*, not the word *ion*), both qualified as 'rare', which do have the predicted pattern: *regionic* [ˌriːdʒi'ɒnik] and *visionic* [ˌvɪʒi'ɒnik].

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Tournier (1993: 149) notes that these correspondences can be attributed to the principle of articulatory proximity, according to which the source phoneme is reproduced in English by the closest English phoneme, articulatorily speaking. This is to be opposed to the principle of graphic analogy according to which regular spelling-to-sound correspondences are used to pronounce foreign words. The most common ‘odd’ correspondences can be summarized as in (19), in which  $\bar{V}^f$  represents foreign free vowels.<sup>23</sup>

(19) $\bar{V}^f$		$\bar{V}$
[a:]	<a>	[eɪ]
[eɪ]	<e>	[i:]
[i:]	<i>	[aɪ]

These irregular correspondences can help us identify this ‘foreign’ vocabulary. This is one of a series of characteristics which define foreign vocabulary, along with other characteristics such as morphology, segmental structure, semantics and stress (see Dabouis and P. Fournier (to appear) for an extended discussion of these characteristics).<sup>24</sup>

Additionally, Guierre (1979: 831) points out that only spelling could predict interdialectal variation such as that found in the examples in (20).

(20) <albino>	[æɫ'bi:n əʊ] (GB) ~ [æɫ'bainoʊ] (US)
<tomato>	[tə'mɑ:təʊ] (GB) ~ [tə'meitəʊ] (US)

He argues that the solution which consists in deriving one vowel from the other (as proposed by Chomsky and Halle (1968) and Halle and Keyser (1971)) was a phonetic solution, not a phonological one, and that it missed the predictability of the Anglicisation of these words. Guierre discusses mainly vowels, but the analysis could extend to consonantal alternations such as [ʒ] ~ [dʒ] (for example *barrage, genre*).<sup>25</sup>

### 3 Consonantal Phenomena

In this section, I discuss four phenomena related to consonants, and which could be better analysed using orthographic information. There is a direct relationship with stress placement only in the case of syllabic consonants, as they raise the question of syllable count, which is essential in stress assignment. The other two processes, Velar Softening and alternations involving nasal clusters, only have an indirect relationship to stress, as they are related to the Level I/Level II distinction, which itself is related to stress.

#### 3.1 Velar Softening

Velar Softening refers to a consonantal alternation between velar stops and coronal fricatives or affricates, as in the examples in (21).

<sup>23</sup> Less common examples of foreign vowels are mentioned in footnote 14. Note that <o> and <u> are not realised differently in foreign vocabulary. However, Dabouis (2016: 472; 2018) lists several words with <o> realised as [əʊ] in a context where a checked vowel is expected and which can be argued to be foreign free vowels (for example *oloroso, omerta, origami*).

<sup>24</sup> One could also use other orthographic clues to identify ‘foreign’ vocabulary. For example, for [i] in final position we can have either <i> or <y>, but the former is almost systematically found in ‘foreign’ words. This can be shown if we list the first ten words (apart from proper names) in Wells (2008) which end in <i> and the first which end in <y>:

<i>: *aduki, adzuki, agouti, aioli, alhaji, alibi, alkali, ani, annuli, anthropophagi*.

<y>: *abbacy, abbreviatory, ability, ably, abnormality, aboriginality, absently, absolutely, absorbedly, absorbency*.

<sup>25</sup> Dabouis and P. Fournier (to appear) also discuss spelling-to-sound correspondences for consonants in foreign vocabulary.

- (21) *criti*[k] → *criti*[s]ise  
*electri*[k] → *electri*[s]ity  
*alle*[g]ation ← *alle*[dʒ]e  
*analo*[g] → *analo*[dʒ]y

Standard descriptions of Velar Softening read as in (22), taken from Kiparsky (1982) for the alternation between [k] and [s], but the alternation between [g] and [dʒ] occurs in the same environment.<sup>26</sup>

- (22)  $k \rightarrow s / \text{---} \begin{bmatrix} - \text{back} \\ - \text{low} \end{bmatrix}$

This formulation of the generalisation can capture the facts only if all vowels which trigger Velar Softening are indeed  $\begin{bmatrix} - \text{back} \\ - \text{low} \end{bmatrix}$ . However, if we consider simply the first and the third examples in (21), the first alternation is triggered by [aɪ], which is not  $\begin{bmatrix} - \text{back} \\ - \text{low} \end{bmatrix}$  and the second alternation occurs before nothing as, in *allege*, [dʒ] is word-final. In order to account for that, one needs to postulate both that the alternations are triggered by underlyingly  $\begin{bmatrix} - \text{back} \\ - \text{low} \end{bmatrix}$  vowels (for example [i] and [e]) and that these vowels may be deleted (as for final [e]). This is one of the reasons which led some to call Velar Softening alternations ‘unnatural’ (J. Myers 1999; Pierrehumbert 2006). Moreover, Velar Softening generally involves a restricted set of suffixes (-ity, -ism, -ify, -ize) and has a number of exceptions. These elements have led some scholars to reject it as a phonological rule (Hyman 1975; Kaye 1995).

So how should Velar Softening be accounted for? Once again, the answer seems to lie with orthography. As Montgomery (2001) argues, it ‘can only be accounted for synchronically through assuming either orthographic reference or, more controversially, through assuming an orthographic underlier’. This is also the position adopted by Raffelsiefen (2010), who argues that ‘synchronically, Velar Softening concerns the relation between spelling and sound, in particular, it expresses a rule for how to pronounce the graphemes <c> or <g> before the graphemes <i>, <e> or <y>’. She formulates this rule as in 0.

- (23)  $\left. \begin{array}{l} \langle c \rangle \rightarrow [s] \\ \langle g \rangle \rightarrow [dʒ] \end{array} \right\} \begin{array}{l} -\langle i \rangle \\ -\langle e \rangle \\ -\langle y \rangle \end{array}$

Building up on what was developed for vowels in the previous sections, we could propose that orthographic consonants such as <c> and <g> are the nodes that links the series {[k], [s]} and {[g], [dʒ]}, just as <a> does for {[æ], [eɪ], [ɑ:], [eə]}, and that the specific realisation is determined contextually.

### 3.2 Stem-Final Clusters Involving a Nasal

There is a number of widely discussed alternations involving a nasal consonant, where a consonant absent from the base ‘reappears’ in a related Class I/Level I derivative. As pointed out by Scheer (2011: §167), there are three types of alternations: [mn] ~ [m] (24a), [mb/ŋg] ~ [m/ŋ] (24b) and [gn/gm] ~ [n/m] (24c).

<sup>26</sup> As pointed out by Aronoff (1976: 52), this rule needs to be restricted to [+Linate] items as it does not apply in [-Linate] items.

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- (24) a. *damn* ['dæm] → *damnation* [dæm'neɪʃən]  
*autumn* ['ɔ:təm] → *autumnal* [ɔ:'tʌmnəl]  
*solemn* ['sɒləm] → *solemnity* [sə'lemnɪti]  
 b. *bomb* ['bɒm] → *bombard* [bɒm'bɑ:d]  
*long* ['lɒŋ] → *longer* ['lɒŋgə]  
 c. *sign* ['saɪn] → *signature* ['sɪɡnətʃə]  
*paradigm* ['pærɪdəɪm] → *paradigmatic* [ˌpærɪdəɪɡ'mætɪk]

Giegerich (1999: 130) argues that '[mn] sequences only occur in a small number of stratum-1 derivatives, and that such occurrence is reliably reflected by (and arguably predicted by) the orthographic representation. [...] the derivation of phonological properties from orthographic ones is not unreasonable in cases such as the present one, and downright unavoidable [...] in others'. Similarly to reduced – full vowel alternations, we are faced with a phenomenon which the phonological information contained alone in the base cannot predict. Therefore, once again we can propose an orthographically-guided generalisation to account for this phenomenon. This is what Giegerich (ibid.) proposes with the rule in (25), and similar rules could be put forward to account for cases such as (24b) and (24c).

(25) *n-insertion* (Stratum 1)

$$\emptyset \rightarrow [n] / [m] \begin{array}{c} \langle mn \rangle \\ | \\ \underline{\quad} \quad V \end{array}$$

Bermúdez-Otero and McMahon (2006: 398) propose an alternative analysis within the framework of Stratal Phonology. They assume that the English lexicon contains three items: a root [dæmn], a free noun stem [dæm] and a derived noun stem [dæmneɪʃn]. The consonantal alternation between the root and the free noun stem is captured using a lexical redundancy constraint of nasal cluster simplification. The *-ation* suffixation is assumed to apply to the root and not the free noun stem and the derivation from the stem is avoided using morphological blocking, ‘in the same way that *went* blocks *\*goed*.’

The problem with that analysis has to do with the source of the root [dæmn]. One can assume that it is learned once the speaker encounters *damnation*, but this would create the same problem as the hypothesis of re-structuring proposed by Anderson (1981) for reduced – full vowel alternations discussed in section 2.1. Once again, the issue is that such an analysis cannot predict the generation of novel forms. Note that generating [dæm] from [dæmneɪʃn] is fairly unproblematic and does not require any reference to orthography. One only needs to assume that there is a productive rule or constraint of nasal cluster simplification. This has been shown to be the case using nonce words like [lɪmneɪʃən] and asking speakers to produce the verbal base by back formation and its *-ing* form (Mohan 1986: 23). Speakers produced [lɪm] and [lɪmɪŋ] rather than \*[lɪmn] and \*[lɪmnɪŋ]. It appears that the reference to orthography is necessary to predict novel forms with a nasal cluster. We could imagine an experiment in which participants would be asked to form the *-ation* derivative from a base ending in [m], with one group being shown the spelling of the word with <mn> and another group in which the word is only presented orally. I would expect participants to produce [mn] in the first group, but not in the second.

### 3.3 Syllabic Consonants

There is disagreement in the literature on what the phonological representation of the syllabic consonants should be. Some authors defend that they should be represented uniformly as /əC/

(Bonilla 2003; Wells 1965) while others argue that they can sometimes be represented as a single underlying consonant with no /ə/ and some have argued that this depends on the nature of the consonant (for example [ŋ] would be /ən/ while [ʃ] would be /l/; see Toft (2002)) or on other factors, which I will discuss now (J.-M. Fournier 2010b; Giegerich 1999).

According to J.-M. Fournier, syllabic consonants can be the result of the elision of a schwa before a coda /m/, /n/ or /l/ (or /r/ in American English) or the syllabic realisation of a sonorant when it is found in the coda of an unstressed syllable. Consider the examples in (26), taken from J.-M. Fournier (2010b: 191-192).<sup>27</sup>

(26) a.	<i>balsam</i> ['bɔ:lsəm]	→	<i>balsamic</i> [bɔ:ɫ'sæmɪk]
	<i>angel</i> ['eɪndʒɫ]	→	<i>angelic</i> [æŋ'dʒelɪk]
	<i>ether</i> ['i:θə]	→	<i>etheric</i> [i:'θeɪk]
b.	<i>cycle</i> ['saɪkl]	→	<i>cyclic</i> ['saɪklɪk]
	<i>plasm</i> ['plæzɪ]	→	<i>plasmic</i> ['plæzmɪk]
	<i>nitre</i> ['naɪtə]	→	<i>nitric</i> ['naɪtɪk]

The *-ic* suffix systematically places stress on the preceding syllable and therefore the difference between the words in (26a) and (26b) can be interpreted as a difference in the phonological representations of the bases of the *-ic* derivatives. If the syllable containing the syllabic consonant in the base can receive stress when suffixed with *-ic*, it can be argued to be underlyingly /VC/, which is what is found for the words in (26a). When that syllable does not receive stress when *-ic* is added, then it must be underlyingly /C/, that is to say that it is not a ‘stressable’ syllable because it has no vowel, as in (26b).

It could be argued that alternations such as those in (26) are rare and could not cause a difference in underlying representations. However, it could be argued that spelling can make such a difference. Indeed, all the words in (26a) end in <VC> while those in (26b) end in <C(e)>. If we assume this difference to be transferred into the phonological representations of these words, then the alternations in (26) can be accounted for. Evidence supporting this claim comes from a small survey reported by Giegerich (1992; 1999: 163). He asked ten native speakers of English to form de-nominal adjectives with *-ian* from proper names, on the model of *Newton* → *Newtonian*. The tested words included four names with a potential syllabic consonant: *Lendl*, *Penzl*, *Mendel* and *Handel*. As predicted by the spelling, the first two were never derived with a vowel appearing between the /l/ and the preceding consonant but the last two always were.

However, the picture is not as clear as these first facts would lead us to believe. First, there are issues with syllabic /r/ because it varies between the two spellings (<Cre#> and <Cer#>) and because there are cases such as *calendar* ['kæləndə] → *calendrical* [kə'lendɪkəl] which contradict what spelling would predict. Moreover, there are whole classes of words for which there is no relevant vowel in the spelling of the base and one ‘appears’ anyway in the derivative, as in (27).

(27)	<b>-Cle</b> → <b>-ular/-ulous</b>	<b>-ble</b> → <b>-bility</b>
	<i>circle</i> → <i>circular</i>	<i>accountable</i> → <i>accountability</i>
	<i>spectacle</i> → <i>spectacular</i>	<i>falsifiable</i> → <i>falsifiability</i>
	<i>miracle</i> → <i>miraculous</i>	<i>credible</i> → <i>credibility</i>
	<i>fable</i> → <i>fabulous</i>	<i>noble</i> → <i>nobility</i>

27 Following J.-M. Fournier, I assume syllabic /r/ to be realized [ə] word-finally in British English.

This could suggest that the final syllabic /l/ in the bases actually represents a syllable, contrary to what spelling seems to indicate. An alternative analysis would be to treat these cases as allomorphies.

There are two additional phonological cues which can inform us on the phonological status of these consonants. The first is Luick’s rule (see (12)), more commonly known as Trisyllabic Shortening. If words with phonetic antepenultimate stress which meet the conditions of Luick’s rule all have checked vowels, then it could be argued that the last syllable is in fact a true phonological syllable, contrary to what spelling suggests.<sup>28</sup> A manual search in Wells (2008) for words ending in <-Cle> yields the results in (28).<sup>29</sup>

- (28) a.  $\check{V}$ :                    *amicable, carúncle, cénacle, chrónicle, clávicle, compátible, crédible, despíicable, dirígible, dissóluble, divisible, édible, équable, explicable, extríicable, indéliblé, légible, mánaclé, mániplé, míracle, mónocle, óracle, pánicle, páraclé, pédiclé, pláclable, próbable, rádicle, sánicle, sóluble, ténable, visíble, vóluble* (33/40 – 82%)  
       b.  $\check{V} \sim \bar{V}$ :                *aménable, risíble, spíracle, vésiclé*, (4/40 – 10%)  
       c.  $\bar{V}$ :                        *cápable, pótable, véhiclé* (3/40 – 8%)

Clearly, checked vowels represent the majority of cases, as 92% of words can be realized with that value and 82% can only have that value.<sup>30</sup>

The second phenomenon has to do with primary stress placement. Monomorphemic words or suffixed words derived from bound roots of three syllables or more generally have antepenultimate stress. If words with a final syllabic consonant can have pre-antepenultimate stress, then that could suggest that the final syllable is not phonological. This is systematically the case in *-able* adjectives derived from *-ate* words by affix truncation (29a) (taken from Trevian 2007), in *-able* adjectives derived from bound roots (29b) (taken from Bermúdez-Otero 2018) or in *-ism* nouns derived from bound roots (29c).

- (29) a.                    *cáculable, commúnicable, dissóciable, éduclable, pénetrable...*  
       b.                    *indómitable, indúbitable, inéxorable, irréfragable, équitable...*  
       c.                    *áctinism, álbinism, dýnamism, éxorcism, féminism, sýllogism...*

It seems that most (if not all) words with pre-antepenultimate stress are suffixed. Therefore, it could be argued that the suffixes *-able* and *-ism* are extrametrical (Hayes 1982) and that the stress pattern of words in (29) does not substantially diverge from those observed in other words in which the suffix or the final syllable is extrametrical.

Overall, it appears that different phenomena provide contradictory evidence on the phonological status of final syllabic consonants. More research is required to distinguish what has to do with morphology or with extrametricality and to establish whether or not orthography can really be of any help in determining the underlying status of syllabic consonants.

### 3.4 /r/-Related Phenomena

The issue of /r/ is a highly debated topic in English phonology (for a review, see Navarro (2017)) and it would be impossible to do justice to all the arguments which have been put

28 Deschamps (1994) and Deschamps et al. (2004) do include these words among those which obey Luick’s rule.

29 When a word had two stress variants, only the one with phonetic antepenultimate stress was taken into consideration.

30 If one assumes that Luick’s rule is in fact Trochaic Shortening (Bermúdez-Otero and McMahon 2006; Prince 1991), then these facts could be captured assuming that the syllabic /l/ is extrametrical (Hayes 1982).



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forward by various authors in a small section such as this one. Therefore, I will focus on three issues and relate them to the question of orthography.

### 3.4.1 R-Sandhi

One of the main issues is related to /r/ is r-sandhi phenomena, which are usually divided between:

- ‘linking-r’, where an [ɹ] can be found between a word ending in an orthographic (or etymological) r and a vowel-initial word (see (30a))<sup>31</sup> and
- ‘intrusive-r’, where an [ɹ] can be found between a word ending in [ə, ɑ:, ɔ:] (and, more rarely, [ɪə]) as in *idea*, which is not present in the spelling or etymologically, and a vowel-initial word (see (30b))

(30) a.	<i>ca</i> [ɹ] <i>allowance</i>	b.	<i>schwa</i> [ɹ] <i>insertion</i>
	<i>doo</i> [ɹ] <i>outside</i>		<i>law</i> [ɹ] <i>enforcement</i>
	<i>lette</i> [ɹ]- <i>opener</i>		<i>salsa</i> [ɹ]- <i>evening</i>

There has been some debate regarding whether r-sandhi involves the deletion of an underlying /r/ in pre-consonantal or pre-pausal contexts, the insertion of an [ɹ], or both (see Giegerich 1999: §6.2, Honeybone 2017 and Navarro 2017: Ch.4 for overviews). I will not attempt to get into the details of the various analyses but will briefly discuss one piece of evidence. Honeybone (2017) quotes several studies on r-sandhi which have quantified the realisation rates for both linking-r and intrusive-r in speech. The figures range from 58% to 88% for linking-r and from 9% to 58% for intrusive-r, linking-r being systematically more frequent than intrusive-r. This difference in realisation rates could be interpreted in two ways. First, one could argue that linking-r has higher realisation rates because there is an <r> in the orthographic representation and that, therefore, speakers have concrete evidence that there is an /r/ at the end of certain words, which they can pronounce in appropriate contexts.<sup>32</sup> Second, the relatively low realisation rates for intrusive-r could have to do with prescriptivism. Precisely because linking-r has orthographic support and intrusive-r does not, some speakers feel like r-sandhi should only be used when it corresponds to an orthographic <r> and proscribe it when it does not (Cruttenden 2014: 316).

Clearly, spelling can be part of the explanation, but it cannot constitute all of it. As intrusive-r occurs in words with no orthographic <r>, a mechanism of analogical restructuring independent of spelling is required to account for this phenomenon (see Bermúdez-Otero (2011)).

### 3.4.2 Pre-r Dentalisation

Honeybone (2017) describes some of the properties of English spoken in Gosforth (Cumberland). This dialect is fundamentally non-rhotic, as shown by the absence of [r] in the coda (for example *arse* [a:s], *badger* [badʒə], *chair* [tʃɛ̃ə]) and has the property of exhibiting pre-r dentalisation (for example *dry* [d̥raɪ], *tread* [t̥rɛ̃d], cp. *darning* [da:nən], *tea* [ti:]). Interestingly, it shows pre-r dentalisation for words which have no surface rhotic (for example *butter* [bʊt̥ə], *spider* [spaɪd̥ə]). Honeybone interprets this as a sign that words like *butter* and

31 The examples are taken from Heselwood (2009).

32 Heselwood (2009) makes a similar point when he asserts that ‘[t]here is no difference in the possible distribution of [r] at wordform boundaries in relation to *lettER* and *commA* words unless induced by knowledge of spelling and a greater prescriptive desire to avoid intrusive R over linking R’.

*spider* do have an underlying /r/. The acquisition of this underlying /r/ could be achieved through the exposure to forms with linking-r alternating with forms without a surface rhotic or through the learning of literacy. More evidence is required to determine which hypothesis is to be retained.

### 3.4.3 Vowel Reduction

The question of the presence of an underlying /r/ extends to word-internal positions (for example *card*, *weird*, *articulate*). In these positions, vowels which have historically been derived from a sequence of a vowel and an /r/ never display alternations which could support the presence of an underlying /r/. Synchronically deriving [ɑ:] or [ɪə] from an underlying /Vr/ sequence would mean positing free ride derivations which have been rejected by most phonologists in the post-SPE era. However, new evidence from word-internal positions calls for an explanation.

Data taken from Dabouis and J.-M. Fournier (2019)<sup>33</sup> shows that <rC> clusters pattern with true consonant clusters (but not with <C'C'>) with regards to vowel reduction in the initial pretonic position in non-derived words (see Figure 4.2 below for figures). Vowels in open syllables very often reduce but vowels in closed syllables, including those orthographically closed by <r>, rarely do so. As pointed out by Bermúdez-Otero (personal communication), this does not necessarily mean that these words have an underlying /r/ but could be due to the fact that, historically, vowel reduction preceded the loss of coda /r/. Experimental evidence is required to see whether the blocking of vowel reduction before <rC> clusters in the initial pretonic position is still synchronically active.

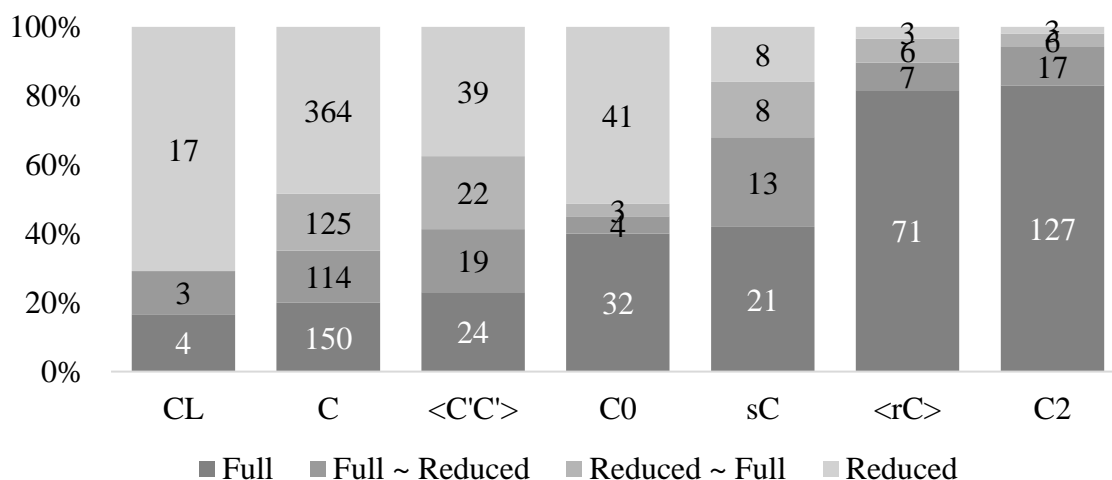


Figure 4.2 Vowel reduction in the initial pretonic position and right-hand context. C represents any consonant, L a liquid, <C'C'> orthographic geminates, C<sup>0</sup> the absence of any consonants, C<sub>2</sub> a cluster of at least two consonants

Dabouis and J.-M. Fournier (2019) also reports that vowel digraphs reduce considerably less than monographs. The effects of <rC> on vowel reduction are therefore similar to those of

33 Dabouis and J.-M. Fournier (2019) is a large-scale dictionary study of vowel reduction in the initial pretonic and intertonic positions. It uses data from Jones (2006) and Wells (2008), coded for morphological and syllabic structure. It seeks to test the different parameters put forward in the literature on vowel reduction. The data presented in Figure 2 concerns words which are not derived from another word and which do not contain any form of prefix, even etymological prefixes such as *ad-*, *con-* or *ob-*.

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vowel digraphs but diverge from those of <C’C’>, which do not pattern differently from singletons. Therefore, these facts suggest that a theory in which orthographic information is translated into (surface or underlying) phonological representations would have to translate <rC> and <C’C’> differently (for example a consonantal slot vs a mora).

#### 4 Orthographic Diacritics

Some orthographic elements can be described as diacritics, in the sense that they mark a particular behaviour of the phoneme that they represent or that they give indications about how the letters that precede them are pronounced. I will focus on the three main ones: vowel digraphs, final mute <e> and orthographic consonant geminates. It has been suggested that some of these elements are contained in underlying forms and then deleted in the derivation (Burzio 1994; Chomsky and Halle 1968; Trevian 2003) or that words which contain them should be diacritically marked in the lexicon (Liberman and Prince 1977; Schane 1979). These elements indicate that general rules are not to be applied in words which contain them. Any theory which makes an attempt at formalising the relationship between orthography and phonology will have to take a stance on what is to be done with these diacritics.

##### 4.1 Vowel Digraphs

In (4), I presented the rule relative to vowel digraphs. It states that vowels spelled with a digraph are normally pronounced as free vowels in all contexts<sup>34</sup>, even contexts for which checked vowels are the norm, for example:

- before consonant clusters: *feast, augment, acoustic*
- in a stressed antepenult: *counterfeit, fraudulence, boomerang*

Without orthographic information, it is strictly impossible to account for the multiple violations of ‘shortening’ rules by words with vowel digraphs.

Moreover, recent work by Dabouis and J.-M. Fournier (2019) shows that vowel digraphs tend to reduce much less than monographs in the initial pretonic position (for example *augmént, baptíze, éléven, routíne*).<sup>35</sup> This result suggests that spelling cannot be reduced to a representation of speech but that it can be a determining factor on pronunciation.

##### 4.2 Final Silent <e>

As mentioned in footnote 17, <-e#> appears in the structural description of the rule  $-V\# \rightarrow \bar{V}$ , as it marks that the preceding vowel is a free vowel. <-e#> is most efficient when the preceding vowel is stressed, and the presence or absence of <-e#> is the only element distinguishing the pairs of words in (31a), but can also account for the unreduced final free vowels in (31b) or the free variants in (31c).

- |         |                                 |                               |                    |
|---------|---------------------------------|-------------------------------|--------------------|
| (31) a. | <i>fate ~ fat;</i>              | <i>bite ~ bit;</i>            | <i>cote ~ cot</i>  |
| b.      | <i>démonstr[e]te;</i>           | <i>ánecd[əʊ]te;</i>           | <i>dýnam[ai]te</i> |
| c.      | <i>cómpos[ai ~ i]te (adj.);</i> | <i>ádvoc[eɪ ~ ə]te (adj.)</i> |                    |

34 Obviously, there are exceptions with checked vowels, for example *head, bread, breath, sweat, foot, book, good, could, should*, or exceptional orthographic changes in derivatives, for example *beast* → *bestial*; *feast* → *festal*.

35 This observation is not new (see Dahak (2011), Deschamps (1994: 111), Deschamps et al. (2004: 217) and Guierre (1984, 1987)) but had not been tested with multiple variables such as syllable structure or word frequency.

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Although alternations like those listed in (32) are scarce, they show that silent <-e#> behaves just as pronounced <e> does with regards to Velar Softening. Any analysis which would derive these alternations without any reference to spelling would have to assume that there is an underlying vowel at the end of the words with final [dʒ] alternating with [g].

- (32) *alle*[dʒ]e → *alle*[g]ation  
*centrifu*[dʒ]e → *centrifu*[g]al  
*obli*[dʒ]e → *obli*[g]ation

These two phenomena show that silent <-e#> somehow behaves like a vowel.<sup>36</sup> However, it is almost never pronounced and never counts as a syllable, as is shown by the examples in (33). One way to analyse this is that silent <-e#> may affect segmental processes but not suprasegmental ones.

- (33) *énvelope; páradise;* (and not \**envélope; \*parádise*)

Therefore, the behaviour of silent <-e#> can be summed up as in Table 4.2.

Table 4.2 The behaviour of final silent <e>

Phenomenon	Behaves like a pronounced vowel?
Tenseness in (-)VCV#	✓
Triggers Velar Softening	✓
Counts as a syllable in stress assignment	✗

#### 4.3 Orthographic Consonant Gemimates

Orthographic consonant gemimates (for example *colossus, vanilla, grammar*) are the orthographic elements which are the most commonly referred to in the literature on English phonology (see, among others, Chomsky and Halle 1968: 148; Burzio 1994: 56; Giegerich 1999: 164; Stockwell and Minkova 2001: 173; Collie 2007: 134; J.-M. Fournier 2010b: 28). The reason for this might be that they are involved in four phenomena which would otherwise be considered exceptional: the behaviour of <u>, exceptions to CiV Lengthening, secondary stress placement and stressed light penults.

First, it has been noted that <u> is realised as a free vowel, except when it is followed by a consonant cluster (see (6)) or a final consonant (see (7)). However, words like those in (34a) do not contain ‘true’ consonant clusters, as they correspond to phonetic singletons and yet they are still pronounced with short [ʌ], just as in words with true consonant clusters like those in (34b) (Deschamps 1982).

- (34) a. *butter*  
*mutter*  
*rubber*
- b. *function*  
*pustule*  
*vulture*

Second, as pointed out by Chomsky and Halle (1968: 149) and Burzio (1994: 56-57), words with these orthographic gemimates in (35a) also behave like words with true consonant clusters

<sup>36</sup> This is actually unsurprising as most orthographic <-e#>s used to be pronounced (Bermúdez-Otero 1998; Duffell 2008; Minkova 1982, 1991).

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(35b) with regards to rule (11), more generally known as ‘CiV Lengthening’, and unlike those with single consonants, in (35c).

- (35) a.        *pot[æ]ssium*    b.        *c[æ]lcium*        c.        *gymn[ei]sium*  
                  *conf[e]ssion*                    *comp[e]ndium*                    *magn[i:]sium*

Note that this effect seems to extend to nonce words as shown by the systematic use of [æ] for *Gussmannian* (← *Gussmann*) in the experiment reported by Giegerich (1999: 163), as opposed to the use of free vowels in the nonce words derived from bases with a single final consonant (for example *Anders[əʊ]nian* ← *Anderson*). However, there are well-known exceptions to CiV Lengthening without orthographic geminates (for example *c[æ]nyon*, *It[æ]lian*, *r[e]quiem*) and, in a recent paper, Steriade (2019) shows that CiV Lengthening only applies in derived environments when the vowel is reduced in the base (36a), but not when it is full (36b). This means that checked vowels may be preserved in the derivative, even when there are no orthographic geminates.

- (36) a.        *Ab[ə]l* → *Ab[i:]lian*  
                  *Can[ə]da* → *Can[ei]dian*  
                  *col[ə]ny* → *col[əʊ]nial*  
       b.        *Color[ɑ:]do* → *Color[ɑ:]dian*  
                  *Louisi[æ]na* → *Louisi[æ]nian*  
                  *Rav[e]l* → *Rav[e]lian*

Therefore, it appears that there are other factors at work here and that the role of orthography might actually be minor, if it has any role at all.

Then, in a study on secondary stress placement in monomorphemic words or words derived from bound roots, Dabouis et al. (2017) found that the position of secondary stress was determined by syllable closedness and by the presence or absence of an initial onset. Interestingly, orthographic consonant geminates have the same effect on the position of secondary stress as true consonant clusters:

- Pen-initial stress is always possible if the second syllable is closed: *amòntilládo*, *Monòngahéla*, *Ticònderóga* cp. *appòggiatúra*, *acciàccatúra*, *Pàntellería*.
- Initial stress is always possible when the first syllable is closed: *èspionáge*, *Pàntagruél*, *prèstidigitátion* cp. *Càssiopéia*, *hùllabalóo*, *Winnipesáukee*.

Finally, following the ‘Romance Stress Rule’, which is typically adopted for main stress placement in English, stress should fall on the penult if it is heavy (37a) and on the antepenult if the penult is light. Therefore, stressed light penults are not predicted to occur, and yet they do when they are marked with orthographic geminates, as in (37b).<sup>37</sup>

- (37) a. *agénda*, *seméster*, *advénture*, *elíxir*, ...  
       b. *vanílla*, *colóssus*, *spaghétti*, *amarétto*, ...

37 They do also occasionally occur without orthographic geminates (for example *alpáca*, *bandána*, *spèrmacéti*, *tantívy*), although most of the relevant cases are occurrences of [æ], which often alternate with [ɑ:], and are generally realised as the latter vowel in British English (for example *banána*, *Còlorádo*, *nirvána*, *sopráno*). Pater (1994) discusses words with light penult stress in detail.

Therefore, these orthographic consonant clusters behave like true consonant clusters in all these environments, which leads Guierre (1979: 285-6) to argue that they share two of the three properties of the latter.<sup>38</sup> We saw that they seem to ‘attract’ stress in the pre-final position, and that vowels which immediately precede them are short (this is the rule  $C_2 \rightarrow \check{V}$ ), but they do not behave in the same way as ‘true’ consonant clusters with regards to vowel reduction in pretonic unstressed syllables. The latter tend to block vowel reduction in this environment<sup>39</sup> whereas reduction is not systematically blocked by geminates. The results in Figure 1 clearly show that orthographic geminates (marked as <C’C’>) pattern with the absence of consonants, single consonants and obstruent + liquid clusters (that is to say open syllables). The behaviour of orthographic geminates can be summed up as in Table 4.3.

Table 4.3 The behaviour of orthographic geminates

Phenomenon	Behaves like a pronounced consonant cluster?
Laxness of preceding <u>	✓
Blocking of CiV Lengthening	?
Secondary stress placement	✓
Can attract stress on the penult	✓
Less vowel reduction in the initial pretonic position	✗

## 5 Some Implications for Lexical Stress

Most analyses of English stress in the generative literature derive the position of stresses from the segmental structure of words, vowels included. This state of affairs is not without raising a few questions. First, when native learners of English acquire their language, their input contains both vowels and stress. If the input contains both, what justifies that vowels should be seen as lexical and not stress? Why should stress be derived from lexical vowels? Why not derive vowels from lexical stress? Many analyses of English stress crucially rely on the difference between long and short vowels,<sup>40</sup> but they would be faced with considerable difficulty to extend the analysis to dialects such as Standard Scottish English, which does not have long vowels and yet has overall the same stress patterns as standard British or American English (Carr 2000). Second, if vowel reduction is seen as a consequence of stresslessness, then it seems difficult to argue that there are underlying reduced vowels which cannot be stressed. These issues show that the position that has been adopted in the literature regarding the relationship between vowels and stress is not unquestionable. Now, how would including spelling make things any different?

38 This should not be surprising as there were geminates in Old English and Middle English (Britton 2011) and they triggered Shortening before Consonant Clusters, like other consonant clusters (Bermúdez-Otero 1998). Guierre (2001) also reports that when geminate consonants were simplified, the use of double orthographic consonants to indicate that the previous vowel is ‘short’ was systematised.

39 This reduction blocking knows one major class of exceptions: Latinate prefixes, which tend to reduce systematically (Burzio 1994: 56-57; Chomsky and Halle 1968: 118; Collie 2007: 129, 215, 318-319; Dabouis and J.-M. Fournier 2019; Deschamps 1994; Guierre 1979: §3.4.11; Halle and Keyser 1971: 37; Halle and Vergnaud 1987: 239; Hammond 2003; Hayes 1982; Liberman and Prince 1977; Pater 2000; Selkirk 1980; Stockwell and Minkova 2001: 173).

40 Some would say tense and lax, but see Durand (2005), who argues that phonological length (be it in the form of x-slots or morae) is required to cross-classify the vowel phonemes in English.

Throughout this chapter, it has been shown that a number of generalisations allow us to predict the value of a vowel in a given context quite reliably. Some of these generalisations refer to the position of stress, which suggests that the rules or constraints regulating stress placement have to dominate or precede those regulating vowel values.<sup>41</sup> Moreover, if one assumes that spelling restructures vowels into series such as those suggested in section 2.2, then a given orthographic vowel would not have a fixed weight which could be used to determine the position of stress. Once again, this suggests that the computation of vowel values has to be subordinated to that of stress. In a model that includes orthography (and especially in a reading grammar), vowels are fundamentally variable and depend on context. As a consequence, they cannot be part of the parameters which determine stress placement, unlike consonants, which display a far greater stability.<sup>42</sup>

Finally, orthographic information can be used to account for stress placement in classes of words which otherwise would remain unaccounted for. One such example is words with light penults. Pater (1994) shows that there is a considerable proportion of words with a light penult which have penultimate stress, such as those in (38).

(38) *vanilla, Mississippi, Kentucky, confétti, abscíssa, Philíppa*

The stress behaviour of these words, along with some of the phenomena discussed in section 4.3, has led Chomsky and Halle (1968) to postulate that they had underlying ‘double consonants’ in the prefinal position (= between the last two vowels), which would be deleted by a degemination rule after stress assignment had taken place. Taking spelling into consideration makes stress a lot more predictable and allows us to get rid of most of these exceptions, even though some persist (for example *Attila* [ə'tɪlə], *Alabama* [ˌælə'bæmə], *Cincinnati* [ˌsɪnsə'næti]).

However, there is an alternative explanation to these exceptions. Pater (1994) observes that none of the words he found with light penult stress were Anglo-Saxon or other Germanic words. Instead, most of them turn out to be borrowings or proper names. This leads him to propose that light penult stress ‘is a productive property of the periphery of the grammar, and antepenult stress the core’. Following J.-M. Fournier (2010a) and Dabouis and P. Fournier (to appear), one could go further and argue that penultimate stress *in general* is a property of the periphery of the grammar.<sup>43</sup> However, this analysis would not allow us to account for the behavior of vowels discussed in section 4.3 and the reference to spelling is still necessary to account for the high regularity of penultimate stress in words with a prefinal <C’C’>, as opposed to the variability found for words with a single prefinal consonant.

In sum, in this section, I have shown that the relationship between vowels and stress is problematic and that assuming that vowels are lexical and stress is not raises a few questions, which should probably be asked more often. I have also shown there is a class of words, those with light stressed penults, which could be accounted for more easily if spelling were taken into consideration. I am not aware of any existing analyses of English stress which assign stress without using the weight of vowels while accounting for all the stress-related phenomena that weight-based analyses account for (for example aspiration, the distribution of [h], expletive

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41 At least at the lexical level. As an anonymous reviewer points out, phrase-level processes such as iambic reversal may affect stress without changing vowel values.

42 As pointed out by an anonymous reviewer, this is a simplification if one considers processes such as consonant cluster simplification, /h/ elision or glottaling. These processes are however highly constrained by the phonological environment and do not affect all consonants equally.

43 That claim deals with words which do not contain stress-affecting affixes such as *-ic* or semantically opaque prefixes, which are regularly associated to penultimate stress in words which are not nouns (for example *consider*, *determine*, *embarrass*; see section 2.2.1 in Chapter 2, this volume).

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infixation), but J.-M. Fournier’s (2010b) model provides a satisfactory account of stress placement, although it remains to be seen whether this analysis can incorporate those other phenomena.

## **6 Where Does Orthography Stand?**

There are two main options regarding the manner in which orthographic information could be brought about in phonology. I will not consider the option taken by Giegerich (1999), which consists in having phonological rules which are able to refer to orthographic information, as in (26). Instead, the first option that I will assume is a modular framework in which there would be an orthographic module. Domain specificity (Fodor 1983) requires that each module has its own vocabulary, suggesting that one way to import orthographic information into the phonological module is to translate that information into phonological vocabulary (segments, morae, prosodic boundaries, CV units...). The second option, which is not necessarily incompatible with the first one, would consist in assuming that there are graphophonological representations that emerge from the system of correspondences between orthography and phonology and from which both orthographic and phonological representations could be derived.<sup>44</sup> There is a third option which does not involve any claims on the relationship between orthography and phonology: to study a reading grammar. As mentioned in section 0, Guierre (1979) found that this grammar was the most efficient to determine the position of stress(es) and vowel values out of all four possible grammars.

The aim of this chapter is not to say which of these options should be preferred but mainly to pave the way for future research by laying down the empirical facts that a theory willing to include orthographic information should account for and by proposing some of the ways that this could be achieved. Let me conclude on the nature of the generalisations discussed in this chapter. Recent evidence suggests that speakers do not use categorical rules but use statistical-learning, that is to say that ‘people implicitly pick up associations between spelling and phonology through their experience with written words’ (Treiman et al. 2020). Therefore, a theory seeking to model the linguistic ability of English speakers will have to use probabilistic generalisations rather than categorical ones.

## **7 Conclusions**

This chapter has shown the necessity of taking orthographic information into account when dealing with English phonology. The reasons for doing so are numerous: psycholinguistic evidence suggests that orthography strongly influences and restructures phonological knowledge and some dead-end problems of phonology which can be resolved if orthographic information is taken into consideration. This chapter can only begin to scratch the surface of what remains largely uncharted territory: the links between orthography and phonology. Consequently, there are many additional issues which would need to be taken into consideration, such as spelling pronunciations, sometimes called the Buben effect (Chevrot and Malderez 1999; Chevrot 2015; Giegerich 1992, 1999),<sup>45</sup> or the role of spelling in diachronic changes (for example Neuman (2009: 395-398) on [h] in French borrowings in English).

I have also shown how integrating orthography opens the way for an analysis of English stress which does not depend on the length of vowels, and such an analysis can be taken up in

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<sup>44</sup> See Ryan (2008, 2017) on a writing grammar.

<sup>45</sup> Roché (2010) gives an interesting series of examples to support his view that ‘Dans une langue comme le français, la mémoire lexicale est pour une large part une mémoire de la graphie’ [‘In a language such as French, lexical memory is for the most part a memory of spelling’]. He quotes a number of neologisms based on names of presidential candidates (for example *sarkozymment*, *bovément*, *bayroument*) and observes that these neologisms are strongly influenced by spelling. Indeed, names with final [ɛ] are derived differently according to how they are spelled: *laguillèremment*, *bovément*, *buffettement*, *devilliersement*.



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frameworks which do not integrate orthographic information. However, the advantages of integrating orthography are twofold: we can correctly predict stress in words with prefinal orthographic consonant geminates and we can provide a general account of the distribution of vowels rather than simply assume that they are lexical.

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