The History of the Graphematic Foot in English and German

Martin Evertz

Abstract. Suprasegmental graphematics holds that there are units in alphabetical writing systems comprising more than one segment. While units such as the graphematic syllable and the graphematic word seem to be well established, the graphematic foot was only recently proposed. This paper provides further insights into this unit by discussing diachronic data from English and German.

There are two phenomena that make the graphematic foot especially visible: graphematic geminates in English and German and the silent <e> in English. Both phenomena coded segmental information in earlier stages of the languages, i.e., spelling geminates coded phonological geminates and the final -e in English coded schwa. At some time, phonological geminates in both languages and the word-final schwa in English disappeared. That rendered the original functions of these spelling devices obsolete. However, instead of vanishing, graphematic geminates and the final -e acquired new functions connected to the graphematic foot.

The phonological segments, which were coded by the discussed phenomena, developed because of suprasegmental conditions: geminates and the word-final schwa played a major role in the development of the vowel quantity systems of both languages, which is connected to syllable and foot structure. In today's systems, the graphematic foot bidirectionally corresponds to the phonological foot and thus helps the reader to gain information about the phonological foot and syllable structure of a word.

This new diachronic approach may not only enhance our understanding of the unit graphematic foot but it may also help to understand how and why suprasegmental units developed in writing systems in the first place.

1. Introduction

In traditional writing system research, written language is analysed as a linear sequence. Contrary to this view, suprasegmental graphematics holds that there are units in alphabetical writing systems comprising more than one segment, which are organized in a hierarchy parallel to the phonological hierarchy (cf. Evertz and Primus 2013; Evertz

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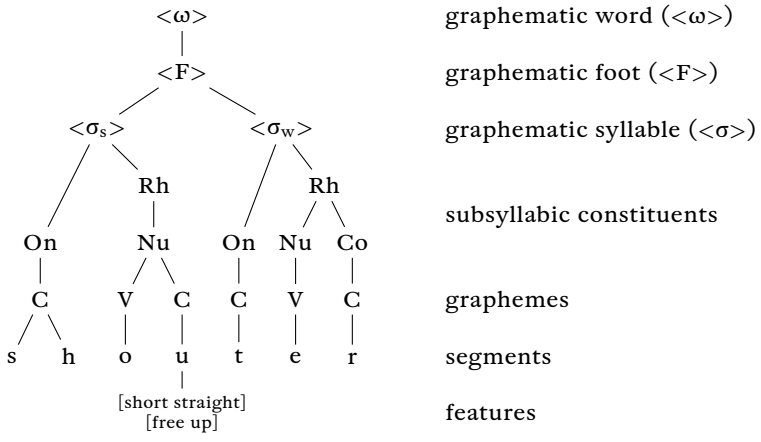

FIGURE 1. The graphematic hierarchy (cf. Evertz and Primus 2013; Evertz 2018)

2018). Moreover, suprasegmental graphematics claims that written language bidirectionally corresponds to spoken language (cf. Primus 2003; U. Domahs and Primus 2015). The units which make up the *graphematic hierarchy* are available in spoken and written language.

The existence and relevance of some of these units are quite uncontroversial; for example, there is no doubt that the graphematic word is a relevant unit (at least in writing systems of languages such as English and German). Other units, e.g., the graphematic syllable, are widely acknowledged in the literature (cf. e.g., Butt and Eisenberg 1990; Roubah and Taft 2001; Rollings 2004; Primus 2003; F. Domahs, Bleser, and Eisenberg 2001). The unit which will be the focus of this paper, the graphematic foot, was only recently proposed for German (Primus 2010) and English (Evertz and Primus 2013; Evertz 2016; Ryan 2017; Evertz 2018). The whole graphematic hierarchy is shown in Fig. 1.

The research on the graphematic foot so far has taken a synchronic perspective. This paper is the first attempt at shedding some light on the history of the graphematic foot. This might provide some insights on how suprasegmental units come into being and may be the foundation for explaining some until now only poorly understood phenomena.

The remainder of this paper is organized as follows: In order to lay a foundation for the discussion of the graphematic foot, I will discuss some phonological preliminaries. After that I will discuss how the graphematic foot developed. I will argue that the development of the obligatory branching nucleus in stressed syllables was one of the key changes in the prosodic systems of English and German that impacted the development of the graphematic foot. The paper closes with a short

conclusion, in which I will briefly summarise the findings presented in this paper.

2. Phonological Preliminaries

In order to understand the phonological changes in the history of English and German some phonological facts have to be established first.

The theory of prosodic phonology (e.g., Selkirk 1980; 1981; Nespor and Vogel 1986) holds that speech is arranged into hierarchically organised constituents. These constituents form the domains for phonological rules or constraints, which are joined together into a hierarchical structure known as the prosodic or *phonological hierarchy*. Most theories agree that the phonological hierarchy contains at least the syllable, the foot, the phonological word and one or more constituents above the word (cf. Shattuck-Hufnagel and Turk 1996, for a comparison of the constituent inventories of some of the most influential theories). In this paper, we will focus on the syllable and the foot.

Under minimal assumptions, the principal subparts of the syllable are the syllable peak and the two margins, which can be called onset and coda. The syllable peak contains the most sonorous segment, where sonority is an abstract property of a segment (Zec, 2007). It is defined as the (sole) sonority peak of a syllable and represented as a structural position V. V does not necessarily dominate a vowel. In languages such as English and German, the V-slot can also be occupied by liquids and nasals in unstressed syllables. Non-peak positions are denoted by C and must not necessarily dominate a consonant; this is, for instance, the case in the representation of diphthongs, in which the second vowel of the diphthong is dominated by C (cf. Clements and Keyser 1983).

A non-linear syllable model such as the CV-model can represent vowel opposition between long/ tense and short/lax vowels in languages such as contemporary English and German by the association of long/tense vowels with two structural positions while short/lax vowels are associated with one structural position, cf. Fig. 2a in which the vowel of the first syllable is dominated only by V, while in Fig. 2b the vowel of the first syllable is dominated by V and C. Note that the structural representations of *filler* and *poker* in Fig. 2 hold for German and English.[1]

In modern English, some tense vowels are realised as diphthongs in many varieties, including Received Pronunciation and General American English (cf. Giegerich 1992, pp. 44–47). A diphthong as in the received pronunciation of *poker* is analysed and represented as an under-

1. In Standard German, the last syllable of *Poker* and *Filler* is open and ends in [ɐ]; in American English, both words end in [ɚ]. The illustrations in Fig. 2 are approximations.

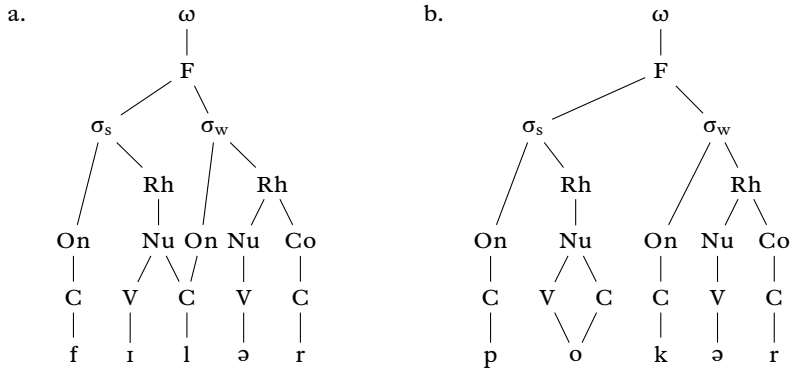

FIGURE 2. Phonological representation of *filler* and *poker* in modern English and German, cf. Evertz and Primus (2013, p. 4)

lying tense vowel, as shown in Fig. 2b. Tense vowels and diphthongs alternate, as in *line* – *linear*, *provoke* – *provocative* and *bathe* – *bath*. The phonetic correlate of the vowel contrast under discussion is a matter of debate and the terminology varies considerably (e.g., tense – lax, long – short, free – checked). Due to the structural property of tense vowels and diphthongs to occupy two structural positions, I will call them *binary* vowels. Lax vowels occupy one structural position and, hence, are *unary*.

In addition to the CV-tier, most phonologists assume that there is a richer structure with mediate constituents between the CV-tier and the *σ*-node. I will adopt a syllable structure model in which a syllable necessarily comprises a rhyme (Rh) which dominates a nucleus (Nu) that in turn dominates the V-position. Optional subsyllabic constituents are the onset (On) and the coda (Co), cf. Fig. 2.

An important observation for contemporary English and German is that in both languages stressed syllables may never end in a unary vowel. A stressed syllable or even a monosyllabic word like */pɪ/ or */pɛ/ is ill-formed in modern English and German. This property of stressed syllables in English and German can be accounted for by a syllable structure constraint demanding that the nucleus of a stressed syllable is obligatory branching (cf. Becker 1996). According to Wiese (2000, pp. 46–47) all full, stressed or unstressed, syllables have a branching nucleus that dominates V and C. A similar restriction is formulated by Giegerich (1992, p. 182) in terms of a branching rhyme. We will see that this constraint began to develop in Old English and Old High German. I will argue that the development of the branching nucleus is the key in understanding how the graphematic foot developed in English and German.

The next higher unit, the phonological foot, is defined as a sequence of one or more syllables, in which exactly one syllable is the head of the foot, i.e., stressed/strong. In German and English, the default foot pattern is trochaic. In other words, feet in English and German are by default head-initial. For a recent overview and comparison of the phonological foot in English, German and Dutch see U. Domahs, Plag, and Carroll (2014).

As previous work on the graphematic foot shows, phonological structures and constraints discussed here have close correspondents in graphematic structures and graphematic constraints (cf. Evertz and Primus 2013; Fuhrhop and Peters 2013; Evertz 2018). It is important to understand, however, that graphematic structures and constraints are not derived from phonology. In this model, phonology and graphematics are two interdependent systems connected by bidirectional correspondences, all graphematic constraints are be motivated independently on graphematic grounds (cf. Evertz 2018; Evertz and Primus 2013).

3. Before and during the Rise of the Branching Nucleus

In this paper, we will examine time periods of English and German before and after the development, or rise, of the branching nucleus in the prosodic systems of these languages. The time periods under discussion are Old English (OE; ca. 450 to 1150 CE) and Old High German (OHG; ca. 700 to 1050 CE), Middle English (ME; ca. 1150 to 1500), modern English (from ca. 1550 on) and modern German (from ca. 1650 on). The rise of the branching nucleus began in the middle periods of the languages discussed here.

3.1. Phonological Realisation of Gemination and Final -e

In Old English (3.1) and Old High German (3.1) geminate (long) consonants contrast with single (short) consonants. The following minimal pairs thus demonstrate that gemination in OE and OHG was relevant on a phonemic level and that it was phonological distinct from single consonants, cf. Britton (2012) and Simmler (2000).

(1) *wike* /k/ ‘week’ vs. *wikke* /kː/ ‘wicked’; *sune* /n/ ‘son’ vs. *sunne* /nː/ ‘sun’
(2) *miti* /t/ ‘thereby’ vs. *mitti* /tː/ ‘middle’; *filu* /l/ ‘much’ vs. *fillu* /lː/ ‘I beat’

Final -e (schwa) developed in Middle English due to vowel reduction and was not mute but contrasted with other vowels, cf. (3.1), Minkova (1991).

(3) *bode* 'message' vs. *bodi* 'body'; *dule* 'devil' vs. *duly* 'truly'

The examples provided here show two things: first, in earlier stages of English and German, there is a contrast of long and short consonants, and this contrast is marked by graphematic gemination, i.e., by doubled letters. Second, the final -e in English used to correspond to a vowel.

3.2. Gemination in OE and OHG

In the late stages of OE and OHG, the quantity and stress system of both languages began to change. One of the major developments was *vowel shortening*. Long vowels and diphthongs in strong syllables were shortened especially before geminates, before three consonants, and before groups of two consonants in polysyllabic forms if at least two unstressed syllables followed (Lahiri, Riad, and Jacobs, 1999, p. 347). Thus, it seems that vowel shortening often happened in order to avoid overlong syllables.

Vowel shortening could also occur in words which do not fit in the description above, for instance in words like *hlǣder* 'ladder'. If in a word like this the vowel is shortened, this shortening could be compensated by the gemination of the consonant that immediately follows that vowel. Thus, vowel shortening could trigger gemination (Hickey, 1986), see (3.2).

(4) Development in late OE

a.	*hlǣder*	→	*hlædder*	'ladder'
b.	*fōder*	→	*fodder*	'fodder'

Let us have a look at the syllable structure of the words in (3.2). A word like *hlǣder* consists of two syllables. The vowel in the first syllable occupies two structural positions. In other words, the syllable nucleus is branching. Due to vowel shortening, the vowel in the first syllable becomes short and occupies only one structural position; the second structural position that used to be occupied by the long vowel becomes free. This shortening is compensated by the geminate: the geminate occupies the structural position that became free.

This leads to the conclusion that the second structural position of the nucleus in a stressed syllable must not be free, it must be occupied by a vowel (either a long vowel or the second element of a diphthong) or by a consonant. In other words, the nuclei of stressed syllables became obligatory branching.

The phonological structure of words with a geminated consonant can be reconstructed like in Fig. 3a. (adapted from the phonological structure of gemination in contemporary languages, cf. Davis 2011).

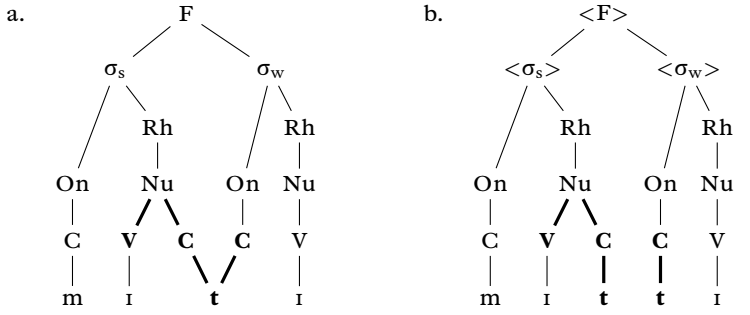

FIGURE 3. Phonological foot structure of words with geminates in OE and OHG (a.) and their graphematic structure (b.), example OHG *mitti* 'middle'

The positions of the phonological geminates within the syllable structure is identical in OHG and OE: the geminate occupies the last position of the rhyme of the first syllable and simultaneously the first position of the onset of the following syllable. The geminate is associated with two skeletal positions and is thus long. In the gaphematic representation, it seems that a single letter cannot be associated with two structural positions. This is in line with findings pertaining the representation of ambisyllabicity in modern German (cf. Eisenberg 1989, p. 82; Primus 2003, p. 35). The geminated consonant is thus indicated by a geminated (doubled) letter. These letters are also associated with two skeletal positions, see Fig. 3b.

3.3. Final -e in ME

We have seen in the previous section that from OE and OHG on, English and German developed obligatorily branching nuclei in stressed syllables. In other words, at least the structural position dominated by the syllable peak of a stressed syllable and the immediately following position must not be empty but associated with a segment.

The lengthening process which took place in the middle periods of English and German commonly dubbed *open syllable lengthening* fits into the development of branching nuclei in stressed syllables. In open syllable lengthening, short vowels occurring in open syllables were lengthened (Lahiri, Riad, and Jacobs, 1999, p. 350). At the same time, a process commonly dubbed *vowel reduction* reduced unstressed full vowels at the end of words to schwa (Minkova, 1991), see (3.3).

(5)

	OE		ME	
a.	*wŭdu*	→	*wōde*	'wood'
b.	*năme*	→	*nāme*	'name'
c.	*nŏsu*	→	*nōse*	'nose'

From a structural perspective this means that the empty position after the syllable peak is filled by associating this position with the vowel, i.e., by lengthening it. Fig. 4 is a reconstruction of the phonological structure of ME *name*. Note that the final schwa opens the first syllable by taking [m] as onset. The graphematic representation of *name* is identical to its phonological counterpart.

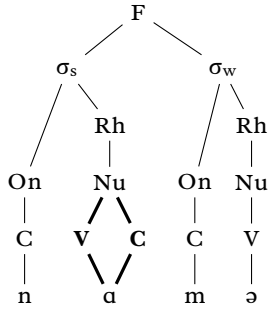

FIGURE 4. Phonological foot structure of words with final -e and one intervocalic consonant, example ME *name*

3.4. Cause and Effects in the Phonological Systems

As we have seen in the previous sections, gemination and open syllable lengthening were caused by a reorganisation of the prosodic systems of English and German, especially in terms of quantity and stress. From a structural perspective, one of the major changes was the rise of the branching nucleus, i.e., the nucleus of stressed syllables became obligatory branching.

Gemination and final schwa were coded in a transparent way: phonological gemination was coded by graphematic gemination, i.e., by doubling the letter that corresponds to the geminated consonant. Since the final -e corresponds to a vowel, schwa, it was coded by <e>.

In the middle periods, phonological geminates disappeared in English and German and the final -e (schwa) in English – but not in German

– became mute.[2] After the disappearance of geminates and the muting of the final -e, the doubled consonant and the final -<e> became obsolete. But instead of vanishing, these spelling devices acquired new functions connected with the graphematic foot, as I will show in the following sections.

4. After the Rise of the Branching Nucleus

4.1. Ambisyllabicity (De-)coding

Because stressed syllables developed branching nuclei, a single consonant adjacent to two single vowels (the first one being short and in the stressed syllable) is ambisyllabic, cf. Fig. 5a (Giegerich 1992, pp. 170–172; Wiese 2000, pp. 46–47; McMahon 2001, pp. 111–112). An ambisyllabic consonant is a consonantal segment that simultaneously belongs to the rhyme of one syllable and to the onset of the immediately following syllable. Early influential accounts promoting this concept include Kahn (1976) and Gussenhoven (1986) for English, and Vennemann (1982) for German.

On first glance, gemination and ambisyllabicity might appear quite similar. Both phenomena involve consonants with ambiguous associations to syllables. But while geminated consonants occupy two structural positions where the first position belongs to the nucleus of one syllable and the second position belongs to the onset of a following syllable, an ambisyllabic consonants is associated with one structural position only. This position is simultaneously dominated by the nucleus of one syllable and the onset of a following syllable. On the surface, this difference can be perceived as a difference in quantity: geminated consonants are long while ambisyllabic consonants are not.

Due to geminate loss, the earlier geminate (de-)coding (cf. Fig 3) became obsolete. But instead of vanishing, the geminate (de-)coding was reinterpreted as ambisyllabicity (de-)coding by the graphematic system, cf. Fig. 5b and Fig. 3b.

Note that in modern English and modern German, this system is obscured in some cases. As Evertz and Primus (2013, p. 9) point out, there are independent constraints which can block the gemination of some consonant letters. For instance, complex graphemes (such as <sh> in English or *sch* in German) or other letters such as <v> cannot be geminated. Words such as *navvy* and *skivvy* are marginal (cf. Cook 2004, p. 60), but they show the tendency to violate a highly ranked constraint ('do not geminate <v>') in order to conform to the model presented here

2. These changes can be as well attributed to the establishment of the current syllable and foot structure, cf. Britton (2012).

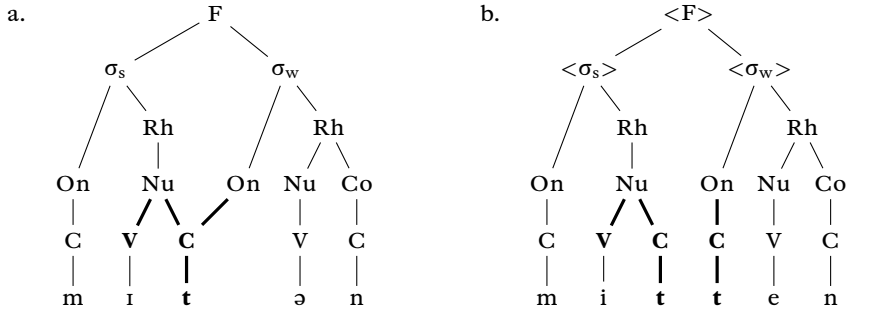

FIGURE 5. a.: Ambisyllabicity in Engl. and Ger.; b.: graphematic gemination, example *mitten*, Engl. a type of glove, Ger. '(in the) middle'

(cf. also Ryan 2010, p. 31). Words such as *give* and *dive* are opaque with respect to the vowel contrast under discussion.

4.2. Final -e in Modern English

In late middle English and early modern English, final -e lost its phonological correspondent (schwa). The graphematic structure for final schwa leading to vowel lengthening (see Fig. 4) persisted and was reinterpreted as a sign of vowel length, i.e., a vowel in a branching nucleus.

Structurally speaking, the final <e> constitutes a graphematic syllable, which in turn constitutes a graphematic foot together with the preceding syllable. Because the nucleus in a strong syllable branches, a single vowel consonant in an open graphematic syllable is interpreted to be associated to two structural positions. A reader thus can infer that this vowel letter corresponds to a binary vowel.

Although the final -e is mute, it *visually* opens the first syllable of words like <name>, Fig. 6b. Because of that, the reader can infer that the corresponding phonological syllable is branching, Fig. 6a.
It has to be noted, however, that this model does not hold for every occurrence of final -e in today's English. Evertz and Primus (2013, p. 9) point to following exceptional patterns:

i. <o+Nasal+e> for a unary vowel: *done, one, come, some*
ii. <e> after <s> distinguishing stem final from inflectional <s>: *goose, mouse, cheese, dense, tense*. This kind of <e> does not disambiguate the phonological value of the first vowel.
iii. idiosyncratic cases: *camel, belle, tulle*

Some instances in which this model does not hold are explicable by their non-native origin:for instance, the word *belle* with a unary vowel and a

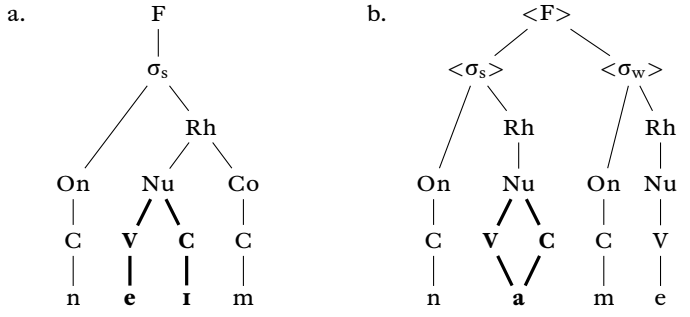

FIGURE 6. Phonological (a.) and graphematic (b.) foot structure of the word *name*

superfluous mute <e> and *tulle* with a binary vowel and an irregular c-gemination are explicable by their Modern French origin (cf. Venezky 1999, p. 86).

5. Conclusion

This paper presents some insights of how the graphematic foot developed in English and German. The graphematic foot is considered to be a suprasegmental unit in the writing systems of English and German that bidirectionally corresponds to the phonological foot.

There are two phenomena in the writing systems of today's English and German that make the graphematic foot especially visible, graphematic geminates (i.e., doubled consonant letters) and silent <e> in English. Originally, graphematic geminates and the final <e> were coding segmental information: graphematic geminates coded phonological geminates (i.e., long consonants) and word-final <e> coded word-final schwa. Phonological geminates and word-final schwa in turn developed because of suprasegmental conditions: they played a major role in the reorganisation of the prosodic systems of both languages (especially in terms of quantity and stress).

During the reorganization of the prosodic systems of English and German, phonological geminates disappeared and final -e became mute in English. This rendered the connected spelling devices, i.e., graphematic geminates and word-final <e>, obsolete. But instead of vanishing, graphematic geminates and final <e> acquired new functions.

In middle English and middle German the nuclei of stressed syllables became obligatory branching, this means that the syllable peak and structural position immediately following must not be empty. It follows that an open stressed syllable can never have a short vowel. This leads

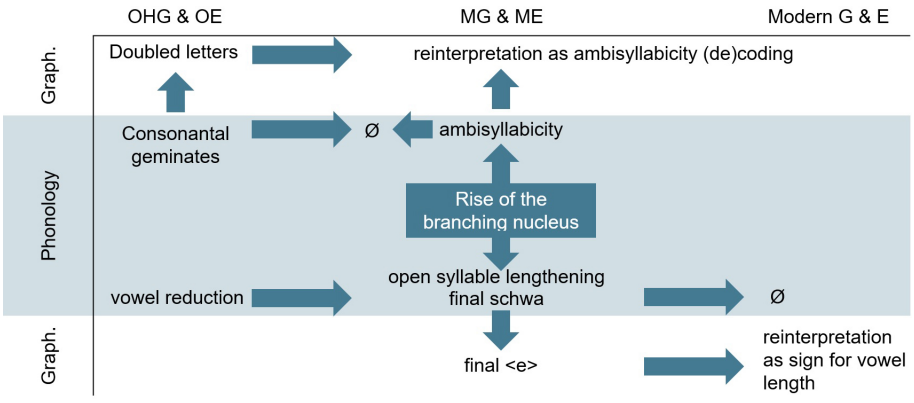

FIGURE 7. Summarizing model of the development of two of the most prominent phenomena connected to the graphematic foot

to ambisyllabicity in words in which a single consonant is adjacent to a short vowel in a stressed syllable and another syllable peak. Graphematic geminates that used to correspond to phonological geminates were reinterpreted to (de)code ambisyllabic consonants.

Silent <e> on the other hand is used to (de)code vowel quantity. Although the final <e> is mute, it visually opens graphematic syllables. Because the nucleus of a strong syllable (in phonology and in graphematics) is branching, a single vowel letter in an open graphematic syllable that is the head of a graphematic foot is interpreted as (de)coding a long vowel.

In short, after phonological geminates disappeared and final -e became mute, their graphematic correspondents, graphematic geminates and the final <e>, acquired new functions connected to the graphematic foot, cf. Fig. 7 for a summary.

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