Prosodic structure and suprasegmental features: Short-vowel stød in Danish

Pavel Iosad

The University of Edinburgh

`pavel.iosad@ed.ac.uk`

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Abstract

This paper presents a phonological analysis of a glottalization phenomenon in dialects of Danish known as 'short-vowel stød'. It is argued that both short-vowel stød and common Danish stød involve the attachment of a laryngeal feature to a prosodic node — specifically the mora. In the case of short-vowel stød that mora lacks segmental content, as it is projected top-down due to local prosodic requirements, not bottom-up by segmental material. I show that this device provides an account of the distribution of short-vowel stød as arising from the interplay of constraints on metrical structure (both lexically stored and computed by the grammar) and the requirement for morae to be featurally licensed. The analysis provides further evidence for the analysis of 'tonal accents' and related phenomena in terms of metrical structure rather than lexical tone or laryngeal features, and contributes to our understanding of the relationship between segmental and suprasegmental phonology in Germanic languages.

1   Introduction: suprasegmental phonology and feature theory

Traditionally, the theory of phonological features has focused on (sub)segmental representations, that is, on features that distinguish the segments (or phonemes) of a particular language. The nature (and existence) of featural representations in the suprasegmental domain remains more problematic: Yip (2002, chapter 3) provides a useful summary of some approaches to tone, but overall there seems to be little agreement (see Clements, Michaud & Patin 2010, Hyman 2010, Odden 2010 for three very different accounts). There are still relatively few unified treatments of features relevant to both subsegmental and suprasegmental contexts (although see Lodge 1993, 2007, Bradshaw 1999, Kehrein & Golston 2004, Pearce 2013, Golston & Kehrein forthcoming), and the relevance of suprasegmental facts to debates familiar from theories of segmental phonology also often remains unclear.

   In this paper I consider the phenomenon of 'short-vowel stød' in Zealand Danish, which involves glottal activity associated with phonologically short vowels, unlike the more familiar and much-researched common Danish stød (e. g. Hansen 1943, Fischer-Jørgensen 1989, Grønnum & Basbøll 2001, Basbøll 2005). I suggest that stød is represented as a laryngeal feature, which I write as [constricted glottis], or [c. g.] for convenience (e. g. Halle & Stevens 1971, Avery

& Idsardi 2001), attached directly to the moraic node rather than being subsegmental, i. e. dominated by a root node. The difference between short-vowel stød and common Danish stød lies in the fact that the former is associated with an empty mora that is not projected by a segment but is instead inserted due to top-down prosodic conditioning requirements; the latter represents the same feature, but the mora it attaches to is projected by a long vowel or by a sufficiently sonorous coda.

The proposed analysis bears both on the nature of suprasegmental featural representations and on the analysis of 'tonal accent' systems. The [c. g.] feature is not qualitatively different from distinctive features in the subsegmental domain (such as, indeed, [c. g.] as commonly used to encode phonetic properties such as 'ejective' and 'glottalized'). In other words, the association of features with root nodes is not a hard constraint on the architecture of phonological representations. Given this blurring of the lines between 'subsegmental' and 'suprasegmental' features, the analysis brings out the close relationship between stød and 'tonal accents'. This similarity is even more pronounced if we accept recent analyses of North and West Germanic 'tonal accent' systems in terms of lexically specific metrical structure coupled with general mechanisms for the assignment of tone (Morén-Duolljá 2013, Kehrein forthcoming, Hermans 2009, 2012, Köhnlein 2011, forthcoming, van Oostendorp forthcoming) rather than the traditional view of lexical tones.

In section 2 I provide a very brief overview of the nature of common Danish stød and introduce some of the representational machinery used in this paper. Section 3 presents relevant data from Zealand Danish, with reference to both short-vowel stød and the covert 'tonal accent' system of this variety. The analysis is provided in section 4, where I discuss its representational aspects and account for the distribution of short-vowel stød using Optimality Theory. In 5 I discuss the relevance of the results in a broader context, with particular reference to the controversy over the proper representation of 'tonal accent', and show some broader applicability of the representational devices proposed in the paper. Section 6 provides a brief conclusion.

2 Common Danish stød

Danish is well known for the phenomenon of stød, manifested mostly as glottalization on vowels and sonorants (Fischer-Jørgensen 1989). The literature on the phonetics and phonology of stød is enormous; a brief overview can be found in Grønnum & Basbøll (2001), while Basbøll (2005) provides a wide-ranging discussion of numerous aspects of the behaviour of stød in Standard Danish.[1] This type of stød generally corresponds historically to the Accent 1 of Norwegian and Swedish dialects, and appears in most varieties of Danish. I will call this type the 'common Danish stød', using a calque from the convenient Danish term *fællesdansk*. Although the conditioning of the common Danish stød is not the prime focus of the present paper (and it would be impossible to do full justice to the facts here), in this section I provide an overview of those aspects of the phenomenon that are relevant for the present purposes. I mostly follow Basbøll (2003, 2005, *et passim*) in the analysis.

Despite all the intricacies of common Danish stød, it submits to several phonological generalizations. Perhaps the most important among these is the existence of the so-called 'stød basis', i. e. the minimal domain in which stød may appear. Basbøll (2005, p. 277) describes it as follows: 'The notion "stød-basis"... covers two kinds of conditions for a syllable to have stød,

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[1]See Basbøll (2005, pp. 12–16) for discussion of the sociolinguistic content of the term 'Standard Danish'.

namely, (i) a segmental condition: it should have either a long vowel or a short vowel followed by a sonorant consonant; and (ii) a prosodic condition: it should either have primary or secondary stress.' Basbøll (2005) convincingly argues that the proper phonological interpretation of the 'stød basis' notion is a bimoraic syllable (assuming only sonorants contribute to weight in Danish; see Zec 1988, Morén 2001 for discussion of relevant restrictions), and I adopt this analysis here.

Basbøll (2005) argues that stød is the default specification of a second mora in a Danish syllable, i.e. that all bimoraic syllables have stød unless a particular factor intervenes. These factors can be lexical (e.g. lexical extrametricality, which prevents a potentially sonorous coda from projecting a mora) or morphological (certain morphological structures are more or less conducive to stød), but in their absence the phonological computation enforces stød on such morae.

While Basbøll (2005) is relatively agnostic on the exact phonological representation of stød in Danish, other authors have proposed to view stød as an essentially tonal phenomenon, in effect the phonetic realization of a rapidly falling tone (Itô & Mester 1997, Riad 2000b, 2009, Morén 2003).[2] However, Grønnum, Vazquez-Larruscaín & Basbøll (2013) provide arguments against this approach, and defend the 'reification of stød as a non-tonal phonological object' (Riad 2009, p. 12). The analysis presented here is compatible with the position of Grønnum, Vazquez-Larruscaín & Basbøll (2013): irrespective of whether Riad (2000a,b, 2009) is correct with respect to the tonal origin of common Danish stød, synchronically it is seen as a single object attaching to a particular node in the metrical structure, not a composite tonal entity. More specifically, I propose that common Danish stød in a word like ['halˀ] 'hall' (*hal*) is represented as follows:

(1)   Common Danish stød: ['halˀ] 'hall'
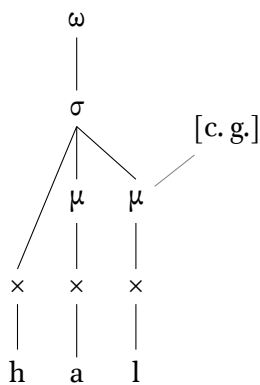
Here, the second mora of the stressed syllable is associated with both segmental content (the consonant [l]) and with the suprasegmental feature [c. g.], which is phonetically realized as creakiness on the sonorant (with some attendant effects such as higher tone on the vowel; see Fischer-Jørgensen 1989).

With this minimum of information regarding the common Danish stød, we now turn to short-vowel stød.

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[2]The relationship between falling tone and creakiness (glottalization) can also be established in other North Germanic dialects (Riad 2000a, Hognestad 2007) and Livonian (Kiparsky forthcoming).

3 Short-vowel stød: data

In this paper I concentrate on a type of stød found in the dialects of the island of Zealand (Sjælland), which Ejskjær (1967) calls 'short-vowel stød' (*kortvokalstød*). Unlike common Danish stød, short-vowel stød is found in monomoraic syllables, i. e. syllables with a short vowel that are either open or closed by obstruents rather than sonorants. In this section I review the evidence for a phonological contrast between common Danish stød and short-vowel stød and then discuss the distribution of short-vowel stød in a number of straightforward cases. In section 3.3 I turn to a more complex class of words with short-vowel stød, namely those that have historically undergone apocope of a final schwa. I show that phonologically these words retain a second syllable, and that such apocopated words demonstrate expected behaviour with respect to short-vowel stød.

The data in this section come from Ejskjær (1965, 1967, 1970), Geist (1976); I refer to these works for in-depth description of the facts. These sources use the Dania transcription system; here, I retranscribe forms using IPA, based on Kristensen (1924) and Basbøll (2005, Appendix 1).

3.1 The phonological status of short-vowel stød

Short vowel stød is characteristic of some traditional dialects of the island of Zealand (Sjælland), mostly those spoken in a wide east-west belt in the central part of the island and also on the northernmost coast (see e. g. the map in Ejskjær 2006). The descriptions by Ejskjær (1967), Geist (1976) include data from the dialect of the parish of Strøby in the south-east of Zealand on the Stevns peninsula (also the subject of the longer Ejskjær 1970), as well as from Højby (north-west Zealand), Alslev (south of Strøby), Skørpinge (south-west Zealand), Glumsø in the central region of the island, and Glænø, an island off the south-west coast of Zealand.

In Zealand Danish, common Danish stød coexists with stød that is associated with a short vowel followed by a voiceless fricative or a stop (or a cluster of two such consonants). Note that there is no laryngeal stop contrast in non-initial position in Danish: the non-syllable-initial unaspirated stops [b̥ d̥ ɡ̊] alternate almost exceptionlessly with syllable-initial aspirated stops: Standard Danish [ˈlɑɡ̊] *lak* 'lacquer', [laˈkʰeːˀə] *lakere* 'to lacquer'. Given this lack of contrast, it is not immediately obvious what the laryngeal specification for these medial stops is, and they certainly cannot be assumed to bear the feature [+voice] that would be required for them to have high sonority.[3] Thus, when Ejskjær (1967) says that short-vowel stød is found after a short vowel before [p t k f s], and clusters containing these consonants, this essentially means short-vowel stød is in complementary distribution with common Danish stød, in that it appears in syllables whose rhymes cannot support a second mora. For instance, this happens when the stressed syllable is open and has a short vowel.

(2) Short-vowel stød in Zealand Danish

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[3]In Standard Danish, word-medial stops are unaspirated and categorically devoiced (Hutters 1985, Basbøll 2005). For Zealand Danish Ejskjær (1970) claims that both voiced and voiceless realizations are possible, with a preference for voiced realizations word-medially. This could be consistent with an account along the lines of Iverson & Salmons (1995), Hsu (1998), Jessen & Ringen (2002), Jansen (2004), Honeybone (2005), where the variation could result from lack of phonological laryngeal specification, but in the absence of detailed instrumental data on the Zealand dialect I will refrain from further speculation.

    a.   ['stɑˀɠ̊əl]   *stakkel*   'wretch'
    b.   ['lɑˀd̥ər]   *latter*   'laughter'
    c.   ['tʰɾˀb̥ɪŋ]   *tippen*   'tip, def. sg.'

Short-vowel stød is restricted to polysyllabic words. In monosyllables containing short vowels followed by (clusters of) [p t k f s], the vowel cannot bear stød:

(3) a.   ['kʰnɑ(*ˀ)ɠ̊]   *knakk*   'to break, past'
     b.   [b̥re(*ˀ)d̥]   *bred*   'wide'
     c.   [ɠ̊lɑ(*ˀ)s]   *glas*   'glass'

Crucially, short-vowel stød is distinct from (common Danish) stød on long vowels, as discussed by Ejskjær (1967, p. 12–14). The number of (sub)minimal pairs is not great, due partly to the fact that Old Danish long vowels tend to be reflected as diphthongs in the Zealand dialect, as in many other island varieties (see e. g. Hansen 1962). Nevertheless, (sub)minimal pairs contrasting stød on short and long vowels are found in the dialect:

(4) a.   ['pʰʌˀd̥ɪŋ]   *potten*   'pot (obsolete unit of measurement), def. sg.'
     b.   [b̥rʌːˀd̥ɪŋ]   *brodden*   'spike, def. sg.'

(5) a.   [b̥røˀɠ̊ɐ]   *brygger*   'to brew, pres.'
     b.   [b̥røːˀɠ̊ɐ]   *brøker*   'fraction, pl.'

(6) a.   ['naˀd̥ən]   *natten*   'night, def. sg.'
     b.   [ɠ̊ra'naːˀd̥ən] *granaten* 'grenade, def. sg.'

Thus, stød on short and long vowels corresponds to different phonological representation in the language. With the existence of this contrast established, we turn to a description of contexts where the short-vowel stød is found in Zealand Danish.

3.2   Unpredictable and predictable stød

In underived forms, the distribution of short-vowel stød is unpredictable: some words of the right phonological shape bear stød, and others do not. Compare the following examples:

(7) Short-vowel stød

    a.   ['stɑˀɠ̊əl]   *stakkel*   'wretch'
    b.   ['ɛˀd̥ɐ]   *efter*   'after'
    c.   ['faˀstɐ]   *faster*   'aunt'

(8) No short-vowel stød

    a.   ['kʰlab̥ɐ]   *klapper*   'clapper'
    b.   ['tʰɛskəl]   *tærskel*   'threshold'
    c.   [kʰa'rafəl]   *karaffel*   'jug'

The same is true in certain morphologically complex forms:

(9) Short-vowel stød

    a. [ˈɛˀsɐ]   *esser*   ‘ace (playing card), pl.’
    b. [ˈnɛˀd̥ɐ]   *nætter*   ‘night, pl.’
    c. [ˈb̥røˀg̊ɐ]   *brygger*   ‘to brew, pres.’

(10) No short-vowel stød

    a. [ˈlɛb̥ɐ]   *lapper*   ‘sheet of paper, pl.’
    b. [ˈd̥oftɐ]   *dufter*   ‘smell, pl.’
    c. [ˈtʰab̥ɐ]   *taber*   ‘to lose, pres.’

The unpredictability of the distribution in these contexts means that whatever motivates the appearance of stød here, it definitely does not follow exclusively from the phonological shape of the word; in other words, the distribution here is lexically and/or morphologically conditioned at least to a certain extent. However, there are at least two contexts where short-vowel stød is required irrespective of lexical conditioning, i. e. wherever the two important conditions of bisyllabicity and coda make-up are met.

One of these is the definite singular form of monosyllabic words. Recall that monosyllables generally do not bear short-vowel stød; however, the addition of the postposed definite article always leads to short-vowel stød:

(11) a. [ˈløst]   *lyst*   ‘desire’
     b. [ˈløˀstən]   *lysten*   ‘desire, def. sg.’

(12) a. [ˈtʰɪb̥]   *tip*   ‘tip’
     b. [ˈtʰɪˀb̥ɪŋ]   *tippen*   ‘tip, def. sg.’

ɹfsdklj <glodss> fdslk <
A second context where short-vowel stød is invariably found in Zealand Danish is in the second part of a compound, again provided that the underlying form is both disyllabic and does not provide a coda of sufficient sonority for the first syllable. Thus, even if the word in isolation does not bear short-vowel stød, secondary stress in the compound requires the appearance of the stød:

(13) a. [ˈb̥røg̊ɐ]   *brygger*   ‘brewer’
     b. [ˈølˌbrøˀg̊ɐ]   *ølbrygger*   ‘beer-brewer’

(14) a. [ˈhog̊ɐ]   *hugger*   ‘cutter’
     b. [ˈkʰlamb̥ˌhoˀg̊ɐ] *klamphugger* ‘sloppy worker’

Finally, we find obligatory short-vowel stød on verbal roots when preceded by the unstressed prefixes *be-* and *for-* (and followed by another syllable):

(15) a. [fʌˈpʰiˀsg̊əð]   *forpisket*   ‘to whip, past participle’
     b. [fʌˈløˀstəlsə]   *forlystelse* ‘entertainment’
     c. [b̥eˈnʏˀd̥ə]   *benytte*   ‘to use, inf.’

Note that the identity of the first unstressed syllable as a prefix is crucial: words with a similar prosody that do not contain a prefix may have short-vowel stød, but it is not obligatory:

(16) Short-vowel stød

    a. [kʰaˈpʰɪˀd̥əl]   *kapitel*   'chapter'
    b. [reˈg̊iˀstɐ]   *register*   'list'

(17) No short-vowel stød

    a. [miˈrɑg̊əl]   *mirakel*   'miracle'
    b. [spɪˈtʰɑg̊əl]   *spektakel*   'noise'

Before we continue to the analysis of short-vowel stød, I discuss the behaviour of disyllables with (historical) final [ə].

3.3 Apocope and 'tonal accent' in Zealand Danish

All examples of words with short-vowel stød in the previous section involve words where the syllable following the stressed one contains a sequence of schwa and a sonorant ([n], [l] or [ð]) or the segment [ɐ], phonologically [ɹ] or at least derived from /ər/ in Danish, see the discussion in Basbøll (2005). Given the phonotactics and morphology of Danish, we expect many words to have the shape CVC(C)ə, but these are not represented in the previous section. Here, I discuss the historical development and synchronic structure of such words, and argue, following in many respects Ejskjær (1970), that they should be treated together with the disyllables discussed in the previous section.

Many Danish dialects are characterized by historical apocope of word-final schwa. Whereas in the dialects of Jutland the apocope is completed, many island dialects show variability in apocope; examples of such varieties are the dialects of Funen and Zealand. The description of the Eastern Funen dialect by Andersen (1958) only refers to 'variability' in the realization of the final schwa in forms such as [ˈføːlə] 'to follow' (*følge*), [ˈgrisə] 'pigs' (*grise*), and [ˈhʌb̥ə] 'to hop' (*hoppe*). For Zealand, however, more reliable data are available, in particular in Larsen (1976). In Ejskjær (1967, 1970), the final schwa is generally not written, whereas the word-final consonant is normally written as long: [ˈføːl̩], [ˈg̊riːs̩], [ˈhʌb̥̩].

Nevertheless, Larsen (1976) shows that pairs such as [ˈgris] 'pig' and [ˈgriːs] 'pigs' are normally distinct in the Zealand dialect. The distinction can be expressed in a number of ways. The final schwa in historically disyllabic words is normally, but not categorically, absent, and thus may contribute to the distinction. It is, however, not the only, or even the main realization of the contrast.

In particular, forms such as [ˈhʌb̥ː] and [ˈg̊riːs], where the second consonant is a voiceless obstruent, contrast with [ˈhʌb̥] and [ˈg̊ris] in terms of their pitch contour: Larsen (1976) describes the contour in the apocopated words as having a 'smoother and later rise' („jævnere og senere rejsning") than the historically monosyllabic words. In cases like [ˈføːl̩], i. e. words with a final sonorant, the contrast is expressed as one of length of the sonorant in addition to the pitch accent.

Further, as Ejskjær (1970) notes, the structural contrast between monosyllabic and apocopated words is preserved in sonorant-final items when such forms become second members of a compound and bear secondary stress.[4] As noted above, in stems that have the right phonological properties (i. e. lack a sonorant coda) that position requires the appearance of

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[4]I use the word 'compound' loosely here, to include both compounds with two roots and particle verbs; their behaviour for our purposes is identical.

short-vowel stød. In fact, stems with basis for common Danish stød also receive [c. g.] in this position, whether they are disyllabic or monosyllabic. Crucially, however, the presence of the apocopated schwa makes a difference to the phonetic realization of what appear to be stød-bearing sonorant codas, as demonstrated by pairs such as the following:

(18) a.   [ˈɛləˌvilˀ]   *ellevild*   'wild'
      b.   [ˈɛləˌvilːˀ]   *ellevilde*   'wild, pl.'

(19) a.   [ˈʌmˌvɛnˀ]   *omvend*   'turn around, imp.'
      b.   [ˈʌmˌvɛnːˀ]   *omvende*   'turn around, inf.'

In forms with monosyllabic second components (as in *ellevild* and *omvend!*), the stød-bearing sonorant is voiceless, with no voice bar and no formant structure visible on the spectrogram. In their apocopated counterparts (*ellevilde* and *omvende*), the presence of the stød does not inhibit full voicing of the sonorant (Ejskjær 1970, p. 41).

The maintenance of this contrast leads Ejskjær (1967, 1970), who works in the strongly structuralist-influenced Danish grammatical tradition, to interpret forms such as [ˈg̊risː] 'pigs' as containing a phonemic final schwa (/grisə/). I suggest, instead, that while the basic insight — the phonologically disyllabic status of such words — is sound, a treatment in terms of a final segment is not appropriate. Instead, I suggest that the *surface* representation of these forms contains an empty nucleus: that is, it contains a root node that projects the requisite metrical structure (making the form disyllabic) but does not dominate any segments, as shown in (20).

(20)   Representation of [ˈmofː] 'muff'
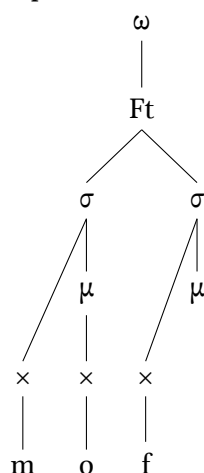
This representation is different from that proposed for Standard Danish by Basbøll (2005, §11.5), who suggests that 'schwa-assimilated' words like [ˈmas] 'mass' (*masse*, with variant form [ˈmasə]) are monosyllabic, with the obstruent treated as a nonmoraic coda. This analysis is partly based on the fact that such forms in Standard Danish are not distinct from underlyingly monosyllabic ones like [ˈmas] 'Mads (personal name)'. This cannot be the case in Zealand Danish, since the contrast is still expressed by pitch movement and other means.

In fact, the contrast between [ˈhʌb̥] 'hop' and [ˈhʌb̥ː] 'to hop' could be described as one of tonal accent (cf. Ringgaard 1960a, Ejskjær 1990), although the distribution of these accents is quite different from the familiar accent 1 vs. accent 2 contrast of Norwegian and Swedish. Specifically, in Zealand Danish the 'tonal accent' distinguishes between what appear to be monosyllables, whereas in the most varieties in of Norwegian and Swedish monosyllables neutralize

the accent contrast. I suggest that the pitch contrast between [ˈhʌb̥] 'hop' and [ˈhʌb̥ː] 'to hop' is best expressed as a contrast in the number of syllables, with the latter represented as in (20). Thus, the 'tonal accent' contrast involves not distinctive tones but rather distinctive metrical structure, coupled with general rather than lexically specific mechanism for the assignment of tone. This proposal fits quite well with the approach of Larsen (1976), who suggests that mono- and polysyllables in Zealand Danish differ not in the tonal contour itself but in the fact that in monosyllables the contour is spread over a larger domain.

More specifically, the second mora in a form like [ˈhʌb̥ː] 'to hop' (more precisely [ˈhʌb̥_]) provides a later landing site for a high tone, leading to the smoother rise throughout the initial syllable. Absent a detailed description of the intonation system of the language, I will, for simplicity, assume a L*H melody for the stressed syllable (cf. Donegal Irish, Dalton & Ní Chasaide 2005, and Köhnlein 2013 for more discussion of declarative rising contours and their role in the genesis of 'tonal accents'). In a monosyllabic form such as [ˈhʌb̥] 'hop', both the L* and the H tones are associated to the initial syllable to give a relatively steep rise, whereas in a disyllabic [ˈhʌb̥_] 'to hop' the H tone gets associated to the second syllable, producing the 'smoother and later rise'.[5] The difference is illustrated in (21).

(21) a. Tonal representation of [ˈhʌb̥] 'hop'

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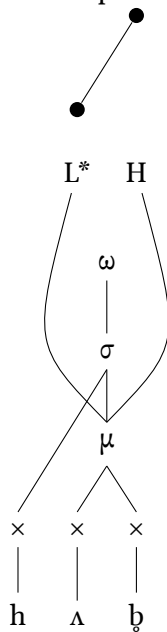
[5]Other interpretations are available, of course: for instance, one could see the pitch accent as a H* tone that is realized later in phonologically disyllabic words due to peak delay. This does not change the fundamental phonological generalization.

b. Tonal representation of [ˈhʌb̥_] 'to hop'
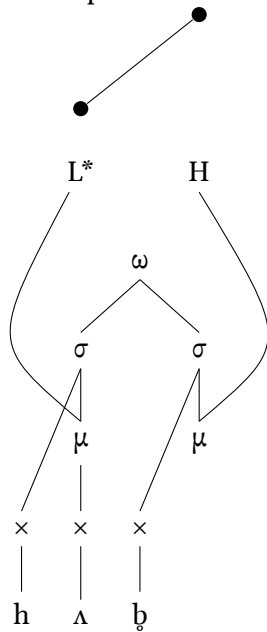
Since it is the timing of the pitch contours, rather than the presence of a schwa-like portion of the signal, that appears to be the main correlate of the contrast in Zealand Danish, I suggest that postulating a word-final phonological schwa in these cases is no longer warranted. A [ə]-type acoustic phenomenon is a not an *a priori* unreasonable phonetic implementation of an empty nucleus, especially given that the second syllable is also required to host a tone. The alternative of assuming a word-final schwa in the output of phonology would require a gradient phonetic implementation rule with an unclear status.

I do not consider sonorant-final forms such as [ˈføl:] 'to follow' in detail here; it might well be that they have the representations proposed by Basbøll (2005), which do not involve empty nuclei. However, since any stød in such forms is of the common Danish rather than the short-vowel variety, they are a relatively peripheral concern for the purposes of the present paper.

Having established the phonological representation of forms such as [ˈhʌb̥:] 'to hop', we will now consider their behaviour with respect to short-vowel stød.

3.4   Short-vowel stød in apocopated words

The distribution of short-vowel stød in apocopated words is essentially identical to its distribution in the forms described in section 3.2. Thus, for instance, in underived forms of the right phonological shape the distribution of stød is lexically determined (although apparently the number of such words with stød is very small)

(22)   Short-vowel stød

a.	[ˈsɪˀst:]	*sidste*	'last'
b.	[ˈeˀg̊:]	*ikke*	'not'
c.	[ˈʌˀs:]	*også*	'too, also'

(23) No short-vowel stød

    a. [ˈpʰub̥ː]   *puppe*   'larva'
    b. [ˈd̥ysː]   *dysse*   'dolmen'
    c. [ˈb̥øsː]   *bøsse*   'rifle'

Note that apparently no CVC_ nouns have short-vowel stød; given that CVCəS (where S is a sonorant) nouns do appear to take stød quite freely, this could be a historical gap rather than a real one. Crucially, CVC_ nouns also fail to acquire short-vowel stød in the definite singular form, even though it is obligatory for CVC nouns:

(24) a. [ˈkʰlɑ(*ˀ)g̊ː]   *klokke*   'bell'
     b. [ˈkʰlɑ(*ˀ)g̊ən] *klokken*   'bell, def. sg.'

Short-vowel stød is also possible when the relevant stem is preceded by an unstressed syllable or another stem in a compound. For the purposes of this generalization, apocopated words also behave like other monosyllables. In cases of possible stød (the stem being preceded by an unstressed syllable other than the prefix *be-* or *for-*), short-vowel stød is possible but not obligatory:

(25) Short-vowel stød

    a. [pʰrenˈsɛˀsː]   *prinsesse*   'princess'
    b. [ʌˈmʌˀsː]   *om også*   'even if'

(26) No short-vowel stød

    a. [ɑˈd̥rɛsː]   *adresse*   'address'
    b. [raˈd̥askː]   *radaske*   'good-for-nothing woman'

When the short-vowel stød is obligatory (i. e. following unstressed *be-* and *for-* and as the second element in a compound), CVC_ forms behave like any other disyllabic form and take the stød even if it is absent in isolation:

(27) a. [ˈhɑd̥ː]   *hatte*   'hat, pl.'
     b. [ˈhɑlmˌhɑˀd̥ː] *halmhatte* 'straw hat, pl.'

(28) a. [ˈaskː]   *aske*   'ash'
     b. [ˈpʰʌd̥ˌaˀskː] *potaske*   'potash'

(29) [b̥eˈrɛˀd̥ː]   *berette*   'tell, inf.'

To sum up the distribution of short-vowel stød, it is found in disyllabic forms, where the first syllable has a short vowel and the stem does not provide the melodic material of sufficient sonority to project a second mora. Adopting the traditional terminology used for common Danish stød, I shall refer to forms whose phonological make-up is compatible with exhibiting short-vowel stød, as having a *basis* for short-vowel stød.

In certain contexts, short-vowel stød is obligatory, subject to these phonological restrictions; in others, its presence is possible but not obligatory. In the next section I provide an analysis of short-vowel stød.

4 Analysis

Given the analysis of common Danish stød as involving a [c. g.] feature on a second mora projected by a segment in section 2, I propose to view short-vowel stød as being the realization of an essentially similar structure, albeit with the second mora not dominating a segmental node. Thus, the contrast between [ˈb̥røːˀɡ̊ɐ] 'fractions' (*brøker*), with common Danish stød, and [ˈb̥røˀɡ̊ɐ] 'to brew, present' (*brygger*), with short-vowel stød, is represented as in (30).

(30) a. Common Danish stød: [ˈb̥røːˀɡ̊ɐ] 'fractions'
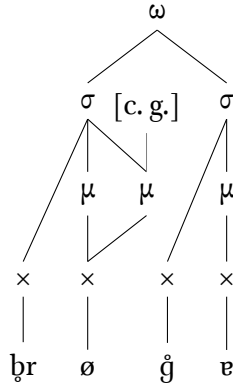
   b. Short vowel stød: [ˈb̥røˀɡ̊ɐ] 'to brew, pres.'
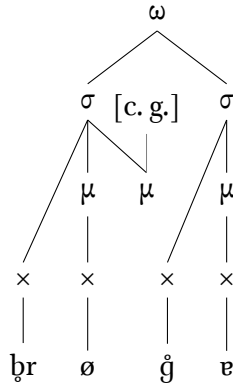
With these representations in mind, we turn to the analysis of the distribution of short-vowel stød. It will be useful to distinguish between three subcases:

1. The definite singular of nouns: obligatory short-vowel stød for CVC nouns, obligatory lack of short-vowel stød for CVC_ nouns

2. Forms with unstressed prefixes

3. Underived forms with short-vowel stød

I will argue that short-vowel stød is licensed only in a particular prosodic context, namely that in a recursive foot (Elfner 2011, Martínez-Paricio 2013). The definite article clitics force the construction of a recursive foot when adjoining to CVC forms but not when adjoining to CVC_-ones, which accounts the difference between these two types of nouns. This requirement for short-vowel stød to be licensed by higher-level metrical structure also provides a reason for the absence of CVˀC forms, as these lack the melodic material to construct a recursive foot.

4.1 Short-vowel stød and enclisis

In this section I argue that short-vowel stød must be licensed by a metrical structure that is constructed when an enclitic cannot use pre-specified structure and has to project a syllable in order to be correctly parsed. This situation arises particularly with the definite singular forms of CVC nouns, so we start the analysis there.

4.1.1 Obligatory short-vowel stød and non-minimality

Short-vowel stød is obligatory in the definite singular forms of monosyllabic nouns (which I shall refer to as CVC for convenience) of the right phonological shape, even if the underived form lack short-vowel stød. This applies to nouns of both genders, so the stød is not necessarily tied to a particular definiteness morpheme.

(12, repeated)   Common gender

    a.   ['tʰɪb̥]   *tip*   'tip'

    b.   ['tʰɪˀb̥ɪŋ]   *tippen*   'tip, def. sg.'

(31)   Neuter gender

    a.   ['vɑɡ̊s]   *voks*   'wax'

    b.   ['vɑˀɡ̊səð]   *vokset*   'wax, def. sg.'

Although the definite forms of CVC_ nouns appear to have the same phonological shape as those of CVC nouns, there is no obligatory short-vowel stød:

(32)   a.   ['mofː]   *muffe*   'muff'

      b.   ['mofən]   *muffen*   'muff, def. sg.'

(24, repeated)   a.   ['kʰlɑɡ̊ː]   *klokke*   'bell'

               b.   ['kʰlɑɡ̊ən]   *klokken*   'bell, def. sg.'

I suggest that the appearance of short-vowel stød is driven by the special prosody of singular definite forms. As in other North Germanic languages, definiteness in Zealand Danish is expressed by the so-called postposed definite article, which takes the form /ən/ in the common gender and /əð/ in the neuter gender respectively (phonetically also [n̩] and [ð̩]). In many North Germanic varieties, these definiteness markers exhibit special prosodic behaviour. In particular, while they interact in non-trivial ways with common Danish stød (a point to which we shall momentarily return), it is important to note that in Norwegian and Swedish their presence does not change the tonal accent of the word. The fact that they are outside the domain of tonal accent assignment leads authors such as Wetterlin (2010, §4.2.1.2, for Norwegian) and Morén-Duolljá (2013, for Swedish) to treat them as enclitics rather than inflectional morphemes (see also Lahiri, Wetterlin & Jönsson-Steiner 2005b; although contrast Riad 2014, §10.5.2, where these are treated as prosodically neutral suffixes). I suggest that this interpretation can usefully be transplanted to Zealand Danish.

For the purposes of this paper, I assume that the property of being a (prosodic) clitic entails adjoining to a foot rather than being incorporated into it. I suggest that the definite morphemes /ən/ or /əð/ are encliticized just in the case where they have to project a nucleus. Assuming that clitics are adjoined to a foot to form a recursive foot, we arrive at the following metrical

structure for the definite singular [ˈtʰɪˀb̥ɪɲ] 'the tip' (the importance of the circled and squared nodes is explained below):

(33)
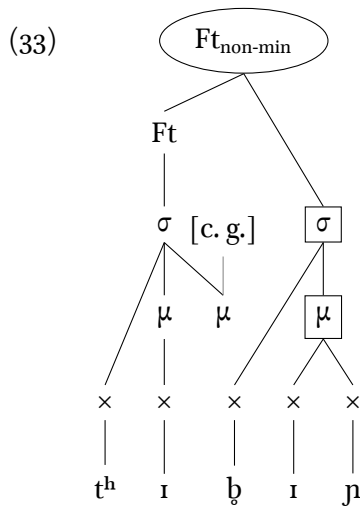
The stem-final consonant [b̥] fails to project a mora, since its sonority is too low for this in Danish. (This failure is less likely to be due to a ban on ambisyllabic geminates, as shown by the case of sonorant-final stems discussed below). Here, I assume for concreteness that it is simply resyllabified to become an onset, although see Basbøll (2005, chap. 9) for arguments that such consonants remain codas, based in part on the fact that they do not behave like onsets for the purposes of consonant gradation. The precise analysis here is immaterial for the present purposes.

There are two important considerations here. First, the circled node in (33) represents a *non-minimal* foot (cf. Martínez-Paricio 2013, and Itô & Mester 2009, 2013 for the use of recursion below the level of the word), since it dominates another foot node. The essence of the analysis is that short-vowel stød appears because the heads of non-minimal feet are required to branch, but in some cases the melodic material provided by the lexicon does not allow for a mora to be projected by a segment. Since repairs such as vowel lengthening or segmental epenthesis are unavailable, the phonology has no choice but to license the mora by associating it directly with a [c. g.] feature. In a sense, short-vowel stød in this case is the mirror image of [h]-epenthesis in Huariapano as analysed by Bennett (2013), where enhancement constraints enforce the insertion of a crucially non-moraic segment, while in Zealand Danish they require the epenthesis of a mora, but not of a segment.

Note that under the standard assumptions of X-bar theory the circled node in (33) is not only non-minimal (dominating another node of the same type) but also maximal (not dominated another node of the same type). The branching requirement, however, must make reference to a non-minimal rather than a maximal foot. This is because a non-recursive constituent is also maximal under this definition, and requiring (the first syllables of) maximal feet to branch would incorrectly predict short-vowel stød in CV monosyllables like [ˈnʌ(*ˀ)] 'now' (*nå*).

4.1.2 Non-enclisis and pre-specified metrical structure

If, as suggested above, short-vowel stød is connected with the presence of enclitic elements, then its lack in the definite forms of CVC_ nouns requires an explanation. On the surface, it

would appear that CVCən/CVCəð forms should have the same structure, irrespective of whether they are morphologically /CVC-ə{n,ð}/ or /CVC_-ə{n,ð}/. In this section I argue that the presence of the lexically stored empty nucleus in CVC_ forms provides a crucial condition for the blocking of cliticization, and consequently the failure of short-vowel stød to appear in superficially similar forms.

The definite singular [ˈmofən] 'the muff' is represented as follows:

(34)

Ft

σ   σ̨

μ   μ̨

×   ×   ×   ×   ×

m   o   f   ə   n
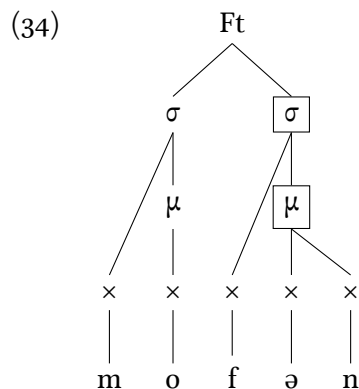
There is no recursion of the foot node in (34), unlike in (33), and thus there is no non-minimal foot that requires a branching head. I suggest the key difference between the two types lies in the status of the syllabic and moraic nodes highlighted by a square. In (33), the nodes that dominate the nucleus in the definite clitic are projected by the clitic itself, because the noun 'tip' lacks the segmental structure to project a second syllable when unsuffixed. Faithfulness constraints prevent the incorporation of new syllables into a minimal foot at the stage when the definite article is inserted. This forces recursion, which incorporates the clitic into a non-minimal foot.

In contrast, the underlying form of the word 'muff' already contains an (empty) syllable node that the definite article can use receive a prosodic parse; this form was given above as follows:

(20, repeated)   Representation of [ˈmofː] 'muff'

Ft

σ   σ

μ   μ

×   ×   ×

m   o   f
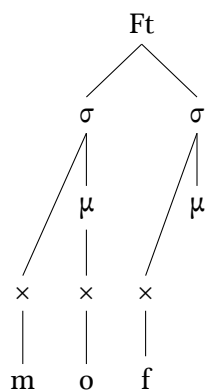
The segmental material in the definite article becomes incorporated into the metrical structure without the need to project a syllable that is not already present in the underlying representation. Since there is no need for recursion, the sole foot node is not non-minimal, and does not enforce a branchingness requirement.

4.1.3   The connection between stød and clitics

As far as I am aware, the proposition that the definite article morphemes are (at least in certain circumstances) clitics cannot be straightforwardly tested by other phonological means.[6] There is, nevertheless, evidence that the appearance of short-vowel stød is independently connected with encliticization, which provides a further argument for the importance of clitic status.

The phenomenon of 'enclitic stød' is studied in detail by Geist (1976), who focuses on combinations of monosyllables with unstressed forms of personal pronouns (both direct and object cases, and including the inanimate *den*, *det*) and the adverbs *her* 'here' and *der* 'there', i. e. phrases such as *gik her* 'went here', *slap ham* 'let him go (past)', *til hende* 'to her'. Such unstressed forms appear to fulfil most accepted criteria for clitic status, and there is, as far as I am aware, no evidence for viewing them as affixes.

According to Geist (1976), the host regularly acquires short-vowel stød when the entire group has short-vowel stød basis:

(35)   a.   [ˈslɑˀb̥ hɑm]   *slap ham*   'let him go (past)'
      b.   [ˈloˀg̊ d̥n]   *luk den!*   'close it!'

(36)   a.   [ˈtʰeˀ d̥n]   *til den*   'to it'
      b.   [ˈmɛˀ hɑm]   *med ham*   'with him'

Geist (1976) explicitly says that such syntagms are not distinct from 'single words', including, crucially, noun-article combinations: example (35b) *luk den* is not distinct from *lugten* 'the smell' [ˈloˀg̊d̥ən]. In other respects, these host-clitic combinations in Zealand Danish also behave like noun-article complexes. For instance, there is no addition of stød to disyllabic words, even with empty nuclei, as in disyllabic *han* [ˈstød̥_] *sig* 'he stumbled' with no stød (*han stødte sig*) versus monosyllabic *han har* [ˈstøˀd̥] *sig* 'he has stumbled' (*han har stødt sig*). Similarly, words that are stød-less in isolation appear with common Danish stød when followed by an enclitic: [ˈgœɐˀman] 'one does' (*gør man*), [ˈiːˀʌs] 'in us' (*i os*), again in parallel with the definite singular of stød-less nouns.

I conclude that the parallel between what are undoubtedly clitic-host combinations and the definite singular forms of nouns is strong enough to warrant a unified treatment, and since the affixal solution is clearly inappropriate in the former case, we can treat the latter as involving a clitic adjoining to a foot. In addition, 'enclitic stød' provides a strong argument for treating short-vowel stød as a phonological phenomenon. While its appearance in connection with morphological events such as suffixation of the article or compounding might tempt us to view it as being an exponent of some morphological category, enclitic stød must clearly be part of fully productive postlexical phonological computation, which by necessity involves chunks larger than the morphological word.

Note that an alternative analysis of the 'enclitic stød' facts is available, involving recursive prosodic words rather than feet. I discuss this approach below and show that it is not tenable

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[6]The syntactic analysis of the postposed definite articles is contested: authors such as Faarlund (2009) have argued that the definiteness markers have become affixes, but others point out that their status does not necessarily preclude clitic-like phonological behaviour (e. g. Lahiri, Wetterlin & Jönsson-Steiner 2005b, Börjars & Harries 2008). It might be worth noting that many of the arguments for affixhood hinge on the so-called 'double definiteness' (the concurrent presence of a preposed definiteness marker and the bound article in certain constructions), which is not generally characteristic of Danish.

for independent reasons. It is worth noting here that 'enclitic stød' is triggered not only by cliticization to content words, as in (35) but also when two functional elements come together in a phrase, as in (36). In the former case, it is reasonable to expect the presence of a prosodic word node in the input, which is crucial to the analysis; in the latter case, on the other hand, constructing a prosodic word over the single functional element such as a preposition is difficult to motivate. This still leaves the question of how exactly groups such as those in (36) are prosodified, which I leave open for reasons of space and focus. However, if the constituent involved is the foot rather than the word it stands to reason that the prosodification is driven by metrical considerations and constraints on layering, which do not force the assumption of prosodic words formed over functional elements (see e. g. Šurkalović 2013 for some discussion, albeit with reference to English).

4.1.4 OT analysis

In this section I argue that the distribution of short-vowel stød is determined by the combined effect of constraints that require featural licensing for morae and faithfulness to input metrical structure. Short-vowel stød is parasitic on the creation of a recursive foot. Its appearance is due to a family of constraints which I shall refer to as LICENSE-μ:

(37) LICENSE-μ[F]: assign a violation mark for every mora that is not associated with some feature

(38) LICENSE-μ[Seg]: assign a violation mark for every mora that is not associated with some root node

In most cases, these constraints are satisfied, since most morae are projected by some segment (a vowel or a coda of sufficient sonority). They become more important, in situations where a mora is inserted due to top-down requirements rather than being projected 'bottom-up'.

Consider the definite singular of CVC nouns, as in [ˈtʰɪʔb̥ɪŋ] 'the tip'. It has the following metrical structure.

(33, repeated)
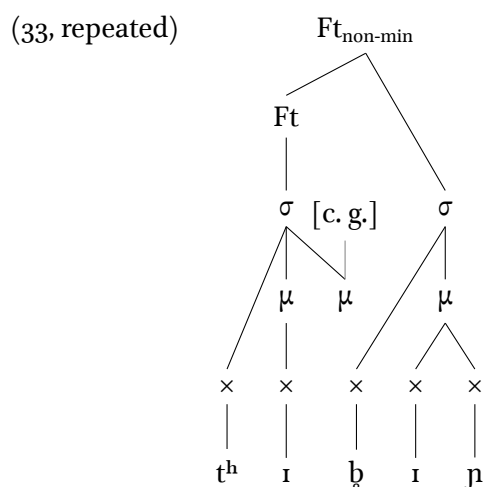
Under this representational system, we need to provide an account for two facts beyond the addition of [c. g.] to the second mora in the first syllable: the appearance of that mora and the construction of the recursive foot. I suggest the following analysis:

1. Under a clitic analysis of the definite article, the input to phonological computation at the stage where the article is concatenated with the stem contains a fully prosodified form of the stem, complete with a foot node;

2. The recursive foot is constructed because faithfulness prohibits the insertion of association lines between a minimal foot (i. e. one that is not dominated by another foot) and a syllable node;

3. There is a requirement for initial syllables in recursive structures to be bimoraic.

In concrete OT terms, these requirements can be implemented as follows, respectively:

1. The input in the computation of ['tʰɪˀb̥ɪŋ] 'the tip' is /('tʰɪb̥)$_{Ft}$ɪŋ/. In this paper I assume a stratal/cyclic mode of phonological computation (e. g. Bermúdez-Otero 2011), so that prior to the suffixation of the article the stem has already undergone a cycle of phonological computation, including prosodification and foot construction;

2. The insertion of association lines is prohibited by a constraint of the DEPLINK family (Morén 2001): in this case, DEPLINK(Ft$_{min}$,σ).

3. For the sake of the argument, I implement the bimoraicity requirement as a head-dependent asymmetry along the lines of Dresher & van der Hulst (1998), using the constraint BRANCHING COMPLEXITY/Ft$_{non-min}$, which requires the head of a recursive foot to have more branches than its dependent. This has to dominate DEP-μ, prohibiting the insertion of morae.

The construction of the recursive prosodic word requires DEPLINK(Ft$_{min}$,σ) to dominate *RECURSION-Ft, which militates against recursive prosodic words; for the sake of brevity I do not show constraints which ensure that the definite article does project a syllable node.

(39) DEPLINK(Ft$_{min}$,σ) ≫ *RECURSION-Ft

/('tʰɪb̥)$_{Ft}$ɪŋ/	DEPLINK(Ft$_{min}$,σ)	*REC-Ft
a. [('tʰɪb̥ɪŋ)$_{Ft}$]	*!	
b. ☞ [((('tʰɪˀ)$_{Ft_{min}}$b̥ɪŋ)$_{Ft}$]		*

Among the candidates with the recursive foot, the ranking selects one where LICENSE-μ is satisfied through the attachment of [c. g.] to the second mora. The analysis is shown in (40).

(40)

/('tʰɪb̥)$_{Ft}$ɪŋ/	BRCOMP-Ft	DEPLINK(V,μ)	*μ[b̥d̥g̊]	LIC-μ[F]	DEP([c. g.])
a. [(((tʰɪ)$_{Ft}$b̥ɪŋ)$_{Ft}$]	*!				
b. [(((tʰiː$_{μμ}$)$_{Ft}$b̥ɪŋ)$_{Ft}$]		*!			
c. [(((tʰɪb̥$_μ$)$_{Ft}$b̥ɪŋ)$_{Ft}$]			*!		
d. [(((tʰɪ($_{-μ}$))$_{Ft}$b̥ɪŋ)$_{Ft}$]				*!	
e. ☞ [(((tʰɪˀ$_μ$)$_{Ft}$b̥ɪŋ)$_{Ft}$]					*

Candidate (a.) fails to satisfy BRANCHING COMPLEXITY by not having a heavy initial syllable in the recursive structure. Candidates (b.), (c.), and (d.) do ensure the correct branching asymmetry, but violate other constraints. Candidate (b.), with vowel lengthening, falls foul of a DEPLINK constraint that prohibits vowels from acquiring a mora that they are not associated with in the input (see Morén 2001 for discussion of such cases). Candidate (c.) provides the branching structure using gemination of the stop, but moraic obstruents are generally prohibited in the language due to $*\mu[\b{b}\d{d}\g{g}]$. Finally, candidate (d.) simply inserts a second mora but does not associate it with any melodic material: although it is not obvious how this structure would be phonetically realized, the representational system provides for this possibility; the candidate is eliminated by LICENSE-$\mu[F]$.

In the case of disyllabic words like /mof_/ 'muff', no violation of *REC-Ft is necessary, since there is no need for the foot incorporate a syllable that is not already present in the input. This case provides an insight into the connection between the two rankings identified above: the incorporation of the definite article into the preceding foot incurs a violation of DEPLINK(V,μ), and the fact that it is allowed in the winning candidate shows the higher ranking of the no-recursion constraint relative to DEPLINK(V,μ):

(41)

/(mof_)$_{Ft}$ən/	DEPLINK(Ft$_{min}$,σ)	*REC-Ft	DEPLINK(V,μ)	DEP([c. g.])
a. ☞ [(mofən)$_{Ft}$]			*	
b. [((moʔ)$_{Ft}$fən)$_{Ft}$]		*!		*

A final explanandum in this section is the behaviour of sonorant-final words, which are not eligible for short-vowel stød. In isolation, they may or may not bear common Danish stød: [ˈhalʔ] 'hall' (hal) but [tʰal] 'number' (tal). Crucially, the addition of the definite article forces that appearance of stød in the stem: [tʰalʔəð] 'the number' (tallet).

In representational terms, as noted above, I follow the analysis by Basbøll (2003, 2005), who sees common Danish stød as the automatic addition of the laryngeal feature onto any second mora of a syllable, which in Standard Danish can only be projected by a sonorant or a vowel. Consequently, Basbøll (2003, 2005) contends that special provision must be made not for stød on sonorant codas (as in [ˈhalʔ]) but for its absence (as in [ˈtʰal]), and analyses the latter as involving lexically specified consonant extrametricality: /tʰa<l>/. Since extrametricality is only available at a word edge, the suffixation of the definite article forces the final sonorant to lose its special status and be parsed as a moraic geminate in line with the behaviour of sonorants in the language generally.

This analysis is compatible with the analysis of short-vowel stød proposed here. Under the rankings in this section, [ˈtʰalʔəð] 'the number' also contains a recursive foot, and should thus have a bimoraic initial syllable. In such words, however, the second mora can be provided by the sonorant, since $*\mu[son]$ is ranked relatively low (Morén 2001). The winning candidate has the following structure:

(42)

Ft$_{non-min}$
- Ft
  - σ [c. g.] σ
    - μ μ / μ
      - × × × × ×
        - tʰ a l ə ð
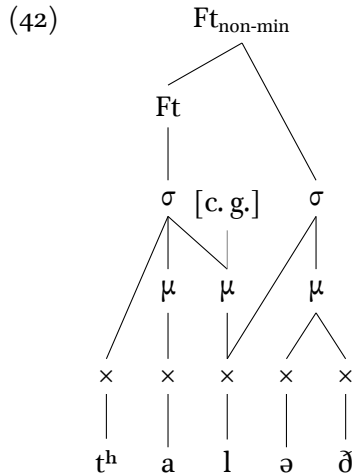
The OT analysis is shown in (43); for reasons of focus, I do not consider in detail the ranking that forces all second morae in a syllable to become associated with stød even when they are otherwise segmentally and featurally licensed, but the relevant constraints (notated as STØD for convenience, although see below for one possible concrete proposal) clearly outrank DEP([c. g.]).[7]

(43)

/(tʰa)$_{Ft}$ləð/	STØD	BRCOMP-Ft	DEP([c. g.])	LIC-μ[Seg]	*μ[son]
a. [((tʰa)$_{Ft}$ləð)$_{Ft}$]		*!			
b. ☞ [((tʰalʔ$_μ$)$_{Ft}$ləð)$_{Ft}$]			*		*
c. [((tʰal$_μ$)$_{Ft}$ləð)$_{Ft}$]	*!				*
d. [((tʰaʔ$_μ$)$_{Ft}$ləð)$_{Ft}$]			*	*!	

Candidate (a.) fails to provide the second mora in the branching structure. Candidate (c.) satisfies the branching requirement by creating an ambisyllabic geminate [l], which projects a mora but lacks stød; this is generally disallowed in Danish. Candidate (d.) has short-vowel stød, in parallel to obstruent-final stems. It ties with the winning candidate on DEP([c. g.]), since both receive some sort of stød; however, candidate (b.) wins, because the second mora is licensed by a segment, a requirement that short-vowel stød fails to satisfy. Thus, the proposed ranking accounts for the behaviour of both short-vowel stød and common Danish stød in clitic constructions.[8]

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[7]For simplicity's sake, I follow Basbøll (2005) in viewing the sonorant in ['tʰalʔəð] as a classic flopped geminate, although there is no phonetic length associated with this segment (see Grønnum & Basbøll 2001 for discussion). An alternative analysis would be to assume that the sonorant is crisply captured as a coda, with the following syllable remaining onsetless; see e. g Bye & de Lacy (2008) for an analysis of flapping in New Zealand English along these lines.

[8]This analysis also provides evidence for choosing the foot rather than the word as the key recursive constituent (cf. section 4.1.3). Briefly, the fact that an extrametrical consonant must be incorporated into the prosodic word under definite article suffixation follows automatically if the stem-article complex is contained within a single (maximal) foot. Moreover, if extrametricality involves adjunction to a prosodic word (cf. Vaux & Wolfe 2009 for discussion), and the recursive constituent requiring branching heads was the word rather than the foot, the analysis in section 4.1.1 would require words like /tʰa<l>/ 'number' to be represented in the input as /((tʰa)$_ω$l)$_ω$/. This would be counterfactually expected to surface with short-vowel stød.

A final set of ranking arguments involving the constraints discussed in this section involves the underived forms of words such as ['mof_] 'muff'. Above it was suggested that these contain a final empty mora that remains unlicensed either segmentally (e. g. through the insertion of some default vowel) or featurally (through the insertion of [c. g.]). The lack of segmental licensing must be due to some faithfulness constraint dominating Lɪᴄ-μ[Seg]. I suggest that this constraint is the positional version of Mᴀx-μ that applies only to morae that head syllabic domains ([Beckman 1998](#)); I write this as Mᴀx-μ$_{Hd}$. It follows that *non-head* empty morae may not be preserved, since they are not protected by Mᴀx-μ$_{Hd}$; I argue that featurally unlicensed non-head morae are indeed disallowed in Zealand Danish below in section [4.3](#).

As for the lack of featural licensing, I suggest that, although Lɪᴄ-μ[F] outranks Dᴇᴘ([c. g.]), the candidate ['mof_ʔ] fails because of a general ban on the association of head positions in the *syllable* with the feature [c. g.].[9] This constraint prohibits all morae which head a Danish syllable from bearing [c. g.]. This constraint is generally unviolated in Danish: if we assume that the head mora in the syllable is the leftmost one, its action accounts for the fact that [c. g.] only ever associates to *second* morae, whether in common Danish or short-vowel stød.[10] Following [de Lacy (2006)](#), I write the constraint as $^*\Delta_\sigma$[c. g.] ('assign a violation mark for each head of syllabic domain associated with [c. g.] ').

(44)

/mof_/	Mᴀx-μ$_{Hd}$	Lɪᴄ-μ[Seg]	$^*\Delta_\sigma$[c. g.]	Lɪᴄ-μ[F]	Dᴇᴘ([c. g.])
a. ☞ ['mof_]		*		*	
b. ['mof]	*!				
c. ['mof_ʔ]		*	*!		*

4.2 Short-vowel stød and unstressed prefixes

In this section I analyse another context where short-vowel stød is obligatory, namely that of polysyllabic forms with unstressed prefixes. I show that the appearance of short-vowel stød in this context is driven by the same principles as in the case of definite singulars of CVC nouns. In addition, these forms provide valuable evidence for a generalization that cannot be extracted from the definite singular cases, namely that short-vowel stød may only appear in a non-final syllable. This generalization plays an important role in the analysis of lexical short-vowel stød that follows in section [4.3](#).

Short-vowel stød is completely disallowed in monosyllables (section [3.2](#)). The requirement for stød to be licensed only in a recursive foot immediately accounts for this distributional gap, since monosyllables lack the segmental content to build such a structure, much as the tonal accent contrast in most varieties of Norwegian and Swedish is neutralized in monosyllables due to the requirement for 'accent 2' to be realized over two syllables.

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[9]Cf. the *Pᴇᴀᴋ/X constraints in [Prince & Smolensky (1993)](#) or, more pertinently, constraints on domain heads in [de Lacy (2006)](#)

[10]In fact, one possible formalization of the constraint Sᴛøᴅ in (43) is the ranking $^*\Delta_\sigma$[c. g.] $\gg$ Lɪᴄ-μ[c. g.] $\gg$ Dᴇᴘ([c. g.]), with the middle constraint also replacing Lɪᴄ-μ[F]. This would force all non-head morae in Danish to bear stød. The difference between Standard Danish and Zealand Danish would then be easily derivable in terms of the ranking of Lɪᴄ-μ[Seg]: in Zealand Danish, its low ranking ensures the possibility of both short-vowel stød and empty morae in words like ['mof_], which are *both* absent in Standard Danish.

The behaviour of verbal forms with unstressed prefixes [b̥e-] and [fʌ-] provides further evidence for the necessity of a following syllable in forms with short-vowel stød. Given the right segmental content in the stem, short-vowel stød is obligatory following these prefixes, *but only if another syllable follows*:

(15, repeated) a. [fʌˈpʰiˀskəð]   *forpisket*   'to whip, past participle'[11]
               b. [fʌˈløˀstəlsə]   *forlystelse*   'entertainment'
               c. [b̥eˈnʏˀd̥ə]   *benytte*   'to use, inf.'

If the post-prefix part is monosyllabic, short-vowel stød is impossible, as in all other cases where the short-vowel stød basis is absent:

(45) [fʌˈslɪd̥]   *forslidt*   'tattered'

The consistently unstressed status of [b̥e-] and [fʌ-] suggests that they have some lexical property that influences their prosodic parse. There are a number of options for what that property might be. Basbøll (2005) suggests that these prefixes in Standard Danish have the lexical property of not being included in a minimal stem, and also that they are not specified as bearing a [stress] feature. For Norwegian, where much the same facts hold, Kristoffersen (2000) proposes a cyclic solution, where the prefixes are concatenated with the stem after the application of the main stress rule in the latter. Finally, Riad (2014) analyses the Swedish prefixes as involving subcategorization for a recursive prosodic word. In this section, I argue that the latter approach holds most promise for the Zealand Danish facts.

The proposed representation for a short-vowel stød word with an unstressed prefix is shown in (46).

(46)   Representation of [fʌˈpʰiˀskəð] 'whipped'

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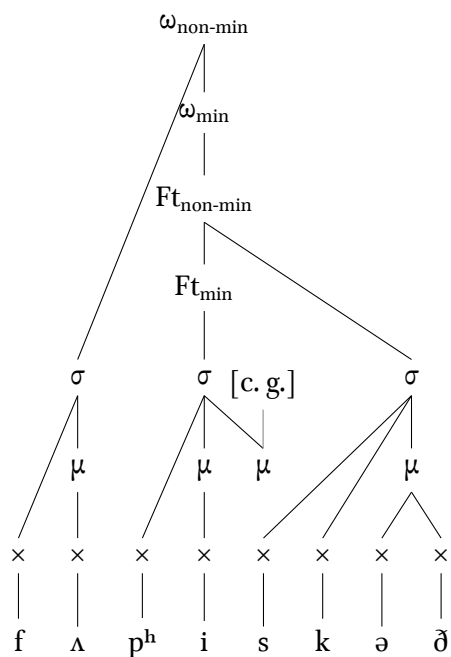
[11]See section 5.3 below for the exact representation of non-moraic codas.

Note that the minimal prosodic word (i. e. the whole form minus the prefix) has exactly the same metrical structure as the noun-definite article combinations discussed in section 4.1, and the appearance of short-vowel stød is driven by the exact same mechanism. The explanandum in this section is why the second syllable in the minimal prosodic word has to be adjoined to a preceding foot rather than being incorporated into it. I propose that a consideration of the domain structure of such forms allows us to assimilate them to the enclisis cases discussed above.

It is worth noting that there is a morphosyntactic restriction on the words discussed in this section, since the prefixes *be-* and *for-* are generally associated with verbal roots; Ejskjær (1967, p. 23–24) is explicit about this, saying that a second stressed syllable in a trisyllabic (or longer) word has short-vowel stød 'as long as the [initial] unstressed syllable is one of the prefixes *be-* or *for-* added to a *verbal root*' (emphasis mine).[12]

Both the morphosyntactic restriction and the appearance of short-vowel stød are accounted for in a stratal/cyclic model of phonological computation, if the prefixes are required to adjoin to a prosodic word. The domain structure of forms such as [b̥eˈnʏˀd̥ə] 'use (infinitive)' is $\llbracket^{\mathcal{WL}}\llbracket^{\mathcal{SL}}$b̥enʏˀd̥$\rrbracket$e$\rrbracket$: the innermost domain is reasonably analysed as the stem, whereas the inflectional suffix is a word-level domain. This analysis, incidentally, is compatible with that proposed by Basbøll (2005) on the basis of the behaviour of common Danish stød, where the unstressed prefix and the root cohere to form a domain Basbøll calls MED-STEM, and which can joined with unproductive suffixes to form a 'minimal word', the innermost domain for stød-manipulating rules. The fact that *be-* and *for-* show idiosyncratic semantics also supports the view of the '*be-* + root' complex as a stem-level domain; see Kaisse & McMahon (2011), Bermúdez-Otero (2012) for discussion of the 'stem-level syndrome'.[13]

If the portion /b̥enʏd̥/ is a stem, it is expected to undergo phonological computation, including prosodification (see also Bermúdez-Otero 2012, 2013 for arguments that stem-level constructs are lexically stored with metrical structure, including foot structure). Coupled with the requirement for the prefix /b̥e/ be adjoined to a prosodic word, the result is that the root *must* project a monosyllabic foot, as shown in (47).

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[12] „[N]år blot den trykløse stavelse er et af præfikserne *be-* ell. *fʌ-* 'for' føjet til en verbal rod."

[13] We also find short-vowel stød in deverbal derivatives like *forlystelse* 'entertainment', which include suffixes that do not fall within Basbøll's 'minimal word' domain, but since they are derived from verbal stems (cf. *forlyste* 'to entertain'), they still have the stem-level domain boundary after the root: $\llbracket\llbracket$fʌløˀst$\rrbracket$əlsə$\rrbracket$.

(47)

The projection of the foot follows from basic layering assumptions: if the prefix is lexically required to adjoin to a prosodic word, that prosodic word must be projected; but under standard assumptions a prosodic word includes at least one foot.

At later levels, this prosodified input is concatenated with other suffixes, which may or may not be syllabic. When they are syllabic, however, the situation is exactly parallel to that seen with definite clitics in section 4.1.4: a syllable has to be incorporated into an input foot (circled in (47)), which forces the creation of a recursive foot and the satisfaction of asymmetry requirements through short-vowel stød. When there is no additional syllable projected after suffixation, as in [fʌˈslɪḍ] 'tattered', nothing forces foot recursion, and hence there is no short-vowel stød.

Having established that short-vowel stød is only licensed in a disyllabic recursive foot, we turn to cases where its distribution is less predictable, and where faithfulness must be involved. I argue that the relevant aspect of faithfulness is metrical structure rather than the presence of stød itself.

4.3 Lexical short-vowel stød

In the case of morphologically simple words, the distribution of short-vowel appears unpredictable, as the following pairs demonstrate:

(7, repeated)   Short-vowel stød

    a. [ˈstɑˀǧəl]   *stakkel*   'wretch'
    b. [ˈɛˀḍɐ]   *efter*   'after'
    c. [ˈfaˀstɐ]   *faster*   'aunt'

(8, repeated)   No short-vowel stød

    a. [ˈkʰlɑḅɐ]   *klapper*   'clapper'
    b. [ˈtʰɛskəl]   *tærskel*   'threshold'
    c. [kʰaˈrafəl]   *karaffel*   'jug'

In OT, such unpredictability arises when the relevant property (short-vowel stød) is present in underlying representations of some morphemes and reproduced faithfully when present. When the property is absent underlyingly, and when its appearance is not enforced by the computation (as in the cases considered above), it is also absent in surface forms. In terms of constraint ranking, relevant faithfulness constraints must outrank (at least some) markedness constraints. In this section, I argue that the constraints relevant to the preservation of input stød do not necessarily refer to stød itself but rather to metrical structure.

The crucial evidence is provided by underived forms which *lack* short-vowel stød basis, notably monosyllabic ones. Recall that short-vowel stød is impossible unless the relevant form is at least disyllabic; this indicates that some markedness constraint outranks the faithfulness constraint that requires the preservation of the stød. More specifically, a form such as /b̥reˀd̥/, provided by the rich base ([McCarthy 2005](#)), cannot surface with short-vowel stød (contrast [ˈb̥red̥] 'wide'), due to the effect of some markedness constraint.

I suggest that this constraint is Lɪc-μ[Seg], which we already encountered in the analysis of stød, where it forced common Danish stød rather than short-vowel stød where a sonorant coda was available (tableau 43). This constraint must outrank Mᴀx([c. g.]), which demands that instances of [c. g.] present in the input should be preserved in the output, and Mᴀx-μ, which could otherwise force the retention of the input mora.

(48) No preservation of lexical short-vowel stød

/b̥re_ˀd̥/	Lɪc-μ[Seg]	Mᴀx([c. g.])	Mᴀx-μ
a. [ˈb̥re_ˀd̥]	*!		
b. [ˈb̥re_d̥]	*!	*	
c. ☞ [ˈb̥red̥]		*	*

Note that this ranking only applies to non-head morae. As discussed above in section [4.1.2](#), in the case of morae that are the heads of syllables Mᴀx-μ_{Hd} *must* outrank Lɪc-μ[Seg], because such unlicensed morae are preserved in disyllables like [ˈmof_] 'muff' thanks to them being the head of the syllable; this is a classic positional faithfulness effect as discussed by [Beckman (1998)](#).

How, then, does lexically determined short-vowel stød surface at all? I suggest that since short-vowel stød in underived forms obeys the same prosodic conditions as that in derived contexts, the same structure that forces its appearance in the latter (i. e. a recursive foot) must also be present in the former, except that in this case it is lexically specified rather than derived by the computation. Thus, the presence of short-vowel stød in a morpheme like [ˈstɑˀɡəl] 'wretch' is due to the fact that the morpheme is stored with *lexical foot structure*, namely as /((stɑ)_{Ft_{min}}ɡəl)_{Ft}/, as opposed to /tʰɛskəl/ 'threshold', which is not stored with this sort of recursive structure. For ease of exposition, assume for the moment that the [c. g.] feature is also stored. The correct result obtains under the ranking in (49), where Fᴀɪᴛʜ(Ft) is a shorthand for the constraint or constraints that demand the preservation of input foot structure.

(49)

/((stɑˀ)$_{Ft}$ǧəl)$_{Ft}$/	Lɪᴄ-μ[F]	Fᴀɪᴛʜ(Ft)	BʀCᴏᴍᴘ-Ft	Lɪᴄ-μ[Seg]	Mᴀx([c. g.])	Mᴀx-μ
a. ☞ [((stɑˀ)$_{Ft}$ǧəl)$_{Ft}$]				*		
b. [((stɑ$_{-μ}$)$_{Ft}$ǧəl)$_{Ft}$]	*!			*	*	
c. [((stɑ)$_{Ft}$ǧəl)$_{Ft}$]			*!		*	*
d. [(stɑǧəl)$_{Ft}$]		*!			*	*

The same result is obtained even if the [c. g.] feature is not stored lexically: the correct outcome must contain a recursive foot due to faithfulness, and the ranking shown in (40) then compels the insertion of a [c. g.]-bearing mora.

The crucial role of Bʀᴀɴᴄʜɪɴɢ Cᴏᴍᴘʟᴇxɪᴛʏ is underscored by the fact that short-vowel stød is absolutely impossible in monosyllables. Technically, if foot recursion is allowed by Gᴇɴ, one could imagine a monosyllabic input with a recursive foot leading to short-vowel stød. However, since the persistence of the segmentally empty mora is enforced by Bʀᴀɴᴄʜɪɴɢ Cᴏᴍᴘʟᴇx-ɪᴛʏ, which is vacuously satisfied by a non-branching (i. e. monosyllabic) recursive foot, Lɪᴄ-μ[F] compels the deletion of the stød.

(50)

/((b̥reˀd̥)$_{Ft}$)$_{Ft}$/	Lɪᴄ-μ[F]	BʀCᴏᴍᴘ-Ft	Lɪᴄ-μ[Seg]	Mᴀx([c. g.])	Mᴀx-μ
a. [((b̥reˀd̥)$_{Ft}$)$_{Ft}$]			*!		
b. [((b̥re$_{-μ}$d̥)$_{Ft}$)$_{Ft}$]	*!		*	*	
c. ☞ [((b̥red̥)$_{Ft}$)$_{Ft}$]				*	*

The winning candidate in (50) does have a vacuous recursive foot; given the absence of short-vowel stød in such forms, such structures probably cannot be phonetically implemented in a way that would make them distinct from ordinary monosyllables, so the learner would never be tempted to set up such inputs. What is important here, however, is that this lack of distinction between stød-bearing and stødless monosyllables is not accidental but rather established by the ranking, which correctly rules out short-vowel stød in this prosodic context.

Since the metrical structure is assumed to remain in place throughout the paradigm, the present approach accounts for the tendency of short-vowel to not cause paradigmatic alternations: '[short-vowel] stød appears in the definite singular, plural, and indefinite plural of words of the [ˈstɑˀǧəl] 'type" (Ejskjær 1967, p. 21).[14]

This relative stability of short-vowel stød contrasts with common Danish stød, which shows numerous paradigmatic alternations depending on a number of phonological, morphological, and lexical factors (Basbøll 2005). Under the present account, this difference stems from the different nature of lexical specifications involving the two types of stød. With short-vowel stød, there is little pressure in the phonological grammar to remove the lexically specified recursive foot, which therefore persists under affixation, as does the stød. With common Danish stød, the lexical specification, under the analysis by Basbøll (2005), is *lack* of moraicity, which can be overridden by a variety of factors in different paradigm cells, leading to complex alternations.

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[14] „Stød forekommer i bsgl., pl. og bpl. af ord af typen 'stakkel'…"

Tellingly, if short-vowel stød is *present* in a morphologically simpler form, it is also *present* in a derivative. If it is *absent* in some form in the paradigm, it can also *appear* in a different cell. In the current analysis, this means that the morphosyntactic properties associated with the stød-bearing form are spelled out by a morpheme that includes the recursive metrical structure. A case in point is the small number of verbs that lack short-vowel stød in the infinitive but acquire it in the present tense, as in [ˈb̥røg̊_] 'to brew' (*brygge*), present [ˈb̥røˀg̊ɐ] (*brygger*). It is by no means the case that all present-tense forms of monosyllabic verbs acquire short-vowel stød, which shows that there is nothing in the phonological make-up of present-tense forms that requires short-vowel stød. As the process is lexically specific, it is easily formalized as involving a separate conjugational class of verbs that form their present tense by combining a segmental suffix /ər/ with a recursive-foot template. A similar account is applicable to the few plurals that show short-vowel stød absent in the singular, as in [ɛs] 'ace', pl. [ɛˀsɐ] 'aces' (*es*, *esser*). Most crucially, there do not appear to be cases where a more complex form lacks short-vowel stød but a simpler one shows it. This is accounted for by faithfulness to foot structure persisting under all manner of affixation, which means that phonology is powerless to destroy the context for stød.

4.4   Stød in compounds

A final context for short-vowel stød is regularly found in second components of compounds under secondary stress, provided they have the correct structure, i. e. are disyllabic and consist of the correct segments (Ejskjær 1965). Its obligatory nature in this context may be accounted for if we assume that compounding involves the imposition of a particular prosodic template, which in the case of Zealand Danish involves the same sort of recursive foot as that seen in lexically stored short-vowel stød. The creation of this template appears to be somehow a part of the morphological operation of compounding rather than a function of the phonological make-up of the stem. The crucial difference between 'compound stød' and other type of short-vowel stød is the fact that the former obligatorily applies to underlyingly disyllabic words, contrast (51b) and (51c):

(51) a. [ˈask_]   *aske*   'ash'
      b. [ˈaskən]   *asken*   'the ash'
      c. [ˈpʰʌd̥ˌaˀsk_]   *potaske*   'potash'

It would thus appear that a solution relying on adjunction to a monosyllabic foot, as in the case of unstressed prefixes (section 4.2) is not directly applicable here. The requirement for a disyllabic, recursive foot in the second element of a compound could be either simply morphological or connected to some kind of templatic requirement active in the conjunction of two separate phonological words. I leave the precise elucidation of the nature of this requirement for the future. From a phonological perspective, however, if such a templatic requirement is enforced, it creates the correct conditions for the epenthesis of [c. g.] much as in the other cases of short-vowel stød.

This concludes the phonological account of short-vowel stød in Zealand Danish. For the sake of completeness, the full ranking is shown in fig. 1.
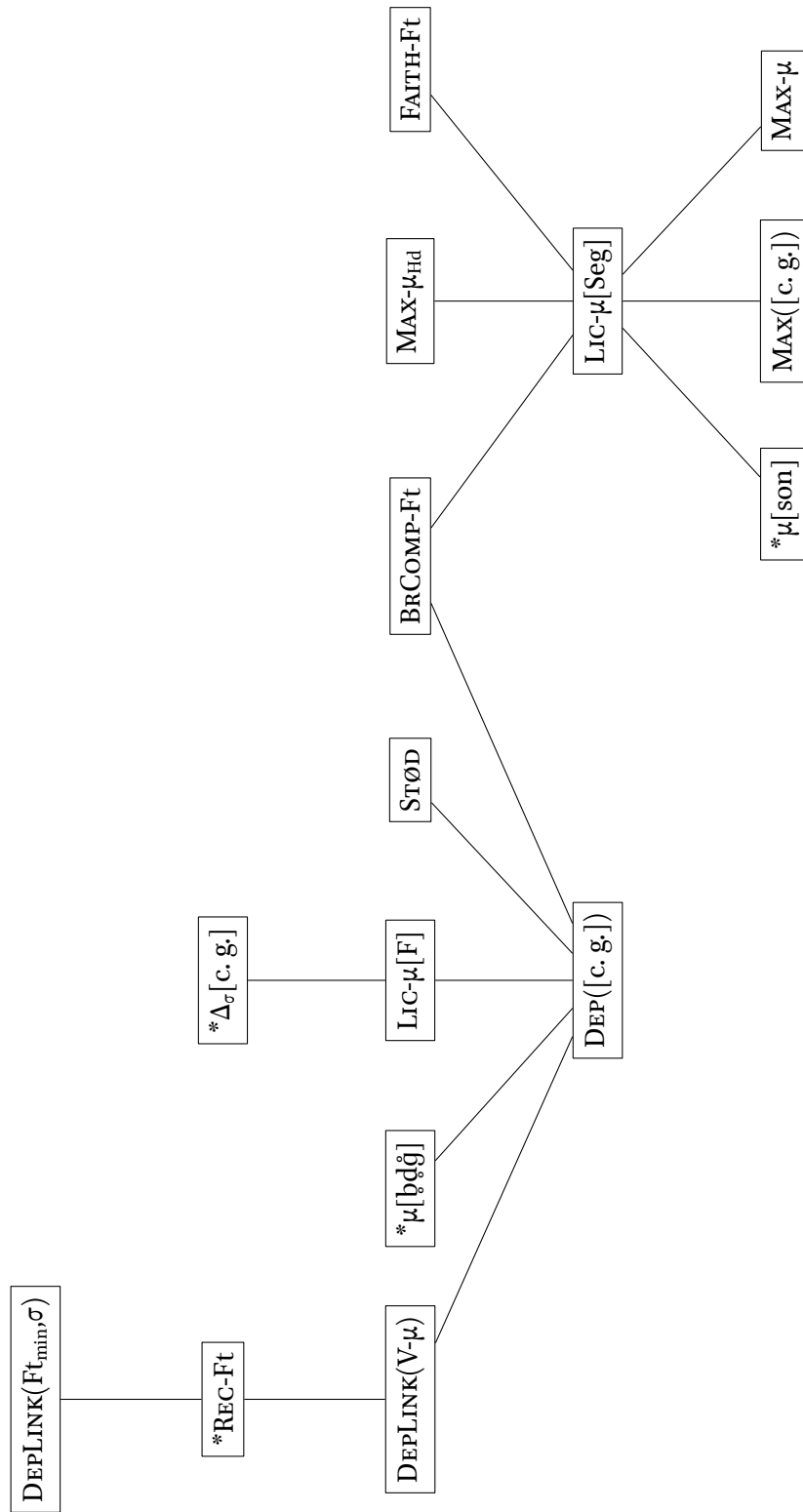
Figure 1: The complete ranking

4.5 Stød and syllable weight

The representation of short-vowel stød as a marker of syllable weight is not dissimilar to the analysis given by Ejskjær (1967, 1970). Working in the structuralist Danish tradition, she sees both short-vowel stød and common Danish stød as the representation of vowel or consonant length: for instance, [ˈbrøːˀɡ̊ɐ] 'fractions' is phonemically /bröökər/ and [ˈbrøˀɡ̊ɐ] 'brew (pres.)' is phonemically /brökkər/. Such an analysis is perhaps feasible in purely descriptive terms; I submit, however, that it does not contribute directly to explaining the nature of the phenomenon at hand.

Most obviously, given the lack of an elaborated theory of suprasegmental structure, it is not at all clear why 'consonant length' interacts with top-down prosodic conditions and properties such as the number of syllables in a word. Moraic structure provides a way of tying the internal structure of higher-level constituents with their syntagmatic properties; 'consonant length' does not appear to have any prosodic properties. Therefore, I conclude that the representation used here provides a more motivated account of the properties of short-vowel stød.

5 Discussion

In this concluding section I put the proposed account of short-vowel stød into the broader context of 'tone accent' system in Germanic and discuss some theoretical issues arising from the existence of empty morae.

5.1 Contrastive metrical structure

The major point of this paper concerns the interaction of (covert) metrical structure and suprasegmental phonological units such as features and tones. In the case of Zealand Danish, I have proposed that there are two phenomena where the presence of a particular metrical structure determines the presence of particular suprasegmental correlates: 'covert disyllables' (section 3.3) and short-vowel stød itself. In this section I argue that this type of interaction between metrical structure and suprasegmental features is consistent with what can be found elsewhere in Germanic (and beyond).

As noted above in section 3.3, the diachronic process of apocope has not led to a neutralization of the contrast between mono- and disyllables in Zealand and Funen Danish. Since the contrast is expressed through a difference in pitch contours, it has naturally been conceptualized in the literature as a type of 'tonal accent' distinction (Ringgaard 1960a, Larsen 1976, Ejskjær 1990). Such an approach to the accentual consequences of apocope is not unprecedented even within the relatively narrow confines of the North Germanic group: apocope has also led to the creation of a 'tonal accent' contrast in monosyllables in a large area of central Scandinavia (Trøndelag, Norrland and parts of Northern Norway), where the old disyllables bear so-called 'circumflex accent'; see e. g. Dahlstedt (1962), Liberman (1975), Apalset (1978), Elstad (1979), Dalen (1985), Kristoffersen (1992, 2011a), Almberg (2001), Lorentz (2008).

In generative approaches, such distinctions have normally been formalized by assuming the presence of lexical tone: a representative example is the analysis of Urban Eastern Norwegian by Kristoffersen (2000). In that variety, 'accent 1' is realized with a L+H contour, and 'accent 2' is realized as H+LH, and under Kristoffersen's analysis 'accent 2' words have a lexical H tone that 'accent 1' words lack. In principle, this analysis could be extended to Zealand Danish, for instance by assuming a H tone on old monosyllables and a L+H contour on old disyllables.

The proposal in section 3.3 to view this distinction as a matter of (lexical) contrast in metrical (more precisely syllabic) structure, if correct, makes Zealand Danish an example of an alternative analysis of tonal accents. Under this alternative 'metrical' analysis tonal accent contrasts are formalized without reference to lexical tone: the tonal differences arise from contrasts in metrical structure and a single phonological grammar that assigns the same tonal melody to different metrical structures in the several accentual classes. This approach has previously been applied to other North Germanic languages by Morén (2003), Morén-Duolljá (2013), to Franconian tone accents (Köhnlein 2011, forthcoming, Kehrein forthcoming, Hermans 2009, 2012, van Oostendorp forthcoming) and to Scottish Gaelic (Ladefoged 2003, Iosad 2015). In all of these cases, the pitch differences are, at least in some contexts, seen as a matter not so much of the presence or absence of certain tones but rather of the *alignment* of a single tonal melody across different domains, and indeed this 'metrical' approach is consistent with the suggestion by Ladd (2004, 2005) that (phonetic) differences in the alignment of pitch peaks are the diachronic source of both 'tonal-accent' systems (as in Swedish and Norwegian, Hebridean Gaelic, or most of Franconian) and prosodic contrasts involving glottalization (as in Danish, Argyll Gaelic, and Cologne Franconian).

With regard to Zealand Danish, an important empirical advantage of this metrical account of tonal differences between mono- and disyllables is the possibility of an explicit connection between these facts and short-vowel stød. Recall that mono- and disyllabic nouns differ in whether they acquire short-vowel stød under suffixation of the definite article. Under the account proposed here, the connection between disyllabicity and short-vowel stød is explicit: only monosyllables cannot incorporate the article into the same foot, so recursion occurs and leads to short-vowel stød. It would seem that whatever the precise details of any tonal account, it is difficult to see how the presence of a particular lexical tone should have an influence on the behaviour of the stem under suffixation. The metrical analysis, on the other hand, ties together the tonal pattern of disyllabic words and the syllable-count-related restrictions on short-vowel stød. Therefore, Zealand Danish presents an important argument for the viability of the metrical approach to Germanic tonal accent contrasts.[15]

5.2   Laryngeal features and metrical structure

A crucial representational device for the account presented here is the possibility of assigning features that are normally associated with the subsegmental domain to suprasegmental nodes. This proposal stands in contrast to the more widespread view whereby prosodic nodes such as morae must be projected by some segmental material. The latter view is, however, not universally accepted, perhaps most notably in frameworks that allow for empty syllable nuclei; see e. g. Kaye (1990), Piggott (1991). As for the association of traditionally subsegmental features to suprasegmental nodes, a very similar proposal has been made by Kehrein & Golston (2004), Golston & Kehrein (forthcoming), who argue that laryngeal features (including, importantly, [constricted glottis]) and vocalic features associate directly to syllabic constituents such as onsets and codas, not to individual segments. Their evidence comes primarily from the cross-

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[15]In addition, if the account proposed here is correct, Zealand Danish shows another case of stored syllable structure, adding to the body of evidence speaking in favour of allowing lexical contrasts in syllabification, or at least in syllable counts; see Vaux (2003), Köhnlein (forthcoming), Ladefoged (2003), Iosad (2015) for other cases and discussion.

linguistic lack of certain contrasts within particular subsyllabic constituents, and they do not consider the possibility that features may associate to segmentally empty prosodic nodes.

I suggest that the approach proposed here, which represents a combination of the two devices independently proposed previously (segmentally empty metrical structure and prosodic licensing of 'subsegmental' features) may be fruitful beyond Zealand Danish. A case in point is Icelandic preaspiration and sonorant devoicing (e. g. Jóhannes G. Jónsson 1994, Ringen 1999, Morén 2001, Pétur Helgason 2002, Gunnar Ólafur Hansson 2003, Kristján Árnason 2011). As is well known, 'fortis' stops following a short stressed vowel (traditionally seen to be 'geminate', given the effect of obligatory bimoraicity) are preaspirated:

(52) a. [ˈθahka]   *þakka*   'to thank'
        b. [ˈfahta]   *fatta*   'to understand'
        c. [ˈkʰɔhpɪ]   *koppi*   'chamber pot (dat. sg.)'

The consensus in the phonetic and phonological literature is that this preaspiration is a separate segment, based on both its durational properties and its phonological behaviour, particularly the fact that it contributes the obligatory second mora in a stressed syllable (see Kristján Árnason 2011 for an overview of previous approaches). Several authors, notably Jóhannes G. Jónsson (1994) and Ringen (1999), have also sought to connect this preaspiration to sonorant devoicing before underlyingly fortis stops:

(53) a. [ˈʋan̥ta]   *vanta*   'to need'
        b. [ˈçaʋl̥pa]   *hjálpa*   'to help'
        c. [ˈʋɛr̥ka]   *verka*   'to process'

I suggest that the device of using segmentally empty nodes associated with a laryngeal feature (in this case, [spread glottis]) provides a unified account of the two phenomena whilst disposing with some traditional assumptions that might be unnecessary. Consider the case of preaspiration. It is often assumed (see e. g. Morén 2001) that words such as *þakka* are lexically stored with fortis geminates (/θakʰ$_\mu$a/) and contrast with words like *baggi* 'bundle' (/pak$_\mu$ɪ/, surface [ˈpakːɪ]), with a short vowel (and another moraic stop) and word like *fata* 'barrel' ([fɑːt(ʰ)a], with the presence of aspiration depending on dialect), stored with a short vowel that undergoes lengthening (with neutralization of the laryngeal contrast outside the stressed syllable).

These accounts suffer from an important shortcoming, especially given an Optimality Theoretic perspective: they fail to consider the full range of possible input candidates, focusing only on /CVC$_\mu$V/ and /CVCV/.[16] In particular, the input /CVCʰ$_\mu$V/ is usually considered to correspond to output [CVːC(ʰ)V] (presumably following the historical development from Old Norse). The input /CVːC(ʰ)V/ tends not to be considered, even though the grammar must be able to map it to a licit output. Given the lack of a preference for consonant moraicity over vowel moraicity, there does not seem to be a reason why such inputs should map to anything other than [CVːC(ʰ)V].

This has consequences for the analysis of preaspiration. If output [CVːC(ʰ)V] is presumed to be faithful (at least as far as moraic structure is concerned), then input /CVCʰV/ does not *have* to undergo vowel lengthening. This means that preaspiration does not have to be restricted to *underlyingly moraic* fortis stops. Assume the word *þakka* is stored lexically as /θakʰa/,

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[16]There is some discussion of deviant inputs in Gunnar Ólafur Hansson (2003), and see Kristoffersen (2011b) for a detailed consideration of related issues in other North Germanic varieties.

with a short vowel and nonmoraic stop. The fully faithful candidate cannot be optimal, since stressed syllables in Icelandic are obligatorily bimoraic. Assume further that vowel lengthening is prohibited, e. g. due to highly ranked DEPLINK(μ,V); see Morén (2001) and Bye & de Lacy (2008) for similar cases. Assume further that, following Ringen (1999), Morén (2001), moraic fortis stops are ruled out. Entirely parallel to the Danish case, an empty mora is added to the stressed syllable to satisfy the top-down bimoraicity requirement, enabling [spread glottis] associating leftwards to this mora. The representation is sketched in (54).

(54) Icelandic: derivation of ['θahka] from /θak^{h}a/
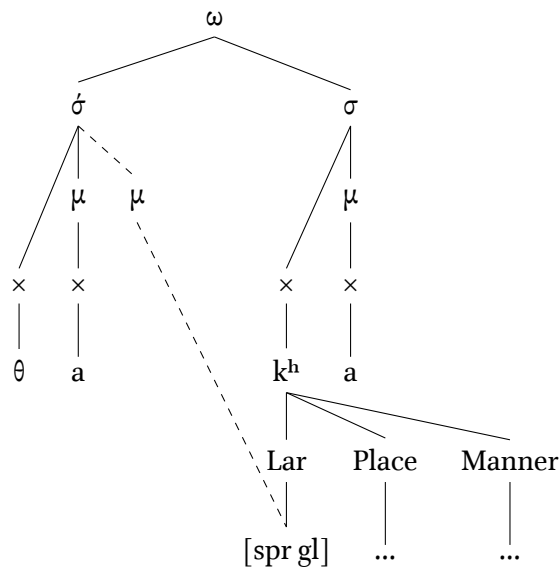
An essentially similar parse is given to an input /θak$^h_\mu$a/, with the difference that the second mora in the stressed syllable is not inserted but present in the input (and that the lexically present link between that mora and the stop is deleted). The spreading of [spread glottis] could be accounted for by the constraint LIC-μ[F], similar to the one used here for short-vowel stød; in view of the existence of sonorant devoicing in Icelandic, however, it seems preferable to suggest that [spread glottis] simply spreads leftward whenever there is a suitable landing site. This gives the entirely parallel representation for sonorant devoicing shown in (55), which is consistent with the approach of Kehrein & Golston (2004), modulo the attachment of the Laryngeal node to the stop rather than the onset.

(55) Icelandic: derivation of [ˈvan̥ta]
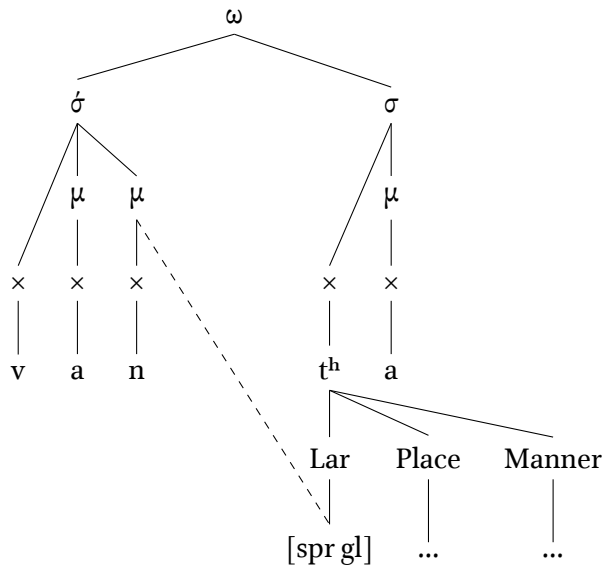
The only difference is that the second mora of the stressed syllable is not inserted due to top-down pressures but projected by the coda through weight-by-position. The mora is therefore licensed. This suggests that there is an independent requirement for [spread glottis] to spread leftward, covering spreading both to empty and segmentally licensed morae. The fact that this account unifies the motivation for preaspiration and sonorant devoicing under the rubric of completely ordinary directional spreading is an advantage over accounts such as that by Ringen (1999), who has to introduce the constraint MULTILINK, which requires that a [spread glottis] feature should be multiply linked in all circumstances and not only when there is a suitable target for spreading (and thus compels the creation of a landing site if it is absent). In this account, the spreading only happens such a target is present: it is not motivated after unstressed syllables, where there is no second mora, or after long vowels, presumably because a mora dominating a vowel cannot be associated with [spread glottis]. Both of these predictions are correct for Icelandic.

In this section I hope to have shown that the linking subsegmental features to prosodic nodes is not necessarily an *ad hoc* theoretical innovation of no use beyond accounting for Zealand Danish; on the contrary, it provides viable analyses of unrelated patterns in other languages. It would, in particular, be an intriguing possibility that a similar representation could be involved in another phenomenon combining stød and short vowels, namely the 'West Jutland stød' (Ringgaard 1960b), which has been argued to be cognate with Icelandic preaspiration (e. g. Pedersen 1912, Page 1997, Gunnar Ólafur Hansson 2001, Kusmenko 2008).[17] I leave further exploration of this phenomenon for the future.[18]

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[17] In fact Kusmenko (2008, pp. 137–138) suggests a possible historical connection between preaspiration and the Zealand type of short-vowel stød, although he acknowledges that the distribution of the two is far from parallel.

[18] Note that I am not suggesting that, for instance, *all* cases of preaspiration (e. g. in languages such as Scottish Gaelic) are to be accounted for in this way. For instance, Northern Sámi as analysed by Bals Baal, Odden & Rice (2012) shows a variety of 'segmentalized preaspiration' superficially similar to the Icelandic one, but the [h] segment produced in this process does not necessarily consist of just a [spread glottis] feature. This is because it patterns with continuants in triggering a process of vowel lengthening, and thus may share some other feature with them.

5.3   Submoraic structure

One issue that is potentially raised by the proposal of segmentally empty morae is the representation of non-weight-bearing codas. Consider a word or word-clitic combination with short-vowel stød followed by an obstruent cluster, such as [ˈvʌˀg̊səð] 'the wax' (*vokset*) or [loˀg̊d̥n] 'close it!' (*luk den*). What is the precise syllabic parse of the postvocalic consonant? It seems implausible that the first syllable should be open ([.ˈvʌˀ.g̊səð.]). One option frequently seen in the literature to deal with consonants that do not contribute to syllable weight (i. e. do not project their own mora) is to adjoin them to the preceding mora; see in particular Broselow, Chen & Huffman (1997). However, it is not immediately obvious how this could be implemented if the preceding mora is empty.

I suggest that a possible solution (again) involves recursion of prosodic constituents. Just like adjunction to a foot and to a prosodic word involves the projection of a recursive word or foot, so adjunction to a mora should also involve recursion. In this case, a syllable like [.vʌˀg̊.] is represented as in (56).

(56)
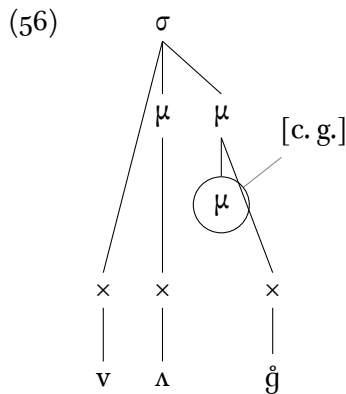
Here, the empty (circled) node is the *head* of the moraic domain; it is a reasonable suggestion that constraints such as *μ[b̥d̥g̊] (cf. de Lacy 2006, where such constraints are also reinvented in terms of moraic domain heads) and Lɪᴄ-μ should really be targeting domain heads rather than simply moraic nodes.

Recursion of subsyllabic constituents has not frequently been proposed in the literature, but such proposals do exist, cf. Hayes (1995), Kariņš (1996) for morae and Smith (1999) for syllables. Since recursion as a representational device is often used to implement adjunction above the level of the syllable, I would suggest that we should not entirely discount the possibility of recursion also below the syllabic level. If this possibility is left open, then closed syllables with short-vowel stød can be accommodated in the present model. Again, I leave a broader investigation of this representational possibility to the future.

5.4   Features or concurrent segments?

A final issue is worth discussing with regard to the key representational proposal of this paper, namely the formalization of stød as a feature attaching to a prosodic node. The crucial aspect of this definition is that stød should not be identified with a glottal stop *segment*, i. e. a representation involving the feature [c. g.] dominated by what many versions of non-linear phonology call the *root node*. This distinction is important for the analysis, since featural and segmental licensing of morae are assumed to be distinct in Zealand Danish.

A possible alternative analysis sees short-vowel stød as involving simple insertion of a [ʔ] segment to satisfy stress-to-weight requirements. An immediate objection to this analysis is that it breaks the representational unity of short-vowel and common Danish stød: if syllables with short-vowel stød have a [ʔ] coda, then, for instance, under standard assumptions an open syllable with a long vowel and stød cannot contain a coda. Technically, it would be possible to propose a representation along the lines of (57):

(57)
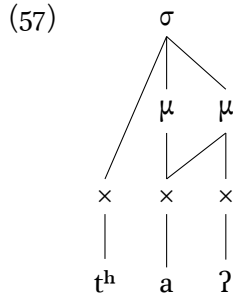
Such a solution, however, does not appear to be much more than a technical fudge, quite apart from the fact that such representations are usually assumed to correspond to surface strings of the form [tʰaːʔ] (e. g. Bals Baal, Odden & Rice 2012). More seriously, note how in (57) the root nodes corresponding to [a] and [ʔ] (i. e. the stød) stand in a crisp precedence relation. This goes against a basic result of the phonetic study of stød (Fischer-Jørgensen 1989) by ignoring the fundamental *simultaneity* of the glottalization and vocalic articulation in stød-bearing syllables.

The simultaneity could be incorporated into an analysis of stød as a glottal stop 'phoneme' by adopting the proposal of Bradfield (2014), who suggests that segments can be not only linearly ordered (as in (57)) but also *concurrent*.[19] Concretely, Bradfield (2014) proposes that certain portions of the phonological output may represent the simultaneous realization of more than one segment otherwise available in the language, represented by means of the operator ⊗. In this case, short-vowel stød is represented simply as the insertion of a glottal stop: [tʰaʔ]. Common Danish stød, on the other hand, can be represented using concurrent segments, especially obviously in the case of a sonorant coda: forms like [halʔ] 'hall' would then more precisely be [ha{l⊗ʔ}].

The problem with this analysis, of course, is that [ʔ] is not usually assumed to be a 'phoneme' of Danish. This problem is especially acute for Standard Danish, where there is no short-vowel stød. For varieties with short-vowel stød, it could be assumed that underived forms with unpredictable stød like ['stɑʔɡ̊əl] 'wretch' exemplify the phoneme /ʔ/, but Standard Danish, of course, lacks such forms, meaning that /ʔ/ can only appear concurrently with another phoneme.

Nevertheless, accepting the existence of a /ʔ/ phoneme in Zealand Danish on the strength of examples like ['stɑʔɡ̊əl] does not immediately resolve the issue of why stød appears in predictable phonological environments such as the definite singular of CVC nouns. The analysis presumably should follow the lines of section 4.1, with the difference that the mora is licensed segmentally rather than purely featurally. The vast majority of the points made in the present paper with respect to the relationship between metrical structure and stød will therefore remain intact. Given the disadvantages of this account for a unified analysis of the two types of

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[19]See also Ladd (2014, ch. 1) for a similar proposal.

stød, I conclude that while a concurrent-segment approach to stød cannot be decisively ruled out, the account proposed in section 4 still has nontrivial advantages.

6   Conclusion

In this paper I have proposed a phonological analysis of the phenomenon of 'short-vowel stød' in the traditional Danish dialects of Zealand. I have argued that its distribution is best understood if we view it as a consequence of top-down prosodic conditioning, whereby certain prosodic categories are required to branch even if the underlying segmental material is insufficient to provide the underpinning for the necessary structures. Short-vowel stød then emerges as a way of featurally licensing the morae inserted by the computation due to this top-down pressure. In representational terms, the understanding of stød as a feature-like (rather than tonal) entity associated to the second mora of a heavy syllable has been argued for in much relevant work, most recently in Grønnum, Vazquez-Larruscaín & Basbøll (2013): the difference between 'common Danish' and 'short-vowel' stød boils down to whether this second mora is projected by segmental material or inserted due to top-down requirements.

The proposal allows us to not only account for the distribution of short-vowel stød in Zealand Danish but also place this phenomenon into its proper cross-linguistic context. Short-vowel stød is not merely a matter of some lexical specification of a particular laryngeal feature: it represents the outcome of interaction between local conditions on prosodic well-formedness and the assignment of suprasegmental features. This type of interaction has been argued to result in a particular type of 'tonal accent' system observed in Germanic and elsewhere. It is also noteworthy that the representational apparatus proposed for short-vowel stød can also be used for common Danish stød. The appeal to (partly lexically stored) metrical structure in accounting for both stød and Swedish and Norwegian tonal accent allows us to bring out the similarities between the two phenomena. Coupled with recent work arguing for a unified prosodic conditioning of stød and Swedish and Norwegian 'accent 1' (Lahiri, Wetterlin & Jönsson-Steiner 2005a, Wetterlin 2010, Morén 2003, Morén-Duolljá 2013), the present paper opens the way to a better understanding of the synchronic similarities between the systems despite the superficial differences in implementation, and without appeals to stød as an essentially tonal phenomenon, which Grønnum, Vazquez-Larruscaín & Basbøll (2013) argue to be unwarranted.

More generally, the proposal in this paper shows the importance of taking seriously the possibilities inherent in current representational theory. Although devices such as empty morae, prosodic adjunction via recursion at all levels of the hierarchy, lexically stored syllabic structure, and direct association of features to prosodic nodes are rarely discussed as viable representational options, they are certainly logical possibilities, and if they are to be excluded, it is desirable that this should be done on strong conceptual and/or empirical grounds. In this paper I have shown that these possibilities can in fact be fruitfully exploited in the analysis of phonological phenomena, and therefore that they should perhaps be taken more seriously by analysts.

Acknowledgements

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