

Schwa loss and its results in Low German

Tone or Overlength?*

Maike Prehn
Meertens Instituut

1. Introduction

The deletion of a final element in a prosodic word is called apocope, the deletion of a non-final element is called syncope. E.g., in an original Middle Limburgian word */beddə/ the final schwa gets deleted diachronically, resulting in Limburgian /bed/ 'bed-n.sg.'. This phenomenon also occurred in the development from Middle Low German (MLG) to modern Low German (LG). The traditional interpretation of schwa loss in LG (e.g. Bremer 1929; Winter 1979; Hayes 1989) is as follows: due to the transfer of the schwa's duration and pitch contour to the preceding vowel, there is compensatory lengthening. Hence, an already long vowel receives even more duration and becomes 'overlong'. This development is accompanied by a change in pitch contour. Thus, long vowels differ from the newly developed overlong vowels not only in overall duration, but also in their 'tonal' behavior. The most frequent terms used in the literature for these 'tones' are *Stoßton* or 'pushing' tone for the pitch contour accompanying long vowels, and *Schleifton* or 'dragging' tone for the pitch contour accompanying the overlong vowels, respectively. Up to now, however, it has not definitely been established whether it is the quantitative contrast or the tonal features that are distinctive in LG.

This article evaluates both positions of phonemic overlength and phonemic tone, considering also some recently collected speech data on LG. It seeks to show that the tonal distinction is primary, and the durational differences can be deemed phonetic by-effects.

In Section 2, I present some recently collected data of LG, along with a brief phonetic survey. The emerging issue is first approached in Section 3, where I investigate the hypothesis of LG overlength and demonstrate the problems of this account. Section 4 develops an alternative approach in terms of tonal representations that accounts for the distribution of tones in LG. Section 5, finally, gives the conclusion.

2. Speech data

The area of investigation is located south of the city of Hamburg, in the village of Altenwerder,¹ and east of the city of Hamburg, in the village of Kirchwerder. In the former case, 176 intonationally varying sentences were recorded, produced by three informants, age range from 60 to 89, who are native speakers of Altenwerder LG (Aw.). These subjects had lived in Altenwerder until their relocation in the 1970s. In the case of Kirchwerder, similar recordings were made of two informants in their mid 70s, who speak Kirchwerder LG (Kw.) as their first language. All informants have High German (HG) as their second language and an educated social background.

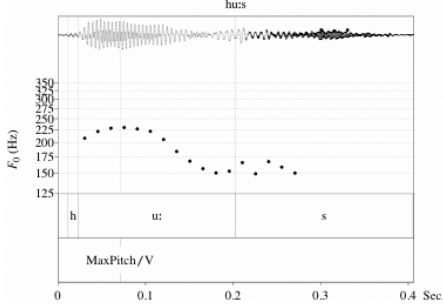
In the following, I limit the description of the phonetic analysis to two minimal pairs. Such a restriction is defensible, since the overall results are basically the same for the complete set of the data.²

2.1 Phonetic analysis

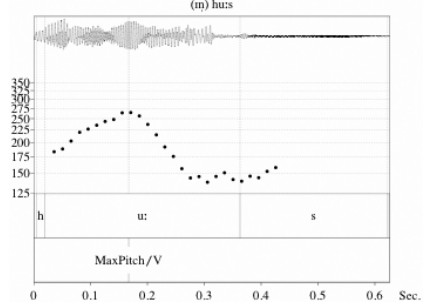
The minimal pairs surveyed below ('house-NOM.SG.' vs. 'house-DAT.SG.' and 'bread-NOM.SG.' vs. 'to brew-3SG.PRES.') are both recorded in focus-final position in declarative sentence-context. The second component of each minimal pair was exposed to apocope/syncope in a certain stage of its historical development, whereas the first component of the pair was not; 'house-DAT.SG.' was also subject to final devoicing.

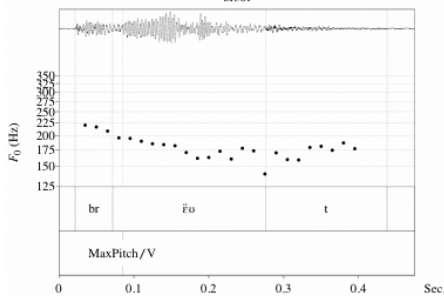
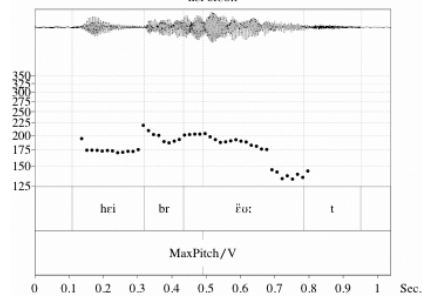
If we take a look at the graphs (I) to (IV) below, it is immediately evident that the ones presented on the left side (without schwa loss) differ remarkably from those presented on the right side (with schwa loss). Where (I) and (III) show a vowel / diphthong with simple long duration (0.179 sec., and 0.204 sec., respectively), (II) and (IV) feature a vowel / diphthong with an expanded duration (0.343 sec., and 0.351 sec., respectively).

(I) 'house-NOM.SG.' [¹hūs]



(II) 'house-DAT.SG.' [²hūs]



(III) 'bread-NOM.SG.' [¹brɛʊt](IV) 'to brew-3SG.PRES.' [²brɛʊt]

In addition to these durational differences, the pitch contours also vary. In the graphs (I) and (III), they appear to exhibit a contour HL. Both, 'house-NOM.SG.' and 'bread-NOM.SG.' show a rather early-aligned pitch peak with a moderate but steady fall towards the end of the vowel / diphthong. Indeed, 'house-DAT.SG.' and 'to brew-3SG.PRES.' in the graphs (II) and (IV) also exhibit a HL contour. Here, however, the F0 peak is assigned later to the long vowel / diphthong and is followed by a fairly steep fall of the pitch contour. The two pairs appear to be minimally contrastive, either in terms of vowel duration, or in terms of varying pitch contours. An economical phonology seeks to eliminate one of these two possible candidates. In the following sections I determine which of the significant differences outlined above is distinctive for LG.

3. An 'overlength' account

Until the second half of the 20th century, it was widely believed that not only Low Saxon but also the northern variety of High German exhibits overlength.³ The extensive research carried out by Wodarz (1979), however, provides no evidence for such a suprasegmental phenomenon in northern HG. Neither in duration, nor in diverging formant frequencies of F₁ and F₂, or pitch movements (i.e. tonal representation) do the analyzed speech recordings exhibit clues of overlength in HG. For LG, however, the assumption of overlength is still rather popular (Hayes 1989, Chapman 1993, inter alia).

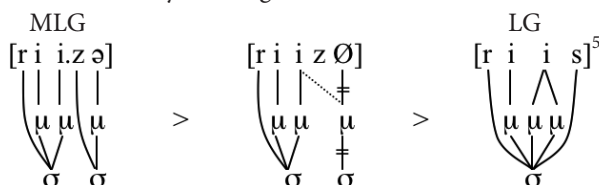
In 3.1, I first give a brief overview of the literature on the phenomenon of overlength in LG. In Section 3.2, I then move on to the crucial problems of the trimoraic approach and the assumption of phonological overlength in LG.

3.1 Explanations for 'overlength'

Hayes (1989) provides an analysis in terms of Moraic Theory. To account for schwa loss and the resulting changes in vowel duration, he employs the mechanism of so-

called *Parasitic Delinking*. ‘Syllable structure is deleted when the syllable contains no overt nuclear segment’ (Hayes 1989:268); i.e. after schwa loss and the resulting deletion of the final syllable, the originally associated mora becomes entirely free, allowing for a new association. It then docks onto the preceding syllable. The structures in figure (1) visualize this process.⁴

- (1) Trimoraic analysis Aw. ‘giant-NOM.SG.’ :



This development leads to the lexical distinction in (2) and the quantity contrast shown in (3).

- | | |
|--|--|
| <p>(2) r i i s vs. r i i s</p> <p style="margin-left: 40px;"> \</p> <p style="margin-left: 40px;">μ μ μ μ μ</p> <p style="margin-left: 40px;">‘rice-NOM.SG.’ ‘giant-NOM.SG.’</p> | <p>(3) /ris/ ‘rip-NOM.SG.’</p> <p> /riis/ ‘rice-NOM.SG.’</p> <p> /riis/ ‘giant-NOM.SG.’</p> <p style="text-align: center;">=</p> <p> short, long, overlong</p> |
|--|--|

A co-occurring dragging tone on the overlong vowels / diphthongs is regarded as purely phonetic and thus phonologically irrelevant (Chapman 1993:136; cf. also Winter 1979:197).

3.2 Problems of Overlength

There are some problems with the trimoraic account. First of all, the spreading of a free mora, i.e. a unit of phonological weight (Kim 2002:193; Blevins 1995:208), is usually not blocked by a preceding voiceless C. According to Cohn (2003:70), the mora serves ‘as the connection or link between prosodic and segmental structure.’ The so-called root nodes cover the segmental aspects of timing whereas moras are argued to cover the prosodic ones. However, there does not necessarily exist a direct one-to-one mapping between the two of them (Cohn 2003:73). Thus, it is expected that the free mora succeeding the voiceless C would either dock onto the C to create a weight bearing consonant, or move further to the left where it would dock onto the preceding vowel. This mora linking, however, does not occur in an example minimally different to (2):

- (4) a. [overlong] LG *ried* 'to ride-1SG.PRES.' < MLG *ride* vs.
 b. [long] LG *riet* 'to rip-1SG.PRES.' < MLG *rite*.

For (4b), MLG voiceless [-t-] appears to have blocked the mora from associating with the preceding vowel, while in (4a) MLG [-d-] did not; it allowed for the creation of an overlong vowel. However, if the mora is assumed to be the relevant unit, it should have been able to also dock onto the preceding voiceless consonant, creating a geminate, or, moving further to the left, creating a lengthened long vowel. MLG *ride* and MLG *rite* would then have been expected to have merged phonetically, but this did not happen.

Assuming an overlong, i.e. trimoraic, syllable gives rise to a further problem, as this violates the presumably universal constraint of **Mora Crowding* ($*\mu\mu\mu$)⁶ which does not allow more than two moras within one syllable.

3.3 Getting rid of the problems?

Kohler's (2001; 1986) conclusion for northern LG is similar to the one drawn by Wodarz (1979) mentioned above. He assumes a binary rather than a ternary quantity distinction for four investigated dialects of Niedersachsen and Schleswig-Holstein. Despite the fact that at least the dialects of the villages Haßmoor and Brarupholz comprise indeed three phonetic degrees of duration in the mid vowels (Kohler 2001:395), minimal triples for a possible ternary opposition are not available, which is why he concludes that 'eine dreistufige Opposition ist heute nur so rudimentär ausgeprägt, daß sie für die sprachliche Kommunikation keine Bedeutung hat [...]' (transl.: a threefold opposition of length is nowadays of rudimentary status, and, thus, has no relevance in verbal communication) (Kohler 2001:398–399). He also did not observe a dragging tone in his data (Kohler 2001:397).

Based on the observation that vowels preceding lenis obstruents are in general phonetically longer than vowels preceding fortis obstruents, Kohler (2001:398) argues that a difference in length was already present in the vowels of Low Saxon before schwa loss. This *phonetic* length contrast was then phonologized by schwa loss and the following desonorization of the final originally voiced obstruent, which is how Kohler avoids a violation of **Mora Crowding*. His examples of schwa loss yield:

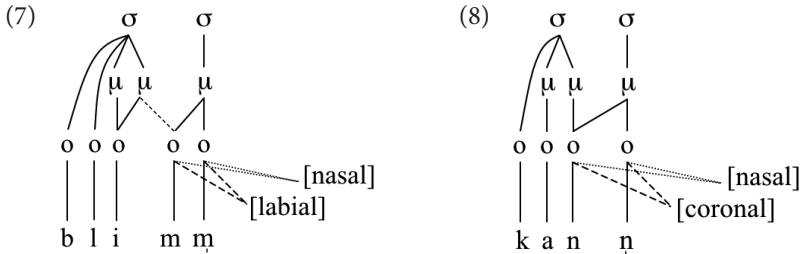
- (5) a. different results in vowel length:
 [overlong] LG *ried* 'to ride-1SG.PRES.' < MLG *ride* vs.
 [long] LG *riet* 'to rip-1SG.PRES.' < MLG *rite*, or
 b. no effects on vowel length at all:
 LG *bliem* 'to stay' < MLG *bliven*.

He argues that compensatory lengthening could not have appeared in LG, since no uniform results emerge. He assumes a binary phonological contrast of both, vowel quality and length, rather than a ternary quantity distinction:

- (6) /rit/ 'to ride-1.SG.PAST' with a lax V
 /rit/ 'to rip-1SG.PRES.' with a tense V
 /riit/ 'to ride-1SG.PRES.' with a tense $\bar{V}$

3.4 The problems persist

However, Kohler fails to take into account the syllable structure of his example MLG [bli.vən] > *[bli.bm̩] > LG *bliem* [bli.mm̩], which is illustrated in figure (7) below.⁷ The assumption of a phonological geminate including a final syllabic part is the least problematic account.⁸



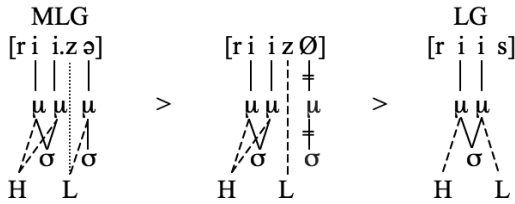
Further evidence of a similar bisyllabic structure is provided by words like LG [kann̩] 'jug-PL'. Here, syncope of the schwa has created an ambisyllabic long final nasal in the plural endings. The structure is displayed in figure (8) above.

It is apparent that the word in (7) LG [bli.mm̩] indeed stays bisyllabic. It therefore does not qualify for a change in vowel duration or pitch contour since the syllable structure stays intact. Kohler, however, employs *bliem* as a counterexample against compensatory lengthening effects based on schwa loss in LG since in his view it is a monosyllable. Thus, his arguments are not as solid as he suggests and do not invalidate an apocope-based account.⁹ Accordingly, a different analysis is needed that can account for all problems mentioned above.

4. A tonal account

The LG data can be accounted for by reanalyzing the quantity distinction in terms of tones, in line with Höder's (2003) and Ternes' (2001; 2006) assumptions. Figure (9) shows a prominence related analysis of the example given in (1).

(9) Prominence related analysis Aw. 'giant-NOM.SG.':



The crucial phonological features here are the tones H¹⁰ and L, not the mora. In the development from MLG to LG, the metrical contours were phonologized by schwa loss and the devoicing of final voiced consonants, and became tone accents (c.f. Boersma 2006). Voiceless coda consonants in words like MLG [riis] 'rice-NOM.SG.' were not able to license tone.

In a first step, schwa was deleted, leaving behind its intonational L. The second syllable along with the third mora was lost, and final *-z#* took over the metrical features of the apocopated schwa.¹¹ In a second step towards LG, final devoicing of *-z > -s* applied. The resulting final devoiced consonant was no longer able to bear a tone, so the tone spread to the left in the direction of stress. The consequence was a HL pitch contour and phonetically overlong vowels, i.e. the vowels influenced by schwa loss and final devoicing. This tone is referred to as Accent 2. On the long vowels without schwa loss, neither the duration nor the pitch contour changed. The assigned tone is referred to as Accent 1. The tonal contour in these cases remained HL, which should have led to a merger with the newly developed Accent 2 words. This did not happen, however. I will explain why in the next section.

4.1 Getting rid of the problems

Such a merger did not take place for the following reasons. In an earlier stage of the language — before the deletion of schwa — metrical tones were assigned to the head mora (i.e. the first mora) of a syllable. One H tone was associated with the stressed syllable in the case of the original monosyllables, since there was only one head mora. Nevertheless, an intonational boundary-tone L% was aligned with the right edge of the word. In the case of the bisyllables, however, each of the two head moras received a metrical tone. The stressed position had a H, while the unstressed position (second syllable) had a L. Schwa loss led to the removal of the second syllable inclusive of its mora. This triggered the association of the L to the preceding voiced obstruent, and the alteration of metrical to phonemic tones. The L then moved further to the left towards the stressed long vowel where it associated with its right edge. This is how a tonal contour HL was established on the new monosyllables. Expansion of the pitch contour of the long vowel resulted in an

increase of the vowel's duration. Phonologically, however, the bimoraic structure stayed intact since both tones were able to associate with one of the moras.¹² The original monosyllables kept their single H tone. The distinction between the two word categories remained since the boundary-tone stayed put. Hence, the contrast of Accent 1 versus Accent 2 is one of a single H + L% versus a contour HL.

The synchronic lexical contrast illustrated in figure (2) can now be reanalyzed in terms of tone, as in figure (10). Figure (11) displays the resulting dual binary distinction of short lax vowel with no tone, long tense vowel with Accent 1, and long tense vowel with Accent 2.

- (10) $\begin{array}{c} {}^1\text{r i i s} \\ | \quad | \\ \text{u u} \\ \diagdown \quad \diagup \\ \sigma \\ \text{H+L\%} \end{array}$ vs. $\begin{array}{c} {}^2\text{r i i s} \\ | \quad | \\ \text{u u} \\ \diagdown \quad \diagup \\ \sigma \\ \text{H} \quad \text{L} \end{array}$
- 'rice-NOM.SG.' 'giant-NOM.SG.'
- (11) /rɪs/ 'rip-NOM.SG.'
 /¹rɪs/ 'rice-NOM.SG.'
 /²rɪs/ 'giant-NOM.SG.'
 =
 Ø Accent, Accent 1, Accent 2

The assumption of tones is in line with the well-known phenomenon of blocking of tonal spreading by voiceless consonants:

- (12) MLG *ride* LG *ried* 'to ride-1SG.PRES.' [Accent 2]
 $\begin{array}{c} [\text{r i i d } \emptyset] \\ | \quad | \quad | \quad | \\ \text{u u } \mu \\ \diagdown \quad \diagup \quad \diagup \\ \sigma \quad \sigma \quad \sigma \\ \text{H} \quad \text{L} \end{array} > \begin{array}{c} [\text{r i i d } \emptyset] \\ | \quad | \quad | \quad | \\ \text{u u } \mu \\ \diagdown \quad \diagup \quad \diagup \\ \sigma \quad \sigma \quad \sigma \\ \text{H} \quad \text{L} \end{array} > \begin{array}{c} [\text{r i i t}] \\ | \quad | \quad | \\ \text{u u } \mu \\ \diagdown \quad \diagup \\ \sigma \\ \text{H} \quad \text{L} \end{array}$
- (13) MLG *rite* LG *riet* 'to rip-1SG.PRES.' [Accent 1]
 $\begin{array}{c} [\text{r i i t } \emptyset] \\ | \quad | \quad | \quad | \\ \text{u u } \mu \\ \diagdown \quad \diagup \quad \diagup \\ \sigma \quad \sigma \quad \sigma \\ \text{H} \quad \text{L} \end{array} > \begin{array}{c} [\text{r i i t } \emptyset] \\ | \quad | \quad | \quad | \\ \text{u u } \mu \\ \diagdown \quad \diagup \quad \diagup \\ \sigma \quad \sigma \quad \sigma \\ \text{H} \quad \text{L} \end{array} > \begin{array}{c} [\text{r i i t}] \\ | \quad | \quad | \\ \text{u u } \mu \\ \diagdown \quad \diagup \\ \sigma \\ \text{H} \end{array}$

MLG [-t-] is not able to license a tone since it lacks the feature [+voice].¹³ Thus, the L cannot dock onto it, nor spread through it to the preceding stressed syllable. The result is that the pitch contour stays H+L%, i.e. Accent 1. Postulating tones has the additional advantage of also accounting for the difference in vowel quality of lax vs. tense. According to Kohler (2001), this specific vowel quality contrast plays a significant perceptual role for the LG informants. The identification process of a stimulus seems to be strongly influenced by the tenseness or laxness of a vowel, a phonetic reality that any phonological interpretation should be able to cope with.

Furthermore, **Mora Crowding* is not violated since a ternary quantity distinction is no longer needed. The binary distinction of tense vs. lax, and the binary distinction between Accent 1 and Accent 2 renders this issue irrelevant.

4.2 Distribution of the tones

In the following, I give a brief summary of the occurrence of Accent 1 and Accent 2 in LG.

LG of the Hamburg area shows in general

- (14) a. a grammatical contrast as in 'house-NOM.SG.' [¹hūs]
vs. 'house-DAT.SG.' [²hūs]
- b. a lexical contrast as in 'bread-NOM.SG.' [¹brɛut]
vs. 'to brew-3SG.PRES.' [²brɛöt].

The occurrence of the tones is limited to $\bar{V}$, V_1V_2 , and combinations of $V+r$ / $V+l$ in the final syllable (Höder 2003). Due to German *r*-vocalization, the cases of $V+r$ can also be regarded as diphthongs. The restriction of Accent 1 and Accent 2 to word-final position is consistent with Zhang's phonetically based findings with respect to tonal melody mapping. He emphasizes that tones generally favor closeness to the left edge of a prosodic word 'for the ease of processing, but contour tones can only occur on the final syllable because of its extended duration' (Zhang 2000:608). Although in LG Accent 1 is theoretically possible on non-final syllables, there is no contrast in this position, since Accent 2 occurs in word-final position only.

Furthermore, LG tones are not contrastive on short — i.e. mono-moraic — vowels, or in unstressed position.

5. Conclusion: Tones >> moras

I have argued in this article that the tones are the relevant features in LG, and not vowel duration or moraic structure. The assumption of phonologically 'overlong' vowels and a resulting ternary quantity distinction is rejected. Instead I assume a dual binary distinction of vowel quality lax vs. tense, and of Accent 1 vs. Accent 2. I have discussed the problems encountered by assuming phonological overlength: the absence of mora spreading in cases where a voiceless *C* precedes the apocopated schwa, and violation of **Mora Crowding*. Moraic structure, however, cannot be abandoned completely. It plays an important role in determining whether or not a syllable is able to bear a tone. Only those syllables comprising a bimoraic vowel / diphthong and positioned word-finally do actually qualify for a tonal contrast.

Several questions still remain for future research. Some of them are given below:

- Are the ambisyllabic LG final long nasals able to bear a tone, creating additional conditions for Accent 2?
- In cases of syncope in the morphological endings, preceding [+voice]-consonants appear to allow for feature spreading while [-voice] ones do not. E.g. *ligən* > *liŋŋ* ‘to lie-INF’, but no *wekən* > **wεŋŋ* ‘week-PL’. What motivates this blocking?
- What are the connections — if any — between the LG dialects and the geographically quite close Scandinavian tonal accents, or the Central Franconian tone accent area?

Notes

* Special thanks to the anonymous LIN-reviewers, and Michiel de Vaan for the valuable remarks on this article.

1. Or rather its remnants, for in the 1970s, Hamburg Harbour was extended, which meant that the approximately 2,000 original inhabitants had to be relocated to an area near Hamburg. The last residents left around 1980.

2. 23 minimal pairs in total, spoken by 5 informants: ‘house-NOM.SG.’ / ‘house-DAT.SG.’, ‘bread-NOM.SG.’ / ‘to brew-3SG.PRES.’, ‘to enjoy-3SG.PRES.’ / ‘joy-NOM.SG.’, ‘cabin-NOM.SG.’ / ‘today-ADV.’, ‘little-ADJ.’ / ‘people-NOM.’, ‘dear-ADJ.’ / ‘love-NOM.SG.’, ‘courage-NOM.SG.’ / ‘fashion-NOM.SG.’, ‘price-NOM.SG.’ / ‘price-PL.’, ‘to let-1SG.’ / ‘to load-1SG.’, ‘to rip-1SG.’ / ‘to ride-1SG.’, ‘scarf-NOM.SG.’ / ‘bowl-NOM.SG.’, ‘ill-ADJ.’ / ‘to tell a lie-1SG.’, ‘side-NOM.SG.’ / ‘silk-NOM.SG.’, ‘already-ADV.’ / ‘all-ADJ.’, ‘letter-NOM.SG.’ / ‘letter-PL.’, ‘through-ADV.’ / ‘door-NOM.SG.’, ‘degree-NOM.SG.’ / ‘straight-ADJ.’, ‘river Main-NOM.’ / ‘to mow-INF.’, ‘rice-NOM.SG.’ / ‘giant-NOM.SG.’, ‘stone-NOM.SG.’ / ‘stone-PL.’, ‘way-NOM.SG.’ / ‘way-PL.’, ‘Vienna’ / ‘wine-NOM.SG.’, ‘mine-POSS.PRON.’ / ‘(gold-)mine-NOM.SG.’.

3. Note that similar proposals existed for the dialects of the Rhineland Accentuation area. The dialects have been proven to be tonal, although some researchers still disagree (p.c. Wolfgang Kehrein); cf. the various references discussed in Schmidt (1986).

4. Hayes (1989) wants to exclude possible interaction between apocopated schwa and its preceding consonant, which is why he crucially assumes that the consonants are not connected to moras but to syllables.

5. The final obstruent of the LG form stays underlyingly voiced.

6. Prince & Smolensky (2004:248f.).

7. In this paper I use the structure originally proposed by Hyman (1985), who assumes that onsets are connected to moras rather than syllables.

8. Alternative possibilities are (a) a phonological non-syllabic nasal geminate, and (b) a phonological singleton + syllabic final nasal. However, (a) is rather problematic since [mm] of LG *blie-m* developed from two independent segments *[bm] which in some LG dialects (e.g. Kirchwerder) are still distinct from each other. Furthermore, it does not reflect the phonetic reality particularly well. With regards to (b), the short/lax [a] of LG [kann] 'jug-PL' needs a coda-position, thus the following [n] would need to also dock onto the preceding syllable in order to occupy the coda.
9. Only (Post-)MLG apocope seems to have triggered compensatory lengthening or tone transfer effects: Aw. /ziit/ [¹zīt] 'side' < MLG *sīt* < OSax. *sida*. In the following, superscripted ¹ refers to tonal accent 1 (Accent 1), and superscripted ² to tonal accent 2 (Accent 2), respectively.
10. A syllable under main stress had a metrical high tone H, whereas an unstressed syllable or a syllable under secondary stress received a metrical low tone L in MLG.
11. The feature [+voice] of -z# is sufficient to license a tone without being moraic (c.f. Bradshaw 1999, Yip 2002, Boersma 2006).
12. As mentioned above, the mora is a unit of syllable weight and thus relates to phonological structure. However, it is not necessarily directly reflected on the phonetic level (e.g. in the actual duration of a sound).
13. C.f. Bradshaw (1999), Yip (2002), Boersma (2006).

References

- Blevins, Juliette. 1995. "The Syllable in Phonological Theory". *The Handbook of Phonological Theory* ed. by John A. Goldsmith, 206–244. Oxford & Cambridge, Mass.: Blackwell.
- Boersma, Paul. 2006. "The history of the Franconian tone contrast", 7 April 2006, <<http://www.fon.hum.uva.nl/paul/>> (8 April 2006).
- Bradshaw, Mary. 1999. "A crosslinguistic study of consonant-tone interaction". <[http://www.ling.ohio-state.edu/publications/dissertations/pdf/Bradshaw 1999.pdf](http://www.ling.ohio-state.edu/publications/dissertations/pdf/Bradshaw%201999.pdf)> (22 May 2007).
- Bremer, Otto. 1929. "Der Schleifton im Nordniedersächsischen". *Niederdeutsches Jahrbuch* 53.1–32.
- Bye, Patrik. 1997. "Representing 'overlength' — Against trimoraic syllables". *Phonology in Progress — Progress in Phonology* ed. by Geert Booij and Jeroen van de Weijer, 61–101. The Hague: Holland Academic Graphics.
- Chapman, Carol. 1993. "Überlänge in North Saxon Low German: Evidence for the metrical foot. An approach to vowel length based on the theory of metrical phonology". *Zeitschrift für Dialektologie und Linguistik* 60:2.129–157.
- Cohn, Abigail C. 2003. "Phonological Structure and Phonetic Duration: The Role of the Mora". *Working Papers of the Cornell Phonetics Laboratory* 15.69–100. Ithaca, N.Y.: Cornell University.
- Hayes, Bruce. 1989. "Compensatory lengthening in moraic phonology". *Linguistic Inquiry* 20.253–306. Cambridge, Mass.: MIT Press.
- Höder, Steffen. 2003. Das Lautsystem des Altenwerder Platt. Eine phonetisch-phonologische Bestandsaufnahme. Term paper, Hamburg University.

- Hyman, Larry. 1985. *A Theory of Phonological Weight*. Dordrecht: Foris.
- Kim, Young-Seok. 2002. "On non-moraic geminates". *Studies in Phonetics, Phonology and Morphology* 8:2.187–201.
- Kohler, Klaus J. 2001. "Überlänge im Niederdeutschen?". *Vulpis Adolatio. Festschrift für Hubertus Menke zum 60. Geburtstag* ed. by R. Peters and H. P. Pütz and U. Weber, 385–402. Heidelberg: Winter.
- Kohler, Klaus J. 1986. "Überlänge und Schleifton im Niederdeutschen. Zusammenfassung der Ergebnisse aus vier Dialektuntersuchungen". *Phonetische Forschung in der Niederdeutschen Dialektologie* ed. by Klaus J. Kohler and Regina Tödter and Michael Weinhold, 5–17. Kiel: University of Kiel.
- Kohler, Klaus J. & Regina Tödter & Michael Weinhold. 1986a. "Ergänzende Untersuchungen zur 'Überlänge' in der Mundart von Haßmoor (Kreis Rendsburg-Eckernförde)". *Phonetische Forschung in der Niederdeutschen Dialektologie* ed. by Klaus J. Kohler, Regina Tödter and Michael Weinhold, 19–116. Kiel: University of Kiel.
- Kohler, Klaus J. & Regina Tödter & Michael Weinhold. 1986b. "Untersuchungen zur 'Überlänge' in den Mundarten von Brarupholz (Kreis Schleswig-Flensburg) und Windbergen (Kreis Dithmarschen)". *Phonetische Forschung in der Niederdeutschen Dialektologie* ed. by Klaus J. Kohler and Regina Tödter and Michael Weinhold, 117–177. Kiel: University of Kiel.
- Prince, Alan. 1980. "A metrical theory for Estonian quantity". *Linguistic Inquiry* 11:3.511–562.
- Prince, Alan & Paul Smolensky. 2004. *Optimality Theory. Constraint Interaction in Generative Grammar*. Oxford & Cambridge, Mass.: Blackwell.
- Schmidt, Jürgen Erich. 1986. *Die Mittelfränkischen Tonakzente*. Stuttgart: Steiner.
- Ternes, Elmar. 2006. "Tone Reversal in Franconian and Elsewhere". *North-Western European Language Evolution* (= NOWELE) 47.91–109.
- Ternes, Elmar. 2001. "Ansätze einer Phonemtypologie deutscher Dialekte". *Gesprochene Sprache — transdisziplinär. Festschrift zum 65. Geburtstag von Gottfried Meinhold* ed. by Margret Bräunlich, Baldur Neubert and Beate Rues, 171–182. Frankfurt, Main etc.: Peter Lang.
- Winter, W. 1979. "Zur 'Überlänge' im Deutschen". *Sprache und Sprechen. Festschrift für E. Zwirner zum 80. Geburtstag* ed. by K. Ezawa and K.H. Rensch and W. Bethge, 197–200. Tübingen: Niemeyer.
- Wodarz, Hans W. 1979. *Phonetische Untersuchungen zum Problem der Überlänge*. Hamburg: Buske.
- Yip, Moira. 2002. *Tone*. Cambridge: Cambridge University Press.
- Zhang, Jie. 2000. "The Phonetic Basis for Tonal Melody Mapping". *Proceedings of the 19th West Coast Conference on Formal Linguistics* ed. by Roger Billerey and Brook Danielle Lillehaugen, 603–616. Somerville, Mass.: Cascadilla Press.