Segmental Structure and Tone

Linguistische Arbeiten

Edited by
Klaus von Heusinger, Gereon Müller,
Ingo Plag, Beatrice Primus,
Elisabeth Stark and Richard Wiese

Volume 552

Segmental Structure and Tone

Edited by
Wolfgang Kehrein, Björn Köhnlein,
Paul Boersma and Marc van Oostendorp

DE GRUYTER

ISBN 978-3-11-034109-6
e-ISBN (PDF) 978-3-11-034126-3
e-ISBN (EPUB) 978-3-11-037749-1
ISSN 0344-6727

Library of Congress Cataloging-in-Publication Data

A CIP catalog record for this book has been applied for at the Library of Congress.

Bibliographic information published by the Deutsche Nationalbibliothek

The Deutsche Nationalbibliothek lists this publication in the Deutsche Nationalbibliografie; detailed bibliographic data are available on the Internet at <http://dnb.dnb.de>.

© 2018 Walter de Gruyter GmbH, Berlin/Boston
Printing and binding: CPI books GmbH, Leck
♻️ Printed on acid-free paper
Printed in Germany

www.degruyter.com

Contents

Björn Köhnlein, Marc van Oostendorp

Introduction — 1

Michael Becker, Peter Jurgec

Interactions of tone and ATR in Slovenian — 11

Paul Boersma

The history of the Franconian tone contrast — 27

Cathryn Donohue

Tones and vowels in Fuzhou revisited — 99

Laura J. Downing

Grounding Nguni depressor effects — 109

Wolfgang Kehrein

There's no tone in Cologne: against tone-segment interactions in Franconian — 147

Paul Kiparsky

Livonian stød — 195

Björn Köhnlein

Synchronic alternations between monophthongs and diphthongs in Franconian tone accent dialects: a metrical approach — 211

Marc van Oostendorp

Tone, final devoicing, and assimilation in Moresnet — 237

Keywords index — 253

Languages index — 257

Björn Köhnlein, Marc van Oostendorp

Introduction

Tonal and segmental phonology are core areas in the study of sound patterns. Roughly, segmental phonology deals with phenomena that affect the pronunciation of vowels and consonants. Tonal phonology, on the other hand, investigates the use of fundamental frequency for linguistic purposes, at the lexical level (prototypically tone languages, such as Mandarin) or at the post-lexical level (prototypically intonation languages, such as Dutch or German). Particularly after the rise of autosegmental phonology (Leben 1973, Goldsmith 1976), many similarities between tone and segmental structure have been uncovered: for instance, both tones and segmental features spread, and both interact with metrical structure, such as with word stress, in similar ways. In most models of phonology, they therefore receive identical treatment. For instance, both are considered to be composed of features, possibly living in some feature-geometric arrangement on a set of autosegmental tiers.

Such a model makes a number of predictions, however, that do not always seem to be sufficiently verified. First, it predicts that tones and segmental features such as [Labial] or [Voiced] have a similar kind of behaviour. Secondly, it suggests that tonal features interact as freely with segmental features as the latter do among each others. These predictions seem to be partly true; but there are also certain problems.

This volume seeks to reevaluate the nature of tone–segment interactions in phonology. The contributions address, among other things, the following basic questions: what tone–segment interactions exist, and how can the facts be incorporated into a phonological account of the language? Is interaction between tones and vowel quality really universally absent? What types of tone–consonant interaction do we find across languages? What is the relation between diachrony and synchrony in relevant processes?

The papers in this volume deal with the relation between segmental features and tone from a variety of angles. There is an empirical emphasis on Franconian dialects in the Netherlands, Belgium and Germany, but other languages and language families are also discussed, such as Fouzhou (Chinese), Livonian (Finnic), Nguni (Bantu), and Slovenian (Slavic). It is shown how some of the predictions of the standard model seem more problematic, and solutions to some of these problems are also mentioned.

Björn Köhnlein, The Ohio State University, koehnlein.3@osu.edu

Marc van Oostendorp, Meertens Institute, marc.van.oostendorp@meertens.knaw.nl

<https://doi.org/10.1515/9783110341263-001>

In this introduction, we briefly sketch some of the theoretical background: which of the predictions are verified? Which ones are problematic?

1 Tones and segments: similar behaviour

Tones and segments sometimes behave in a similar way. Consider for example the influence of word stress on the distribution of tone and vowel quality. The interaction between vowel quality and stress is a driving factor in phonology. For instance, it has been repeatedly observed that vowels in stressed syllables tend to be more sonorous than those in unstressed syllables. In a nutshell, this means that the lower a (peripheral) vowel is, the likelier it is that this vowel will be stressed (Kenstowicz 1997, 2004; de Lacy 2006, 2007).

One example of sonority-driven stress can be found in Takia, a North New Guinea language: in the language, word stress falls on the syllable that contains the most sonorous vowel (Ross 2002, de Lacy 2007):¹

- (1) Sonority-driven stress in Takia
 - a. [ŋi-'saŋes] 'hawk' [ɿ'ŋa-sol] '1sg-flee'
 - b. [kir'ŋen] 'her/his finger, toe' [ŋi-'emi] 'your (pl.) legs/feet'
 - c. [ifu'no] 's/he hit you' [mul'mol] 'a kind of a tree'

(1a) demonstrates that in words containing a low and mid vowel, the low vowel will receive stress, as it is of higher sonority. Likewise, in (1b, c), the mid vowels are preferred over the high vowels. These facts can be expressed in a sonority scale; for purposes of illustration, the sonority scale for tense vowels is provided in (2). The higher a vowel is ranked in the sonority, the likelier it is that this vowel will be a potential stress-bearing unit.

- (2) Sonority scale for tense vowels in descending order
a > e, o > i, u

Crucially, interactions between prominence and stress are not restricted to segments but can also be found in the relation between tone and metrical structure. As de Lacy (2002) argues, the interaction between tone and stress is governed by a tonal prominence scale, comparable to that for vowels: high tones (H) and metrically strong positions attract each other, as do low tones (L)

¹ If vowels are of equal sonority, the rightmost one will be stressed.

and metrically weak positions; mid tones (M) are located in between H and L. The resulting prominence scale, which closely resembles the sonority scale in (2), is provided in (3).

- (3) Tonal prominence scale in descending order
 $H > M > L$

One relevant example comes from Ayutla, a Mixtec language where tonal prominence is relevant for determining the position of stress. For our purposes, it serves to state that stress is realized on a syllable carrying the most prominent tone in the word (the full pattern is somewhat more complex, see Pankratz & Pike 1967, de Lacy 2002 for discussion). In disyllabic words, stress is therefore on H, if the word contains a high tone (4a, b, c). In the absence of H, stress will fall on M (4d).

- (4) Some stress patterns in Ayutla disyllabic words
- a. 'HL ['jĩnĩ?] 'hat'
 - b. L'H [pá'là] 'brown sugar'
 - c. M'H [[jā'kwa?] 'it is crooked'
 - d. 'ML ['nāmà] 'wall'

As these examples demonstrate, tone and vowel quality interact with metrical structure in a similar way. Metrically strong positions correspond to relatively prominent tones/vowels, and metrically weak positions correspond to less prominent tones/vowels.

2 Non-interaction between segmental features and tone

Given that tonal features and the segmental features responsible for vowel height interact with the stress system in a similar way, one would expect them to also interact with each other. Interestingly, however, there seems to be much less clear-cut evidence for such interactions. In fact, it has even been assumed that direct interactions between tones and vowels are absent in the world's languages. Consider the following universal that has been proposed in the literature:

- (5) An alleged universal of tone systems: no interactions of tones and vowel quality
 Vowels and tones cannot determine each other's quality (Hombert 1977, 1978; Hombert, Ohala & Ewan 1979).

At a phonetic level, correlations between pitch and vowel quality have been established: higher vowels tend to be produced with higher pitch than lower vowels, which is referred to as intrinsic pitch height (e.g. Lehiste 1970). Therefore, one might expect that this could potentially result in phonological contrasts; yet it is commonly assumed that this interaction does not lead to cognitively controlled phonological patterns.² There are two main arguments underlying this assumption. First, the effect of intrinsic pitch height is rather small and may not be universal (Kingston 2007). Furthermore, little evidence has been put forward so far that would indicate a direct relation between tone and vowel quality, which is why many phonologists still hold (5) to be correct (see e.g. de Lacy 2007).

Notably, there is more evidence for interactions between consonants and tone, particularly with respect to those between laryngeal features and tone; but still, there seems to be an asymmetry concerning the direction of attested interactions. The basic facts are as follows: cross-linguistically, two types of interactions between voicing and tone are particularly frequent. First, voiceless consonants tend to have a raising effect on the tone of the next vowel whereas voiced consonants tend to have a lowering effect on the vowel to their right. In Suma (Bradshaw 2000), for instance, imperfective verbs start with a High tone (6a), except when they begin with a voiced obstruent, in which case the first tone is rising (6b). Diachronically, the effect is also known from other tone languages, where voicing contrasts on onset consonants turn into tone contrasts on following vowels (see Yip 2002 for summary and discussion).

(6) Imperfective verbs in Suma

- a. éé ‘leave behind’
kírí ‘look for’
- b. bùsí ‘bland’
zìkídí ‘delay’

Another frequent interaction is that the spreading of a high tone can be blocked by intervening voiced obstruents, and the spreading of a low tone can be blocked by intervening voiceless obstruents (Hyman & Schuh 1974). Ngizim (Schuh 1978) is a language where the former process applies: in this language high tones normally spread to adjacent low-toned moras when the L is located between two H’s (7a); yet spreading is blocked by intervening voiced obstruents (7b):

² Notably, the intrinsic pitch effect found in vowels (high vowels → higher pitch, low vowels → lower pitch) goes in the opposite direction of the interactions established for tones/vowels and stress.

- (7) H spreading in Ngizim
 a. /ná kàsúw/ → [ná kâasúw] 'I swept'
 b. /ná bákə-w/ → [ná bàkú] 'I burned (it)'

Crucially, in such interactions, it is the *following* vowel that is affected by the consonant while *preceding* vowels seem to be resistant to a tonal influence from a following consonant (see Odden 2002 for a potential counterexample). The emerging generalization is captured in a second universal that has been proposed:

- (8) Another alleged universal of tone systems
 A consonant's laryngeal features cannot determine the tone of a segment on its left (Maddieson 1978, 1997).

Furthermore, it has been argued (Moreton 2009) that, even though laryngeal features of consonants do sometimes interact phonologically with tones, the relative number of such interactions we find in the typology of the world's languages is still significantly smaller than the interactions between (neighbouring) tones. There is no clear phonetic reason for this typological anomaly: the phonetic effect of voicing on a consonant is at least as big as that of the tone of a neighbouring vowel. Yet the latter get phonologized much more frequently than the former in the world's languages. Moreton argues that the reason for this is to be found in learning Optimality-Theoretic grammars: acquiring a constraint that spans the divide between segmental information and tone would be more difficult than learning one that is stated in the domain of tones (or that of segments) only.

In sum, there is wide agreement in the literature that phonologically relevant interactions between tone and segments are severely restricted across languages. These restrictions seem to be particularly strong with respect to potential interactions between tone and vowel quality: according to (5), these are excluded altogether. Consonant-tone interactions, on the other hand, are much more frequent but still seem to be constrained in some ways. The present state of knowledge in the field seems to indicate that interactions between tones and segments are a rather marked phenomenon, and only possible in certain domains.

3 The place of Franconian tones in the debate

The group of Franconian dialects (West Germanic, Indo-European) which is spoken in the east of Belgium, the south-east of the Netherlands and the neighbouring area in the west of Germany, has a particular interest for the debate since

it seems to show some interactions between tone and segments that are rare or even unattested.

It is often argued that these dialects have a lexical tone contrast, i.e., a word can mean different things depending on which of two tones it contains (e.g. Gussenhoven 2000). Consider the following two words from Roermond (Kats 1985), both of which are usually written as *leuter*:

(9) A minimal pair

[lø:^Htər] ‘to twaddle’

[lø:^{HL}tər] ‘soap suds’

Pronounced in isolation, the first vowel of the first word is realized with a high level pitch; this tone, which we write here as “H:”, has traditionally been called *Schleifton*, *sleeptoon*, *circumflex*, *dragging tone* or Accent 2. The first vowel of the second leuter is realized with a sharply falling pitch; this tone, which we write as “HL”, is traditionally called *Schärfung*, *stoottoon*, *acute*, *falling tone*, or Accent 1.

The tonal dialects are divided into two main groups (Frings 1916): South-East-Low Franconian (Belgian Limburg, Dutch Limburg, Dülken region), and Central Franconian, which is divided into Ripuarian (Aachen and Cologne; Kerkrade region), and Moselle Franconian (a large area with Trier in the centre). From a typological point of view they can be classified as ‘restricted tone languages’ (Yip 2002): tone can only occur on long vowels, on diphthongs, and on short vowels followed by a sonorant consonant (i.e. [n], [m], [ŋ], [l], or [r]) within the same syllable. Restricted tone languages are attested on all continents. In Europe, other examples are for instance Čakavian, Latvian, Lithuanian, Norwegian, Štokavian and Swedish. We can say, then, that in some respects the Franconian dialects fit nicely into the typology of tone languages. In this sense they are well understood.

In many other respects, however, tonal Franconian does not fit with what is known about tone languages. The tonal dialects even contradict the two universals we have seen above and which we repeat here for convenience:

(10) Alleged universals of tone systems

- a. Vowels and tones cannot determine each other’s quality (Hombert 1977, 1978; Hombert, Ohala & Ewan 1979).
- b. A consonant’s laryngeal features cannot determine the tone of a segment on its left (Maddieson 1978, 1997).

Both universals seem to be contradicted by dialects of the Franconian area. Consider first the universal in (10a). In Sittard (Dutch Limburg), earlier long mid vowels became closing diphthongs, but only if they have a falling tone (Dols 1953);

in (11), this is illustrated in a comparison between Sittard and the neighboring Roermond dialect, where diphthongization did not take place:

(11) Sittard diphthongization

	Roermond	Sittard	
falling tone:	[ke: ^{HL} z]	[kɛi: ^{HL} z]	‘gravel’
	[vo: ^{HL} t]	[vɔu: ^{HL} t]	‘foot’
level tone:	[be: ^H t]	[be: ^H t]	‘bite’
	[no: ^H t]	[no: ^H t]	‘nut’

It thus looks as if there is a connection between the preference for a falling tone and that for a closing diphthong, in other words between a low tone and a high vowel. Similar data can be observed in many other locations in the Franconian area, and they pose a clear puzzle for any typology based on (10) above.

Something similar holds for the other universal. For this, we can give an example from the dialect of Roermond. In this dialect, words with a short vowel followed by a sonorant consonant and another voiced consonant allow a tonal contrast:

(12) Roermond contrast in voiced environment

Falling tone:		Level tone:	
[bæn ^{HL} də(n)]	‘gang’	[dʊn ^H dər]	‘thunder’
[hær ^{HL} dər]	‘shepherd’	[mær ^H əl]	‘marl’

If the last consonant of this sequence is voiceless, however, only the level tone is allowed:

(13) Roermond gap in voiceless environment

Falling tone:	Level tone:	
(missing)	[pɪm ^H pəl]	‘booze’
(missing)	[hær ^H səs]	‘brains’

The gap in (13) suggests the following generalization:

(14) Consonant–tone interaction in Roermond

A voiceless consonant disprefers a low tone on a consonant at its left.

This generalization shows that in Roermond a voiceless consonant is capable of determining the tone of the segment on its left, contrary to what (10b) dictates. From a typological view, the tendencies in (11) and (13) are intriguing, since they show that the principles underlying the proposed universals in (10) must somehow be inactive or overruled in some of the Franconian dialects. However, several of the papers in this volume argue that this conclusion is not warranted (see the contributions by Kehrein, Köhnlein, and Van Oostendorp). According to

these authors, the universals still hold because the dialects in question are not properly speaking tonal: the purported tonal contrast rather is one of prosodic organization. The tones are mere realisations of intonational patterns which work out differently on words that have different docking points for those intonational tones. The relations between tones and segments are thus indirect, mediated by prosodic organization. And as we have seen before, the fact that both tones and segments interact with prosody is not problematic at all.

4 This volume

All contributions in this volume describe and discuss data that indicate some kind of relationship between tone and consonants or vowels, from a synchronic and/or from a diachronic perspective. The papers in this book incorporate data from various types of languages where tonal information plays a lexically distinctive role, from “pure” tone languages to so-called tone accent systems, where the occurrence of contrastive tonal melodies is restricted to stressed syllables.

Some contributions present evidence for direct synchronic interactions between tones and segments, also for typologically unusual interactions: relevant data are analyzed in the contributions of Michael Becker and Peter Jurgec as well as in Laura Downing’s paper. Becker and Jurgec argue that the Slovenian language displays a direct interaction between vowel quality and tone, thereby arguing against the alleged universal in (5): Slovenian avoids high tones on lax vowels, for which the authors present evidence from the native phonology as well as from the loanword phonology. Downing discusses the effects of depressor consonants in Nguni languages, which lower the pitch of high tones on following vowels. While some scholars have claimed that this interaction can be captured by assuming that consonant voicing and low tone derive from the same phonological feature, Downing argues that these analyses are too simplistic: instead, she proposes that the effects can best be analyzed in a model that treats low tone and consonant voicing as separate features but includes interactions between different phonological domains.

Other contributors argue that some seemingly direct interactions between tone and segments may rather be indirect. This viewpoint is taken by Wolfgang Kehrein, Björn Köhnlein and Marc van Oostendorp, who all discuss the Franconian tone accent opposition. Kehrein discusses various types of data surrounding the Franconian accent system. He shows that these sources of evidence can be given a unified explanation under the assumption that the contrast between the two accents is metrical: according to Kehrein, Accent 1 and Accent 2 differ in their foot structure. Köhnlein discusses vowel splits between monophthongs and diphthongs in Franconian dialects (cf. the Sittard data given in 11)). The author

argues that these patterns can be explained if we assume that the accents underlyingly differ in their metrical structure, rather than constituting a genuinely tonal opposition. Similarly, Van Oostendorp analyzes a predictable interaction between the voicing quality of coda consonants and the resulting surface tones in the Franconian dialect of Moresnet. He argues that the differences in coda voicing trigger different syllabifications; on the surface, this is reflected in a tonal opposition between Accent 1 and Accent 2.

Lastly, the papers by Paul Boersma, Cathryn Donohue, and Paul Kiparsky discuss tone–segment interactions that presumably have shaped the phonology of modern systems from a diachronic perspective but are not phonologically relevant synchronically. Boersma develops a detailed diachronic analysis of the tone accent opposition in Franconian dialects: he shows how the accent opposition came into being and how vowel quality, vowel lengthening, vowel deletion and consonant voicing have shaped the lexical distribution of the tone accents system at different points in the development of the opposition. Donohue discusses an interaction between tone and vowel quality in the Fuzhou variety of Chinese. Essentially, she claims that there has been an interaction between tone and vowel quality. According to her, however, this interaction does not play a role in the synchronic phonology but should rather be viewed from a diachronic perspective. Kiparsky's paper shows how the opposition between Livonian *stød* (falling tone) and non-*stød* (high level tone) developed. He demonstrates how deletion processes or vowel metathesis have led to the development of *stød*. Next to its falling tone, *stød* also correlates with glottalization, which Kiparsky's regards as a phonetic enhancement of the falling pitch contour.

Together, the contributions to this volume show that the debate about the interaction between segments and tone is still a lively one, and very far from settled. On the one hand, the fact that some interactions can be reanalysed in a different way, does not necessarily mean that such interactions do not exist. At the same time, it remains intriguing that the number of such interactions remains very small. We believe it will be a challenge for phonological theory in the next years to solve this riddle, which may ultimately help us to understand the nature of phonological structure in a better way.

5 Literature

- Bradshaw, Mary M. (2000). *A crosslinguistic study of consonant-tone interaction*. Doctoral dissertation, Ohio State University.
- de Lacy, Paul (2002). The interaction of tone and stress in Optimality Theory. *Phonology* 19(1): 1–32.
- de Lacy, Paul (2006). *Markedness: Reduction and preservation in phonology*. Cambridge: Cambridge University Press.

- Dols, Willy (1953 [1944]). *Sittardse diftongering*. Sittard: Alberts Drukkerijen.
- Frings, Theodor (1916). *Die Rheinische Accentuierung; Vorstudie zu einer Grammatik der Rheinischen Mundarten*. Marburg.
- Goldsmith, John A. (1976). *Autosegmental phonology*. Bloomington: Indiana University Linguistics Club.
- Gussenhoven, Carlos (2000). On the origin and development of the Central Franconian tone contrast. In Aditi Lahiri (ed.), *Analogy, levelling, markedness: Principles of change in phonology and morphology*, 213–260. Berlin: Mouton de Gruyter.
- Hombert, Jean-Marie (1977). Development of tones from vowel height. *Journal of Phonetics* 5: 9–16.
- Hombert, Jean-Marie (1978). Consonant types, vowel quality and tone. In Victoria A. Fromkin (ed.), *Tone: A linguistic survey*, 77–112. New York: Academic Press.
- Hombert, Jean-Marie, John J. Ohala, and William G. Ewan (1979). Phonetic explanations for the development of tones. *Language* 55: 37–58.
- Hyman, Larry M., and Russell G. Schuh (1974). Universals of tone rules: evidence from West Africa. *Linguistic Inquiry* 5(1): 81–115.
- Kats, Jo C.P. (1985). *Remunjs waordeboek*. Roermond: H. van der Marck.
- Kenstowicz, Michael (2004). Quality-sensitive stress [abridged]. In John McCarthy (ed.), *Optimality Theory in Phonology: A Reader*, 191–201. Oxford: Blackwell.
- Kenstowicz, Michael (1997). Quality-sensitive stress. *Rivista di Linguistica* 9.1: 157–188.
- Lacy, Paul de (2007). *The Cambridge handbook of phonology*. Cambridge: Cambridge University Press.
- Leben, Will (1973). *Suprasegmental phonology*. Doctoral dissertation, MIT.
- Lehiste, Ilse (1970). *Suprasegmentals*. Cambridge, MA: MIT Press.
- Maddieson, Ian (1978). Universals of tone. In Joseph H. Greenberg (ed.), *Universals of Human Languages, Volume 2: Phonology*, 335–366. Stanford: Stanford University Press.
- Maddieson, Ian (1997). Phonetic universals. In William J. Hardcastle and John Laver (eds.), *Handbook of phonetic sciences*, 619–639. Oxford: Blackwell.
- Moreton, Elliott (2009). Underphonologization and modularity bias. In Steve Parker (ed.), *Phonological argumentation: essays on evidence and motivation*, 79–101. London: Equinox.
- Odden, David (2002). The verbal tone system of Zina Kotoko. In Bodil Schmidt, David Odden, and Anders Holmberg (eds.), *Some aspects of the grammar of Zina Kotoko*, 15–34. Munich: Lincom Europa.
- Pankratz, Leo, and Eunice V. Pike (1967). Phonology and morphotonemics of Ayutla Mixtec. *International Journal of American Linguistics* 33(4): 287–299.
- Ross, Malcolm (2002). Takia. In John Lynch, Malcolm Ross, and Terry Crowley (eds.), *The Oceanic languages*, 216–248. Richmond: Curzon.
- Schuh, Russell G. (1971). Verb forms and verb aspects in Ngizim. *Journal of African Languages* 10: 47–60.
- Yip, Moira (2002). *Tone*. Cambridge: Cambridge University Press.

Michael Becker, Peter Jurgec

Interactions of tone and ATR in Slovenian*

Abstract: Phonological tone-vowel interactions are cross-linguistically rare. The attested interactions are often problematic because they could be interpreted by mediation of some other feature or prosodic constituent. This paper focuses on tone-ATR interactions in Slovenian that do not suffer from these challenges. We show that the combination of High tone and lax mid vowels is dispreferred in Slovenian. We attribute this preference to a markedness constraint. In the native phonology, the constraint causes mid lax vowels to surface with a Low tone. In the loanword phonology, where High tones are required, the same constraint causes mid vowels to surface tense. This heterogeneity of process and homogeneity of target is a hallmark of markedness constraints.

1 Introduction

The interaction of tone with vowel quality is rarely reported. In fact, Hombert (1977) and de Lacy (2007) deny that such interactions are possible. We present a particularly clear case of synchronic interaction of tone with vowel quality in Slovenian as a counter-example. Slovenian restricts the combination of high tones with lax mid vowels by adjusting the tone in the native phonology and adjusting the vowel quality in the loanword phonology. We use this case to motivate an Optimality Theoretic (Prince and Smolensky, 1993/2004) analysis of Slovenian using a markedness constraint that penalizes high tones on lax vowels.

Most reports of vowel-segment interaction involve the effect of consonants on tone, most commonly the lowering effect of voiced obstruents and the raising effect of voiceless ones (Hyman and Schuh 1974, Hombert 1978, Hombert et al. 1979, Tang 2008, *inter alia*). As for vowel quality-tone interactions, the most well studied case is Fuzhou (Jiang-King 1999; Donohue, *this volume*), in which syllables with tense mid vowels can have H, HM, or M tone, while those with lax mid

* We would like to thank Larry Hyman, Wolfgang Kehrein, Charles Kisseberth, Björn Köhnlein, John McCarthy, Bruce Morén, David Odden, Marc van Oostendorp, Curt Rice, Lisa Selkirk, Matthew Wolf, Draga Zec, and the participants of the Workshop on Segments and Tone (Amsterdam, June 2007). Any remaining errors are entirely ours.

Michael Becker, Stony Brook University

Peter Jurgec, University of Toronto

vowels have HL or ML. In Cantonese (Yue Hashimoto 1972), High tone is restricted in closed syllables: on the tense vowels higher tone surfaces compared to lax vowels. In Hu (Svantesson 1991: 72), high vowels always have High tone in closed syllables, but both H and L are allowed in open syllables. In Lahu (Matisoff 1973), a rising tone raises the vowel. Shua (Odden 2011) contrasts H, M and L on non-high vowels, but high vowels also contrast a fourth, Super High tone. In Tupuri (Odden 2011), both consonants and vowel height determine tone in the imperative: high vowels require High or Super High tone (for further information on the three-way interaction of obstruent voicing, vowel height and tone, see Kingston 2007). In Matsue Japanese (Nitta 2001), the position of an initial rise depends on vowel height: the rise is on the second vowel of the word if the second and third vowels are high, but the rise is on the third if only the second is high. In Awad Bing (Cahill 2001), vowel-initial words have a Low tone, except for initial [i], which has a High tone. These reports lend support to the view that higher or tense vowels prefer High tones, and lower or lax vowels prefer Low tones.

In other languages, however, the opposite is true. In Taiwanese (Zee 1980), high tone correlates with higher F_1 , or a lower vowel. In Rengao (Gregerson 1976), tense vowels select lower tones than lax vowels. In Western Cham (Edmondson and Gregerson 1993), tense vowels have consistently lower pitch than low vowels. In Madurese (Trigo 1991, Cohn 1993), the relationship between tone and vowel height is only indirect: voiceless obstruents increase the fundamental frequency and change vowel quality, such that only lax vowels are possible after plain voiceless onsets. In Kanazawa Japanese (Nitta 2001, Odden 2001), the initial rise depends on vowel height and onset voicing: in words with a voiced onset and a high vowel in the second syllable, the pitch rise occurs on the second syllable if the third vowel is also high, but if the third vowel is non-high, the rise is word-initial. Low vowels in some languages prefer high tone. For example, Ngizim has a predictable High tone on [a] in verbs (Schuh 1971). Similar cases exist in Eastern Maninkakan (Spears 1968) and Kinande (Mutaka 1994, Archangeli and Pulleyblank 1994).

Diachronic effects of vowel quality on tone are reported in Limburg Dutch (Hermans and van Oostendorp 2007) and U (Svantesson 1988, 2001). In these two languages, high vowels triggered the development of High tones.¹

¹ The situation in Dutch is considerably more complex because of the interaction between word- and sentence-level tones (see Gussenhoven and van der Vliet 1999; Gussenhoven 1999, 2012; Köhnlein 2011 for details).

The correlation between vowel height and tone is phonetically grounded. Higher vowels have higher intrinsic F_0 than lower vowels, since the raised tongue tenses the vocal cords (Ohala 1973, 1978, Ohala and Eukel 1987), as has been reported for a large number of languages (e.g. Hombert et al. 1979, Whalen and Levitt 1995, Connel 2002). However, there is also a phonetic grounding for the opposite pattern, in which low vowels give rise to higher F_0 . Larynx height correlates directly with F_0 ; raising the larynx shortens the vocal tract, which in turn raises the formant frequencies, particularly F_1 , resulting in a somewhat lower vowel quality (Hombert et al. 1979, Archangeli and Pulleyblank 1994). Moreover, speakers who have shorter vocal tracts will have higher F_0 and higher formant frequencies, so across speakers, higher pitch correlates with higher F_1 , or lower vowels. In perception experiments, this effect was found significant (Fant 1970, Assmann and Nearey 2007).

These sources of two opposite correlations between F_0 and F_1 have led to claims that the overall correlation is too small to have any phonological consequences, as suggested by Hombert (1977). In a perception experiment, high vowels were judged significantly higher than low vowels with the same pitch, but Hombert attributes this effect to the vowels' spectral properties. Furthermore, while Connel (2002) finds significant influence of Low tone on F_1 , this is not true for other tones, for mid vowels, or languages that have more than two tones. Zee (1980) finds that speakers differ on whether F_0 and F_1 of individual vowels correlate positively or negatively. Pape and Mooshammer (2006) report that intrinsic F_0 is language dependent. Kingston (2007) shows that there are no automatic F_0 – F_1 correlations in American English. In addition, it has been suggested that for many languages mentioned above, where tone and vowel quality interact, there is some other phonetic dimension that interacts with tone, such as phonation type or vowel duration. Examples of languages where the interaction between tone and vowel quality is mediated by additional factors include Turkana, which involves the mediation of phonation type (Dimmendaal 1983, Dimmendaal and Breedveld 1986), and also Fuqing (Jiang-King 1999) and Thai (Abramson 1962, Morén and Zsiga 2006), which involve the mediation of vowel length. Finally, the precise nature of vowel-tone interaction may be obscured considerably by complex tones, as in Cantonese and Fuzhou, or additional consonant-tone interaction as in Tupuri, Madurese and Kanazawa Japanese.

The phonology of Slovenian, which we discuss here, offers a clear case of tone-vowel interaction that isn't complicated by consonant quality, phonation type, or syllable structure. Slovenian shows that lax vowels preferably occur with Low tones and tense vowels with High tones. In the native phonology, lax

mid vowels avoid High tones. In the loanword phonology, only High tones are allowed, and hence mid vowels are tensed to fit them. This uniformity of target and heterogeneity of process is a hallmark of markedness in Optimality Theory. We propose the markedness constraint *H/[–ATR –low], and show its ranking in the native and loanword phonologies of Slovenian. No other phonological property can be held responsible for this interaction.

2 The nominal system of Slovenian

This paper focuses on the nominal system of Standard Slovenian, as it is spoken in Ljubljana (henceforth, Slovenian), also the dialect of the alphabetically second author. Slovenian contrasts two tones on the stressed syllable, High and Low, as in (1).

- (1) 'pót 'path'
 'pòt 'sweat'

Our focus is on nominal paradigms, which are representative of the phonology of the language. With six cases and three numbers, Slovenian nouns are richly inflected. For the majority of nouns, the tones and stress do not change throughout the nominal paradigm, shown by the representative examples in (2).

(2)	NOM.SG	ko'rák	be'dàk
	GEN.SG	ko'rák-a	be'dàk-a
	NOM.PL	ko'rák-i	be'dàk-i
	INSTR.DU	ko'rák-oma	be'dàk-oma
		'step'	'fool'

Previous descriptions of Slovenian tone contain conflicting accounts of tones that appear after the stressed syllable (Toporišič 1968, 1976/2000, Herrity 2000, Lenček 1981, Srebot Rejec 1988). However, Jurgec (2007a,b) shows that these tones are boundary tones that are assigned at the phonological phrase level, as evidenced by their absence inside compounds. In monosyllabic words (1), for example, the pitch is realized either as falling ['pót] 'path' or rising ['pòt] 'sweat'; each contour comprises one word-level tone followed by one phrase-level boundary tone. Since this paper deals with the word-level phonology of the nominal system, we abstract away from these phrase-level tones.

Stress in Slovenian correlates with increased duration and intensity (Srebot Rejec 1988). Unstressed vowels are subject to reduction, both of the neutralizing

and the non-neutralizing kinds (Jurgec 2005, 2006a).² Contrary to the traditional account (Toporišič 1976/2000), there is no distinctive length contrast on vowels (Srebot Rejec 1988, Petek et al. 1996, Šuštaršič et al. 1995, 1999). Slovenian has nine contrastive vowel qualities in stressed syllables (Jurgec 2011), but only six in unstressed syllables (Fig. 1).

Fig. 1: Slovenian vowel system.

In stressed syllables, the unmarked vowels {a, e, i, o, u} can appear with either a High or a Low tone anywhere a stressed vowel is allowed. In other words, there is no restriction on their distribution beyond the restrictions that apply to the category ‘vowel’. Examples of the mid vowels [e] and [o] are in Tab. 1. We present examples of roots with final and penultimate stress (no native root has antepe-nultimate stress).

Tab. 1: Distribution of tones on [+ATR] mid vowels.

	Final stress		Penultimate stress	
e	pe ¹ pél ~ pe ¹ pél-a	‘ash’	‘jézer-o ~ ‘jézer-a	‘lake’
	i ¹ mè ~ i ¹ mèn-a	‘name’	‘dète ~ ‘dètet-a	‘baby’
o	ko ¹ kóf ~ ko ¹ kóf-i	‘chicken’	‘vó juot ~ ‘vójuod-a	‘duke’
	o ¹ bòk ~ o ¹ bòk-a	‘arch’	‘pògrat ~ ‘pògrad-a	‘bunk, bed’

² The quality of unstressed {e, o} is subject to controversy. Toporišič (1976/2000) describes them as lax, whereas Lehiste (1961) and Srebot Rejec (1988, 1998a,b) suggest they are neither tense or lax, but intermediate in quality. Jurgec (2006b) shows that pre-tonic {e, o} are higher than post-tonic. Šuštaršič et al. (1995, 1999), Petek et al. (1996) posit four contrastive unstressed qualities {e, ε, o, ɔ}. See Jurgec (2011) for further discussion. We transcribe the unstressed vowels as {e, o}, without making any explicit claims about their quality. This issue is not relevant to this paper, since unstressed vowels cannot bear tone.

3 Roots with underlying tone

We limit the discussion to roots with underlying tone; they constitute the vast majority of all nouns in Slovenian. These nouns have fixed stress and tone (with some exceptions, see below) throughout the paradigm, and contrast High and Low tones (2). In Slovenian, only one tone per Prosodic Word is allowed, which we attribute to the effect of (3). We assume that tones link to moras universally, even though the evidence for moras in Slovenian is scarce (see Jurgec 2010b for further discussion).

- (3) T/Δ_oPWd
Every mora associated with a tone (either High or Low) must be dominated by the head syllable of the Prosodic Word.

Hence, for an input with one underlying tone in the root *and* one in a suffix, only one tone will surface faithfully, the one in the root. The constraint in (4) ensures that a tone from a suffix doesn't flop over to the stressed syllable and surface there.

- (4) NoFLOP (Alderete 2001: 216)
If output tone t' corresponds to input tone t , and output mora m' corresponds to input mora m , and t and m are associated, assign one violation mark iff t' and m' are not associated, and t' is associated to some other mora m'' .

The tableau in (5) exemplifies this point. The candidates (b) and (c) violate T/Δ_oPWd and NoFLOP respectively, which in turn must be ranked above the MAX(T) constraint. Note that this result only holds if both tones are underlyingly associated with a vowel (i.e. not floating), see (8) for further examples.

- (5) be'dàk-a 'bedak.NOM.DU'

<div>L H</div> <div> </div> <div>/bedak-a/</div>		T/Δ_oPWd	NoFLOP	MAX(T)
a.	[be'dàka]			*
b.	[be'dǎka]		*!	
c.	[be'dàká]	*!		

Some nouns do not have the same tone throughout their paradigm. The feminines contrast High and Low on most members of the paradigm, but the INST.SG and

GEN.PL are normally High in most feminine declension classes. The paradigms in (6) represent the vast majority of feminine nouns.³

- (6)
NOM.SG	'slúz 3 -a	ma'lin-a	'pàmet
GEN.SG	'slúz 3 -e	ma'lin-e	'pàmet-i
INST.SG	'slúz 3 -o	ma'l 1 n-o	'pàmet-jo
NOM.PL	'slúz 3 -e	ma'lin-e	'pàmet-i
GEN.PL	'slú ʃ p	ma'l 1 n	'pàmet-i / 'pàmet-i
	'job'	'raspberry'	'mind'

We propose that suffixes that have a floating tone trump lexical tone. The underlying Low on ['pàmet-jo] is replaced by the floating High of the INST.SG due to the MAX(float) constraint in (7), which prefers the realization of floating tones.⁴

- (7) MAX(float) (Wolf 2007)

If a tone *t* in the input is not linked to a mora, *t* must have an output correspondent.

The derivation of ['pàmet-jo] is in (8). The floating tone is preserved due to high ranked MAX(float), which outranks MAX(T).

- (8) 'pàmetjo 'wisdom.INST.SG'

	<div style="text-align: center;"> L H /'pamet-jo/ </div>	MAX(float)	MAX(T)
a.	['pàmetjo]		*
b.	['pàmetjo]	*!	

Interestingly, floating tones dock onto the vowel that has the underlying tone. If we accept the NOM.SG ['pàmet] as the base for assessing Output-to-Output-faithfulness, then OO-IDENT(stress) is sufficient to exclude candidate (b) in (9).

³ The masculine nouns in Tab. 1 generally follow the same generalizations.

⁴ Wolf (2007) motivates this constraint based on an analysis of phenomena that are unrelated to tone, such as consonant mutations. The current analysis lends support to this constraint. Note that the REALIZE MORPHEME (Kurusu 2001) constraint would not suffice, since most of these suffixes are also segmentally realized.

(9) 'pámetjo 'wisdom.INST.SG'

<div style="text-align: center;">L H /'pamet-jo/</div>		NoFLOP	OO-IDENT(stress)
a.	['pámetjo]		
b.	[pa'métjo]		*!

4 Tone–vowel interactions

Tone is predictable on the marked vowels {ɛ, ɔ, ʌ, ə}. In this paper we discuss the mid vowels, although the situation is similar — yet more complex — for the other two vowels. In paradigms with fixed stress, which normally contrast High and Low tones on the unmarked vowels [e] and [o] (see section 3), [ɛ] and [ɔ] show up with predictable tone: Low tone on all members of the paradigm, except the NOM.SG and GEN.PL.

(10)	NOM.SG	pro'mét	rép	uz'rók	brón
	GEN.SG	pro'mèt-a	'rèp-a	uz'rók-a	'bròn-a
	NOM.PL	pro'mèt-i	'rèp-i	uz'rók-i	'bròn-i
	GEN.PL	pro'mét-ow	'rép-ow	uz'rók-ow	'brón-ow
		'traffic'	'tail'	'cause'	'bronze'

In a few nouns, [ɛ] and [ɔ] can appear as the root's penult vowel, but the penult gets stressed only in the NOM.SG. These [ɛ] and [ɔ] show up with a Low tone (11).

(11)	NOM.SG	'tèle	'òtʃe
	GEN.SG	te'lèt-a	o'tʃèt-a
	NOM.PL	te'lèt-a	o'tʃèt-je
	GEN.PL	te'lèt	o'tʃèt-ow
		'calf'	'father'

Missing from the language are fixed stress paradigms with [ɛ] or [ɔ] and a High tone throughout. We assume that such hypothetical inputs map onto the Low tone paradigms. Since [ɛ] and [ɔ] do not allow faithfulness to High vs. Low, there must be some markedness constraint that prefers Low on [ɛ] and [ɔ]. More formally: *H/[–ATR –low]. The phonetic grounding for the required markedness constraint is reasonable: Higher vowels correlate with higher perceived pitch, and [–ATR] correlates with lower vowels, so the combination is dispreferred; in fact, most languages display this pattern, as outlined in the introduction. We illustrate this

in tableau (12). Candidate (a) violates high ranked $*H/[-ATR -low]$, which outranks the corresponding faithfulness constraint $MAX(T)$.

(12) $ka'tèpa$ (hypothetical)

	H /katɛp-a/	$*H/[-ATR -low]$	$MAX(T)$
a.	[ka'tépa]	*!	
b.	[ka'tèpa]		*

A floating tone, however, causes [ɛ] or [ɔ] to surface with a High tone in the NOM.SG and GEN.PL (13). This is due to the high ranked $MAX(float)$, which is violated by candidate (a).

(13) $pro'métow$ 'traffic.GEN.PL'

	L H /pro'met-ow/	$MAX(float)$	$*H/[-ATR -low]$	$MAX(T)$
a.	[pro'mètow]	*!		*
b.	[pro'métow]		*	*

5 Loanword phonology

Evidence for the markedness of High tones on mid vowels also comes from the loanword phonology. In loanwords, a High tone is required, and mid vowels are raised to accommodate it (Jurgec 2007b), which is just the opposite of the native pattern, where tone accommodates vowel quality. For instance, English [ɔ] is borrowed as [o], even when either choice of vowel is allowed in the native phonology, as evidenced by the cases in Tab. 2, where either choice of vowel is an actual native word.

Tab. 2: Absence of $[-ATR]$ vowels in assimilated loanwords.

Native [+ATR]		Native [-ATR]		Foreign [+ATR] (always)	
rók	'hand. <small>GEN.PL</small> '	rók	'deadline'	rók	'rock'
ós	'wasp. <small>GEN.PL</small> '	ós	'axis'	ós	'Oz'
métj	'sword'	métj	'calf. <small>GEN.PL</small> '	métj	'match'
'kòla	'rod. <small>GEN.SG</small> '	'kóla	'kolo. <small>GEN.SG</small> '	'kóla	'cola'

The loanword phonology respects $*H/[-ATR -low]$, just like the native phonology. While the native phonology repairs violations of $*H/[-ATR -low]$ by changing a High tone to Low, the loanword phonology repairs these violations by changing the tenseness of the vowel. The same markedness constraint is active in both parts of the lexicon, but the activity of an additional markedness constraint in the loanword phonology forces a different repair.

The example in (14) is repeated from (12), with the added candidate (c), which is unfaithful to $[ATR]$. With faithfulness to $[ATR]$ ranked above faithfulness to tone, the vowel quality is kept, and the tone is changed.

(14) ka'têpa (hypothetical)

	H /katɛp-a/	$*H/[-ATR -low]$	MAX(ATR)	MAX(T)
a. [ka'têpa]				*
b. [ka'tépa]		*!		
c. [ka'tépa]			*!	

In the loanword phonology, where only High tones are allowed, the vowel must change to fit the tone.⁵ The tableau in (15) illustrates the situation in the loanword phonology, with a high-ranking constraint against low tones on the head of the Prosodic Word ($*\Delta_oPWd/L$, de Lacy 2002).⁶

(15) métf 'match'

	/mɛtʃ/	$*\Delta_oPWd/L$	$*H/[-ATR -low]$	MAX(ATR)
a. [mètʃ]		*!		
b. [métʃ]			*!	
c. [métʃ]				*

⁵ There are a few predictable exceptions that have Low tones, which includes homophones of older loans and templatic ends of words (see Jurgec 2007b).

⁶ A reviewer suggests that Slovenian may prefer retaining High tone at the expense of vowel quality in loanwords. If this is correct, a high ranked faithfulness constraint may be responsible for avoidance of Low tone on lax mid vowels (in line with the proposal set forth by Yip 2006). The problem with this alternative is that loanwords never allow Low tone, even on vowels where Low tone is allowed in native words. Hence, the High tone preference must be due to a markedness constraint

Having different constraint rankings in the native phonology and the loanword phonology can be achieved using indexed constraints (Itô and Mester 1995, 1999, Pater 2007, Jurgec, 2010a) or cophonologies (Inkelas et al. 1997, Anttila 2002). The argument in this paper is consistent with either approach.

6 Conclusions

We have shown that the interaction of tone and ATR in Slovenian supplies evidence for a constraint that directly relates tone and vowel quality, $*H/[-ATR -low]$. Most previously reported cases of vowel quality-tone interactions were problematic due to the fact that the interactions could be interpreted by the mediation of some other feature/prosodic constituent between vowel quality and tone. Since Slovenian does not distinguish quantity or phonation type on vowels, and the pattern holds regardless of neighboring consonants or syllable structure, it constitutes a particularly clear case of tone – vowel interactions.

In the native phonology, $*H/[-ATR -low]$ causes mid lax vowels to surface with a Low tone. In the loanword phonology, where High tones are required, the same constraint causes mid vowels to surface tense. This heterogeneity of process and homogeneity of target (a “conspiracy” in terms of Kisseberth 1970) is a hallmark of markedness constraints.

The proposed constraint, $*H/[-ATR -low]$, directly relates a supra-segmental feature and a sub-segmental feature, contrary to de Lacy’s (2007:299) proposal to disallow such constraints. The data at hand, however, makes such a constraint necessary for a complete account of the data.

References

- Abramson, Arthur S. 1962. The vowels and tones of standard Thai: Acoustical measurements and experiments. *International Journal of American Linguistics* 28, III.
- Alderete, John. 2001. Dominance effects as trans-derivational anti-faithfulness. *Phonology* 18, 201–253.
- Anttila, Arto. 2002. Morphologically conditioned phonological alternations. *Natural Language and Linguistic Theory* 20, 1–42.
- Archangeli, Diana, and Douglas Pulleyblank. 1994. *Grounded phonology*. Cambridge, MA: MIT Press.
- Assmann, Peter F., and Terrance M. Nearey. 2007. Relationship between fundamental and formant frequencies in voice preference. *Journal of the Acoustical Society of America* 122, EL35–EL43.

- Cahill, Michael. 2001. The unusual tone system of Awad Bing. Paper presented at the 75th Annual Meeting of the Linguistic Society of America (Washington, January 4–7, 2001).
- Cohn, Abigail C. 1993. Voicing and vowel height in Madurese. In Jerold A. Edmondson and Kenneth J. Gregerson (eds.) *Tonality in Austronesian languages*, 107–122. Honolulu, HI: University of Hawaii Press.
- Connel, Bruce. 2002. Tone languages and the universality of intrinsic F0: evidence from Africa. *Journal of Phonetics* 30, 101–129.
- Dimmendaal, Gerrit J. 1983. *The Turkana language*. Dordrecht: Foris.
- Dimmendaal, Gerrit J., and Anneke Breedveld. 1986. Tonal influence on vocalic quality. In Koen Bogers, Harry van der Hulst, and Maarten Mous (eds.) *The phonological representation of suprasegmentals*, 1–34. Dordrecht: Foris.
- Edmondson, Jerold A., and Kenneth J. Gregerson. 1993. Western Cham as a register language. In Jerold A. Edmondson and Kenneth J. Gregerson (eds.) *Tonality in Austronesian languages*, 61–74. Honolulu, HI: University of Hawaii Press.
- Fant, Gunnar. 1970. *Acoustic theory of speech production*. Paris: Mouton de Gruyter.
- Gregerson, Kenneth J. 1976. Tongue-root and register in Mon-Khmer. In Phillip N. Jenner, Laurence C. Thompson, and Stanley Starosta (eds.) *Austroasiatic studies*, volume 1, 323–369. Honolulu, HI: University of Hawaii Press.
- Gussenhoven, Carlos. 1999. Tone systems in Dutch Limburgian dialects. In Shigeki Kaji (ed.) *Proceedings of the symposium Cross-Linguistic Studies of Tonal Phenomena: Tonogenesis, typology, and related topics*. 127–143. Tokyo: Tokyo University of Foreign Studies.
- Gussenhoven, Carlos. 2012. Asymmetries in the intonation system of Maastricht Limburgish. *Phonology* 29, 39–79.
- Gussenhoven, Carlos, and Peter van der Vliet. 1999. The phonology of tone and into-nation in the Dutch dialect of Venlo. *Journal of Linguistics* 35:99–135.
- Hermans, Ben, and Marc van Oostendorp. 2007. Can low tone trigger velarization? Paper presented at the Workshop on segments and tone, Meertens Instituut (Amsterdam, June 7–8, 2007).
- Herrity, Peter. 2000. *Slovene: A comprehensive grammar*. London, New York: Routledge.
- Hombert, Jean-Marie. 1977. Development of tones from vowel height. *Journal of Phonetics* 5, 9–16.
- Hombert, Jean-Marie. 1978. Consonant types, vowel quality and tone. In Victoria A. Fromkin (ed.) *Tone: A linguistic survey*, 77–112. New York: Academic Press.
- Hombert, Jean-Marie, John J. Ohala, and William G. Ewan. 1979. Phonetic explanations for the development of tones. *Language* 55, 37–58.
- Hyman, Larry, and Russell G. Schuh. 1974. Universals of tone rules: evidence from West Africa. *Linguistic Inquiry* 5, 81–115.
- Inkelas, Sharon, Orhan C. Orgun, and Cheryl Zoll. 1997. The implications of lexical exceptions for the nature of grammar. In Iggy Roca (ed.) *Derivations and constraints in phonology*, 393–418. Oxford: Clarendon Press.
- Itô, Junko, and Armin Mester. 1995. Japanese phonology. In John A. Goldsmith (ed.) *The handbook of phonological theory*, 817–838. Cambridge, MA: Blackwell.
- Itô, Junko, and Armin Mester. 1999. The phonological lexicon. In Natsuko Tsujimura (ed.) *The handbook of Japanese linguistics*, 62–100. Oxford: Blackwell.
- Jiang-King, Ping. 1999. *Tone – vowel interaction in Optimality Theory*. München: Lincom Europa.
- Jurjec, Peter. 2005. Formant frequencies of Standard Slovenian vowels. *Govor* 22, 127–144.
- Jurjec, Peter. 2006a. Formant frequencies of vowels in tonal and non-tonal Standard Slovenian. *Slavistična Revija* 54, 467–478.

- Jurgec, Peter. 2006b. O nenaglašanih /e/ in /o/ v standardni slovenščini. *Slavistična revija* 54, 173–185.
- Jurgec, Peter. 2007a. Acoustic analysis of lexical tones in contemporary standard Slovenian. In *Proceedings of the 16th International Congress of Phonetic Sciences*, volume 2, 1089–1092. Saarbrücken: Universität des Saarlandes.
- Jurgec, Peter. 2007b. Novejše besedje s stališča fonologije: primer slovenščine [Neologisms in phonology: The case of Slovenian]. Doctoral Dissertation, University of Ljubljana.
- Jurgec, Peter. 2010a. Disjunctive lexical stratification. *Linguistic Inquiry* 41, 149–161.
- Jurgec, Peter. 2010b. O prihodnosti fonologije slovenščine in v Sloveniji. In *Izzivi sodobnega jezikoslovja*, ed. by Vojko Gorjanc and Andreja Žele, 13–34. Ljubljana: Znanstvena založba Filozofske fakultete.
- Jurgec, Peter. 2011. Slovenian has nine vowels. *Slavistična Revija* 59, 243–268.
- Kingston, John. 2007. Segmental influences on F0: Controlled or automatic. In *Tones and tunes*, ed. by Carlos Gussenhoven and Thomas Riad, volume 2, 171–210. Berlin: Mouton de Gruyter.
- Kisseberth, Charles. 1970. On the functional unity of phonological rules. *Linguistic Inquiry* 1, 291–306.
- Köhnlein, Björn. 2011. *Rule reversal revisited: Synchrony and diachrony of tone and prosodic structure in the Franconian dialect of Arzbach*. Doctoral dissertation, Leiden University.
- Kurusu, Kazutaka. 2001. The phonology of morpheme realization. Doctoral Dissertation, University of California, Santa Cruz.
- de Lacy, Paul. 2002. The interaction of tone and stress in Optimality Theory. *Phonology* 19, 1–32.
- de Lacy, Paul. 2007. The interaction of tone, sonority, and prosodic structure. In Paul de Lacy (ed.) *The Cambridge handbook of phonology*, 281–307. Cambridge: Cambridge University Press.
- Lehiste, Ilse. 1961. The phonemes of Slovene. *International journal of Slavic linguistics and poetics* 9, 48–66.
- Lenček, Rado L. 1981. *The structure and history of the Slovene language*. Columbus, OH: Slavica Publishers.
- Matisoff, James A. 1973. *The grammar of Lahu*. Berkeley, CA: University of California Press.
- Morén, Bruce, and Elizabeth Zsiga. 2006. The lexical and post-lexical phonology of Thai tones. *Natural Language and Linguistic Theory* 24, 113–178.
- Mutaka, Ngessimo M. 1994. *The lexical tonology of Kinande*. München, Newcastle: Lincom Europa.
- Nitta, Tetsuo. 2001. The accent system in the Kanazawa dialect: The relationship between pitch and sound segments. In Shigeki Kaji (ed.) *Proceedings of the Symposium Cross-Linguistic Studies of Tonal Phenomena: tonogenesis, Japanese accentology, and other topics*, 153–185. Tokyo: Tokyo University of Foreign Studies.
- Odden, David. 2001. Comments on “the accent system in the Kanazawa dialect: The relationship between pitch and sound segments”. In Shigeki Kaji (ed.) *Proceedings of the Symposium Cross-Linguistic Studies of Tonal Phenomena: tonogenesis, Japanese accentology, and other topics*, 187–193. Tokyo: Tokyo University of Foreign Studies.
- Odden, David. 2011. Features impinging on tone. In John A. Goldsmith, Elizabeth Hume, and Leo Wetzels (eds.) *Tones and features: Phonetic and phonological perspectives*, 81–107. Berlin: Walter de Gruyter.
- Ohala, John J. 1973. The physiology of tone. In Larry Hyman (ed.) *Consonant types and tone*, 3–14. Los Angeles: University of Southern California.
- Ohala, John J. 1978. Production of tone. In Victoria A. Fromkin (ed.) *Tone: A linguistic survey*, 5–39. New York: Academic Press.

- Ohala, John J., and Brian W. Eukel. 1987. Explaining the intrinsic pitch of vowels. In Robert Channon and Linda Shockey (ed.) *In honor of Ilse Lehiste*, 207–215. Dordrecht: Foris.
- Pape, Daniel, and Christine Mooshammer. 2006. Is intrinsic pitch language-dependent? evidence from a cross-linguistic vowel pitch perception experiment. In *Proceedings of the ISCA international workshop on multilinguistic MULTILING*. Stellenbosch.
- Pater, Joe. 2007. The locus of exceptionality: Morpheme-specific phonology as constraint indexation. In Leah Bateman, Michael O'Keefe, Ehren Reilly, and Adam Werle (ed.) *University of Massachusetts occasional papers in linguistics 32: Papers in Optimality Theory III*, 259–296. Amherst: GLSA, University of Massachusetts.
- Petek, Bojan, Rastislav Šuštaršič, and Smiljana Komar. 1996. An acoustic analysis of contemporary vowels of the standard Slovenian language. In *Proceedings icslp 96: Fourth International Conference on Spoken Language Processing, October 3–6, 1996, Philadelphia*, 133–136. Newark. Available online at <http://www.asel.udel.edu/icslp/cdrom/vol1/820/a820.pdf>.
- Prince, Alan, and Paul Smolensky. 1993/2004. *Optimality Theory: constraint interaction in generative grammar*. Malden, MA: Blackwell.
- Schuh, Russell G. 1971. Verb forms and verb aspects in Ngizim. *Journal of African Languages* 10, 47–60.
- Spears, Richard A. 1968. Tonal dissimilation in Maninka. *Journal of African Languages* 7, 88–100.
- Srebot Rejec, Tatjana. 1988. *Word accent and vowel duration in Standard Slovene: An acoustic and linguistic investigation*. Number 226 in Slavistische Beiträge. München: Otto Sagner.
- Srebot Rejec, Tatjana. 1998a. O slovenskih samoglasniških sestavih zadnjih 45 let. *Slavistična revija* 46, 339–346.
- Srebot Rejec, Tatjana. 1998b. On the vowel system in present-day standard Slovene. In Tomaž Erjavec and Jerneja Gros (eds.) *Jezikovne tehnologije za slovenski jezik: zbornik konference / language technologies for the Slovene language: Proceedings of the conference / mednarodna multi-konferenca Informacijska družba – IS'98, 6. do 7. oktobra 1998 = international multi-conference information society - IS'98, 6–7 October 1998*, 22–24. Ljubljana: Institut Jožef Stefan.
- Svantesson, Jan-Olof. 1988. U. *Linguistics of the Tibeto-Burman Area* 11, 64–133.
- Svantesson, Jan-Olof. 1991. Hu – a language with unorthodox tonogenesis. In *Austroasiatic languages – essays in honour of H. L. Shorto*, ed. by Jeremy Davidson, 67–79. London: SOAS.
- Svantesson, Jan-Olof. 2001. Tonogenesis in Southeast Asia – Mon-Khmer and beyond. In Shigeki Kaji (ed.) *Proceedings of the Symposium Cross-Linguistic Studies of Tonal Phenomena: Tonogenesis, Japanese accentology, and other topics*, 45–58. Tokyo: Tokyo University of Foreign Studies.
- Tang, Katrina. 2008. The phonology and phonetics of consonant-tone interaction. Doctoral dissertation, University of California, Los Angeles.
- Toporišič, Jože. 1968. Liki slovenskih tonemov. *Slavistična revija* 16, 315–393.
- Toporišič, Jože. 1976/2000. *Slovenska slovnica*. Maribor: Obzorja.
- Trigo, Loren. 1991. On pharynx–larynx interactions. *Phonology* 8, 113–136.
- Šuštaršič, Rastislav, Smiljana Komar, and Bojan Petek. 1995. Slovene. *Journal of the International Phonetic Association* 25, 86–90.
- Šuštaršič, Rastislav, Smiljana Komar, and Bojan Petek. 1999. Slovene. In *Handbook of the international phonetic association*, 135–139. Cambridge: Cambridge University Press.

- Whalen, D. H., and Andrea G. Levitt. 1995. The universality of intrinsic F_0 of vowels. *Journal of Phonetics* 23, 349–366.
- Wolf, Matthew. 2007. For an autosegmental theory of mutation. In Leah Bateman, Michael O’Keefe, Ehren Reilly, and Adam Werle (eds.) *University of Massachusetts occasional papers in linguistics 32: Papers in Optimality Theory III*, 315–404. Amherst: GLSA, University of Massachusetts.
- Yip, Moira. 2006. The symbiosis between perception and grammar in loanword phonology. *Lingua* 116, 950–975.
- Yue Hashimoto, Oi-kan. 1972. *Studies in Yue dialects, 1. Phonology of Cantonese*. Cambridge: Cambridge University Press.
- Zee, Eric. 1980. Tone and vowel quality. *Journal of Phonetics* 6, 247–258.

Paul Boersma

The history of the Franconian tone contrast

Abstract: The aim of this paper is to show that a sequence of typologically not unusual sound changes has led to three conspicuous properties of the dialects in a large connected area of Low and Central Franconian. First, these dialects have a binary contrast between acute and circumflex tones. Second, the majority of these dialects (“group A”) show *length reversal*, in the sense that originally short non-high vowels have become longer than the corresponding originally long vowels. Third, the remaining dialects (“group B”) show *tone reversal*, in the sense that where group A retains the original acutes, group B has circumflexes, and the reverse (at least in declarative intonation). This paper proposes a history consisting of a series of synchronic states connected by speakers’ gradual phonetic shifts and listeners’ discrete phonological reinterpretations. Each of the proposed elements is shown to have parallels elsewhere: the retraction of stress to the first mora, the lengthening of vowels in open syllables with retention of the linkage between syllables and tones, the inaudibility of tone on voiceless consonants, the drop of final schwa, the pronunciation of final voiced obstruents, the audibility of tone on voiced consonants, the devoicing of final obstruents, degemination, schwa insertion, and the effects of a markedness constraint that correlates tones and duration.

1 The tone contrast as a focus alignment contrast

In continental West-Germanic, a contiguous group of Low Franconian dialects (Limburgian or “Southern Low Franconian”) and Central Franconian dialects (Ripuaric and Moselle Franconian) exhibit a binary lexical tone contrast on long vowels and diphthongs, which interacts with the intonation contour of the

sentence. While this state of affairs has been known since Nörrenberg (1884), recent research by Carlos Gussenhoven and colleagues has taken large steps towards disentangling the influence of the lexical tone from the influence of the intonation contour. As a result, we can now more clearly see what the fundamental nature of the contrast is. The following real-life examples from Geleen Limburgian show that if the word **kniin** ‘rabbit-PL’ is in focus sentence-internally, it is pronounced with a rising or falling tone contour, depending on whether the sentence is declarative or interrogative (L = low, H = high):

- (1) a. L L L L HL L L b. L L L LH H HL
 vər fiəbə də kniin ɣəflax **fiəptxər də kniin ɣəflax**
 ‘we have slaughtered the rabbits’ ‘have you-PL slaughtered the rabbits?’

A minimally contrasting word is **kniin** ‘rabbit-SG’. If it is in focus sentence-internally, it is pronounced with a level high or low tone, depending on whether the sentence is declarative or interrogative:

- (2) a. L L L L HH L L b. L L L LL H HL
 vər fiəbə də kniin ɣəflax **fiəptxər də kniin ɣəflax**
 ‘we have slaughtered the rabbit’ ‘have you-PL slaughtered the rabbit?’

Following Gussenhoven (2000b) for Roermond, the intonation contour of the declarative sentence in (1a) can be characterized underlyingly as an L tone at the left boundary, an L tone at the right boundary, and an H* focus tone; on the surface, H* becomes aligned with the first mora of the stressed syllable (**kniin**), and the two L tones spread from the edges in toward this focus tone, yielding (1a). The intonation contour of the interrogative sentence in (1b) is then characterized underlyingly as an L tone at the left boundary, an HL contour at the right boundary, and an L* focus tone; on the surface, L* becomes aligned with the first mora of **kniin**, and the two boundary tones spread inwards toward this focus tone, yielding (1b). Gussenhoven analyses the examples in (2) as having an additional underlying lexical tone, which surfaces on the second mora of **kniin**, as H in (2a) and as L in (2b).

For the examples in (1) and (2), a different analysis than a tonal one is possible, namely an analysis in terms of *focus tone alignment*. Both in (1a) and in (2a), there is a high focus tone on **kniin**, but the transition to the L boundary tone occurs after the first mora in (1a) but after the second mora in (2a). Likewise, both (1b) and (2b) have a low focus tone on **kniin**, but the transition to the HL boundary tone occurs after the first mora in (1b) but after the second mora in (2b). The present paper proposes, now, that the Franconian tone contrast arose

historically as precisely this distinction between early and late alignment of the focus tone.¹

In the present paper I denote the moving tones (HL or LH) of (1) by the term *acute accent*, following traditional terminology for Lithuanian and Ancient Greek (Kiparsky 1973 claims the acute is realized as HL in Lithuanian and as LH in Greek); other terms in use are *Stoßton* ('abrupt tone'; also used for Lithuanian), *Schärfung*, *correction*, and (since Schmidt 1986) *accent 1*. I denote the level tones (HH or LL) of (2) by *circumflex accent*, again following traditional terminology (Kiparsky 1973 identifies the circumflex as HH in both Lithuanian and Greek); other terms in use are *Schleifton* ('slurring tone'; also used for Lithuanian), *Trägheitsakzent*, and *accent 2*.

The fundamental insight of the present paper can be told in a couple of sentences. Around the year 1100, Franconian had no tone contrast, but it did have a short–long vowel contrast in open syllables: */ma.kən/* 'make' versus */slaa.pən/* 'sleep' (where "." stands for a syllable boundary). In sentence-internal focus position, these words were all accented on their first mora, i.e. realized as [mákən, slâápən] in declarative sentences or [màkən, slâápən] in interrogative sentences. Subsequently, the common process of *open syllable lengthening* lengthened the vowel, and lengthened the tone with it, yielding the present-day contrast, which is [máákən] versus [slâápən] in declarative sentences and [mààkən] versus [slâápən] in interrogative sentences. Many subsequent developments have complicated this original correlation, but I will argue in detail that the lexical tone contrast originated in open syllable lengthening rather than in the later processes of schwa drop (as claimed by De Vaan 1999) or analogical lengthening (as claimed by Gussenhoven 2000c).

2 Historical correlations of the present-day tones

The present-day tone contrast occurs on syllables that contain two (or more) sonorant moras, i.e. on long vowels and on diphthongs, where any sequence of a short vowel and a sonorant consonant counts as a diphthong. I denote the acute tone

¹ The question whether the early-versus-late-alignment hypothesis can be maintained for the present-day Franconian dialects, i.e. whether it can also explain what happens nowadays in positions *outside* focus or whether an analysis of the data outside focus instead requires tone, has not been answered with certainty yet. Gussenhoven's synchronic analyses in terms of tone are countered by several synchronic analyses in terms of metrical structure (Kehrein this volume, Köhnlein this volume, Hermans 2012, Oostendorp this volume). This debate is not the subject of the present paper.

with an acute accent sign above the first sonorant mora: **ʃlɔ̌pən** ‘sleep’, **kléin** ‘small’, **láu** ‘long-FEM’. The circumflex tone is depicted with a macron above the second sonorant mora: **ʃpeélən** ‘play’, **daāk** ‘roof’, **brēit** ‘broad’, **laŕjk**.²

The rules that relate the current Franconian tones to original West-Germanic vowels have been known for some time (Nörrenberg 1884, Engelmann 1910). I summarize them in (3); they are described in more detail in the following sections.

(3) *The historical correlations of the Franconian acute and circumflex*

- a. “Spontaneous acute accent”: originally long non-high vowels (***aa**, ***εε**, ***ɔɔ**, ***ee**, ***oo**) currently have acute accent.
- b. “Combinatory acute accent”: originally long high vowels (***ii**, ***yy**, ***uu**), original diphthongs (***ēi**, ***ɔu**), and lengthened originally short vowels have circumflex accent, except under the following region-dependent condition, in which case they have acute accent:

“Rule A”: in most of Ripuaric and Moselle Franconian (Welter 1933), these vowels have acute accent if they were originally followed by an voiced consonant followed by schwa.

“Rule A2”: certainly in most of Limburgian and other Low Franconian areas (Nörrenberg 1884: 409, Maurmann 1898, Grootaers 1909, Dols 1944), but also perhaps in some parts of Moselle Franconian (Vianden: Engelmann 1910: 390; Trier: Reitz 1986: 6), these vowels have acute accent if they were originally followed by a voiced consonant followed by schwa, but *only if this schwa was deleted*.

In (3), “originally” refers to the state of Low and Central Franconian around the year 1100, when the “Old” stage of these languages turned into the “Middle” stage. Table (3) makes references to at least three sound changes: vowel lengthening (in open syllable), schwa deletion (word-final), and consonant devoicing (also word-final). A strict chronology that works for rule A2 is:

² The citation forms of the acute words can be pronounced with an early falling pitch contour: [ʃlɔ̌pən, kléin, lau], those of the circumflex words with a late falling pitch contour on the disyllables ([ʃpeélən]) or (as a special result of the interaction between the lexical tone and the declarative intonation; see Gussenhoven 2000b) with a high-mid-high contour on the monosyllables ([dāāk, brēit, laŕjk]); other often-mentioned phonetic differences between the citation forms are that the circumflex is longer than the acute, which is especially audible in the second mora, and that the acute has strong intensity in the first mora. General remarks on the pronunciation of Limburgian consonants are: voiceless plosives are unaspirated, voiced plosives are fully voiced, /t, d, n/ are dental stops, /c, ɟ, ɲ/ are palatalized palatoalveolar stops, /r/ is a uvular trill, tap, fricative or approximant, /l/ is “light” in all positions, /w/ is a bilabial approximant, and /ɦ/ is a voiced glottal fricative.

- (4) *A simplified strict chronology for Franconian tonogenesis, rule A2*
- a. First, long non-high vowels receive the acute accent, and long high vowels and diphthongs receive the circumflex accent. The tone contrast is “just phonetic” (§4).
 - b. Subsequently, short vowels lengthen in open syllables and some other places, receiving the circumflex accent. This leads to a lexical tone contrast between originally long non-high vowels and the new lengthened vowels (§5).
 - c. Next, final schwa is deleted, causing a preceding circumflex to change to acute if the intervening consonants are voiced. This leads to a higher functional load of the tone contrast for words that end in a sonorant (§7).
 - d. Finally, final obstruents are devoiced. This leads to a higher functional load of the tone contrast for words that end in a fricative (§11).

Rule A2 was formulated later than Rule A and is perhaps for that reason sometimes regarded as an exceptional variant, or even a later development, of Rule A (e.g. Tans 1938: 21, 160, 216). This view cannot be correct, because the Rule A2 areas retain a contrast that was lost in the Rule A areas: in rule A2, disyllabic words with a voiced medial consonant have an acute for originally long non-high vowels (**kéezən** ‘choose’) but a circumflex for lengthened vowels (**lēēzən** ‘read’); in rule A, both have an acute (**kéezən**, **léēzən**), thus neutralizing an original etymological distinction. If anything, therefore, the Rule A2 areas represent a more archaic situation, and the situation in the Rule A area is a later neutralizing development (a circumflex changed into an acute if followed by another syllable after intervening voiced consonants, e.g. **lēēzən** > **léēzən**). See §8 for details.

Finally, there are the Rule B areas. In one variant (Bach 1921), the tones are the reverse from those in area A, i.e. wherever area A has an acute, area B has a circumflex, and the reverse. Köhnlein (2011) shows that this is true only for declarative intonation. See §9 for details.

The order in (4) is nearly dictated by the correlations in (3). Nörrenberg (1884: 408, 410), for instance, argues that logically (4b) must precede (4c) and that very likely (4a) precedes (4c); to make this more precise, the present paper argues on the basis of non-neutralization that (4a) must precede (4b). Yet, some recent publications on the subject propose different orders. For instance, De Vaan (1999) proposes that the lexical contrast arose with schwa drop, i.e. with (4c) rather than with (4b), and Gussenhoven (2000c) proposes that it arose with a very late case of “analogical lengthening”, namely during the schwa drop of (4c), rather than with the earlier lengthening in open syllable. Also Schmidt (2002) maintains that schwa drop is the cause of the lexical contrast. In §13 I show that these alternative proposals cannot account for all the facts, and that the order in (4) must be correct, including the establishment of the lexical contrast in stage (4b).

The remainder of this paper gives a detailed account of the development of the Franconian tone system in terms of the phonology, the phonetics, the speakers, the listeners, and the learners of this language throughout the preceding millennium.

3 The dialects in space and time

This section presents the dialect described in this paper, and its relation with earlier stages of the language and with neighbouring dialects.

3.1 Why East Limburgian, and why Geleen?

The facts presented in §2 require that among the Franconian tone languages we investigate the dialect group that retains the original contrasts best, i.e. the dialects that follow Rule A2. This limits our choice to the Limburgian tone dialects. Within Low Franconian, these tonal dialects occupy an area in the Southeast (in Belgium, the Netherlands and Germany), separated from more Western and Northern varieties of Low Franconian by a thick bundle of isoglosses. Together, the Low Franconian tonal dialects are sometimes called Southern Low Franconian (*Südniederfränkisch*), but in this paper I simply call them Limburgian, which is the name given by its speakers in Belgium and the Netherlands, and by Goossens (1965) even for the German parts.

Fortunately, it is also within Limburgian that we find the most conservative vowel systems, which will allow us to easily project back and forth between the earliest forms and the modern forms. The most conservative group is what Goossens (1965) calls East (mainly Dutch) Limburgian, a group that comprises the cities of Venlo, Roermond, Sittard and Geleen. Within this group, Geleen has the most conservative vowel system, with the fewest mergers and a nearly one-to-one correspondence with the common West Germanic and Old High German vowel systems. As our source of present-day language data, therefore, I take the group of East Limburgian dialects, and I will write the present-day forms in a spelling most suitable for the Geleen variety.

3.2 The dialects in time

Table (5) shows the systems of long and short vowels in four stages of the language. Historical correspondences can be read off horizontally.

(5) *Four consecutive vowel systems*

*î	*iu	*û	î	ûi	û	*ii	*yy	*uu	ii	yȳ	uū
*ê ₂	*eo	*ô	ie		uo	*ee	*øø	*oo	ée	øø	óo
			ei		ou	*ɛi	*œy	*ɔu	ɛi	œi	ɔū
*ai		*au	ê		ô	*εε	*æœ	*ɔɔ	éa	øa	óa
	*â			â		*ææ	*aa		éa	ɔɔ	
*i		*u	i		u	*e	*ø	*o	e,eē	ø,øō	o,oō
*e		*o	e		o	*æ,ε		*ɔ	ε,εē		ɔ,ɔō
	*a			a			*a		æ	a,aā	
Proto			Old (Eastern)			Early Middle			New East		
West Germanic			Low Franconian			Limburgian			Limburgian		

In table (5), “Proto West Germanic” is the traditionally reconstructed language that can be regarded as the common ancestor of all current West Germanic languages, including English, German, and Dutch.

“Old (Eastern) Low Franconian” (OLF) in table (5) is the language of the Wachtendonk psalms, usually thought to have been written around the year 900. The OLF vowel system is virtually identical to that of most known Old High German dialects. This language is generally considered a predecessor of current Limburgian (Cosijn 1872–1873; Van Helten 1896, 1902; Cowan 1959, 1969; Sanders 1968–1969); an introduction can be found in Robinson (1992), but the present paper uses the publication by Kyes (1969) and follows the historical connections proposed or assumed in the etymological dictionaries (Kluge 1915, Van Wijk 1912/1929).

“Early Middle Limburgian” (Early MLb) is the language that we need to reconstruct here as the first stage that is relevant for understanding the rise of the Franconian tone system. It is characterized by a general change of vowels in unstressed vowels to schwa, and must have been spoken around the year 1100. The Early MLb vowel system is reconstructed in §3.3, its accent system in §4.

“New East Limburgian” (NLb) is the language currently spoken by about 300,000 people in the central part of the Dutch province of Limburg, as exemplified by the Geleen dialect. Table (5) shows the situation after step (4b), i.e. after open syllable lengthening; the effects of step (4c), i.e. the drop of final schwa, have not been included in the table.

3.3 Reconstruction of the Early Middle Limburgian vowel system

This section discusses how the various Early MLb vowels can be reconstructed. The reconstruction requires projections from earlier as well as from later varieties. The projection from OLF to MLb requires an interpretation of the written OLF source.

Many historical correspondences have been suggested in table (5) by writing the vowels of various stages at the same height. Thus, PWG long **û* is still long **uû** in NLb (where not changed by schwa drop), and **ô* is still **ôo**. PWG short **u* developed into NLb **u** or **ôo**, and short **o* developed into **ɔ** or **ɔ̃**; in these examples, the long circumflex vowels originated by open-syllable lengthening. Through an ambiguous vertical alignment, the table also shows the split of PWG **au*, which developed into **uû** and **ôa** in NLb. The thing that happened around “**æ, ɛ*” in the table is a complicated twist: OLF *e* lowered to MLb **æ*, whereas some instances of OLF *a* raised all the way to MLb **ɛ*. The following subsections discuss the OLF and Early MLb vowels in detail.

The long high vowels. The OLF documents contain no length marks for vowels, but many of the vowels that were written <i> and <u> continue the Common Germanic long high vowels and must have been long in OLF since they are still long in the later dialects. Therefore, the traditional transliteration, which we will follow, is *î* and *û*. These vowels occur in words like *wîn* ‘wine’, *riki* ‘empire’, *hûs* ‘house’. There is no reason to assume that these vowels were pronounced very differently from [i:, u:] in any of the four periods under consideration, so we can write **wiin*, **riikə*, **huus* for Early MLb (but see §4.6 for some important structural and phonetic detail). The vowel *ûi* (<ui>) continues the West Germanic diphthong /iu/ and is found in *fûir* ‘fire’. This spelling, with *i* as a syllable-internal marker for fronting, shows that it was already pronounced as [y:] in the OLF period, so we can reconstruct MLb **vyyr*.

Another source of MLb **yy* is *i*-umlaut of OLF *û*. The transition from the Old to the Middle stages of the West Germanic languages is traditionally defined by the loss of vowel distinctions in unstressed syllables. For Eastern Low Franconian, this meant that OLF *gevan* ‘give’ would become MLb **yævən*, and OLF *namo* ‘name’ would become MLb **namə*. However, if the vowel in the final syllable was *i* (or if it contained *j*), this vowel tended to leave a trace: the vowel of the first syllable was fronted (at least if it was back; if it already was front, it was raised). Thus, a hypothetical OLF *ûwila* ‘owl’ corresponds to MLb **yylə*. The easiest way to think of the order of events is that *i*-umlaut preceded the loss of the vowel quality, i.e., that the sequence of forms was [u:wila] → [y:wila] → [y:wələ].

The closing diphthongs. Table (5) shows a phonemic split as a result of the monophthongization of West Germanic **ai* before /h, w, r/ and in final position, and of West Germanic **au* before /h/, before the dentals /d, t, θ, ð, s, z, l, r/, and in final position. Thus, OLF has *stein* ‘stone’, *leidon/leiden* ‘lead’, *loupon* ‘walk’, but *sêo* ‘sea’ (< **saiw*), *sêla* ‘soul’ (< **saiwala*), *-hôr-* ‘hear’, *dô³* ‘death’.

³ I write voiceless final consonants that alternate with voiced consonants (*dôdi*) by underlining them, both in OLF and in MLb.

This innovation equally affected OLF and most Old High German dialects, including the predecessors of Ripuarian and Moselle Franconian; it did not affect Low Saxon and Western Low Franconian (the predecessor of Dutch), both of which monophthongized nearly all of these diphthongs to /e:/ and /o:/. Because of the later reflexes, we can assume that *ei* and *ou* stood for /ei/ and /ou/. Mechanically, we expect the following correspondences between OLF and MLb: *stein* > ***stein**, *leidon* > ***leidən**, *loupon* > ***lupən**. From the spelling of the *short* vowels /ε/ and /ɔ/ as <e> and <o> (see below), and from the spelling of the diphthongs *ei* and *ou* as <ei> and <ou>, we can hypothesize that the scribe used the symbols <e> and <o> to denote lower mid vowels, so that we can reconstruct the monophthongs *ê* (<e>) and *ô* (<o>) as /ε:/ and /ɔ:/. This would be consistent with the likelihood that the relationships between *ê* and *ei* and between *ô* and *ou* had still been allophonic in an earlier OLF period: the underlying glides in /ei/ and /ou/ were pronounced only in certain positions, deleted with compensatory lengthening in others (e.g. *[stɛjn] vs. *[sɛ:wala]). Also, the later diphthongal reflexes of *ê* and *ô* (i.e. **éa** and **óa**) point to a MLb pronunciation as lower mid vowels, as does the fact that MLb *must* have had and OLF *may* have had a separate series of higher mid vowels (see next subsection). We thus project from OLF to MLb as follows: *sêo* > ***zɛɛə** (also with voicing of initial fricatives), *sêla* > ***zɛɛlə**, *dôt* > ***doɔt**. It is possible that Early MLb already slightly raised the first part: ***zɛlə**, ***ɣrɔt**.

The source of MLb ***œy** is *i*-umlaut of OLF *ou*. We can assume that OLF **rouvâri* ‘robber’ (literally ‘reaver’) was ***roeyvæ(æ)rə** in Early MLb. The source of MLb ***œœ** is *i*-umlaut of OLF *ô*. Thus, *hôren* became ***fiœæran** in Early MLb.

At some time during MLb, the monophthongs ***ɛɛ**, ***œœ**, and ***ɔɔ** must have “broken” into ***ee**, ***œe**, and ***oo**. After this, the two parts of the diphthongs dissimilated. For the back vowel, the stage **oa**, with a close-mid first part, is still present in Geleen and the villages to the West of it (**ɣróat** ‘large’); this vowel has a corresponding morphological umlaut (**póæt**, plural of **póat** ‘paw’). In these areas, dissimilation is complete for the original front vowel (**zíæl** ‘soul’) and for the primary umlaut (**fiýæra** ‘hear’). In most of the remaining parts of East Limburgian (e.g. Maasbracht, and the more peripheral dialect of Venlo to the North), these vowels have simply turned into **ia**, **yə**, **uə**: **zíæl**, **fiýərə**, **ɣrúæt**, **púæt**, **pýæt**; these sounds are also heard in some of the neighbouring areas such as Weert (West) Limburgian to the West and Kerkrade Ripuarian to the South-East. I will transcribe these vowels as **ea**, **œa**, and **oa** when referring to the Geleen region, and as **ia**, **yə**, and **uə** when referring to the other regions. In the East Limburgian city of Roermond, however, these vowels merge with the close mid vowels and are pronounced **ée**, **œœ**, and **óo**. Since Roermond is important in our story, I will generally cite Roermond forms quite often, but mention one of the more conservative dialects when such forms contain any of these three vowels.

The long higher mid vowels. The OLF vowel written <ie> continues West-Germanic *eo (i.e. *iu with *a*-umlaut) when it occurs in *liegon* ‘tell a lie’, and *ê₂ when it occurs in *hiera* ‘here’ and the preterites *riep* ‘called out’, *farliet* ‘left’. The vowel written <uo> continues West-Germanic *ô and occurs in *fuot* ‘foot’, *ruopen* ‘call out’, and with final devoicing in *guot* ‘good’, *muot* ‘mood’, *fluot* ‘flood’ (dative *fluode*). These vowels may have been diphthongs, but since later dialects show evidence of the original /e:/ and /o:/, there are three possibilities, all problematic: the psalms were from different dialects than the later tone dialects, or /ie/ and /uo/ later changed back to /e:/ and /o:/, or written *ie* and *uo* actually represent contemporary /e:/ and /o:/. For Early MLb, I simply write *leeyan ‘tell a lie’ and *voot ‘foot’.

The source of MLb *oo is *i*-umlaut of OLF *oo. We can assume that OLF *gruoni ‘green’ was *ȳrøonə in Early MLb.

The long low vowel. The OLF long vowel written <a> continues West-Germanic â (Germanic *ê₁). The traditional notation is â: *slāpan* ‘sleep’, *jâr* ‘year’, *gâvon* ‘they gave’. Considering its later reflexes, it was probably pronounced as the back vowel [ɑ:] in the Franconian areas. For early MLb, I write **slaapən**.

All of the later dialects can have *i*-umlaut of this vowel, so we can safely assume *kâsi* > *kææzi > *kææza. None of the later dialects makes a difference between this *ææ from umlauted PWG *â and *εε from monophthongized PWG *ai (which was discussed above). Thus, we have Geleen **kiaes**, Maasbracht **kias**, and Roermond **kées**. It is likely, therefore, that the two vowels must have fallen together some time during MLb, perhaps early. Since the MHG handbooks distinguish the two sounds, however, writing them as <æ> and <ê>, I will distinguish *ææ and *εε for Early MLb.

The short high vowels. The OLF short vowels written <i> and <u> continue West Germanic *i and *u: *ist* ‘is’, *tunga* ‘tongue’, *ruggi* ‘back (ridge)’. If we take into consideration their reflexes in any modern West Germanic language, the vowels written *i* and *u* in older West Germanic scribal traditions must usually be regarded as not entirely high, i.e. as **ɪ**, **ʊ**, and (with umlaut) **ʏ**. This must have been especially true of OLF, since these vowels would later become **ee**, **oo** and **oo** after Open Syllable Lengthening, as the table indicates. Following most work on dialects in these regions, I write the vowels as **e**, **o** and **ø** (MLb *es, *tonga, *røgga).

The short low vowel. The OLF short vowel written <a> continues West Germanic *a without *i*-umlaut: *sal* ‘shall’, *craft* ‘strength’.

The short front mid vowel. The OLF orthographic symbol <e>, when referring to a short vowel, continues two different West Germanic sources: *a with *i*-umlaut, and *e. Since the later East Limburgian dialects (although not Venlo) distinguish between æ as a reflex of PWG *e without *i*-umlaut and ε as a reflex of PWG *e and *a with

i-umlaut, the distinction must have been available in OLF if this language is to be the predecessor of those dialects. The distinction was not always available in the form of an *i* or *j* in the next syllable. Thus, the attested OLF forms *tellon* ‘tell’ and *settan* ‘set’ have an original **a* with *i*-umlaut (PWG **taljan*, **satjan*) without having an *i* in the second syllable, whereas present-day East Limburgian has **tɛlən** ‘count’ and **zɛtən** with overt reflexes of *i*-umlaut. If all OLF *e* had been pronounced in the same way, the modern reflexes of *tellon* and *settan* would have been **tælən** and **zætən**, with the same vowel as in **væxtən** ‘fight’ from *fehthan*. It seems likely, therefore, that the OLF symbol *e* stood for two different vowels, a higher one in the case of *i*-umlaut of **a* or **e*, and a lower one in the case of **e* without *i*-umlaut. This situation is the same as with the scribal traditions of most Old High German dialects, in which the contrast was not written but for which a contrast is nowadays generally assumed on the basis of some later dialects (Middle High German grammars write *ē* for *ɛ* and *ë* for *æ*).⁴ Thus, we can assume MLb **tellən**, **zettən**, **bəddə** ‘bed’, **wəggə** ‘loaf’, **bəst** ‘best’ (< **batist*).

The short back mid vowel. The OLF short vowel written <o> continues West Germanic **o* (*a*-umlaut of Germanic *u*): *folkon* ‘people’, *thorna* ‘thorn’. It was probably [ɔ]. Since OLF *o* arises from *a*-umlaut, we do not expect many opportunities for *i*-umlaut; the attested form *ovir* ‘over’ could be the basis of MLb **œvər* and NLb **œðvər**, a local variant of **øðvər** (< **øvər* < **uvir*).

3.4 Reconstruction of the Early Middle Limburgian consonant system

Three changes in consonants are relevant to the conditioning of tone. First, obstruents devoiced in final position. This *First Final Devoicing* is already apparent in the attested OLF, and marked in this paper by underlining (e.g. *gōt* ‘God-NOMSG’ versus *godis* ‘God-GENSG’). Second, non-geminate fricatives became voiced in intervocalic position (*kâsi* > **kɛɛzə**). Third, vowels in final unstressed syllables were neutralized to schwa. Three changes irrelevant to tonogenesis were: the voicing of most fricatives (*fûir* > **vyyr**, *sêla* > **zɛɛlə**), followed by the change of non-intervocalic **ð** (from *th*) to **d**; and *i*-umlaut, which had created the new vowels **øø**, **œy**, **œœ**, and **ɣ**, merged the vowels of *ûwila* and *kâsi* with those of *fûir* and *sêla*, and caused the split between **æ** and **ɛ**. Eastern Low Franconian shares all of these six changes with most High German dialects, including Ripuarian and Moselle Franconian. Examples of MLb words in this stage are **wiin**, **vyyr**, **yylə**,

⁴ Van Wijk (1912/1929) uses the notations *e* and *ë* for OLF (e.g. *tellon*, *settan*, *gëvan*, *fëhtan*).

fiuus, deef, ɣrøʊnə, book, kleina, breit, røyvæærə, lʊpən, zɛɛlə, kææzə, fiœœrən, dɔɔt, slaapən. The Central Franconian dialects differed from their Low Franconian neighbours only in their voiceless obstruents (**boox, lʊfən, slaafən**).

3.5 The dialects in space

This paper mainly refer to those dialects that have no tone-related segmental changes, namely Geleen and the towns and villages to the West of it, and the villages between Roermond and Sittard. The Roermond dialect will be referred to because there is reliable information about its tones in a dictionary (Kats 1985), but the opening diphthongs /eə, øə, oə/ have monophthongized and merged with /ee, øø, oo/. The (older) Sittard dialect will be referred to, but here /ée, øø, óo/ have diphthongized to /éi, œi, úu/ (Dols 1944), causing a merger with schwa-drop-caused /éi, œi, úu/, while /eə, øə, oə/ have turned into /ée, øø, óo/ as in Roermond. The city of Venlo, in the Northern periphery of East Limburgian, is very different and will only very occasionally be mentioned. The Central and West Limburgian dialects of Maastricht, Weert, and the whole Belgian part of Limburg are too different to discuss. In the German part of East Limburgian (e.g. Dülken), the dialects are different as well.

For the present-day forms transcribed in this paper without location the segmental part will be based on the Geleen dialect, but the tones will be based only on absolutely reliable sources, namely on the Roermond data by Kats (1985), the Sittard data by Dols (1944), and occasional Maasbracht data by Ben Hermans (p.c.). If these reliable sources reveal regional variation in tone, this will be noted with markings such as “Rm.” and “Sitt.” where needed. If all reliable sources mention the same tone, and this tone does not contradict the present author’s less reliable knowledge of Geleen, I will generalize this tone on the otherwise Geleen-based transcription without further comment. This transcription strategy is not 100 percent error-proof, but is currently optimal for combining maximally contrastive segmental transcriptions with maximally reliable tone transcriptions.

4 Reconstruction of the Early Middle Limburgian accent

The first pattern to explain is why the Early MLb long non-high vowels (***aa**, ***ɛɛ**, ***ɔɔ**, ***ee**, ***øø**, ***oo**) later on came to behave differently from the long high vowels (***ii**, ***yy**, ***uu**), the diphthongs (***ei**, ***ɔu**), and the short vowels (***a**, ***æ**, ***ɛ**, ***ɔ**, ***e**, ***ø**, ***o**). The basic proposal will be that the six long non-high vowels were bimoraic, and that all the others were monomoraic. The following sections discuss in detail the reconstructed synchronic representations of all these sounds.

For each sound we have to distinguish three kinds of representations. First, there is the underlying form. The absence or presence (in the underlying form) of accent placement or tones will tell us what kinds of lexical contrasts the language has. The second relevant representation is the phonological surface structure, which is a prosodic structure containing metrical material (moras, syllables, feet) and tones (H, L). This is the structure that the speaker's grammar has to create out of the underlying form, and it is also the structure that the listener has to create out of overt auditory-phonetic information. The third relevant representation, then, is this overt auditory-phonetic pronunciation. Since the case of language evolution presented in this paper is proposed to reside for a large part in acquisition, and the acquisition processes proposed in this paper depend on the idea that the child has to invent phonological structures on the basis of overt primary language data, the phonetic representation under scrutiny here must be of an auditory rather than of an articulatory nature.

4.1 Underlying forms of non-high vowels in open syllables: a moraicity contrast

As is evident from table (5), Early MLb non-high vowels were contrastive for length. If we disregard some possible slight detail in vowel quality, we can see several short-long pairs, for instance *e ~ *ee, *ɔ ~ *ɔɔ, and *a ~ *aa. If length was contrastive, it had to be indicated in the underlying form. I follow here the usual solution of writing short vowels as monomoraic, long vowels as bimoraic. The underlying timing structures for short and long non-high vowels, then, are those presented in (6).

(6) *Early MLb underlying forms for short non-high vowels*

$\begin{array}{cccccccccccc} \mu & \mu & & \mu & \mu & & \mu & \mu & & \mu & \mu & \mu & \mu \\ \text{n a m} \acute{\text{e}} & \text{w} \acute{\text{a}} \text{k} \acute{\text{e}} & & \text{b} \acute{\text{e}} \text{k} \acute{\text{e}} & \text{ɔ} \text{p} \text{ə} \text{n} & & \text{h} \text{e} \text{m} \acute{\text{a}} \text{l} & \text{k} \acute{\text{ə}} \text{k} \acute{\text{ə}} \text{n} \acute{\text{ə}} & & \text{s} \text{t} \text{ə} \text{v} \acute{\text{ə}} \\ \text{'name'} & \text{'week'} & & \text{'brook'} & \text{'open'} & & \text{'heaven'} & \text{'kitchen'} & & \text{'stove'} \end{array}$

(7) *Early MLb underlying forms for long non-high vowels*

$\mu\mu$ μ $\mu\mu$ μ $\mu\mu$ μ $\mu\mu$ μ $\mu\mu$ μ
s l a a p + ə n **k æ æ z ə** **z ɛ ɛ l ə** **f i œ œ r + ə n** **b ɔ ɔ n ə**
 'sleep-INF' 'cheese' 'soul' 'hear-INF' 'bean'

 $\mu\mu$ μ $\mu\mu$ μ $\mu\mu$ μ
s p e e y ə l **ɣ r ø ø n ə** **k o o k ə**
 'mirror' 'green' 'cake'

I could have written each vowel in (7) with a single vowel symbol connected to two moras. This is often done in the notation of metrical structures. I chose instead to use the slightly redundant two-symbol notation here for the sake of readability, i.e. in order to have segmental representations that are similar to the linearized

abbreviations of these underlying forms, which are [sloapən], [kææzə], [zɛɛlə], and so on.

The underlying forms in (7) contain no marks for stress. This is because MLb did not have lexical stress. All stress was assigned by the grammar, as shown in the next section.

4.2 Surface structures for non-high vowels in open syllables: moraic stress

Stress in OLF quite likely fell on the first syllable of a word, disregarding a limited number of unstressed prefixes such as *ge-* and *far-*. As we see in table (5), the first syllable of a word could contain any of ten long vowels and diphthongs and any of five short vowels. The last syllable of a word could contain only a short vowel, mostly *-a*, *-e*, *-i* and *-o*. Because these final vowels historically derive from Proto-Indo-European long vowels, the reduced inventory of final vowels must be a Germanic innovation, and scholars agree that the cause of this reduction is the Germanic shift from a lexical accent on the first or second syllable to a grammatical accent on the first syllable. This accent shift caused initial syllables to become increasingly longer, and final syllables to become increasingly shorter.

In MLb, the unstressed vowel inventory had shrunk even more. There may not have been any other final unstressed vowels than **ə*, and full unstressed vowels only in derivational suffixes such as *-liik* ‘-ly’ and *-ækiin* ‘(diminutive)’. We can assume, then, that Early MLb, like OLF, had a grammatical accent that fell within the first syllable (again disregarding some unstressed prefixes), even in words that derive from Latin, such as **køkəna* ‘kitchen’ < *coquīna*.

I propose that the MLb accent was not carried by the initial syllable but by the initial mora (for a possible explanation, see the following section). The difference is illustrated by considering the alignment of sentence-internal focus intonation contours, which I assume to have been H*L for declarative focus (where H* is the high focus tone and L the transition to the low boundary tone) and L*H for interrogative focus (where L* is the low focus tone and H the transition to a high or high-low boundary tone). In present-day German, Dutch and English we can assume that the tone bearer is the syllable, and that it can host two tones, so that the stressed syllable (i.e. the accented syllable of the stressed word) carries the whole HL (or LH) movement. In MLb, I assume that the tone bearer was the mora, and that it could host only a single tone. The H* (or L*) was then connected only to the first mora, while the boundary L (or H) was connected to the following moras. This leads to the surface structures in (8) and (9).

(8) *Early MLb surface structures for short non-high vowels, aligned to H*L* (9) *Early MLb surface structures for long non-high vowel, aligned to H*L*

The recipe for creating these structures can thus be formulated as follows:

(10) *Recipe for creating tone structures inside MLb sentences*

- the declarative focus intonation is H*L, the interrogative focus intonation is L*H;
- the first mora of a word carries the accent;
- moras can host one tone (H or L);
- tones are aligned from left to right, starting with the accented mora.

Present-day reflexes. For the long non-high vowels in (9), the structures in (9) have survived to the present day, at least for those words that did not lose the second syllable. These divide into four types, all of which can be seen in (11) and (12): words that used to consist of three or more syllables, disyllabic words whose second syllable used to end in *-ər*, *-əl*, or *-əm*, or *-ən* (e.g. the infinitive and first and third persons plural present and past of most verbs, the past participle of strong verbs, the plural of most nouns whose singular ended in *-ə*, the first constituent of many compounds, and the masculine singular of adjectives, which derives from the MLb accusative case), some disyllabic words whose second syllable ended in *-ə* (namely the plural and feminine singular of adjectives ending in a MLb plosive or voiceless consonant cluster), and a couple of monosyllabic words that ended in a vowel. For such words, the present-day reflexes of long non-high vowels in open syllables usually follow the structures in (9), i.e. they carry the acute accent.

In non-voiced cases, i.e. where the following consonant was and is voiceless, or where there was no following consonant, the predictability of the present-day accent from the structures in (9) is nearly perfect, as can be seen in (11). The only exceptions are formed by two specific morphological categories, namely some comparative forms of adjectives and the first and third person plural of the past tense of a number of strong verbs.

- (11) *Modern forms with originally long non-high vowels in open syllables, non-voiced case: nearly always acute*

Early MLb ***aa** > Gel. Rm. Sitt. **ǎa**: **ſlǎpən**⁵ ‘sleep-INF/1,3PL’ < ***slaapən**, **lǎtən** ‘let-INF/1,3PL’, **ȳſlǎpən** ‘slept (p.p.)’ < ***ȳſlaapən**, **ȳlǎtən** ‘let (p.p.)’, **ſtrǎtən** ‘streets’, **hǎkən** ‘hooks’, **ſǎpəvlēif** ‘mutton’, **ſtrǎtəndræk** ‘street refuse’, **mǎtən** f.pl. ‘measures’

Early MLb ***ææ** > Gel. **éa** (Rm. Sitt. **ée**): **ȳəspréakələk** ‘talkative’ (cf. NHG *Gespräch* ‘talk’) < ***ȳəspræækəliik**, Sitt. **éekər** ‘bucket’

Early MLb ***εε** > Gel. **éa** (Rm. Sitt. **ée**): **zéa** ‘sea’

Early MLb ***œœ** > Gel. **óa** (Rm. Sitt. **óø**): (no cases known)

Early MLb ***ɔɔ** > Gel. **óa** (Rm. Sitt. **óø**): **ȳróatə** ‘large-PL/FEMSG’ < ***ȳrɔatə**, **ȳróatən**⁶ ‘large-MASCSG’ < ***ȳrɔatən** ‘(acc.)’, **ſtótatən** ‘thrust-INF/1,3PL’, **ȳſtótatən** ‘thrust (p.p.)’, Rm. Sitt. **ȳrōōtər** ‘larger’

Early MLb ***ee** > Gel. Rm. **ée** (Sitt. **éi**): **déepə** ‘deep-PL/FEMSG’, **déepən** ‘deep-MASCSG’, Rm. **deēpər** ‘deeper’, **ȳanéetən** ‘enjoy’, **ſéetən** ‘shoot’, Sitt. **ſléitən** ‘close’, **zéekə** ‘infected-PL/FEMSG’, **zéekən** ‘infected-MASCSG’, Rm. **ſléepən** / Sitt. **ſlēipən**⁷ ‘slept-1,3PL’, Rm. **léetən** / Sitt. **lēitən** ‘let-PAST1,3PL’, Rm. **réepən** / Sitt. **reipən** ‘called-1,3PL’, **knée** ‘knee’ (Sitt. **knéi**; Rm. **kníj**)

Early MLb ***oo** > Gel. Rm. **óø** (Sitt. **óei**): **zóøkən** ‘seek’, **zóōtə** ‘sweet-PL/FEMSG’, **zóōtən** ‘sweet-MASCSG’

Early MLb ***oo** > Gel. Rm. **óø** (Sitt. **óu**): **róopən** ‘call-INF/1,3PL’, **ȳróopən** ‘called (p.p.)’, **kóo** ‘cow’ (Sitt. **kóu**; Rm. **ku**)

⁵ The final **-n** of the infinitive, past participle, and most other forms written here with **-ən** shows up only before words that start with a vowel (i.e. a glottal stop) or **h**, thereby usually replacing the glottal stop or **h**. Because the citation form drops **n**, few authors on Limburgian include **n** in their transcriptions. I do write **-ən** in this paper in order to distinguish these NLb forms unambiguously from MLb forms that ended in a **-ə** that was later lost. Thus, MLb had ***straatə** ~ ***straatən** ‘street ~ streets’, NLb has **ſtrǎt** ~ **ſtrǎtə(n)**, the last of which is written here as **ſtrǎtən**. This **n** is similar to ‘linking *r*’ in English in that it is also used in some non-etymological cases such as after the enclitic **-zə** ‘you-Sg’. However, it cannot be used ‘intrusively’ after adjectival plurals and feminine singulars such as **ȳróatə** and **déepə**, i.e. those words that exceptionally retained MLb final **-ə**.

⁶ The final **-n** of the masculine singular of adjectives shows up before words that start with a vowel, **h**, **d**, **t**, or **n**; the glottal stop or **h** need not be deleted. In other positions, the **-n** is deleted (in Venlo, it turns into **-m** before **b**).

⁷ According to Dols (1944), the diphthong in these three Sittard past tenses betrays an earlier acute.

In voiced cases, the great majority of present-day polysyllables has an acute as well, at least in Sittard, as can be seen in (12). A non-negligible minority, though, is seen to have an unexpected circumflex, especially in Roermond (as observed by Dols 1944). An explanation for these exceptions was given both by Maurmann (1898) and by Dols and is discussed in §7.3.

- (12) *Modern forms with originally long non-high vowels in open syllables, voiced case: usually acute*

Early MLb ***aa** > Gel. Rm. Sitt. **áa**: **jáamər** ‘a pity’, **fjáwəxər** ‘brother-in-law’, Rm. **vráwəxən** / Sitt. **vráwəxən** ‘ask-INF/1,3Pl’, Rm. **ráwəxən** / Sitt. **ráwəxən** ‘guess’ < ***raaðən**, Rm. **bráwəxən** / Sitt. **bráwəxən** ‘fry’ < ***braaðən**, **bláwəxən** ‘blow’, **yəbláwəxən** ‘blown’

Early MLb ***ææ** > Gel. **éa** (Rm. Sitt. **ée**): **jéamərən** ‘lament’, **kréamər** ‘salesman’, **léayən** ‘low-MASC SG’, Rm. Sitt. **leéyər** ‘lower’, **yəbéarən** ‘strive’, Rm. **keēzən** m.pl. ‘cheeses’, **fiéarenj** ‘herring’ < ***fæærenj**

Early MLb ***εε** > Gel. **éa** (Rm. Sitt. **ée**): **kéarən** ‘turn-INF/1,3Pl’ < ***kεεrən** < OLF *kēran*

Early MLb ***œœ** > Gel. **óa** (Rm. Sitt. **óo**): **fióarən** ‘hear’

Early MLb ***ɔɔ** > Gel. **óa** (Rm. Sitt. **óo**): **bóanən** f.pl. ‘beans’

Early MLb ***ee** > Gel. Rm. **ée** (Sitt. **éi**): **kéezən** ‘choose’, **vərléezən** ‘lose’ (Rm. **vərléerən**), **déenən** ‘serve’, **léeyən** ‘tell a lie’, **vléeyən** ‘fly’, **bədréeyən** ‘cheat’, Rm. **fpēēyəl** / Sitt. **fpēiyəl** m. ‘mirror’

Early MLb ***oo** > Gel. Rm. **óo** (Sitt. **óei**): **vóorən** ‘lead’, **róorən** ‘stir’, **vóolən** ‘feel’, **fpóolən** ‘wash the dishes’, **bədróovən** ‘disappoint’, **vóoyən** ‘cement, add’

Early MLb ***oo** > Gel. Rm. **óo** (Sitt. **óu**): Rm. **fióovən** / Mbr. **fióovən** / Sitt. **fióuvən**~**fióüvən** ‘need’, Rm. **bloómən** / Sitt. **blóümən** ‘flowers’

4.3 Pronunciation of non-high vowels in open syllables

Duration of vowels in OLF: short moras. The predecessor of MLb, Old Low Franconian, still had some full (although short) vowels in unstressed syllables, from which we can conclude that the Germanic shift to initial stress had not run to completion yet. In order to accommodate a final vowel contrast, the final syllable in OLF must have taken up an appreciable part of the time needed to pronounce the whole word. In such a situation, where final syllables are

relatively long (as compared with later stages of the language), duration is probably not yet the main auditory cue to phonological stress. As a result, duration was a cue to phonological vowel length only: the short vowels may still have been pronounced really short, say 100 ms, and the long vowels twice that, i.e. 200 ms. Thus, we transcribe [namɔ] but [sla:pən].

Duration of short vowels in MLb open syllables: long moras. Vowel durations changed in Early Middle Limburgian. The only allowed final vowel was -*ə*, and this must have been allowed to be pronounced with a very short duration, so that more of the duration could shift to the initial (i.e. stressed) syllable. In such a situation, duration can become an important auditory cue to stress. We can assume that language users match their own and others' comprehension and production, so speakers will avoid producing stressed vowels with a duration of only 100 milliseconds.

The avoidance of very short rhymes must have affected most those syllables whose rhymes consisted of only a short vowel. The idea is that all other kinds of stressed syllables had something to contribute to length: long vowels may have been 200 ms long, and in closed syllables with a short vowel the coda consonant could contribute to the duration of the syllable, making it perhaps 160 ms. Open syllables with short vowels were now problematic if they lasted only 100 ms, which was too short for a listener to perceive them as stressed. Speakers will thus have lengthened specifically these vowels, perhaps to, say, 130 ms. The vowels in (8) were thus pronounced as half-long, e.g. **namə* was pronounced [na'mə].

That this lengthening occurred is uncontroversial, because all these vowels would ultimately end up as long after a process of Open Syllable Lengthening (OSL), in Limburgian as well as in many other West Germanic languages, among which present-day standard English ([neim]), German ([na:mə]) and Dutch ([na:m]). This process is generally thought to have taken several centuries to complete, and I propose that its consequences made themselves heard already in Early MLb.

MLb long vowels: incomplete push chain effect and short moras. The lengthening of the short non-high vowels may have caused the long non-high vowels to lengthen, but not to double the duration of a short vowel, i.e. not to 260 ms. We know this because in the West Germanic languages where OSL took place, the two kinds of vowels ended up being equally long (e.g. the lengthened vowel in Dutch *maken* is nowadays the same as the originally long vowel in Dutch *slapen*). Perhaps they just lengthened to 220 ms in MLb. I still simply write [sla:pən]. If these 220 ms count as two moras, these moras must each have been shorter (namely 110 ms) than the lengthened mora of the short vowel (130 ms).

The alignment of the tone movement. In order to get the first “phonetic” tone distribution started, we need one assumption about the phonetic implementation

of the surface structures in (8) and (9). The proposed phonetic implementation rule is simply: a high tone is audible on every voiced segment that is linked to a H in the surface structure, and a low tone is audible on every voiced segment linked to an L. The auditory forms of the words in (8) and (9) are therefore [ná:mə], [wæ:kə], [bé:kə], [ʒ:pə̀n], [hé:mə̀l], [kø:kə̀nə̀], [stó:və̀], [slá:pə̀n], [kæ:zə̀], [zé:lə̀], [fiœ:rə̀n], [bô:nə̀], [spê:yə̀l], [ýrø:nə̀], [kô:kə̀].

The monomoraic circumflex. The short vowels in open syllable, like [á:], carry relatively long high tones: if counted from the mora head, they last 130 ms, as opposed to the high tones in words with long vowels, which last only 110 ms (i.e. one half of 220 ms). We could call this opposition *monomoraic circumflex* versus *bimoraic acute*, and perhaps write the above words in a mixed phonological–phonetic orthography (phonological length; phonetic accent) as *nāmā, *wākā, *bēkā, *ʒpən, *fiēməl, *kōkənə, *stōvə, *sláapən, *kææzə, *zéélə, *fiéœrən, *bôcnə, *spéeyəl, *ýrøønə, and *kóokā.

Foreshadowings. In the auditory forms we already see two factors that contribute to the later tone contrast and its conditioning. First, the enhanced duration of the monomoraic high tones will later lead to their reinterpretation as linked to two moras rather than one (§5.1). Second, tone is audible on voiced consonants, not on unvoiced consonants. This difference will later lead (twice) to the cross-generational preservation of an association line to L for voiced consonants but not for unvoiced consonants (§5.5, §7.2, §7.3).

4.4 Short and long non-high vowels in closed syllables

If a short V was monomoraic and a long VV was bimoraic, how many moras went into a VC rhyme? In general, languages differ as to whether they count coda consonants as moraic. For MLb, I propose that codas in monosyllabic words were not moraic. The main reason for this is the phonetic duration of VC rhymes as compared to V and VV rhymes.

There are two reasons to think that the vowel in VC sequences was phonetically short, i.e. that these rhymes were pronounced [VC], not [V:C]. The first reason is theoretical and has been explained before: the C contributed to the duration of the rhyme, so that the vowel did not have to be lengthened in order to provide a duration cue for foot headship. The second reason is observational and involves back projection: the present-day languages that underwent OSL retain a length distinction between original [VC] and [V:C] rhymes (e.g. NLb *mañ* vs. *ʃɔp*, NHG *Mann* vs. *Schaf*), whereas the original length distinction between [V] and [V:] rhymes has been lost (e.g. NLb *draāyən* vs. *vrócyən*; a full merger is seen in NHG *tragen* versus *fragen*, both with the same long [a:]).

Imagine now a child who has to learn Middle Limburgian and has to decide on the number of moras in a [VC] rhyme. If such a rhyme is ambiguously monomoraic or bimoraic in languages with a [V] ~ [V:] opposition, it must be biased towards monomoraic in languages with a [V·] ~ [V:] opposition, because the duration of [VC] is closer to that of a monomoraic V in languages that pronounce this as a lengthened [V·] than in languages that pronounce this as a really short [V]. Thus, I propose that MLb children interpreted the [VC] rhyme as monomoraic. Some surface structures are shown in (13) and (14).

In (13), we see that closed syllables with short vowels consisted of one mora. The vowel heads the mora, and all consonants that follow the vowel are included as satellites into this same mora. In the case of monosyllabic words, no L is included in the structure; since these structures reflect a sentence-internal alignment with H*L, there is room for the L to be realized on the first syllable of the next word, analogously to what happens in (2).⁸

(13) *Early MLb structures for short vowels in closed syllables*

In (14) we see that closed syllables with long vowels consist of two moras. There is always room to host both the H and the L tone.

(14) *Early MLb surface structures for long non-high vowels in closed syllables*

If, as usual, the intonational cue to stress was implemented as a tonal movement directly *after* the first mora, *deey must have been pronounced as [déef] or [dèef] depending on the intonation contour of the sentence.

Present-day reflexes. The structures in (14) have survived in modern Limburgian, if a final schwa was not lost later. The forms are either MLb monosyllables (e.g. most masculine and neuter singular nouns, the imperative singular of most

⁸ Sentence-finally, the L would either have to be deleted or (more interestingly) incorporated somehow into the last mora (a case of *tone crowding*).

strong verbs, and the independent forms of most adjectives) or MLb polysyllables with the first syllable ending in **-s** or **-r**. The predictability is perfect: all of these forms have an acute accent and I am not aware of any exceptions in Geleen, Roermond, or Sittard.⁹

- (15) *Modern forms with originally long non-high vowels in closed syllable: acute*
 Early MLb ***aa** > **ǎa**: **flǎp** ‘sleep-IMP SG’ < ***slaap**, **lǎt** ‘let-IMP SG’, **flǎp** m. ‘sleep’ (OLF *slāp*), **flǎp** n. ‘sheep’ < ***sxaap**, **ǎr** n. ‘year’ (OLF *iār*), **wǎr** ‘true’, **flwǎr** ‘heavy’, **flǎr** m. ‘hair’, **dǎt** m. ‘deed’ (OLF *misdāt* ‘crime’), **rǎt** m. ‘advice’, **drǎt** m. ‘thread’, **pǎl** m. ‘pole’, **mǎltiit** m. ‘meal’, **krǎm** ‘shop’, **pǎfǎn** ‘Easter’ < ***paasxǎn** ‘Easter-DAT PL’

Early MLb ***ææ** > Gel. **éa**, Rm. Sitt. **ée**: (no instances known)

Early MLb ***εε** > Gel. **éa**, Rm. Sitt. **ée**: **fiéal** ‘whole’ (cf. non-monophthongized OHG *heil*), **éaftǎ** (Rm. **éerstǎ**) ‘first-PL/FEM SG’ < ***εerstǎ** (MHG *êrste*), **éaftǎn** (Rm. **éerstǎn**) ‘first-MASC SG’

Early MLb ***œœ** > Gel. **óa**, Rm. Sitt. **óø**: **róastǎr** m. ‘grid’

Early MLb ***ǣǣ** > Gel. **óa**, Rm. Sitt. **óø**: **yróat** ‘great’, **dóat** m. ‘death’ (OLF *dỗt*), **dóat** ‘dead’, **róat** ‘red’, **lóan** n. ‘salary’, **ftóat** m. ‘thrust’, **tóan** m. ‘tone’, **ftóattóan** ‘acute accent’, **fióax** ‘high’ < ***fiǣax** (i.e. not ***fiǣax**)

Early MLb ***ee** > Gel. Rm. **ée**, Sitt. **éi**: **déef** m. ‘thief’, **léef** ‘nice, cute’, **léex(t)** ‘light’ (OLF *lioht*), **déep** ‘deep’, **féet** ‘shoot-IMP SG’, **yǎnéet** ‘enjoy yourself’

Early MLb ***øø** > Gel. Rm. **óø**, Sitt. **éi**: **wóøstǎn** ‘savage-MASC SG’

Early MLb ***oo** > Gel. Rm. **óø**, Sitt. **úu**: **bóok** n. ‘book’, **dóok** m. ‘cloth’ (NHG *Tuch* n.), **fióot** m. ‘hat’, **fióok** m. ‘corner’, **fióostǎn** ‘cough’, **yóot** ‘good’, **blóot** ‘blood’, **móot** ‘mood, courage’, **fióon** ‘chicken’, **ftóol** ‘chair’

4.5 Diphthongs

I propose that the MLb diphthongs ***ei**, ***œy**, and ***ɔu** were monomoraic. When short vowels in open syllables lengthen to half-long, their duration will approach that of the diphthongs, which do not have to lengthen (their duration is already compatible with foot headship). As the duration of short vowels in open syllable increases, a child learning MLb becomes more likely to perceive a diphthong as

⁹ Some imperative singulars have a circumflex in the Low Franconian – Ripuaric transition dialects of Moresnet (Jongen 1972: 42): **flǎp**.

a single mora, as long as the comparably long lengthened vowel is perceived as a single mora.

Structurally, the diphthongs **ei*, **œy*, and **ɔu* can be interpreted as monomoraic if we regard them as the underlying VC sequences /*ej*/, /*œy*/ and /*ɔw*/, and if coda consonants are still non-moraic. Conversely, if the diphthongs are VC sequences, they side with other VC sequences in not requiring lengthening of the first part in open syllables, and in being interpreted by learner as equally long as the lengthened vowels in open syllables, i.e. as monomoraic. We see some example words in (16), which assumes, as before, default left-to-right tone assignment on moras.

(16) *Early MLb structures for diphthongs*

If Middle Limburgian had the default phonetic interpretation of the link between segments and tones (§4.3), **lɔwpən* must have been pronounced as [lɔ́wpə̀n] or [lɔ̀wpə́n] depending on the intonation contour of the sentence. Aligned with H*L, the words in (16) sounded like [kléjɲə̀], [bréjt], [rœ́qvæ̀rə̀], [lɔ́wpə̀n], and [drɔ́wm], with the usual restriction of not sounding tone on voiceless segments.

The new situation. If we compare the data in (16) with those of the previous section, we see that Middle Limburgian had moving tones on long vowels, and level tones on diphthongs. The same diversion between monophthongs and diphthongs occurred in the early history of Lithuanian tonogenesis. Garde (1976) gives the form /sé:dé:teĩ/, in which the two long vowels receive an acute, and the diphthong a circumflex.¹⁰

4.6 The long high vowels: monomoraic

The cross-linguistic weight distinction between CVV and CVC (§4.4) and the parallel development found in Lithuanian (§4.5) are enough for me to judge the proposed early MLb structures as typologically feasible. We do still have to explain why the high vowels (**ii*, **yy*, **uu*) side with the diphthongs and short vowels rather than with the other

¹⁰ Garde's notation indicates that the diphthong was bimoraic, as in a later stage of MLb. It may have started its life as monomoraic, though.

long vowels, as they do in Lithuanian. In Lithuanian, the long high vowels receive an acute accent, suggesting that they were bimoraic in Lithuanian just like the non-high vowels. By contrast, I propose that in early MLb the long high vowels were monomoraic. Unlike Lithuanian /i:/ and /u:/, the MLb long high vowels did not have to contrast with short vowels (all MLb short vowels were non-high), so that they were not pushed towards the duration of 220 ms that I proposed for the non-high long vowels. Also, long high vowels tend to be universally shorter than long non-high vowels, so that their duration may have been shorter than the old duration of the non-high vowels, which was 200 ms. Perhaps it was 170 ms, close to the duration of the lengthened short vowels. It was easy for a learner, then, to interpret these high vowels as monomoraic.

If the MLb long high vowels were monomoraic, there are still two possibilities for their phonological surface representation: they were phonologically simple short vowels (/i/, /y/, /u/), or they were, like the diphthongs, VC structures (/ij/, /yʊ/, /uw/). It is unlikely that ***ii** and ***uu** were short, since their later reflexes before /st/ are long (Rm. **liistən** ‘lists’, **vuüstən** ‘fists’), whereas the later reflexes of the short vowels before /st/ are still short (Rm. **kastən** ‘cupboards’, **kəstən** ‘cost’, **kestən** ‘chests’, **kəestən** ‘coasts’). So it is likely that ***ii** and ***uu** were diphthongal VC structures (with non-moraic C). Liberman (1999) actually argues that ***ii** and ***uu** were the diphthongs /ij/ and /uw/ in the whole West-Germanic area. This would explain the fact that when later the lengthening of vowels in open syllables started to crowd the vowel space, the high vowels changed towards [aj] and [aw] independently in at least three unconnected areas (England, Brabant, and Bavaria, ultimately leading to the diphthongs in ‘wine’ and ‘house’ in standard English, Dutch, and German). The fact that none of the Scandinavian languages has developed this kind of diphthongs, despite the same lengthening of vowels in open syllables, should then be attributed to the idea that the Scandinavian high vowels were genuinely bimoraic /i:/ and /u:/. Thus, an explanation for the difference between Lithuanian and Limburgian is given in the structures in (17).

(17) *Early MLb structures for long high vowels*

Foreshadowings. Given the diversion between non-high monophthongs on the one hand, and diphthongs and high vowels on the other hand, we can now already see the contours of an explanation for the behaviour of the words in §1 and §2: modern **flóʒpən** ‘large’ has a moving tone because it has an original long vowel (MLb ***sllaəpən**), while **breit** ‘broad’ and **laŋk** ‘long’ have level tones because they have an original diphthong or short vowel. But we can also see that

several issues still have to be settled: the apparent bimoraicity of modern **breit** and **laŋk** is related to a MLb process of open syllable lengthening (§5), and the fact that the moving tone in **knīin** ‘rabbits’ is different from the level tone in **kniin** ‘rabbit’ is related to a later process of final schwa drop (§7).

4.7 Geminate consonants: moraic

There is an exception to the non-moraicness of coda consonants. If the coda consonant is the first half of a geminate, it has to be represented lexically by a separate mora, at least according to the usual view of the singleton–geminate distinction in universalist phonology. Thus, both long vowels (§4.1) and long consonants have an additional underlying mora. Surface structures will reflect this. Examples are in (18).

(18) *Early MLb structures for geminates*

I propose, therefore, that geminates project a mora, whereas syllable-final sonorants do not, e.g. that ***kattə** ‘cat’ has three moras but ***kantə** ‘side’ (§4.4) only two.

Under the usual assumptions, the articulations must have been [bédðð]_{Art} and [káttə]_{Art}. The auditory forms must just have been [bédðð]_{Aud} and [káttə]_{Aud}, because tones can only be heard on voiced consonants. In other words, an intra-syllabic fall was heard on ***beddə**, but not on ***kattə**.

4.8 The predictable accent contrast and its phonetic correlates

The previous sections illustrate that Early MLb and other Franconian dialects had a predictable (i.e. non-lexical) phonological accent contrast. The accent could be predicted by the number of moras in the syllable, which was always unambiguously derivable from the phonetic duration.

First, there was the predictable phonetic acute accent: when aligned to H*L, this was realized as a short H mora followed by L. It audibly occurred in the long non-high vowels [áà], [éè], [éê], [éè], [óò], [éè], [óò], and [óò], and in the voiced geminates such as [én:] and [éd:]. There was also a predictable phonetic circumflex accent: when aligned to H*L, this was realized as a long H mora. It audibly occurred in the lengthened vowels [áː], [éː], [éː], [óː], [éː], [óː], and [óː], in the long

non-high vowels [íj], [ýǫ], and [úw], in the diphthongs [éj], [óǫ], and [ów], and in sequences of a short vowel and a voiced non-geminate coda (which was always a sonorant) such as [én]. The remaining rhymes were sequences of a short vowel and a voiceless coda. The geminate case was articulatorily acute, i.e. had an early fall ([éss̥]_{Art}), while the non-geminate case was articulatorily circumflex, i.e. had a late fall ([és̥]_{Art}), but auditorily both were ambiguous ([és]_{Aud}, [éss]_{Aud}), because tone cannot be heard on voiceless segments.

5 The Late Middle Limburgian bimoraic reanalysis

It is a surprisingly small step from the predictable phonetic accent contrast described in §4.8 to a lexical accent contrast. Since the predictability in §4.8 depends on knowing the number of moras in the first syllable, all that is needed for the switch to occur is that the lexical length contrast, which relies on having different numbers of moras in a syllable, is suspended. Precisely that is what happened when Open Syllable Lengthening proceeded in Late Middle Limburgian and its Central Franconian neighbours.

5.1 Even more lengthening of vowels in open syllables

In §4.3 we saw that as a result of the West-Germanic initial stress shift, phonologically short (i.e. monomoraic) vowels in open syllables were phonetically half-long. Thus, ***makən** ‘make’ was pronounced [maːkən].

When this lengthening progressed over the generations, the phonetic durations of the phonologically short vowels in open syllable came very close to the durations of the phonologically long vowels. As a result, some learners decided to ignore the duration distinction between the two groups and to analyse the lengthened vowels as bimoraic. We know that this happened in the histories of many current Germanic languages, and our Franconian dialects formed no exception. But whereas in most languages the lengthening vowels completely coalesced with the originally long vowels, the Franconian dialects kept the distinction alive, albeit not in the mora count.

The location of the pitch drop in Early MLb was *after* the first syllable in these words, i.e. [máːkən] and [náːmən], and it is this syllable alignment that the learners honoured in their newly constructed phonological representations. If the vowels in [máːkən] and [náːmən] are reinterpreted as bimoraic, and the tone movement is interpreted as occurring after the first syllable, the learner has no option but to interpret the H tone as including both the first and the second mora. The structures in (8) now become those in (19). For the lengthened vowels, the distinction between ***æ** and ***ɛ** was lost, either at this point or later; I will write both as **εε** from now on.

(19) *Late MLb surface structures for lengthened non-high vowels*

Present-day reflexes. For the lengthened non-high vowels in (19), the structures in (19) have survived to the present day, at least for those words that did not lose the second syllable (phonetically, the present-day circumflexes are longer than the acutes, a length reversal that I return to in §9). Examples from present-day Limburgian are listed in (20) and (21). All of these forms necessarily have two or more syllables, since no short vowels occurred word-finally in Early MLb monosyllables.

(20) *Modern forms with lengthened vowels in open syllables, non-voiced case:*

always circumflex

Early MLb *a > aā: **maākən** ‘make’, **naātə** ‘wet-PL/FEMSG’, **aāpən** m.pl. ‘apes’

Early MLb *æ > ēē: **wēēkən** f.pl. ‘weeks’, **brēēkən** ‘break’, **ʃprēēkən** ‘speak’, **ʃtēēkən** ‘sting’, **ēētən** ‘eat’, **ȳēētən** (Rm. **ȳȳēētən**) ‘eaten’, **bēētər** ‘better’ < ***bētərə** (OLF *betera*)

Early MLb *ε > ēē: **bēēkən** f.pl. ‘brooks’, **pēēpər** m. ‘pepper’

Early MLb *ɔ > ɔɔ: **ɔɔpən** ‘open (adj.)’ < ***ɔpən**, **ȳəɔɔpən** ‘boozed’, **ȳəbrɔɔkən** ‘broken’, **ȳəʃprɔɔkən** ‘spoken’, **ȳəʃtɔɔkən** ‘stung’, **ȳəɔɔtən** ‘enjoyed’, **ȳəɔɔkən** ‘smelled’, **ȳəʃlɔɔtən** ‘closed’

Early MLb *e > eē: **ȳəweēkən** ‘give way’, **ȳələēkən** ‘seemed’, **ȳəbeētən** ‘bitten’, **lēēkən** ‘leak’

Early MLb *ø > øø: **køøkən** f. ‘kitchen’ < ***køkənə** (MHG *küchene*), **ʃløøtəl** m. ‘key’

Early MLb *o > oō: (no examples)

(21) *Modern forms with lengthened vowels in open syllables, voiced case: usually circumflex*

Early MLb *a > aā: **draāȳən** ‘carry’, **jaāȳən** ‘hunt’, **klaāȳən** ‘complain’, **vaārən** ‘to drive’, **bətaālən** ‘pay’, **naāmən** m.pl. ‘names’, **ʃmáalən** ‘meagre-MASC SG’

Early MLb *æ > ēē: **ȳēēvən** ‘give’, **lēēvən** ‘live’, **lēēzən** ‘read’, **rēēȳən** ‘rain’, **tēēȳən** ‘against’ < ***təȳēȳən**, **ēēzəl** ‘donkey’, **lēēvər** ‘liver’, Rm. **vēēȳən** ‘wipe’, Rm. **bəwēēȳən** ‘move’

Early MLb ***ε** > **ε̄**: **zε̄εγ̃an** ‘saws’, Rm. **zε̄εγ̃an** ‘saw’ (denominative verb)

Early MLb ***ɔ** > **ɔ̄**: **bɔ̄ɔṽan** ‘above’, **ɔ̄ɔṽan** m. ‘oven’, **bəɔ̄ɔṽan** ‘promise’, **hɔ̄ɔl̃an** ‘fetch’ (NHG *holen*; note that Du. *halen* is a false friend), **γəftɔ̄ɔl̃an** ‘stolen’, **γəɔ̄ɔγ̃an** ‘lied’, **γənɔ̄ɔm̃an** ‘taken’, **γəbɔ̄ɔj̃an** ‘bid (p.p.)’ < ***γəbɔ̄ɔð̃an**, **γəbɔ̄ɔr̃an** ‘born’, **vərlɔ̄ɔr̃an** ‘lost’, **γəkɔ̄ɔz̃an** ‘chosen’ < ***γəkɔ̄ɔr̃an**¹¹, **γrɔ̄ɔṽan** ‘course-MASCSG’

Early MLb ***e** > **ē**: **ʃpēel̃an** ‘play’, **fīēm̃al** m. ‘heaven’, **zēēṽan** ‘seven’, **γəblēēṽan** ‘stayed’, **rēēγ̃al** m. ‘ruler’ (NHG *Riegel*)

Early MLb ***ø** > **ø̄**: **ø̄øṽar** ‘over’ < ***øṽar** (NHG *über*), **bø̄øγ̃al** m. ‘braces’ (NHG *Bügel*), **mø̄øl̃an** f. ‘mill’ < ***mø̄l̃anə**, **γəbø̄ø̄r̃an** ‘happen’, **lø̄øγ̃an** f. ‘lie’ (NHG *Lüge*)

Early MLb ***o** > **ō**: **zōōm̃ar** m. ‘summer’, **wōōñan** ‘dwell’, **vōōγ̃al** m. ‘bird’

The new situation. For the originally long non-high vowels, the structures will still be those in (9). The alignment of H*L with moras is no longer predictable from the number of moras in the syllable. It is possible, of course, that the H*L alignment was predictable from vowel quality, i.e. the lengthened vowels might have been ‘lax’, the originally long vowels ‘tense’, or some such contrast. However, at some point in time the qualities of the lengthened vowels have fallen together with those of the originally long vowels, in all languages involved. Present-day East Limburgian constitutes no exception, as we can see when comparing (11), (12) and (15) with (20) and (21) for present-day **ɔ̄**, **ē**, **ō**, and **ø̄**.

If Early MLb ***aa** had already shifted to ***ɔ̄ɔ** in Late MLb (and Early MLb ***ɔ̄ɔ** had shifted to ***ōa**), then it is possible that the four originally long MLb vowels ***ɔ̄ɔ**, ***ēe**, ***ōo**, and ***ø̄ø** already coalesced with the lengthened vowels ***ɔ̄ɔ̄**, ***ēē**, ***ōō**, and ***ø̄ø̄** in Late MLb. In that case, Late MLb had a lexical mora-accent contrast for these four vowels.

We do not have sufficient information yet as to whether and where the vowel groups coalesced. Some relevant examples, though, can be found. From 14th century Sittard, forms like *daighen* ‘days-DAT’ (< ***daỹan**), *saicken* ‘things’ (< ***zak̃an**), and *aepen/oepen* ‘open’ (< ***ɔ̄p̃an**) have been transmitted (Dols 1944: 200–202), with *i* and *e* used as length symbols, indicating that the vowel lengthening had reached phonological (i.e. bimoraic) status; this is confirmed by writing an original ***aa** with a single vowel symbol, as in *beswaren* ‘burden’ and *na* ‘after’, which indicates coalescence with the lengthened vowel.

¹¹ With a **z** introduced from the infinitive **kéez̃an**.

If such written evidence is valid, a lexical mora-accent contrast must have emerged for the non-high long vowels already in Late MLb. But even if Late MLb vowels were also distinguishable on the basis of tenseness or some such thing, the mora alignment distinction must have been a major auditory cue to the new distinction between ***ɔ̄/ēē/ōō/oo** on the one hand and ***ɔ̄/eē/ōō/oō** on the other. In such a case, one could just as well say that vowel quality was predictable from mora alignment as that mora alignment was predictable from vowel quality.

5.2 Bimoraic reanalysis of diphthongs

Now that ‘short’ vowels had been reanalysed as bimoraic, the diphthongs had to follow suit. That is, children had to interpret these as bimoraic *a fortiori*. We can therefore use VV notations (/ei/, /œy/, /ɔu/) again. The structures in (16) now become those in (22).

(22) Early MLb structures for diphthongs

Present-day reflexes. In words that did not lose their final syllable, the diachronic predictability of the accent is good. As usual, some morphological classes and disyllabic voiced cases diverge.

(23) Modern forms with diphthongs in open syllables: non-voiced cases: always circumflex

Early MLb ***ei** > **ēi**: **fiētə** ‘hot-PL/FEMSG’, **fiētən** ‘hot-MASC SG’, **wēikə** ‘weak-PL/FEMSG’, **wēikən** ‘weak-MASC SG’, **blēikə** ‘pale-PL/FEMSG’, **blēikən** ‘pale-MASC SG’, Rm. **fiētən** ‘be called’, **fweītən** ‘sweat’, **teikən** n. ‘sign (token)’, **fleipən** ‘drag’

Early MLb ***œy** > **œi**: **dœipən** ‘baptise’ (NHG *taufen* has lost the umlaut)

Early MLb ***ɔu** > **ōū**: **lōūpən** ‘run, walk INF’, **kōūpən** ‘buy-INF’

(24) Modern forms with diphthongs in open syllables: voiced cases: usually circumflex

voiced cases: usually circumflex

Early MLb ***ei** > **ēi**: **eiȳən** ‘own (adj.)’, **klēinən** ‘small-MASC SG’, **fēivən** ‘skewed-MASC SG’, **ēinən** ‘one-MASC SG’

Early MLb ***œy** > **œi**: **drœīmān** ‘dream’, **ylœivān** ‘believe’ (NHG *glauben* has lost the umlaut), **bœiγān** ‘bend, bow’ (note that NHG *beugen*; Du. *buigen* [bœyγə] is a false friend)

Early MLb ***ɔu** > **ɔū**: **ɔūγān** n.pl. ‘eyes’, **ɔūvān** ‘deaf-MASC SG’

(25) *Modern forms with diphthongs in closed syllables: always circumflex*

Early MLb ***ei** > **ēi**: **brēit** ‘broad’, **fēif** ‘skewed’ (Du. *scheef*, NHG *scheib*), **wēik** ‘weak’, **blēik** ‘pale’, **hēit** ‘hot’, **lēit** n. ‘suffering’, **rēip** m. ‘bar’, **ftein** m. ‘stone’, **bēin** n. ‘bone, leg’, **hēim** n. ‘home’, Gel. Sitt. **hēifjan** ‘be called’ < *(h)**eisxān** ‘ask’ (NHG *heischen* ‘strive’), **γeis(t)** ‘ghost’, **mēistār** ‘master’, **fleiptōan** ‘circumflex accent’

Early MLb ***œy** > **œi**: (probably no examples)

Early MLb ***ɔu** > **ɔū**: **lɔūp** ‘run, walk (*leap*) IMP SG’, **knɔūp** m. ‘button’, **rɔūk** m. ‘smoke’, **lɔūk** n. ‘leek’, **hɔūp** m. ‘heap’ (note that NHG *Haufen* < MHG *hûfe* is a false friend), **ɔūx** (Venlo **ɔūk**) ‘also’ < ***ɔuk** (**k** > **x** testifies of being in the Rhenish fan), **bɔūm** m. ‘tree (*beam*)’, **zɔūm** m. ‘seam’, **drɔūm** m. ‘dream’, **tɔūm** m. ‘bridle (*team*)’, **ɔūf** ‘deaf’

5.3 Bimoraic reanalysis of long high vowels

High vowels were now interpreted as bimoraic as well. The forms in (17) were reinterpreted as those in (26), with two high-toned moras (in sentence-internal H*L alignment) each carries by a full vowel.

(26) *Late MLb structures for long high vowels*

Present-day reflexes. The structures in (26) have survived in NLb, at least if the final syllable was not lost.

(27) *Modern forms with high vowels in open syllables:*

non-voiced case: always circumflex

Early MLb ***ii** > **iī**: **kiikān** ‘look’, **liikān** ‘look like’, **ftriikān** ‘spread’, **biitān** ‘bite’, **fjitān** ‘shit’, **riikā** ‘rich-PL/FEM SG’, **riikān** ‘rich-MASC SG’, **vrij** ‘free’, **bij** ‘by’, **hij** ‘here’

Early MLb ***yy** > **yȳ**: **kyȳkān** n. ‘chicken’ (< *kiukîn*), **ryȳkān** ‘smell’

Early MLb *uu > uū: **bruūkən** ‘need’, **ʏəbruūkən** ‘use’, **fluūtən** ‘close’,
nuw̄ ‘now’, **fuw̄** ‘shy’

- (28) *Modern forms with high vowels in open syllables:*

voiced case: usually circumflex

Early MLb *ii > iī: **friivən** ‘write-INF’, **bliivən** ‘stay-INF’, **wiizən** ‘point-INF’, **ftiivən**
‘starch-INF’, **wiizən** ‘wise-MASC SG’, **ʏriizən** ‘grey-MASC SG’, **ftiivən** ‘stiff-MASC SG’

Early MLb *yy > yȳ: **zyȳvər** ‘clean’, **yȳlən** m.pl. ‘owls’, **hyȳrən** ‘hire’,
ftyȳrən ‘send, steer’

Early MLb *uu > uū: **druūvən** f.pl. ‘grapes’, **duūvən** f.pl. ‘doves’, **friuūvən**
f.pl. ‘screws’, **duūmən** m.pl. ‘thumbs’, **duūzənt** ‘thousand’

- (29) *Modern forms with high vowels in closed syllables: always circumflex*

Early MLb *ii > iī: **tiit** m. ‘time’, **wiit** ‘wide’, **iis** n. ‘ice’, **wiis** ‘wise’, **ʏriis**
‘grey’, **friif** ‘write-IMP SG’, **bliif** ‘stay-IMP SG’, **wiin** m. ‘wine’, **liistən** f.pl. ‘lists’

Early MLb *yy > yȳ: **vyȳr** ‘fire’

Early MLb *uu > uū: **fluūs** ‘house’, **uūt** ‘out’, **muūs** ‘mouse’, **luūs** ‘louse’,
bruūt¹² ‘bride’, **vuūs(t)** ‘fist’, **fuūm** ‘foam’, **zuūr** ‘sour’

5.4 Bimoraic reanalysis of vowel-sonorant sequences

The long H tone was audible on all sequences of short vowel and tautosyllabic sonorant coda. As in the case of the diphthongs and high vowels, learner will have interpreted this sequence as a bimoraic circumflex. The relevant cases in (13) will be reanalysed as the structures in (30).

- (30) *Early MLb structures for short vowels in closed syllables*

Present-day reflexes. The structures in (30) have been preserved in NLb, at least in words where no syllable was later lost (by final schwa drop, see §7) or gained (by schwa insertion into sequences like **-lf** and **-rx**, see §12.2) and otherwise no segments dropped (by lenition and degemination, see §7.7 and §12.1). The present

¹² The underlining of the **t** is based on the MLb reconstructed form, which must have had **d** (e.g. NHG *Braut*). Present-day Roermond has the unexpected plural **bruūtən**.

forms are listed in (31) and (32). As usual, forms where there is a *following* voiced consonant are listed separately; all these are from Venlo, because lenition and degemination later deleted a segment in the other dialects, causing these forms to go into a different accent class (§7.7).

(31) *Modern forms with tautosyllabic vowel-sonorant sequences:*

non-voiced case: always circumflex

(for nonhomorganic cluster cases see §12.2)

Early MLb ***am** > **a $\ddot{m}$** : **da $\ddot{m}$ p** m. ‘vapour’

Early MLb ***om** > **o $\ddot{m}$** : **do $\ddot{m}$ p**¹³ ‘dumb’, **ko $\ddot{m}$ p** m. ‘bowl’ (MHG *kumpf*)

Early MLb ***an** > **a $\ddot{n}$** : **ma $\ddot{n}$** ‘man’ < ***man**, Venlo **ka $\ddot{n}$** ‘can-1,3SG’, **va $\ddot{n}$** ‘of, from’, **ha $\ddot{q}$ j $\ddot{c}$** f. ‘hand’ < ***hant**, **la $\ddot{q}$ j $\ddot{c}$** n. ‘land’, **za $\ddot{q}$ j $\ddot{c}$** n. ‘sand’, **wa $\ddot{q}$ j $\ddot{c}$** f. ‘wall’, **ka $\ddot{q}$ j $\ddot{c}$ an** f.pl. ‘sides’ < ***kant $\ddot{a}$ n**

Early MLb ***en** > **e $\ddot{n}$** : **e $\ddot{n}$** ‘in’, Rm. **ki $\ddot{h}$ j $\ddot{c}$** , Gel. **ke $\ddot{h}$ j $\ddot{c}$** n. ‘child’, Rm. **we $\ddot{h}$ j $\ddot{c}$ ar**, Gel. **we $\ddot{h}$ j $\ddot{c}$ ar** m. ‘winter’

Early MLb ***on** > **o $\ddot{n}$** : **ho $\ddot{q}$ j $\ddot{c}$** m. ‘dog’, **gro $\ddot{q}$ j $\ddot{c}$** m. ‘ground’, **mo $\ddot{q}$ j $\ddot{c}$** m. ‘mouth’, **yo $\ddot{z}$ o $\ddot{q}$ j $\ddot{c}$** ‘healthy’, **blo $\ddot{q}$ j $\ddot{c}$** ‘blonde’

Early MLb ***a η** > **a $\ddot{\eta}$** : **la $\ddot{\eta}$ k** ‘long’, **da $\ddot{\eta}$ k** m. ‘thanks’, **yo $\ddot{\eta}$ k** m. ‘gait, passage’

Early MLb ***e η** > **e $\ddot{\eta}$** : **de $\ddot{\eta}$ k $\ddot{a}$ n** ‘think’

Early MLb ***e η** > **e $\ddot{\eta}$** : Rm. **de $\ddot{\eta}$ k**, Gel. **de $\ddot{\eta}$ k** n. ‘thing’, Rm. **re $\ddot{\eta}$ k**, Gel. **re $\ddot{\eta}$ k** m. ‘ring’

Early MLb ***al** > **a $\ddot{l}$** : **ba $\ddot{l}$** m. ‘ball’, **a $\ddot{l}$** ‘all’, **va $\ddot{l}$** m. ‘fall’, **ka $\ddot{l}$** m. ‘chat’, **za $\ddot{l}$** ‘shall-1,3SG’, **wa $\ddot{l}$** m. ‘wall’, Venlo¹⁴ **a $\ddot{l}$ t** ‘old’, Venlo **ka $\ddot{l}$ t** ‘cold’, Venlo **wa $\ddot{l}$ t** n. ‘wood’, Venlo **za $\ddot{l}$ t** n. ‘salt’

Early MLb ***ael** > **a $\ddot{e}$ l**: **yo $\ddot{a}$ l $\ddot{c}$** n. ‘money’, **ha $\ddot{e}$ l** ‘hard’

Early MLb ***ol** > **o $\ddot{l}$** : **vo $\ddot{l}$** ‘full’

Early MLb ***el** > **e $\ddot{l}$** : **we $\ddot{l}$** ‘want-1SG’, Rm. **we $\ddot{l}$ ċ**, Gel. **we $\ddot{l}$ ċ** ‘wild’

¹³ The underlined final clusters **mp**, **j $\ddot{c}$** , **ŋk**, and **l $\ddot{c}$** derive from the MLb ‘underlyingly voiced’ **mp**, **nt**, **ŋk**, and **lt**, which became **mb**, **nd**, **ŋg**, and **ld** before a vowel. Late MLb deleted the plosives in prevocalic position, leaving just the present-day **m**, **n**, **ŋ**, and **l** in prevocalic position (as well as word-finally in cases of schwa drop). See §7.7 for more detail.

¹⁴ These Venlo forms end in **-a $\ddot{a}$ t** or **-a $\ddot{u}$ t** etc. in the other dialects. According to Van der Meer (1949: 299), Venlo mainly had **-aat** in the 14th century as well, and **-alt**-like forms were reintroduced in the 15th century.

- (32) *Modern forms with tautosyllabic vowel-sonorant sequences: voiced case: usually circumflex*

Early MLb ***an** > **añ**: Venlo **añdər** ‘other’

Early MLb ***en** > **eñ**: Venlo **beñdən** ‘bind’

Early MLb ***on** > **oñ**: Venlo **oñdər** ‘under’

Early MLb ***al** > **āl**: Venlo¹⁵ **faāldən** ‘hold’

5.5 Reanalysis of voiced and voiceless geminates

The next question to answer is how the learning child interpreted the auditory forms [béddə]_{Aud} and [kättə]_{Aud} (§4.7). Now that the language allows acute as well as circumflex syllables, it is no longer evident that the child should interpret both forms as acute, as their parents were forced to do. In fact, we know that the present-day dialects tend to distinguish these forms (as least their MLb plurals ***bëddən** ‘beds’ and ***kattən** ‘cats’ which did not undergo final schwa drop later). In the modern language, where the difference between the two groups has become larger, ‘beds’ has a clearly audible acute whereas ‘cats’ has a clearly audible circumflex (Ben Hermans, p.c.; see §12.1 for details).

Although the acute for ***bëddə** and the circumflex for ***kattə** could have arisen later, it is tempting to seek the cause of the distinction in the bimoraic reanalysis of Late MLb, when children had the first chance to create it. Thus, I propose that the structures of (18) turned into the contrasting pair in (33).

- (33) *Late MLb structures for geminates, aligned to H*L*

Taking the structures in (33) at face value, the first thought of a phonologist is that the explanation for the split must lie in the commonly attested correlation of tone with voice, namely that H tones go together with voicelessness and L tones with voicedness. This correlation is visible in (33), and in fact a similar explanation has been provided by Hermans (2006) for a similar but different case in Limburgian. However, the voice-tone correlation exemplified so beautifully in (33) in fact owes its plausibility entirely to the presence of the H*L (declarative) contour that I used to illustrate

¹⁵ This form is **faājən** in the other dialects. The same comment as in the previous footnote applies here.

sentence-internal surface structure. I could just as well have used the L*H (interrogative) contour. In that case, the surface structures would have been those in (34).

(34) *Late MLb structures for geminates, aligned to L*H*

Both the structures in (33) and those in (34) must have coexisted in Late MLb. Unless the declarative contour H*L was *much* more frequent than the interrogative (or continuative) contour L*H, no universal correlation between voice and tone can explain why ***bēddə** received an acute accent and ***kātə** a circumflex.

I propose instead that the split was caused by a difference in the audibility of the tones. The auditory form [bēddə]_{Aud} contains much more information about the tone on the second mora than the auditory form [kātə]_{Aud} does. It is not surprising that [bēddə]_{Aud}, with its overtly low first [d], was interpreted as acute. The form [kātə]_{Aud}, by contrast, had a voiceless second mora (the first [t]), which was ambiguous with regard to tone, so we know that it was phonetically more circumflex than [bēddə]_{Aud}. But if [kātə]_{Aud} was ambiguous, why did children decide to analyse it as circumflex? Wouldn't an acute analysis have been equally likely?

One explanation could involve a directional on-line perceptual-phonological bias. If you hear a H tone, you are waiting for the next L tone, and you will decide that the tone has changed to L only when you hear positive evidence of it, i.e. a low pitch on a voiced segment. If a voiceless stretch intervenes between the H vowel and the L vowel, this stretch contains no information on the fall, so it is better for you not to assume yet that it has happened. After all, the next vowel could still be high-pitched, in which case you should perceive a continuous H tone shared by both syllables. If you wait until you get positive evidence, you will perceive both a disyllabic H tone and a disyllabic HL contour correctly. So the second, voiceless mora of [kātə]_{Aud} is perceived with the same tone as the preceding [a].

Another explanation could lie in the non-directional competition between mora-based and syllable-based cues. Perceiving the second mora of [kātə]_{Aud} as having a H tone (i.e. perceiving the first syllable as circumflex) violates the cue constraint that says that “a mora without phonetic high pitch should not be perceived as a phonologically high-toned mora”. Perceiving the second mora of [kātə]_{Aud} instead as having a L tone (i.e. perceiving the first syllable as acute) would violate the cue constraint that says that “a syllable without a phonetic pitch movement should not be perceived as an acute”. If the syllable-based constraint outranks the mora-based constraint, i.e. if the ranking follows the prosodic hierarchy, the interpretation of [kātə]_{Aud} as circumflex is explained.

A third explanation could lie in a language-specific structural constraint. A comparison of the number of forms in (11), (12) and (15) on the one hand, and

(20), (21), (23), (24), (25), (27), (28), (29), (31) and (32) on the other suggests that in Late MLb the circumflexes must have outnumbered the acutes by a factor of two or so.¹⁶ The MLb-specific markedness constraint “syllables are circumflex” could have caused the interpretation of [káttə]_{Aud} as the default, i.e. as circumflex.

5.6 Reanalysis of voiceless non-geminate codas

Two of the forms in (13) have not been discussed yet. It is those with a voiceless coda that is not part of a geminate, namely ***kɔp** and ***kestə**. The stressed syllables of all forms that we have seen so far, including those ending only in a half-long vowel, were interpreted by Late MLb learners as bimoraic, and there is no reason to suppose that it would be otherwise for these forms. Following the same reasoning as in §5.5 (with the same three possible explanations), the accent must have been analysed as circumflex *a fortiori*, because the parent articulation [kéšìə]_{Art} is even less likely than [káttə]_{Art} to have had a small cue on the first mora to the impending pitch drop. The structures that the child builds are those in (35).

(35) *Early MLb structures for short vowels in closed syllables*

Present-day reflexes. For words that did not lose final schwa (as e.g. ***kestə** itself), present-day Limburgian retains the structures in (35). The current pronunciation of these forms is such that the movement to L occurs well after the stressed syllable, as in (2), so that the circumflex on e.g. **kestən** is no longer inaudible.

(36) *Modern forms with sequences of a short vowel and a voiceless consonant: circumflex*

kɔp m. ‘head’ < ***kɔp**, **kraḡ(t)** f. ‘strength’ < ***kraft**, **eḡ** (Venlo **ek**) ‘I’, **meḡ** ‘me’, **deḡ** ‘you-SG’, **zeḡ** ‘herself, himself, themselves’, **ræḡ(t)** ‘right’ (OLF *reht*), **flæḡ(t)** ‘bad’, **keṣtən** f.pl. ‘chests’ < ***kestən** (NHG *Kisten*)

¹⁶ One counts all the forms, even the ones that have a different accent in present-day Limburgian (because the accent changes are of a later date). One should also count the Late MLb forms of the words introduced in later chapters, but these will not change the factor of two for Late MLb. For present-day Limburgian, the factor is much closer to 1, because of the later changes described from §7 on.

5.7 The influence of voicing

The tonogenesis described in the previous section provides the first opportunity for the split between Rule A and Rule A2.

In general, the tone contrast is more difficult to hear on disyllables with voiced consonants than on disyllables with voiceless consonants. In [ʒ́ɔ̀pə̀n̩], the low tone starts one vowel plus one consonant later than in [slɔ́ɔ̀pə̀n̩], whereas in [lɔ́ɔ̀ʏə̀n̩], the low tone starts only one vowel later than in [vɔ́ɔ̀ʏə̀n̩]. It is possible that some reanalysing children were capable of positing a tone opposition only on the voiceless cases, while merging the voiced cases into acutes just as the non-tonal Germans, Dutch and English must have done.

5.8 The new situation: a lexical contrast for non-high vowels in polysyllabic words

In Late Middle Limburgian, all stressed syllables were phonologically long, i.e. bimoraic (as in present-day Swedish, for instance). On the surface, every stressed syllable either had the acute accent (where each mora had a different tone) or the circumflex accent (where each mora had the same tone).

In many cases, the Late MLb accent was predictable by grammatical rule. High vowels, closing diphthongs, ***aa**, ***εε**, monosyllabic words with short vowels, and rhymes with voiceless codas or with non-geminate voiced codas were always circumflex. The vowels **ea**, **oa**, and **oa** and closed syllables with non-high long vowels were always acute. The only VC rhymes that were predictably acute were the geminate voiced codas like ***bédðə**. The explanation of this exception involved both a phonological and a phonetic observation: phonologically, geminates were the only VC rhymes that were forced to be bimoraic, hence had to host a L tone, and phonetically, voiced codas were the only codas on which an L tone could be audible.

In a minority of cases, namely for the vowels ***ɔɔ**, ***ee**, ***oo**, and ***oo** in an open syllable in polysyllabic words, the accented mora had to be specified in the lexicon (e.g. by a star on the first mora for acutes, and on the second mora for circumflexes; this lexical star then aligns on the surface with the star in H*L or L*H). This is what made Late Middle Limburgian a lexical mora-accent language. Hermans (1984) argues that it still is.

6 Analogical lengthening

After lengthening of vowels in open syllable, some verbal, nominal, and adjectival paradigms contained alternations between short and long vowels. In these cases the paradigm was levelled towards the long version, so that many short

vowels in closed syllables lengthened as well. Since the model form, with a vowel lengthened in the previous step, necessarily had a circumflex tone, the analogically lengthened vowel was circumflex as well.

In the verbal paradigm, not much happened. In weak verbs, all forms had a theme vowel (schwa), so all forms had been lengthened already (e.g. **lēvā** ‘I live; live-IMP SG’, **lēvān** ‘to live; we/they live’, **lēvāt** ‘lives; you-PL live; live-IMP PL’, **lēvās** ‘you-SG live’). In strong verbs, the infinitive was lengthened (**ȳēvān** ‘to give’), as were several forms of the present indicative, namely the first person singular (**ȳēvā** ‘I give’), the second person plural (**ȳēvāt** ‘you-PL give’), and the first and third person plural (**ȳēvān** ‘we/they give’). The only consonant-final form in strong verbs was the imperative singular. This stayed short (cf. present-day **ȳef** ‘give!’), perhaps because the second and third persons singular of the present indicative stayed short as well (cf. present-day **ȳofs** ‘you-SG give’ and **ȳof** ‘gives’).

In the nominal paradigm, the nominative/accusative singular of (mainly masculine) nouns with a plural ending in **-ā**, genitive singular in **-ās**, and dative singular in **-ā**, was lengthened: **dax** ‘day’ became **daāx** analogously to **daāȳā** ‘days’. For neuter nouns with zero plural endings and for nouns without plurals, the source of analogy was restricted to the genitive or dative singular:¹⁷ **fiōf** ‘garden’ became **fiōȳf** analogously to **endān fiōȳvā** ‘in the garden-DAT SG’, and **ȳras** ‘grass’ became **ȳraās** ‘grass’ analogously to **optān ȳraāzā** ‘on the grass-DAT SG’.

In the adjective paradigm, the predicative form, e.g. **nat** ‘wet’ was lengthened to **naāt** in analogy with attributive forms such as the feminine and plural nominative singular (**naātā**) and the masculine accusative singular (**naātān**).

It will turn out (§6.2) to be relevant that analogical lengthening created circumflex tones independently of whether the following consonant (or the following consonant elsewhere in the paradigm) was voiced or voiceless. Thus, analogical lengthening is the source of the following present-day Limburgian forms with an original voiceless consonant:

(37) *Analogical lengthening in voiceless paradigms: circumflex*

Early MLb ***a** > **aā**: **daāk** f. ‘roof’, **ȳōmaāk** n. ‘ease’, **vaāt** n. ‘barrel’, **naāt** ‘wet’, **vlaāk** ‘flat’, **fwaāk** ‘weak’

Early MLb ***æ** >> **ēē**: (no cases known)

Early MLb ***ɔ** >> **ōō**: **flōt** n. ‘lock’, **fpōr** f./n. ‘track’

Early MLb ***e** >> **ēē**: **ȳābeēt** n. ‘teeth’, **jeēp** n. ‘ship’, **bleēk** n. ‘tinplate’

Early MLb ***o** >> **ōō**: perhaps **noōt** ‘nut’ < ***not**(ə) (MHG *nuz*, MDu *note*)

¹⁷ Or sometimes perhaps the form that was the first part of a nominal compound.

It is also the source of the following forms that end in a voiceless consonant that corresponds to a voiced consonant elsewhere in the paradigm:

(38) *Analogical lengthening in voiced obstruent paradigms: circumflex*

Early MLb ***a** > **aā**: **daāx** m. ‘day’, **ȳraās** n. ‘grass’, **flaāx** m. ‘stroke’, **paāt** n. ‘path’, **raāt** n. ‘wheel’, (for Rm. **kāaf** n. ‘chaff’ see §7.3)

Early MLb ***æ** >> **ēē**: **wēēx** m. ‘way’, **ȳobeēt** n. ‘prayer’

Early MLb ***ɔ** >> **ōō**: **hōōf** m. ‘court’, **ȳobōōt** n. ‘commandment’, **ȳrōōf** ‘coarse, rude’ < ***ȳerōf**

Early MLb ***e** >> **eē**: **fmēēt** m. ‘smith’ (pl. **fméej**), **ȳoleēt** n. ‘member’

Early MLb ***o** >> **ōō**: (no cases known)

And it is the source of the following forms that end in a voiced consonant:

(39) *Analogical lengthening in sonorant paradigms: circumflex*

Early MLb ***a** > **aā**: **laām** ‘lame’, **fmaāl** ‘narrow’, **taām** ‘tame’

Early MLb ***æ** >> **ēē**: (no cases known)

Early MLb ***ɔ** >> **ōō**: **hōōl** ‘hollow’

Early MLb ***e** >> **eē**: **fmēēl** n. ‘game’, **teēn** n. ‘tin’

Early MLb ***o** >> **ōō**: (no cases known)

A possible fourth group consists of four adjectives that are reported as ending in a consonant in Middle High German, but in a schwa in Middle Dutch. These are words that had ***-û** in West Germanic:

(40) *Possible analogical lengthening for û words: circumflex*

ȳēl ‘yellow’ (MHG *gël*, MDu *gele*)

fēl ‘squinting’ (MHG *schël*, MDu *schele*)

kaāl ‘bald (*callow*)’ (MHG *kal*, MDu *kale*)

vaāl ‘pale (*fallow*)’ (MHG *fal*, MDu *vale*)

If these words ended in a vowel in Early MLb (***ȳael**, ***fæ̌l**, ***kal**, ***val**), these must be cases of analogical lengthening. If these words had a schwa in early MLb (***ȳaelə**, ***fæ̌lə**, ***kalə**, ***valə**), their long vowels must be due to Open Syllable Lengthening (***ȳēlə**, ***fē̌lə**, ***kaālə**, ***vaālə**), in which case the present circumflex accent suggests that the final schwa dropt early (see §7.1).

Analogical lengthening did not happen in Limburgian and Central Franconian alone. It generally happened in ‘standard’ Middle High German as well, although

it was restricted there to cases in which the consonant was voiced in the oblique forms, i.e. in the cases of (38), (39), and (40) (NHG *Tag* ‘day’, *Weg* ‘way’, *Gras* ‘grass’, *schmal* ‘narrow’), but not in the voiceless cases of (37) (NHG *Dach* ‘roof’, *Schloss* ‘lock’). In Dutch, no analogical lengthening occurred (except perhaps in *noot* ‘nut’): it still has a **dax** ~ **daayən** alternation. The Franconian dialects are thus the only ones with lengthened vowels in **naāt** and **daāk**. And since Dutch adjectives were levelled towards the short vowel (**naatə** ‘wet-Pl’ turned into **natə** analogously to the predicative form **nat** ‘wet’), the Franconian dialects are also the only ones with lengthening in Limburgian **naāto** ‘wet-Pl’ or Ripuaric **naāso** ‘wet-Pl’.

The fact that lengthening in consonant-final syllables was analogical is proved by the existence of an unlengthened vowel in the cases where there was no paradigm or where the paradigm did not contain lengthened vowels. Examples of unlengthened vowels outside the paradigms can be found in prepositions. Limburgian still has short vowels in **eñ** ‘in’, **vañ** ‘of’, **met** ‘with’, whereas we find a regularly lengthened vowel in **doōr** ‘through’ (< *thuru*). Other examples are **dat** ‘that’ and especially the content word **wex** ‘away’, which was apparently felt to be outside the paradigm of **wēx** ‘way’ (this word has a short vowel in NHG *weg* as well). Examples of unlengthened vowels inside paradigms are those that were originally followed by geminate consonants, as in **man** ‘man’, whose plural was **mennə** ‘men’ (these examples are less convincing than the former, though, since it cannot be completely excluded that the pronunciation was **mann**).

6.1 The new situation: lexical contrast on monosyllables with long non-high vowels

Analogical lengthening led to a large reduction in the correlations between tonal structure, syllable structure, and segmental structure. Before the change, the tone in monosyllables with long vowels could be predicted from vowel quality: high vowels and diphthongs had a circumflex, non-high vowels an acute. After the change, tone has become contrastive in monosyllables. Thus, the new form **flōt** ‘lock’ contrasts with the old form **rōt** ‘advice’, and **fmeēt** ‘smith’ contrasts with **léet** ‘song’.

6.2 Implications for dating the Rule A/A2 split

In the Rule A dialects, all forms in (24), (28) and (32) have an acute rather than the circumflex that is characteristic of the Rule A2 dialects under discussion here.

Many authors have tried to explain the history of Rule A without assuming an intermediate Rule A2 stage. But if Rule A developed directly as a result of bimoraic reanalysis, the disyllabic forms on which the monosyllabic forms in (38) and (39) are based must have had an acute accent in the Rule A area at the moment when analogical lengthening occurred. In that case, the forms in (38) and (39) should have an acute accent in the Rule A area. They have not. They currently all have a circumflex, even in the Rule A area. This is evidence against an early split between Rule A2 and Rule A, and evidence in favour of the theory (also assumed by De Vaan 1999) that the present Rule A dialects went through an earlier A2 stage.

6.3 Dating analogical lengthening

Analogical lengthening most probably started some time after Open Syllable Lengthening. In Van der Meer (1949) one can see that in the earliest records of Venlo MLb (the year 1320) long vowels in open syllables can be written with a single vowel symbol. Thus, *jaer* ‘year-NOM’ but *jare* ‘year-DAT’. The writing therefore coalesces with that of originally short vowels in open syllables, e.g. *maken* ‘make’. If we assume that the vowel in *jare* was long, the vowel in *maken* must have been long as well. We could thus place Open Syllable Lengthening in the 13th century at the last, i.e. not long after the start of Middle Limburgian, which was characterized by the coalescence of unstressed short vowels into schwa.

Analogical Lengthening in Venlo MLb happened in the 15th century, with some early forms in *haoff* (i.e. **ɦɔɔf**) and *daegh* (i.e. **daax**).

7 Schwa drop

There have been several rounds of the drop of schwa in final unstressed syllables, and these rounds had different effects on the tone system.

7.1 Early schwa drop

The earliest schwa drop was interconsonantal, and it occurred even before Open Syllable Lengthening. It happened in front of the final **t** of the second and third person singular in the present indicative of strong verbs. Thus ***brekəs** > ***breks**

‘break-2sg’ and ***brekət** > ***brekt** ‘break-3sg’.¹⁸ This earliest schwa drop prevented the application of Open Syllable Lengthening, which affected most other forms in the paradigm such as the first person singular (***brekə** > ***breĕkə**), the first and third person plural (***brekən** > ***breĕkən**), or indeed the second person plural (***brekət** > ***breĕkət**). This gives us the present-day paradigm **breĕk breks brek breĕkən breĕk(t) breĕkən**.

The earliest schwa drop just discussed was restricted to the second and third person singular of strong verbs ending in obstruents. The second schwa drop, which is more important to the story of the origin of tone in Limburgian, applied after Open Syllable Lengthening, and occurred when the schwa was preceded by a long vowel and a sonorant consonant but followed by a coronal obstruent (**s**, **z**, **d**, or **t**). The conspicuous characteristic of this second schwa drop (and what distinguishes it from the later general schwa drop discussed in §7.3) is that it had no effect on tone.

Unlike the morphologically limited first schwa drop, the second schwa drop occurred across the board, for instance in the second and third person singular of weak as well as strong verbs and in the past participle of weak verbs (the past participle of strong verbs did not end in **-t**). Thus, we crucially see that the circumflex on lengthened vowels remained in the following present-day Limburgian forms, the infinitives of which were mentioned in (21): **fiĕĕls** ‘fetch-2sg’, **fiĕĕlt** ‘fetch-3sg’ and **ȝəfiĕĕlt** ‘fetched’ from the weak verb **fiĕĕlən**, and in **vōōrs** ‘drive-2sg’ and **vōōrt** ‘drive-3sg’ from the strong verb **vaārən**. Other examples are the forms of the weak verbs **woōnən** ‘dwell’ (**woōns**, **woōnt**, **ȝəwoōnt**) and **ȝəbōōrən** ‘happen’ (**ȝəbōōrt**, **ȝəbōōrt**). Presumably (although the present-day tone cannot evidence it, as will become clear in §7.3), this second schwa drop also occurred in

¹⁸ The divergently high vowel in **breks** and **brekt** is either due to an earlier *i*-umlaut (***brekis** > ***brikis**), or to the non-application (because of the following high vowel) of the even earlier West-Germanic *a*-umlaut ({ ***brikis**, ***brikan** } > { ***brikis**, ***brekan** }), or to both of these. Not surprisingly, this vowel is often identical to the vowel in the non-lengthened imperative singular (§6), e.g. in **et** ‘eat-IMPsg’ ~ **ets** ‘eat-2sg’, although the two can diverge as well, as in our earlier example **ȝef** ‘give-IMPsg’ ~ **ȝofs** ‘give-2sg’. The 2sg and 3sg forms have been subject to an extensive morphologization of phonological alternations. One alternation is due to an original *i*-umlaut and explains the phonologically regular alternation of **flōpən** ‘sleep-INF’ (< ***slaapən**) ~ **flēaps** ‘sleep-2sg’ (< ***slææpis**). Another alternation is the regular long-short alternation of **brekən** ~ **breks**, which was analogically extended to originally long vowels, as in **lōpən** ‘walk-INF’ (< ***lupən**) ~ **lōps** ‘walk-2sg’, which occurs instead of the perhaps regular **lōips**. The third alternation is the regular rounding alternation of **zeēn** ‘see-INF’ (< WGM ***seo**- < ***siu**- with *a*-umlaut) ~ **zyys** ‘see-2sg’ (< WGM ***siu**- without *a*-umlaut), which was analogically extended to forms like **ȝofs** and **flōaps** ‘sleep-2sg’ (an alternate form of **flēaps**). Thus, the present-day strong-verb 2sg and 3sg morphemes are synchronically characterized to various extents by umlaut, shortening, and rounding, instances of which can be seen in several examples in the text.

the acute verbs mentioned in (12), for instance **vóors** ‘lead-2Sg’, **vóort** ‘lead-2Sg’ and **ȝavóort** ‘led’ from the weak verb **vóorən**.

Another set of forms that probably show this early second schwa drop are those with (usually sonorant) consonants flanked by two originally high vowels:

- (41) *Early drop of a schwa that used to be a high vowel after a high vowel*

zoōn ‘son’ (OHG *sunu*)

dōor ‘door’ (OLF *duri*), cf. the NHG variant *Türe*

doōr ‘through’ (OLF *thuro*; Old Saxon *thuru*)

vōōr ‘for, before’ (OLF *furi*)

Some of these forms could be dismissed as cases of schwa drop before Open Syllable Lengthening, followed by analogical lengthening (e.g. **sunu* > ****zon** > ***zoōn**). Quite apart from the need to explain such an earlier schwa drop, it would not account for the case of **dōor**, which has no source for analogy. De Vaan (1999) mentions some of the words in (41) separately as well as possible cases of an early schwa drop (namely ‘son’ and ‘door’, but also ‘sow’, which is **zoōx** in some dialects).¹⁹

The idea that schwa dropped rather early between sonorants and coronals obstruents is confirmed with the data from Middle Dutch as transcribed in the dictionary by Verdam (1961), who allows forms like *geweget* ‘aimed’, *gevoedet* ‘fed’, and *gevollet* ‘filled’ (beside *geweecht*, *gevoet*, and *gevolt*) but not *gewonet* ‘resident’ or *gemalet* ‘painted’ (only *gewoont* and *gemaelt*).

7.2 Drop of final schwa: voiceless version

All words that ended in a schwa, or that ended in a schwa followed by an obstruent, eventually dropped it. The main exception is the plural and feminine singular of adjectives ending in a plosive or voiceless consonant cluster. Thus present-day Limburgian still has **naātə** ‘wet-FEMSG’, **riikə** ‘rich-FEMSG’ and **ȝaŋsə** ‘whole-FEMSG’, but in nearly all other cases final schwa was lost.²⁰

¹⁹ Perhaps the word **aān** ‘at, on’ (< ***anə**) lost its schwa in this round as well, perhaps in order to improve the distinction with ***áanə** ‘without’ after Open Syllable Lengthening (***aānə**).

²⁰ Other scattered exceptions exist, for instance the word **néafə** ‘sewstress’ < ***nææjərsə**, cf. attested MLb (sermons) *minnerse* ‘female lover’.

We know that the loss of schwa ultimately led to a change in phonological structures across generations: original **stró̌tə** ‘street’ and **dó̌t** ‘deed’ consisted of three and two moras, respectively, as shown in (7) and (14), while present-day **ʃtró̌t** and **dó̌t** rhyme perfectly, i.e., they must consist of the same number of moras, which I will assume to be two. As in the account of Open Syllable Lengthening, the account of Schwa Drop will involve three elements: the phonological structure maintained by the first generation (cf. (8)), the variation in pronunciation allowed by this structure, and the reinterpretation of selected overt forms as a new phonological structure by the next generation (cf. (19)). The lexical tonal representations for generation 1 of the acute form **stró̌tə** ‘street’ and the circumflex form **wé̌kə** ‘week’, aligned to an HL intonation contour, are given in (42), which also includes the structures for words without final schwa.

(42) *Surface structures of words with and without final schwa, voiceless version*

In these graphs syllable boundaries are represented as periods.

Now that we have the surface structures of generation 1, the next question is how the structures were actually pronounced. For **dó̌t** and **tíit** we can assume the pronunciations [dó̌t] and [tíit] (in H*L-focus environments); in the absence of evidence to the contrary we can assume that the final consonants were fully released, as they are in present-day Limburgian. For **stró̌tə** and **wé̌kə**, obviously possible pronunciations are [stró̌tə] and [wé̌kə], with a full final vowel. But in a situation of imminent schwa loss there must have been variant forms with a reduced final vowel, which after a voiceless consonant could well be voiceless: [stró̌t̚] and [wé̌k̚]. Note that in these forms the L tone is not audible on the final vowel, because this vowel is voiceless. Such situations, with vowels that are fully present in the phonological surface structure but are hardly audible in the overt form, can in some languages, like Japanese, apparently easily be maintained by speakers and transferred to the next generation.

But Limburgian is not Japanese. Learners of Japanese “only” have to know that word-final consonants are generally ruled out in their language, as is evidenced by the full vowels that have to occur after voiced obstruents and sonorants. Limburgian learners, however, had ample evidence that Limburgian did allow word-final consonants of all sorts. In a situation where the learner interprets [dó̌t] as the corresponding structure in (42), she also has to interpret [stró̌t̚] in a way that makes sense in her emergent phonology. While some

learners may indeed come up with the bisyllabic structure in (42), perhaps aided by some overt adult forms with full vowels, some learners will act differently. We have to understand that the transcription [stróðt̚] suggests a final vowel, but that a voiceless vowel, especially a short one, often cannot be distinguished from the glottal fricative [h], so that an almost equivalent transcription is [stróðth]. Since utterance-final plosives tend to be slightly aspirated anyway (by the continuation of uninhibited expiration), so that **dóut** will sound very much like [dóðtʰ], we have the ingredients for a merger, especially since word-final aspiration contrasts are cross-linguistically extremely rare. Some children, therefore, will perceive [stróðt̚] and [wéék̚] as the monosyllabic structures in (43).

(43) *Surface structures after schwa drop, voiceless version*

For **stróut** the change was well integrated in Limburgian phonotactics: the resulting rhyme was identical with the already existing rhyme in **dóut**. For **wéék**, the change was also reasonably well integrated, because the vowel **éé** was already allowed in monosyllabic words deriving from analogical lengthening (note that the MLb ***éé** had become **éa**). Now if some children create the structures in (43), they may go on to learn at a later point that some of these words can have a schwa appended to them. In effect, the structures have changed across the two generations from bisyllabic with variable schwa drop to monosyllabic with variable schwa extension (perhaps like modern French **sêc** ‘five’). It is likely that speakers with the structures in (43) produce forms with schwa less often than people who still have the bisyllabic structures. The third generation, then, will hear even fewer forms with schwa than the second and is thus even more likely to posit a monosyllabic analysis, leading to even more schwa-less pronunciations. The merger, once started, appears irreversible, at least if schwa-less structures are fully licit in the language to begin with (this excludes the Japanese case).

If the consonant was voiceless, therefore, the lexical tone on the newly created monosyllabic word was identical to the lexical tone on the original bisyllabic word. Thus, originally long non-high vowels retained the acute. We can see this in many present-day Limburgian forms, which usually still end in *-e* in German. These forms include the first person singular of the present tense of verbs, the singular of many nouns (mostly feminine; if masculine, they usually

end in *-en* in present-day German)²¹, and the plural of some nouns. The following list presents up to four forms of each word mentioned: the current East Limburgian form, the reconstructed form just before schwa drop (but after open syllable lengthening), the reconstructed early MLb form, and sometimes the attested or reconstructed OLF form.

(44) *Schwa drop after acute plus voiceless consonant: acute*

Early MLb **aa**: **ſtrōt** f. ‘street’ < ***straatə** (NHG *Straße*), **mōt** f. ‘measure’ (MHG *māze*), **hōk** m. ‘hook’ (NHG *Haken*), **ſlōp** ‘sleep-1SG’, **lōt** ‘let-1SG’

Early MLb **ee**: **tēek** f. ‘cover’ (< Lat. *thēca*; NHG *Zieche*)

Early MLb **oo**: **zōok** ‘seek-1SG’ < ***zōokə** (NHG *suche*), **vōot** ‘feet’, Rm. **hōok** ‘beech’, **zōot** ‘sweet’ (OLF *suoti*), **wōos** ‘savage’ < **wōostə** (OLF *wuosti*)

Early MLb **oo**: **kōok** m. ‘cake’ < ***kookə** (NHG *Kuchen*)

And high vowels, diphthongs, and lengthened vowels retained the circumflex:

(45) *Schwa drop after circumflex plus voiceless consonant: circumflex (for nonhomorganic cluster cases see §12.2)*

Early MLb high vowels and diphthongs: **riik** n. ‘empire’ < ***riikə** (OLF *rīki*), **riik** ‘rich’, **liik** n. ‘dead body’ (NHG *Leiche*), **ruūt** ‘diamond’, **zeip** ‘soap’ (NHG *Seife*), **ēik** ‘oak’ (NHG *Eiche*)

Early MLb **an**: **kaȳc** ‘side’ (NHG *Kante*)

Early MLb **om**: **kloŋp** ‘lump’ (NHG *Klumpen*), **hoŋp** ‘chunk’ (NHG *Humpen*), **loŋp** ‘rag’ (NHG *Lumpen*)

Early MLb **ol**: **bōūt** ‘bolt’ < ***bōltə** (NHG *Bolzen*)

Early MLb **a**: **zaāk** f. ‘business’ < ***zaākə** < ***zakə** (OLF *saka*, NHG *Sache*), **aāp** m. ‘ape’ (NHG *Affe*), **faāt** m. ‘hate’, **laāt** ‘late’

Early MLb **ε**: **bēēk** ‘brook’ < ***bēēkə** < ***bekə** < ***baki** (cf. umlautless NHG *Bach*)

Early MLb **æ**: **wēēk** ‘week’ < ***wēēkə** < ***wækə** < ***weka**, **brēēk** ‘break-1SG’ < ***brækə** (NHG *breche*), **ſprēēk** ‘speak-1SG’

Early MLb **ɔ**: **knōk** m. ‘bone’ < ***knōkə** < ***knokə** (NHG *Knochen*), **kōk** ‘cook-1SG’ < ***kokə** (NHG *koche*), **hōp** ‘hope-1SG’ (NHG *hoffe*)

²¹ Both the feminine and masculine nouns had a nominative in *-e* and an accusative in *-en* in early MHG. The feminine nouns soon changed their accusative into *-e*, generalizing the nominative affix. Most masculine nouns later changed their nominative to *-en*, generalizing the accusative. Some masculine nouns (e.g. *Name* ‘name’, *Wille* ‘will’, and nouns denoting males like *Junge* ‘boy’ and *Affe* ‘ape’) retain the *-e/-en* alternation in present-day German.

The new situation. Like analogical lengthening, schwa drop led to less predictability in the relation of the mora accent with segmental and syllable structure. Thus, the new form **fiɔ̃p** ‘hope-N; hope-1SG’ contrasts with the old form **slɔ̃p** ‘sleep-N; sleep-1SG’ and with the new form **slɔ̃p** ‘sleep-1SG’.

7.3 Drop of final schwa: voiced version

Something slightly different happened when the intervening consonant was voiced rather than voiceless. The structures of generation 1 are shown in (46).

(46) *Surface structures of words with and without final schwa, voiced version*

These structures are completely analogous to (42). Again, the tones are only associated with the heads of the tonal moras, and onset segments cannot head moras. As before, there cannot be more than two moras in a syllable, simply because no more than two tonal moras are needed to represent the surface structure. This means that the final **n** of **fióon** or **wiín** does not head a mora (this contrasts with cases like **mañ** ‘man’, in which the final **n** is the second tonal mora of the syllable).

The next question is how these abstract structures were pronounced. I assume that every segment belongs to a mora, as in (46), and that every segment is realized with the tone that its mora head is linked to. Thus, the **n** of **fióon** or **wiín** can be regarded as a part of the second mora, hence will be pronounced with the tone linked to that mora: [fióòh̃] and [wííh̃]. For the full pronunciations of **blóomə** and **drúvə** I assume that the syllable boundary coincides with a mora boundary, so that the **m** and **v** can be regarded as a part of the mora in the second syllable, hence the pronunciations [blóòh̃ə] and [drúúṽə]. In a situation where final schwas are heavily reduced, some realizations must have sounded like [blóòh̃] and [drúúh̃]. The crucial difference with the voiceless forms of the previous section is that a low tone can now be heard on the final consonant. Forms like [drúúṽ] may look weird, with a low-toned final segment, but it is the same pronunciation that was judged as ‘trivial’ by Kiparsky (1973) for the Lithuanian word **dvaāras**, which came to be pronounced [dváā̃rs] when the final vowel was dropt (for more details, see §7.4).

Some learners of generation 2 will base their surface structures on the reduced forms [blóòh̃], [drúúh̃], [fióòh̃] and [wííh̃]. A perception as disyllabic would violate a constraint against having a syllable that is not headed by a vowel. This structural constraint is cross-linguistically high ranked and we can assume that it is

also high ranked for beginning learners. So the learner will assign monosyllabic structures to all of the four forms (note that the four forms have analogous segmental patterns: [drúúv̥] looks different from the others since it ends in a fricative, but it stands in for a large number of forms that also include sonorant-final cases like the generation-1 word **duūmə** ‘thumb’, which has the reduced form [dúú̃m̃]). The forms show three overt tone patterns: an level high pattern in [wíí̃ñ], a fall before the last segment in [drúú̃v̥], and a fall in the midst of the long vowel in [blóò̃m̃] and [fíóò̃ñ]. The learner can make sense of this by positing a mora boundary at every change of tone. This requires that she posit the trimoraic analysis shown in (47).

(47) *Trimoraic analysis of schwa loss, voiced version*

Some generation-2 learners may indeed come up with the structures in (47), thus violating a cross-linguistically high-ranked constraint against having more than two tonal moras in a syllable. The result is a triple contrast: the tone moves after the first, second, or third mora. Such a situation is uncommon in languages, like e.g. the triple contrast between oral, nasal, and half-nasal vowels, or the triple contrast between dentals, alveolars and retroflexes: not impossible, but uncommon, either for perceptual reasons (the auditory contrast is too small) or for structural reasons (here: three moras is too crowded). In Limburgian there were also systemic reasons that disfavoured these trimoraic forms. First, the triple contrast is specific to monosyllables and does not occur in disyllabic words. When an ending is added, the third mora is typically resyllabified as a non-moraic consonant, as in **.druū.vən.** ‘grapes’. These restrictions on the third mora are in stark contrast with the freedom of sonorant consonants as a *second* mora. Thus, **n** can be the second mora in the monosyllabic **mañ** ‘man’, or when followed by a voiced plosive in MLb **lañt** ‘land’, or when in the disyllabic **.mən.nə.** ‘men’, where it stays in the first syllable (for the tone structure of this word, see the next section).

With the problematicity of the trimoraic analysis, several generation-2 learners will directly create non-trimoraic analyses from the [blóò̃m̃], [drúú̃v̥], [fíóò̃ñ] and [wíí̃ñ] of generation 1. And generation-2 learners that do create the forms in (47) will beget generation-3 learners, some of whom will create non-trimoraic analyses from the [blóò̃m̃], [drúú̃v̥], [fíóò̃ñ] and [wíí̃ñ] of this generation-2 subgroup. All these non-trimoraic analysers will come up with a bimoraic analysis, and the two moras will be the two parts of the long vowels in (46) and (47). For the three forms [blóò̃m̃], [fíóò̃ñ] and [wíí̃ñ] the analysis is easy, since it can be the same as for [fíóò̃ñ] and [wíí̃ñ] in (46). For [drúú̃v̥], the choice is simply between the two forms in (48).

(48) *The two bimoraic options for the perception of [drúúṽ]*

The first of these forms honours the high tone audible on the second part of the vowel in [drúúṽ], but since the child must pronounce the first form in (48) as [drúúṽ], analogously to [wííñ], it does not honour the low tone audible on the final consonant. The second form, on the other hand, does honour the audible low tone in [drúúṽ], but since it must be pronounced as [drúúṽ], analogously to [fíóð̃], it does so by severing the audible link between the high tone and the second part of the vowel in [drúúṽ]. The choice is between two evils, and what the Franconians did is clear: they chose the second option in (48), thus creating an acute accent on **drúuv** ‘grape’. When we compare the new structure to the ‘grape’ versions in (46) and (47), we see that Limburgian has “preferred the stability of tones to the stability of segment-to-tone links”. The square quotes are necessary here, because the same “stability preference” would predict the same circumflex-to-acute change in the case of the voiceless consonants of the previous section. Speaking in terms of “stability”, i.e. speaking in terms of conversions between phonological structures, is of course incorrect for sound change, which must pass through the bottleneck of the overt-form-and-reanalysis scheme. The “voiceless” form **wēēkə** has to pass through the overt form [wēēk(ə̃)] and thereby loses the information about the low tone on the schwa in the surface structure. The four structures, then, are the ones shown in (49).

(49) *Surface structures after schwa drop, voiced version*

When comparing the voiceless and voiced forms, we see that only one of the eight forms changed the tonal contour on the first two moras: **drúuv**. Its structure has become indistinguishable from that of **fíoon**, so that we must assume that the F0 contour in the pronunciation of **drúuv** as spoken by generation 3 fell in the middle of the vowel, so that we must conclude that there was a pronunciation change from [drúúṽ] to [drúúṽ] within a couple of generations.

The seemingly weird accent alignment change is less exceptional than it may seem: for a comparable change in Lithuanian, see §74.

The change of the mora accent around voiced consonants has left its reflexes in present-day Limburgian. List (50) shows the present-day forms for original acutes, which stayed acute. The forms in the list do not take into account

the effects of the second final devoicing (§11), so many forms end in a voiced obstruent in (50) whereas most of the present dialects have voiceless obstruents instead.

(50) *Modern forms with schwa drop after acute and voiced consonant: acute*

Early MLb ***aa** > **ǝa**: **lǝay** f. ‘layer’ < ***laayə** (NHG *Lage*), **mǝon** f. ‘moon’ (OLF *māno*), **yrǝon** m. ‘count’

Early MLb ***ææ** > Gel. **éa**, Rm. Sitt. **ée**: **kéaz** f. ‘cheese’ < ***kææzə** (NHG *Käse*), **léay** ‘low’ (OHG *lāgi*), **jéar** ‘scissors’ (NHG *Schere*)

Early MLb ***εε** > Gel. **éa**, Rm. Sitt. **ée**: **zéal** ‘soul’ < ***zεεlə** < *sēla* < WGm **saiwala* (NHG *Seele*)

Early MLb ***œœ** > Gel. **óa**, Rm. Sitt. **óø**: **dróay** ‘dry’ < ***drœœyə**

Early MLb ***ɔɔ** > Gel. **óa**, Rm. Sitt. **óo**: **bóan** f. ‘bean’ < ***bɔɔnə** (NHG *Bohne*), **jóan** ‘beautiful’, **óar** n. ‘ear’, **dóaz** f. ‘box’ (NHG *Dose*), **jóal** f. ‘school’

Early MLb ***ee** > Gel. Rm. **ée**, Sitt. **éi**: **vléey** f. ‘fly’ (NHG *Fliege*)

Early MLb ***oo** > Gel. Rm. **óø**, Sitt. **óei**: **yróon** ‘green’ < ***yrœonə** (OHG *gruoni*), **kóol** ‘cool’, **vróoy** ‘early’

Early MLb ***oo** > Gel. Rm. **óo**, Sitt. **óu**: **blóom** f. ‘flower’ < ***bloomə** (NHG *Blume*), **hóor** f. ‘whore’

The **drúuv** case extends to all high vowels, diphthongs, and lengthened vowels. In all these cases, an original circumflex shows up as an acute in the present language if schwa was dropped after a voiced consonant:

(51) *Modern forms with schwa drop after circumflex and voiced consonant: acute (for nonhomorganic cases see §12.2)*

Early MLb ***ii** > ***īi** > **īi**: **wīiz** f. ‘melody’ (NHG *Weise*), **līin** f. ‘line’ (NHG *Leine*), **pīin** ‘pain’ (Late Latin *pēna*), **yardīin** ‘curtain’, **fiiv** f. ‘disc’ (NHG *Scheibe*)

Early MLb ***yy** > ***ȳy** > **ýy**: **krýyn** ‘crown of head’ < ***kryȳnə** < ***kryynə**

Early MLb ***uu** > ***uū** > **úu**: **kúul** ‘mine’ < ***kuūlə** ‘pit’ < ***kuulə**, **drúuv** f. ‘grape’ (NHG *Traube*), **dúuv** f. ‘pigeon’ (NHG *Taube*), **dúum** m. ‘thumb’ (NHG *Daumen*)

Early MLb ***ei** > ***ēi** > **éi**: **kléin** ‘small’ < ***kleīnə**, **aléin** ‘alone’ (NHG *alleine*), **ȳaméin** ‘nasty’ (MHG *gemeine*)

Early MLb ***ɔu** > ***ōū** > **óu**: **óuy** n. ‘eye’ < ***ōūyə** < ***ouyə** (NHG *Auge*), **ȳalóuv** n. ‘belief’ (NHG *Glaube*)

Early MLb *a > *aā > áa: náam m. ‘name’ < *naāmǫ < *nāmǫ < *namǫ < *namo*, báan f. ‘road’, fwáan f. ‘swan’ < *swanǫ, ráam m. ‘frame’ (NHG *Rahmen*), náaz f. ‘nose’, ráav m. ‘raven’ (NHG *Raben*), máay m. ‘stomach’ < *maāyǫ < *mayǫ (NHG *Magen*), máax(t) f. ‘virgin’ < *máaxt < *maāyǫt < *mayǫt (NHG *Magd*), jáaj f. ‘damage’ < *sxaðǫ (NHG *Schade* f., *Schaden* m.), kráay m. ‘collar’ (NHG *Kragen*), dráay ‘carry-1SG’ (NHG *trage*), Rm. (also in Belgian Limburg; Goossens 1977) káaf n. ‘chaff’ < *kavǫ²²

Early MLb *æ > *ēē > ēē: nēēv ‘nephew, cousin’ < *nǣvǫ, wēēm ‘whom’ < *wǣmǫ, lēēv ‘live-1SG’ < *lǣvǫ

Early MLb *ε > *ēē > ēē: zēēy f. ‘saw’ < *zēyǫ

Early MLb *ɔ > *ōō > ōō: kōōl f. ‘coal’ < *kōōlǫ < *kōlǫ (NHG *Kohle*), bōōr f. ‘drill’ (NHG *Bohre*), bōōy m. ‘bow’ < *bōyǫ (NHG *Bogen*)

Early MLb *e > *eē > ēē (Sitt. ēī): fmēej m.pl. ‘smiths’ < *smēēðǫ < *smēðǫ (NHG *Schmiede*), fēēm m. ‘shade’ < *sxemǫ (Old Saxon *scimo*; different vowel NHG *Schemen*)

Early MLb *o > *ōō > ōō (Sitt. ōu): ftóov f. ‘stove’ < *stoōvǫ < *stovǫ (NHG *Stube*)

The new phonology. The changes proposed in this section only work if the language can be regarded as a lexical mora-alignment language both before and after the change. Schwa drop after voiced consonants greatly extended the number of forms in which mora alignment could be contrastive. The acute accent could now appear on high vowels, on diphthongs (including short vowels followed by sonorant consonants), and on the long vowels **aa** and **ēē**. It may be possible that schwa drop in this way saved the mora accent contrast in the Franconian dialects, whereas the neighbouring High-German dialects lost the contrast because they retained final schwa.

Reflexes in present-day phonology. Schwa drop led to a large number of tone alternations within paradigms where the consonant was voiced and the vowel

²² Reported mediaeval forms from surrounding languages of the word meaning ‘chaff’ are *kaf* and *kave*. The present-day Dutch form *kaf*, with a short vowel, must come from *kaf*. As Goossens notices, the acute accent shows that the present-day Limburgian form comes from *kave* (if it had come from *kaf*, it would have become **kaāf** by analogical lengthening). Of course, this form cannot be an argument for the historical predictability of the present-day tone; rather, the tone disambiguates the mediaeval form in this case.

originally had a circumflex tone. In weak verbs, the first singular could receive an acute, while the infinitive retained the circumflex:

lē̃v ‘live-1SG; live-IMP SG’ ~ **lē̃vən** ‘to live’

In strong verbs, where the imperative singular ended in a consonant, some minimal pairs were introduced:

bliif ‘stay-IMP SG’ ~ **bliiv** ‘stay-1SG’ ~ **bliivən** ‘to stay’, **draāx** ‘carry-IMP SG’ ~ **draāy** ‘carry-1SG’ ~ **draāyən** ‘to carry’

In adjectives, the plural and feminine singular could form a minimal tone pair with the predicative form:

wiis ‘wise’ ~ **wiiz** ‘wise-PL&FEM SG’ ~ **wiizən** ‘wise-MASC SG’

This example also shows that the masculine singular received an unexpected acute, perhaps in analogy with the feminine and plural form (De Vaan 1999).

In nouns, we have to distinguish various classes. Consonant-final stems (mostly masculine) lost the schwa in the plural:

daāx ‘day’ ~ **dāay** ‘days’, **kniin** ‘rabbit’ ~ **kniiin** ‘rabbits’

Schwa-final stems (mostly feminine) lost the schwa in the singular:

liin ‘line’ ~ **liinən** ‘lines’, **dúuv** ‘dove’ ~ **duūvən** ‘doves’, **dúum** m. ‘thumb’ ~ **duūmən** ‘thumbs’, **frúuv** ‘screw’ ~ **fruūvən** ‘screws’, **drúuv** ‘grape’ ~ **druūvən** ‘grapes’, **ýyl** ‘owl’ ~ **yylən** ‘owls’, **rēiz** ‘travel’ ~ **rēizən** ‘travels’, **šuy** n. ‘eye’ ~ **šūyən** ‘eyes’, **nāam** m. ‘name’ ~ **naāmən** ‘names’, **báan** ‘job’ ~ **baānən** ‘jobs’, **kóol** ‘coal’ ~ **kōōlən** ‘pieces of coal’

Later on, these alternations led to localized cases of analogy, with the normal exceptions in (11), such as Roermond **blóom** ~ **blóomən**, coming to follow the **drúuv** ~ **druūvən** pattern (Dols 1944). Another thing that arose locally was purely morphological use of tone alternations, such as Moresnet **flōp** ‘sleep-IMP SG’ ~ **flōp** ‘sleep-1SG’, coming to follow the **bliif** ~ **bliiv** pattern (footnote 9).

7.4 Lithuanian parallels of tone change by schwa drop

This seemingly weird change, which has attracted the ingenuity of many researchers (§13), has a parallel in Lithuanian, where the form [dváars] that we saw before is interpreted as an acute accent: **dváars** (Kiparsky 1973). The following makes the parallel explicit:

(52) *Parallel between Lithuanian and Limburgian: schwa drop creates a fake acute*

dvaāras	→	[dváārs]	→	dváars
druūvə	→	[drúúv̥]	→	drúuv

Kiparsky regards **dváars** as a ‘fake acute’ because he claims that it is pronounced as [dváārs] rather than [dváārs̥]. If the pronunciation is indeed [dváārs], Lithuanian would reflect a stage that has been intermediate in the development of Limburgian.

The parallel in (52) also resolves a different problem in Lithuanian that still eluded Kiparsky (1973: 830: fn. 22). In Lithuanian nominal inflection, all disyllabic endings used to have a circumflex in the first syllable, and this shifted later into a short accent on the second syllable, e.g. in the instrumental plural **-oōmis** > **-oomis**. The dative plural form, which can be reconstructed as **-oōmus**, escaped this shift because the **u** was dropped at some point. However, instead of the expected **-oōms**, this form presently turns up as **-óoms**. This form is understandable as a perfect parallel to Limburgian schwa drop: in a language that already has a Limburgian/Lithuanian-type tone contrast, a circumflex will turn into an acute if a schwa drops from the following syllable, at least if the intervening consonant is voiced:

(53) *Parallel between Lithuanian and Limburgian: schwa drop creates a real acute*

druūvə	→	[drúúv̥]	→	drúuv	→	[drúúv̥]
oōmus	→	[óóms̥]	→	óoms	→	[óóms̥]

In (53) we see three steps: a speaker-induced drop of a final vowel, a reinterpretation by listeners as an acute (i.e. as a low tone connected to the second mora), and a new pronunciation based on the reinterpretation (i.e. a pronunciation with low F0 on the second part of the vowel).

7.5 The behaviour of obstruent geminates in schwa drop

After a voiceless geminate consonant such as in ***kattə** ‘cat’, a dropping schwa would leave no trace of the low F0, and there is no reason why the resulting auditory form [kátt̪(̥)] should be perceived as anything else than two high-toned moras, just as the auditory form [stók] (I assume here that a trimoraic analysis is ruled out, so that the final consonant cannot be analysed as a geminate).²³ After a

²³ This opens up the question whether a structure like ((**kat**)_μ)(**t**)_{μσ} is universally ruled out or not. If it is not, then bimoraicity is compatible with syllable-final geminates, and my argument for assigning a mora to the first **d** in ***bedda** (§4.7) would vanish as well, because the structure could then be ((**bed**)_{μσ})((**da**)_{μσ}).

voiced geminate obstruent such as in ***bédðə** ‘bed’, a dropping schwa would still leave a trace of the low F0 on the final voiced consonant, and given the analysis in §7.3 there seems to be no reason for the learner to interpret the new auditory form [béd̥] as anything else than an acute. The structures in (54) show the results.

(54) *Surface structures after schwa drop, obstruent version*

Present-day reflexes. In the areas that maintain a lexical tone contrast on short vowels before voiceless consonants, such as Moresnet (Jongen 1972), words like **kaī** currently have a circumflex, i.e. the pitch movement occurs in the next syllable, and words like **béd** currently have an acute, i.e. the pitch movement occurs in the syllable itself (instead of between **ε** and **d**, the pitch movement nowadays falls within **ε** as a result of the second final devoicing and/or degemination, see §11). Some present-day forms are listed in (55) and (56).

(55) *Schwa drop after voiceless geminates*

naī (Rm. **næī**) m. ‘neck’ < ***naīkə** (NHG *Nacken*), **plæī** m. ‘spot’ < ***plæīkə** (MDu. *plecke*), **fiāī** m. ‘heel’ < ***fiāīkə** (NHG *Hacke* f.), **taī** m. ‘tap’ < ***taīppə** (NHG *Zapfen*), **laī** m. ‘piece of cloth’ < ***laīppə** (NHG *Lappen*)

(56) *Schwa drop after voiced geminate obstruents*

béd n. ‘bed’ < ***bédðə**, **brōēg** f. ‘bridge’ < ***brōēggə** (NHG *Brücke*), **lēg** ‘lie-1SG’ < ***lēggə** (MDu *ligge*), **lēg** ‘lay-1SG’ < ***lēggə** (MDu *legge*), **zēg** ‘say-1SG’ < ***zēggə** (MDu *segge*), **wēg** ‘loaf’ < ***wēggə** (MHG *wecke*), **fiēg** ‘hedge’ < ***fiēggə** (NHG *Hecke*), **fiōēb** ‘have-1SG’ < ***fiōēbbə** (MDu *hebbe*)²⁴

7.6 The behaviour of sonorant geminates in schwa drop

After a geminate sonorant, schwa drop led to a new kind of acute syllables. Thus, the word ***zōnnə** ‘sun’ was pronounced as [zōn̥n̥ə] before schwa drop (§4.7) and as [zōn̥] after schwa drop. In nearly all of the Limburgian and Central Franconian

²⁴ This word may not be actually attested as having an acute, because it is possible that all the areas in which short vowels before obstruent consonants have contrastive tone have the Ripuaric form **fiān** instead (e.g. Jongen 1972).

area (with the exception at least of the peripheral area around Horst, to the north of Venlo), the audibility of the low pitch (in H*L alignments) on the sonorant consonant was apparently enough to make the learners analyse [zónh] as the structure in (57).

(57) *Surface structures after schwa drop, sonorant version*

Present-day reflexes. In words with schwa drop after a sonorant geminate, an acute is found in nearly all of the Limburgian and Central Franconian area, with the exception at least of the peripheral area around Horst, to the north of Venlo, where no tone contrast exists on this type of syllables. Present-day forms typical of Geleen, Roermond and Sittard are listed in (58).

(58) *Schwa drop after geminate sonorants*

vál f. ‘trap’ < **vállə** (NHG *Falle*), **vál** ‘fall-1SG’ < **vállə** (NHG *falle*), **kál** ‘speak-1SG’ < **kállə**, **fiél** ‘hard-PL/FEMSG’ < ***fiállə** (NHG *helle*), **wól** (Rm. **wól**) f. ‘wool’ < **wóllə** (NHG *Wolle*, Low Saxon *Wulle*), **vól** f. ‘full-PL/FEMSG’ < **vóllə** (NHG *volle*), **ftél** ‘silent’ < ***stéllə**, **vær** ‘far’ < ***værrə** (NHG *ferne*), **kær** f. ‘car’ < ***kærrə** (NHG *Karre*, *Karren* m.), **tær** m. ‘tar’ < ***tærrə**, **zón** f. ‘sun’ < ***zónnə** (MHG *sunne*), **tón** f. ‘barrel’ < ***tónnə** (NHG *Tonne*), **mæm** f. ‘female breast’ < ***mæmmə** (MHG *memme*), Sitt. **ftém** Rm. **ftóm** f. ‘voice’ < ***stémmə**/***stémmə** (NHG *Stimme*)

The new phonotactics. This change led to a new kind of lexical tone contrasts, namely in final sequences of a short vowel and a sonorant consonant, i.e. between the forms listed in (31) and those listed in (58). One of the many minimal pairs is **vál** ‘trap; fall-1SG’ versus **vál** ‘fall’.

7.7 Geminate lenition and schwa drop

Original sequences of a lateral or a nasal followed by a voiced homorganic plosive were at some point simplified to a geminate. All the later developments of this class of consonant clusters are identical to the developments in the original sonorant geminates. We can most easily account for this fact if we assume that this change occurred before the advent of the tone contrast. For instance, ***bangə** ‘scared’ > ***ban̥nə** > ***bán̥nə** > ***bán̥**. Another possibility is that the gemination

occurred later; in that case, however, there must have been a tone change when gemination happened: ***bangə** > ***baŋgə** > ***báŋŋə** > ***báŋ**. This question of this timing is not unlikely to be quite relevant to the whole question of Limburgian tonogenesis.

Present-day reflexes. The present Limburgian forms that derive from a schwa drop after a lenited geminate all have the acute tone.

(59) *Schwa drop in geminate lenition environments*

From ***nd**: **máŋ** f. ‘basket’ < ***máŋŋə** < ***maŋŋə** (MHG *mande*), **fiáŋ** f.pl. ‘hands’ < ***fiéŋŋə** < ***fiεŋŋə** (MHG *Hände*)²⁵, **táŋ** f.pl. ‘teeth’ < ***téŋŋə** < ***teŋŋə** (MHG *Zähne*)²⁶, **wóŋ** f. ‘wound’ < ***wóŋŋə** < ***woŋŋə** (NHG *Wunde*), **fióŋ** or **fióŋ** m.pl. ‘dogs’ < ***fióŋŋə** < ***fiopŋə** (NHG *Hunde*), **véŋ** ‘find-1SG’ < ***véŋŋə** < ***veŋŋə** (NHG *finde*), **véŋs** ‘find-2SG’ < ***véŋŋəs** < ***venŋəs** (NHG *findest*), **véŋc** ‘find-3SG’ < ***véŋŋəŋ** < ***venŋəŋ** (NHG *findet*)

From ***ŋg**: **báŋ** ‘scared’ < ***báŋŋə** < ***bangə** (NHG *bange*), **láŋ** ‘long (adv.)’ < ***láŋŋə** < ***langə** (MHG *lange*), **ŋprén** ‘jump-1SG’ < ***ŋpréŋŋə** < ***spreŋgə** (MHG *springe*), **ŋpréŋs** ‘jump-2SG’ < ***ŋpréŋŋəs** < ***spreŋgəs** (MHG *springest*), **ŋprénk** ‘jump-3SG’ < ***ŋpréŋŋəŋ** < ***spreŋgəŋ** (MHG *springet*), **tón** ‘tongue’ < ***tónŋə** < ***tongə** (NHG *Zunge*)

From ***mb**: **dóm** ‘dumb-PL/FEMSG’ < ***dómmə** < ***dombə** (MHG *tumbe*)

From ***ld**: **wéŋ** ‘wild-PL/FEMSG’ < ***wéŋŋə** < ***weŋŋə** (NHG *wilde*)

The new situation. This change led to an extension of the oppositions for forms ending in **m**: **dóm** (< ***dombə**) joins **ŋtóm** (< ***stommə**) in contrasting with **ŋtoŋ**. More interestingly, a new contrast arose between forms like **ŋprénk** (< ***spreŋgəŋ**) and **reŋk** (< ***reŋk**), leading to some minimal pairs such as **zéŋk** ‘sings’ (< ***zengəŋ**) versus **zeŋk** ‘sinks’ (< ***zenkəŋ**). Also, a new correlation between segments and tones arose in the language: all words ending in a short vowel followed by **ŋ**, **ŋ**, or **ŋ** received (and still have) an acute tone; this is ultimately due to the fact that all such forms derive from words ending in a schwa (-**ŋŋə**, -**ŋgə**, -**ŋə**), which again is due to the fact that **ŋ**, **ŋ**, or **ŋ** originally had to be licensed by a following plosive (in the case of **ŋ** and **ŋ** because palatalization required a plosive, and in the case of **ŋ** because **ŋ** was not a separate phoneme of West-Germanic and in fact Proto-Indo-European) and the plosive had to be voiced (and therefore followed by a vowel, because of the first final devoicing) in order to be deletable.

25 The present **æ** instead of the expected **ε** is an example of the new regularized umlaut.

26 The present **æ** instead of the expected **ε** is an example of the new regularized umlaut.

7.8 Schwa drop after a vowel

Early Middle Limburgian had no cases of short vowels followed by a schwa, so Late MLb had no cases of lengthened vowels followed by a schwa. The only circumflex vowels before schwa could have been the high vowels **iī**, **yȳ**, and **uū**. Thus, there must have been forms like ***biīə** ‘bee’ and ***buuə** ‘build-1SG’. However, §4.6 has proposed that in Early MLb the high vowels were monomoraic, so the structures might have been better represented as ***bijə** and ***buwə**, but instead I propose that the actual structures were ***bijjə** and ***buwwə**, with geminated glides. The reason for this proposal is that in the general Late MLb bimoraic reanalysis of stressed syllables such structures would have become ***bījə** and ***búwwə**, with acutes that we still see today in the plurals ***bījən** ‘bees’ and ***búwən** ‘build-1PL’. The forms with a final schwa received a less surprisingly acute: **bīj** and **búw**.

Present-day reflexes. All words with a schwa drop after a vowel have an acute in present-day Limburgian. Some cases are listed in (60).

(60) *Schwa drop after a vowel: acute*

bīj ‘bee’ < ***biīə** (MDu *bije*), **vrij** ‘free-PL/FEMSG’ < ***vriīə** (NHG *freie*), **dýj** ‘push-1SG’ < ***dyyə**, **nýj** ‘new-PL/FEMSG’ < ***nyyə**, **búw** ‘build-1SG’ < ***buuə** (NHG *baue*), **fúw** ‘shy-PL/FEMSG’ < ***sxuuə** (NHG *scheue*)

The new situation. The change led to the first tone contrasts in final vowels, some minimal pairs being **bīj** ‘bee’ ~ **bij** ‘by’, **vrij** ‘free-PL/FEMSG’ ~ **vrij** ‘free’, **nýj** ‘new-PL/FEMSG’ ~ **nyj** ‘new’, and **fúw** ‘shy-PL/FEMSG’ ~ **fuw** ‘shy’.

7.9 Schwa drop and ð loss

At some point in early New Limburgian, a **ð** was lost between a vowel and a schwa. The schwa was also dropped, and if the preceding syllable had a circumflex, this changed into an acute, which comes to no surprise.

Present-day reflexes. All present-day forms with word-internal schwa deletion have an acute.

(61) *Drop of d and schwa: acute*

yáarən ‘collect’ < ***yāððərən** < ***yadðərən**, **éek** ‘vinegar’ < ***ēððək** < ***ēðək**, **léer** ‘leather’ < ***lēððər** < ***lēðər**, **wéer** ‘weather’ < ***wēððər** < ***wēðər**, **léex** ‘empty’ < ***lēððəx** < ***lēðəx**, **bóəm** ‘bottom’ < ***bōððəm** < ***bōðəm**, **bóel** ‘hangman’ < ***bōððəl** < ***bōðəl**, **zīj** ‘silk’ < ***ziiðə** (NHG *Seide*), **zīj** ‘side’ < ***ziiðə** (NHG *Seite*), **lýyk** ‘Liege’ < ***lyyððək**, **śor** f. ‘vene’ < ***áaððər**, **śəm** m. ‘breath’ < ***áaððəm**, **vóorən** ‘fodder’ < ***vōoððərən**

The new situation. Before this change, the lengthened vowels **aa** and **εε** and the high vowels **ii**, **yy** and **uu** could only have an acute in positions before a voiced consonant. While there are certainly statistical tendencies to that extent in present-day Limburgian, the list in (61) shows several new acutes for these vowels before a voiceless consonant (**éek**, **léex**, **lýyk**). The list also shows new acutes for these vowels in disyllabic forms (**yáarən**).

8 Neutralization in voiced environments

The change from circumflex to acute in voiced environments described in §7.3 was conditioned by a drop of schwa in the next syllable. In the larger part of the present tone area, however, this change was not conditioned by schwa drop: it occurred as well in words that stayed disyllabic, such as in **léevən** ‘to live’ and **káamər** ‘room’. In this area, then, all disyllabic forms with voiced intervocalic consonants have an acute, and **bəlcōvən** ‘to promise’, from ***bəlōvən**, rhymes with **ʃtrōcōvən** ‘to punish’, from ***straavən**.

The area in which this neutralization took place is called the *Rule A* area and roughly comprises the Central Franconian area (Ripuaric, Moselle Franconian) as well as the Limburgian-Ripuaric transition area. The more conservative area, where **bəlcōvən** still does not rhyme with **ʃtrōcōvən**, is called the *Rule A2* area and roughly comprises the Low Franconian (Limburgian) area.

There are at least two ways in which the neutralization could have happened. The first is by starting from a paradigmatic analogy, then overgeneralizing phonologically: the form **lēēvən** could have become **léevən** by analogy to the related form **léev** ‘live-1SG’, after which the number of disyllabic voiced circumflexes in the language was so low that the few non-alternating remaining ones, like **kaāmər**, were changed to acute as well.

The second possibility is that the cause of the neutralization is purely phonological. We know that there are neighbouring non-tonal dialects that invariably have an acute in all long vowels, thus **léevən** as well as **éētən**. It is not unlikely that some of these dialects have been tonal at some stage in their development. When compared to present-day Limburgian, these dialects must therefore have gone through a general innovation exemplified by the changes **lēēvən** → **léevən** and **éētən** → **éētən**. The question now is: if there were any intermediate dialects that changed circumflex to acute only in one of these two cases, what would such a dialect look like, i.e. would it change **lēēvən** to **léevən** or would it prefer to change **éētən** to **éētən**? My answer is that it would prefer to change **lēēvən** to **léevən**, simply because the auditory forms [léévən] and

[lɛ̀ɛ̀ṽə̀ñ] are auditorily closer than [ɛ̀ɛ̀t̃ə̀ñ] and [ɛ̀ɛ̀t̃ə̀ñ]: in the former pair, the HL alignment difference is one segment, in the latter pair it is between one and two segments.

9 The Rule A – Rule B distinction

Here I first repeat something that I wrote to Carlos Gussenhoven in March 1998, before Köhnlein (2013) showed that this story would not account for interrogative intonation.

Circumflex accents nowadays tend to be longer than acute accents, although (in the Rule A and Rule A2 regions) they derive from vowels that were shorter (high vowels tend to be shorter than non-high vowels, and the lengthened vowels were shorter than the originally long vowels before OSL). So the Rule A and A2 regions have historically undergone a *length reversal*. I hypothesize that this is because there is a universal tendency for circumflexes to be longer than acutes.

Where does this universal tendency come from? I propose that the direct cue for mora alignment is the question whether or not the syllable contains a pitch movement. Thus, if the syllable contains a pitch movement, the accent must be acute, and if the syllable stays on the same pitch, the accent must be circumflex. Now, movement (e.g. pitch movement) can be perceived even if it is fast, whereas detecting constancy (e.g. monotonicity) takes a while. Hence the Limburgian correlation between pitch movement and duration. Similar correlations are found in some Slavic languages (Van Wijk 1935, 1939).

I propose that in the Rule A and A2 areas the accent distinction was about mora alignment, so that the pitch movement was the main cue and the durations adapted themselves later according to the universal movement-duration correlation. In the Rule B area, however, something different happened: these dialects did not create a mora alignment distinction. Rather, the original duration difference persisted. When vowels lengthened in open syllables, the originally long vowels just became longer (push chain). The dialects thus created a three-way length contrast, and the pitch movement became a cue only later. This new secondary cue was added in line with the universal movement-duration correlation, hence the longest vowels (i.e. the original long vowels) received a constant pitch (which sounds like a circumflex accent), and the middle-length vowels (i.e. the vowels lengthened in open syllable, plus the high vowels and the diphthongs) developed a moving pitch (which sounds like an acute accent).

In this way, the Rule B dialects ended up having an acute everywhere the Rule A dialects had a circumflex, and the reverse. The resulting cross-linguistic apparent reversal is remotely comparable to that between Old Greek and Lithuanian (Kiparsky 1973), and a bit more directly comparable to that between Lithuanian and Latvian.

Recently, Köhnlein (2011) has shed doubt on this account, on the basis of the observation that while the declarative pitch contours are diametrically opposite in Rule A/A2 and Rule B, the interrogative pitch contours are the same in both regions. My analysis above could therefore hold only if the declarative contour is original in the Rule B area and the interrogative contour is somehow secondary, for instance borrowed by language contact. Köhnlein (pp. 197–199), however, sees the interrogative contour as original and the declarative contour as secondary, arguing that all dialects went through a stage when there was no opposition between declarative and interrogative intonation, a situation that stills exists in Hasselt (West-Limburgian). A further development of this theory appears in Köhnlein (2013).

10 Morphological uses of the accent contrast

During the development of Limburgian, much of the inflectional paradigm of nouns and adjectives was lost. In nouns the paradigm became restricted to the singular-plural distinction; in this case, the current singular continues the original nominative singular and the current plural continues the original nominative plural (these nominatives were often, but not always, identical to the accusative forms). In adjectives the paradigm became restricted to the attributive form, the masculine singular, the feminine singular, the neuter singular, and the plural (which is identical to the feminine singular); in this case, the forms are again based on the original nominative, except for the masculine singular, which is based on the original accusative, e.g. present-day **naātən** ‘wet-MASC SG’ ~ and **naātə** ‘wet-FEM SG’.

The reduction of inflexion led to the situation that many nouns now had only a single form. This includes neuter nouns with an original zero plural ending (***bēin** ‘bone, leg-SG&PL, ***woōrt** ‘word’-SG&PL, ***fīōf** ‘court-SG&PL’, ***lant** ‘land-SG&PL’) and mainly masculine and neuter nouns whose plurals came to be identical to the singular as a result of schwa drop (***fōp** ‘sheep-SG&PL). In all cases, a new plural was constructed. In the case of back vowels followed by a voiceless consonant, the choice was the addition of umlaut in the plural: **fōp** ‘sheep-SG’ ~ **fōeep** ‘sheep-PL’ (cf. NHG *Schafe* ‘sheep-PL’). In neuter nouns, this change was often accompanied by the addition of **-ər**, as in **daākər** ‘roofs’. This

changes greatly added to the already existing use of umlaut in plurals not ending in **-ə(n)** and to the already existing use of **-ər** for neuter nouns. In the case of circumflex vowels followed by a voiced consonant, the tone changed to acute, as in the neuter **bēin** ‘leg-SG’ ~ **bēin** ‘leg-PL’, completely analogously to the already existing masculine **ſtēin** ‘stone-SG’ ~ **ſtēin** ‘stone-PL’; if possible, this change is combined with umlaut and/or lenition: **hōōf** m. ‘court-SG’ ~ **hōēœv** ‘court-PL’; **lajic** n. ‘land-SG’ ~ **lājēn** ‘land-PL’ (also **lājēnər**); Rm. **kaṁp** m. ‘comb-SG’ ~ **kāēm** ‘comb-PL’.

The chronology of these events probably varies widely. Given the fact that many of these changes also occurred in High German (*Beine* ‘legs’, *Dächer* ‘roofs’, *Worte/Wörter* ‘words’, *Höfe* ‘courts’, *Länder* ‘lands’), it is possible that some of them precede even schwa drop. Thus, the sequence **bēin** ‘bones’ > **bēinə** > **bēin** is not out of the question. Also, **wōōrt** ‘words’ > **wōēōrdə** > **wōēōrd** is possible; the **d** would then have been based on a still existing dative singular or on compounds such as ***wōōrdənbóok** ‘dictionary’, or on the diminutive (present-day **wōēōrtjə**, not **wōēōrtjə**). More examples will be seen in the next section.

11 Second final devoicing

After schwa drop, many words ended in a voiced obstruent. These include first person singular verb forms such as **bliiv** ‘stay’ and **zēg** ‘say’, feminine singulars such as **drúuv** ‘grape’ and **hēg** ‘hedge’, and masculine plurals such as **dēēv** ‘thieves’. In some regions, the voiced fricatives made it into the 20th century and some voiced plosives still exist (Dupont 1910–11, Leenen 1915, Goossens 1977). In most regions, however, all final obstruents were devoiced, turning e.g. **zēg** into **zēk** (where the underlining as usual denotes the fact that longer related forms still contain a **g**).

The second final devoicing must also have led to some new cases of homophony between singulars and plurals. Thus, **dēēf** ‘thief-SG’ ~ **dēēv** ‘thief-PL’ merged into **dēēf** ‘thief-SG&PL’. Just as in the previous section this merger gave rise to analogies that created new plurals. In the case of **dēēf** ‘thieves’, umlaut was not an option (the vowel was already front), neither was tone change (the tone was already acute), so that the only remaining option was to add an ending. In the case of the masculine **dēēf**, this ending had to be **-ən** (the ending **-ər** is restricted to neuters), so that the present-day form is **dēēvən**. The circumflex accent in this plural form, which does not correspond to the historically expected acute, is explained by the model on which this form must be based by speakers without access to the historical forms, namely the alternating-tone model of **dúuf**

‘dove’ ~ **duūvən** ‘doves’, which is the predominant pattern for nouns with **-ən** plurals. This **-ən** addition was originally restricted to cases where the less shocking modifications (umlaut, tone change) could not apply. In the twentieth century we find an extension of this change to all words with non-umlauting vowels (i.e. back vowels plus, as far as plurals are concerned, the vowel **aa**), independent of whether a tone change can apply. Thus next to the tone pair **daāx** ‘day’ ~ **dáax** ‘days’, which is still in use, one can nowadays hear the plural **daāyən**. Another example is the extension of **jōr** ‘year-SG&PL’ to the new plural **jōrən** ‘years’, analogously to, say, the historical **kól** ‘coal’ ~ **kōlən** ‘pieces of coal’.

12 Four new kinds of tones

First let me assert that present-day Limburgian is not just a lexical mora-accent language. Instead, it may be closer to a tone language, because (for instance) sentence-final acute and circumflex syllables strongly contrast with each other even if the sentence-final word is not in focus. Thus, a Roermond question intonation on the word **yəwées** ‘been’ will sound like [yəwěēs], with an octave drop in the final syllable, whereas a question intonation on the word **yəduōn** ‘done’ will sound like [yədōōn], with both an octave drop and a fifth rise in the final syllable. Gussenhoven (2000ab) interprets [yəwěēs] as having only a HL interrogatory boundary tone, and [yədōōn] as having the same HL boundary tone followed by a H tone that must have been supplied in the underlying form. In Gussenhoven’s view, then, the contrast between acute and circumflex for Roermond is that between the absence and presence of a lexical H tone. Meanwhile, the Roermond sentence-internal contrast is still often one of mora alignment, as in (1) and (2).

But present-day sentence-internal contrasts are not *always* cases of mora alignment contrasts. After schwa drop, the language was still thoroughly mora-accenting, in the sense that the only acute-circumflex contrast was that between a monosyllabic bimoraic acute and a monosyllabic bimoraic circumflex. Beside these two types of accents, however, the later sound changes of degemination and schwa insertion caused the emergence of four more types: the monomoraic acute, the second monomoraic circumflex, the disyllabic acute, and the disyllabic circumflex. These four new accents are discussed in the following sections.

12.1 Degemination and the rise of the monomoraic accents

From §5.5 we know that the words **bəddən** ‘beds’ and **kəttən** ‘cats’ were pronounced [béððə̀n]_{Aud} and [káttə̀n]_{Aud} (we now discuss only the plurals of these

words, because the singulars have lost their final schwa in §7.5). A subsequent probably speaker-induced sound change was a gradual shortening of the geminate consonants. A certain generation of learners must then have interpreted these consonants as singletons. The question then is: with what alignment of the HL contour to the remaining moras?

There is a by now familiar difference between the auditory forms [bédðə̀n]_{Aud} and [káttə̀n]_{Aud}: only in the former does a pitch movement occur within the first syllable (§5.5). If the geminate is reanalysed by a learner as a singleton, the first syllable must be reanalysed as monomoraic, and the original syllabic pitch movement can be reanalysed as a pitch movement within the new monomoraic syllable.²⁷ The resulting form can be abbreviated as **bédən**. Likewise **brægən** ‘bridges’, **fwæmən** ‘to swim’, and so on. Since the pitch movement is (very) early, a structure like **bédən** can be called a *monomoraic acute*.

No acute reanalysis is possible in the case of a shortening geminate in [káttə̀n]_{Aud}. The only possibility is a reanalysis with a H tone on the first (now monomoraic) syllable. Since this means that the pitch movement now occurs after the first syllable, the resulting form can be abbreviated as **kātən** (likewise **ftøkən** ‘pieces’ and so on). This structure can be called a *monomoraic circumflex*.

The contrast just discussed has not received much attention, probably because the distinction is predictable on the basis of the voicing of the consonant. In fact, the post-lexical process of word-final prevocalic voicing causes acute-circumflex alternations within the same word form. Thus (Ben Hermans, p.c.), **bræk** ‘bridge’ and **ftøk** ‘piece’ are both pronounced with a circumflex in **ən bræk tə zeən** ‘to see a bridge’ and **ə ftøk tə kriiʔə** ‘to get a piece’ (with question intonation: rising on t), and both with an acute in **woo də bræg es** ‘where the bridge is’ and **woo ət ftæg es** ‘where the piece is’ (with question intonation: rising in ə).

Nevertheless, the phonetic distinction between **bédən** and **kātən** is large, especially in sentence-final focal position with question intonation: **bédən** has its pitch peak somewhere in the first vowel or the following consonant ([bédðə̀]_{Aud}) whereas **kātən** has its pitch peak in the second vowel ([kātə̀]_{Aud}) (Ben Hermans p.c.). Moreover, scattered monomoraic circumflexes occur in voiced environments, for instance in the Geleen form **fiōmən** ‘shirt’. In this form, the cause of the exceptional circumflex can lie in a late degemination caused by an original heterorganic nasal-plosive sequence: ***fiemədə** > ***fiemda** > ***fiem̥da** > ***fiem̥bə** > ***fiem̥mə**, with a drop of the first schwa bleedingly before Open Syllable Lengthening (§5.1), and the ***d** > ***b** change counterfeedingly after geminate lenition (§7.7). This

²⁷ I say “can be reanalysed”, not “must be reanalysed”, because if one looks closely at the auditory form, an alternative reanalysis with H-toned first syllable seems to be possible as well.

word has an exceptional circumflex in Maastricht as well (C. Gussenhoven, p.c.), and the long vowel in **høomə** in Weert Limburgian (which is nowadays a toneless dialect according to Heijmans and Gussenhoven 1998) must also reflect an earlier circumflex.

12.2 Schwa insertion and the rise of the disyllabic accents

When a liquid was followed by a non-coronal obstruent, a schwa was inserted. The circumflex words **bærf** ‘mountain’ and **wōlf** ‘wolf’ therefore became **bærfə** ‘mountain’ and **wōlfə**, still with the tone movement during or after the final consonant. The resulting accent can therefore be called a *disyllabic circumflex*. Likewise, **ærfəm** m. ‘arm’ and **færf** n. ‘splinter’ (MDu *scerf*, not NHG *Scherbe* f.), which could be added to (31), and with voiceless final schwa drop **balək** m. ‘beam’ (NHG *Balken*) and **keřək** f. ‘church’ (NHG *Kirche*), which could be added to (45).

In large parts of Limburg a schwa is also often appended phrase-finally after a word that ends in a high vowel, as in **nuwə** ‘now’, which is pronounced with a pitch pattern identical to that in **huūs** ‘house’. In Sittard I have heard the same disyllabic circumflex on words where a sonorant consonant is flanked by two short high vowels: **jyñi** ‘June’, **jyli** ‘July’, **fəmiñi** ‘family’, **fiñi** ‘chilli, Chile’, **kiwi** ‘kiwi’, **bəkiñi** ‘bikini’; whether this phenomenon is widespread or idiosyncratic still has to be investigated.

A similar change occurred in acute words: **bæry** ‘mountains’ (< ***bærfya**; NHG *Berge*) became **bærfəy**. The simplest assumption about the pitch movement is that it stayed in the middle of the word, which in **bærfəy** must be close to the syllable boundary. This structure can be called a *disyllabic acute*. Likewise **ərfəv** n. ‘premises’ (< ***erfva**; OLF *erfi* ‘inheritance’, NHG *Erbe*), **ərfəm** pl. ‘arms’ < ***erfma**. These examples could be added to (51).

There is a clear phonetic distinction between the monomoraic circumflex as in **kātən** (pitch movement during **t** or **ə**) and the disyllabic circumflex as in **bærfə** (pitch movement during or after **x**). Whether there is also a phonetic distinction between the monomoraic acute as in **bédən** (pitch movement during **ɛ**) and the disyllabic acute as in **bærfəy** (pitch movement between **æ** and **r**?) remains to be seen.

13 Comparing theories on Franconian tonogenesis

The crucial evidence that establishes the order of events in the Rule A2 regions is the retention of the original accent in disyllabic words, namely the retention of the acute in originally long non-high vowels, both in the voiceless cases of (11) and in

the voiced cases of (12), and the retention of the circumflex in lengthened vowels, both in the voiceless cases of (20) and in the voiced cases of (21). This evidence clearly places the beginning of the lexical accent contrast in the result of the otherwise neutralizing process of open syllable lengthening. No other proposals than the present one realize that this evidence is crucial for establishing the order of events; all other proposals than the present therefore misplace the first occurrence of the contrast, typically locating it later, such as in the result of schwa drop or in the result of analogical lengthening. As a consequence, these other proposals can handle only a small part of the data. I will now review several of these proposals.

13.1 De Vaan (1999)

Of all the other proposals, De Vaan (1999) comes closest to the correct chronology, albeit sometimes for the wrong reasons. I will therefore discuss his proposal in some detail.

De Vaan (p. 35) starts his chronology by stating, as I do here in §4.2, that in pre-OSL times long non-high vowels had a moving (De Vaan says “falling”) pitch, and that other vowels had a level (De Vaan says “rising”) pitch. Presumably (though De Vaan gives no examples here) this means that e.g. the word ‘seek’ from (11) was pronounced [zôðkə̀n̩]. Next, De Vaan states that as a result of Open Syllable Lengthening, originally short vowels became level (De Vaan says “rising”) before single medial voiceless consonants. Presumably, the means that e.g. the word ‘kitchen’ from (20) became pronounced as [kôðkə̀n̩]. Now, I argued in §5.1 that the result is a lexical accent contrast, because words like [zôðkə̀n̩] and [kôðkə̀n̩] differ only in their pitch pattern on the first syllable, which is unpredictable from the surrounding segments. De Vaan, however, does not realize that OSL caused the lexical contrast. Instead, he states next that “the tonal opposition of falling [i.e. moving] pitch versus rising [i.e. level] pitch reached phonemic status through [the process of] apocope [which happened after OSL]”.

De Vaan’s oversight may be due to his failure to look at the system of oppositions at each stage of the language. This happens more often in his paper. In a footnote (p. 29), De Vaan dismisses a proposal by Goossens according to which Limburgian originally had Rule A and then turned many acutes into circumflexes “through analogy”, thus leading to Rule A2. Presumably, this would mean that an acute on lengthened vowels in voiced positions, as in **léezən** ‘read’, turned into a circumflex, as in **lēēzən** from (21). De Vaan correctly notes that there is not much to base an analogy on, but his dismissal is further only based on a principle of “economy”. The logical-chronological reason, however, why the words in (21) could not have come from acutes is that in that case the words in (12), such as **kéezən** ‘choose’, would also have turned their acutes into circumflexes, as in

keēzən, a neutralizing change that according to the list (12) did not happen: circumflexes form a small minority in (12), while acutes form a small minority in (21). Again, De Vaan misses the crucial systemic argument that would derive from looking at the synchronic contrasts and oppositions at every stage of the language. On p. 34, De Vaan correctly states that the Rule A2 dialects “have preserved a more archaic situation” than the Rule A dialects, but he does so for the wrong reason, namely the geographical peripherality of the Rule A2 dialects. This is an invalid argument. In De Vaan’s view, the Rule A2 dialects form a contiguous area in the North and West; since there are more contiguous peripheral areas, not all of them can be archaic, which strongly indicates that peripherality points at archaism only if these peripheral areas are scattered and unconnected, which they are not. The logical reason for the greater age of Rule A2 is their non-neutralization, i.e. the fact that they retain the contrast between the forms in (12) and in (21), a distinction lost in the Rule A areas. Logically, neutralizations are innovations, and retentions of etymological contrasts are archaisms. The only example that De Vaan gives to illustrate the archaism of Rule A2 is **váart ~ vaārən**, and this does illustrate the problematicity of an analogical cause of Rule A2 (why would **váarən** change into **vaārən** if the other forms have an acute as well?), but it does not refer to the more crucial fact, which is the retention of, say, the **vaārən ~ kéezən** contrast.

A third case of unclear argumentation for an original Rule A2 is the statement (p. 35) that “the sequences [...], VD [i.e., originally short vowels before voiced consonant] developed a falling pitch” during OSL. If this had been true, the lengthened V:D would have fallen together with the originally long V:D, as in Rule A. Since in Rule A2 the former nowadays have a circumflex and the latter an acute (as De Vaan acknowledges), this cannot be correct.

I conclude that De Vaan was correct in proposing phonetic pre-OSL contrasts, correct for the wrong reason in proposing the primacy of Rule A2, and incorrect in locating the inception of the lexical accent contrast in the results of schwa drop.

13.2 Gussenhoven (2000c)

Of all the proposals, the one by Gussenhoven (2000c) has been most widely distributed over the world. At the same time, it is the least credible of all the proposals, because it accounts for only a little corner of the data and has logical-chronological problems with the remainder of the data.

Gussenhoven proposes that the lexical accent contrast originated through a mechanism of “fake analogical lengthening” (Fake AL; p. 231). At a certain point

in time, Franconian would have had a length contrast between **dax** ‘day’ and **daax** ‘days’, the length in **daax** resulting from open syllable lengthening followed by schwa deletion (**dayə** > **daayə** > **daax**). At the same time, an influential neighbouring dialect would have had the older **dax** ~ **daayə** alternation but decided that vowel length should be homogeneous throughout the paradigm, leading to **daax** ~ **daayə**. This is the usual process of *analogical lengthening* (§6). At this point, dialect 1 would have had **dax** ~ **daax**, dialect 2 **daax** ~ **daayə**. According to Gussenhoven, the speakers of dialect 1 would decide to mimic speakers of dialect 2 in having a long vowel in the singular. However, doing so would have turned the paradigm into **daax** ~ **daax**, thus removing the distinction between singular and plural. Gussenhoven proposes that the speakers then decided to make a difference between the two forms, somehow adding a high tone to the singular: **daa^Hx** ~ **daax**. This is what Gussenhoven calls “fake analogical lengthening”. Despite the evidence presented in the current paper, Gussenhoven has repeated this hypothesis numerous times, most recently in Gussenhoven (2012).

The largest problem with Gussenhoven’s proposal is that it cannot explain how the tone contrast spread from **daa^Hx** ~ **daax** to the rest of the lexicon. Presumably, fake analogical lengthening would have to have postdated schwa drop (otherwise, no threat of homonymy), which must have postdated open syllable lengthening (otherwise, no vowel lengthening in the plural **daayə**), and this is indeed the order in which Gussenhoven arranges these three changes on p. 233. Also, fake analogical lengthening by itself must have postdated open syllable lengthening, otherwise there would have been no long vowel that could be the source of the analogy. Now, with the order OSL → schwa drop → Fake AL, it is virtually impossible that the change could have spread through the lexicon along etymological lines. If tonogenesis (i.e. Fake AL) follows schwa drop (which comes with final devoicing, as G. states), an original **huus** ‘house’ and **druuvə** ‘grape’ would have neutralized their structures as **huus** and **druuf**. How could subsequently **huus** (and all other such forms without schwa drop) get a H tone, whereas **druuf** (and all other such forms with schwa drop) did not? In other words, how could the neutralization be undone along etymological lines?²⁸ Even more problematically, if tonogenesis (Fake AL) followed OSL, how did **kookənə** ‘kitchen’ (and all other such forms with originally short vowels) get a H tone,

²⁸ For the **huus** ~ **druuf** case, G. tries to save the chronology (in an apparent defence against objections by the present author to an earlier version of G.’s paper) by proposing that there was a stage when schwa drop and Fake AL were optional rules that were in effect at the same time. This proposal cannot work for the **kookənə** ~ **zookən** case, though, where the ordering problem involves OSL as well.

whereas **zōōkən** ‘seek’ (and all other such forms with originally long non-high vowels) did not? In other words, if Gussenhoven’s theory is correct, the spread of tones through the lexicon must have undone the neutralization caused by schwa drop, such as that between **huus** and **druuf**, as well as the neutralization caused by open syllable lengthening, such as that between **kōōkənə** and **zōōkən**. In reality, the original schwa-based contrast between **huus** ‘house’ and **druuvə** ‘grape’ (and many other such forms) has been preserved as the present-day tonal contrast **huūs** ~ **drúuf**, and the original short-long contrast between **kōkənə** ‘kitchen’ and **zōōkən** ‘seek’ (and many other such forms) has been preserved as the present-day tonal contrast **kōōkən** ~ **zōōkən**. Neutralization can have no place in these changes, so Gussenhoven’s proposal must be rejected on the basis of an incompatibility with one of the main heuristic axioms of historical phonology.

One can wonder what the causes are of Gussenhoven’s neglect of the **huūs** ~ **drúuf** and **kōōkən** ~ **zōōkən** cases, i.e. of the majority of the data. One cause seems to be an incorrect view of the data themselves. Within six lines on p. 237, Gussenhoven incorrectly lists Tongeren **zwōōn** ‘swan’ (< ***zwanə**) and **brýāk** ‘fracture’ (< ***brøkə**) as having originally long vowels, and **húāk** ‘hook’ (< **hʌakə**) as having an originally short vowel; under such circumstances it is indeed difficult to arrive at correct generalizations, especially if multiple competing factors play a role, as they do here. Another cause seems to be the failure to acknowledge the known interactions of these competing factors. In a footnote on p. 254, G. claims that “OSL is an unlikely locus for the tonogenesis, since it systematically fails to appear in forms in Table 2 that underwent it.” Gussenhoven’s Table 2 is a list of singular–plural pairs where the singular has AL; the plurals, which underwent OSL, indeed have an acute (**wɛɛx** ‘way’ ~ **wɛɛy** ‘ways’; **ʃmēɛt** ‘smith’ ~ **ʃmēej** ‘smiths’), but this is just the group that received an acute secondarily during schwa drop (***wɛɛyə** → **wɛɛy**; ***smēɛðə** → **ʃmēej**), i.e. half of the forms in (51). The much greater number of forms in (20) and (21), which are still disyllabic, still have the circumflex.

I conclude that G.’s proposal accounts only for the accent in AL cases (here §6) and fails on all other monosyllabic and disyllabic cases, i.e. on over 90 percent of the data. I agree that it is tempting to start an account of the accent contrast from singular–plural pairs; in fact, the examples in (1) and (2) provide just such an example. However, the hypothesis developed here, which is that the accent contrast originated in OSL, explains the **daāx** ~ **dáay** alternation by turning an original **dax** ~ **dayə** first into **dax** ~ **daāyə** by OSL (with a contrastive circumflex accent), then into **daāx** ~ **daāyə** by AL (not “Fake”, because the accent is the same in singular and plural), and finally into **daāx** ~ **dáay** by schwa drop (it is a true minimal pair, because the final consonant is currently voiceless in both

words). In other words, these singular–plural pairs are not the source of the contrast, but instead form the most complicated cases, resulting from an interaction of at least three changes.

13.3 Schmidt (2002)

Jürgen Erich Schmidt criticizes both De Vaan and Gussenhoven for problems such as the phonetic naturalness of their proposed changes, but he does not criticize them for problems with their chronological logic. In fact, Schmidt claims that the lexically contrastive accent originated ‘relatively late’ (p. 207: “relativ spät”) with schwa drop (p. 207: “nach dem Apokopierungsprozess” ‘after apocope’; p. 220 “Apokopierung der Endsilbe” ‘apocope of the final syllable’), summarized as “Auslöser der Tonakzentgenese war ein durchgreifender makrostruktureller Wortveränderungsprozess: der Ausfall einer Endsilbe (Apokope)” ‘the trigger of tonogenesis was a radical macro-structural word change process: the drop of a final syllable (apocope)’. Given that Schmidt is very well acquainted with the historical conditioning of the contrast, one has to wonder how he could have missed the contrast between the old long non-high vowels in (11) and (12), which have acutes, and the lengthened vowels in (20) and (21), which have circumflexes.

The answer is partly in Schmidt’s neglect of Rule A2. On p. 224, Schmidt claims that ‘Rule A2 has been insecurely documented’, because for the Rule A2 areas there sometimes exist dialect descriptions that describe them in terms of Rule A. Perhaps Schmidt thought here of work such as that by Tans (1938), who describes the situation in the Maastricht area (Rule A2) with Welter’s (1910) Rule A conditions; however, Tans’ *data* clearly show Rule A2 conditions, which Tans labels explicitly as exceptions to Welter’s conditions (p. 21, 160, 216). Such a situation, with an apparently uninformed researcher listing exceptions to Rule A that he cannot put in a wider perspective but are regular from a larger point of view (i.e. from the independently reported Rule A2 perspective), should be regarded as *confirming* the Rule A2 situation rather than questioning it. Because of his inappropriate neglect of Rule A2, then, Schmidt does not count the contrast between the originally long vowels in (12), which are acutes nowadays, and the lengthened vowels in (21), which are circumflexes nowadays, as relevant or even existing, because all of these vowels (before voiced consonants) have circumflexes in the Rule A areas today. Likewise, Schmidt may have missed the contrast between (11) and (20) as relevant, because in the Southern part of the area the vowels in (20), standing before voiceless consonants, may never have lengthened.

In an area where Rule A applies *and* lengthening did not occur before voiceless consonants, tonogenesis may indeed have originated in schwa drop. If it

indeed happened so late in these areas, it must still have happened as well in the Rule A2 areas centuries earlier, when open syllables lengthened there. That is, any late tonogenesis in the Southern areas must have followed a much earlier tonogenesis in the North.

13.4 Alternative possible correct proposals

In my discussions of others' proposals above, I not only pointed out their failures but also presented the hypotheses developed in the present paper as true. They do not have to be; there may be other thinkable logically-chronologically correct hypotheses.

The idea that tonogenesis originated with schwa drop can be saved by assuming that the originally long non-high vowels **aa*, **ææ*/**ɛɛ*, **œœ*, **ɔɔ*, **ee*, **oo* and **oo* turned into **ɔə*, **ɛə*, **øə*, **ɔə*, **ɛə*, **øə* and **ɔə* before Open Syllable Lengthening, i.e. all of them “broke” into a diphthong ending in schwa. When OS� then lengthened the originally short vowels, the lengthened vowels would have been kept distinct as a group from the originally long non-high vowels. Subsequently, schwa drop, which came with tonogenesis, would have turned the seven vowels into **ɔ̄*, **ɛ̄*, **ø̄*, **ɔ̄*, **ɛ̄*, **ø̄* and **ɔ̄*, which are not far removed from the present-day Limburgian forms. The evidence for pre-OS� diphthongs is scarce: it may only be in the OLF writing of the higher-mid series as *ie* and *uo* (the present-day diphthongization of the lower-mid series cannot count as evidence, because it would have to follow schwa drop, i.e. monophthongization), but those spellings may have a variety of different causes (e.g. coming from a different region, or representing only an earlier stage than MLb, or representing raised mid monophthongs). Weighing the evidence, I cannot regard this scenario as likely.

14 Conclusion

We have seen that a sequence of synchronic phonological systems, gradual shifts by speakers and discrete reanalyses by listeners accounts for much of the data. The true phonetic and phonological details may differ from the ones presented, but I firmly believe that the order of events is as depicted; especially, the claims are that the accent contrast originated with Rule-A2-like open syllables by Open Syllable Lengthening, that schwa drop did nothing more than produce many new acutes, and that Rule A came about later as a neutralization. Comparisons with

similar sound changes in Lithuanian (lengthening yield circumflexes and vowel drop turns circumflexes into acutes) showed that my account is not peculiar to the Limburgian case. Realizing that about 95 percent of the Limburgian accents have been accounted for, and that no systematic exceptions remain, I conclude that the chronology of the Franconian tonogenesis, at least for Rule A2 and Rule A, has been settled. The main question that remains is how the mora accent language turned into the present-day language with its synchronic tonal and metrical analyses.

References

- Bach, Adolf. 1921. Die schärfung in der moselfränkischen mundart von Arzbach. *Beiträge zur Geschichte der deutschen Sprache und Literatur* 45(2), 266–290.
- Cosijn, Peter Jacob. 1872–1873. De Oudnederlandse psalmen. *De Taal- en Letterbode* 3 (pp. 25–48, 110–124, and 257–270) and 4 (pp. 149–176).
- Cowan, H.K.J. 1959. De localisering van het Oudnederfrankisch der psalmenfragmenten. *Leuvense Bijdragen* 48, 1–47.
- Cowan, H.K.J. 1969. Nogmaals de localisering van de Oudnederfrankische psalmenfragmenten. *Leuvense Bijdragen* 58, 114–132.
- Dols, Willy. 1944. *Sittardse diftongering*. [published posthumously by Alberts' Drukkerijen, Sittard 1953].
- Dupont, J. 1910–11. Het dialect van Bree. *Leuvense Bijdragen* 9, 193–212.
- Engelmann, René. 1910. Ein mittelfränkisches accentgesetz. *Beiträge zur Geschichte der deutschen Sprache und Literatur* 36(2), 382–394.
- Goossens, Jan. 1965. Die Gliederung des Südniederfränkischen. *Rheinische Vierteljahrsblätter* 30, 79–94.
- Goossens, Jan. 1977. De tweede Nederlandse Auslautverscherping. *Tijdschrift voor Nederlandse taal- en letterkunde* XCIII 1–2, pp. 3–23.
- Grootaers, Ludovic. 1909. Het dialect van Tongeren: eene phonetisch-historische studie. *Leuvense Bijdragen* 8.
- Gussenhoven, Carlos. 2000a. The boundary tones are coming: On the non-peripheral nature of boundary tones. In Michael Broe & Janet Pierrehumbert (eds.) *Papers in Laboratory Phonology V: Acquisition and the lexicon*, 132–151. Cambridge: Cambridge University Press.
- Gussenhoven, Carlos. 2000b. The lexical tone contrast of Roermond Dutch in Optimality Theory. In M. Horne (ed.) *Prosody: Theory and experiment. Studies presented to Gösta Bruce*. Dordrecht/Boston/London: Kluwer.
- Gussenhoven, Carlos. 2000c. On the origin and development of the Central Franconian tone contrast. In A. Lahiri (ed.) *Analogy, levelling, markedness: Principles of change in phonology and morphology*, 215–260. Berlin: Mouton de Gruyter.
- Gussenhoven, Carlos. 2012. From Cologne to Arzbach: an account of the Franconian 'tone reversal'. To appear in *Proceedings of Nordic Prosody XI*.
- Heijmans, Linda & Carlos Gussenhoven. 1998. The Dutch dialect of Weert. *Journal of the International Phonetic Association* 28, 107–112.

- Helten, Willem Lodewijk van. 1896. Een en ander over en naar aanleiding van de Oudnederlandsche psalmvertaling. *Tijdschrift voor Nederlandsche Taal- en Letterkunde* 15, 146–171, 269.
- Helten, Willem Lodewijk van. 1902. *Die altostniederfränkischen Psalmenfragmente, die Lipsius'schen Glossen und die altsüdmittelfränkischen Psalmenfragmente, mit Einleitung, Noten, Indices und Grammatiken*. Groningen: Wolters.
- Hermans, Ben. 1984. Het Limburgs en het Litouws als metrisch gebonden toontalen. *Spektator* 14, 48–70.
- Hermans, Ben. 2006. De tonologie van onbeklemtoonde lettergrepen in een Limburgs dialect. *Taal en Tongval* 19, 55–70.
- Hermans, Ben. 2012. *The phonological representation of the Limburgian tonal accents*. In B. Botma & R. Noske (eds.) *Phonological explorations: empirical, theoretical and diachronic issues*, 227–244. Berlin: Mouton de Gruyter.
- Jongen, René. 1972. *Phonologie der Moersneter Mundart: eine Beschreibung der segmentalen und prosodischen Wortformdiakrise*. Assen: Van Gorcum.
- Kats, J.C.P. 1985. *Remunjs waordebook*. Roermond: H. van der Marck.
- Kehrein, Wolfgang. This volume. There's no tone in Cologne: against tone–segment interactions in Franconian.
- Kiparsky, Paul. 1973. The inflectional accent in Indo-European. *Language* 49, 794–849.
- Köhnlein, Björn. 2011. *Rule reversal revisited: synchrony and diachrony in the Franconian dialect of Arzbach*. Doctoral dissertation, Leiden University.
- Köhnlein, Björn. 2013. Optimizing the relation between tone and prominence: evidence from Franconian, Scandinavian, and Serbo-Croatian tone accent systems. *Lingua* 131, 1–28.
- Köhnlein, Björn. This volume. Synchronic alternations between monophthongs and diphthongs in Franconian tone accent dialects: a metrical approach.
- Kyes, Robert L. 1969. *The Old Low Franconian psalms and glosses*. Ann Arbor MI: University of Michigan Press.
- Leenen, J. 1915. Dialecten in Belgisch Limburg. *Limburgsche Bijdragen* 13, 147–164.
- Liberman, Anatoli. 1999. *Schärfung/stoottoon and trägeitsakzent/sleeptoon in the Rhein-Limbourg area and their Scandinavian analogues*. In E.C. Polomé & C.F. Justus (eds.) *Language change and typological variation. In honor of Winfred P. Lehmann on the occasion of his 83rd birthday*, Vol. I: *Language change and phonology*, 275–298. Washington: Institute for the Study of Man.
- Maurmann, Emil. 1898. *Grammatik der Mundart von Mülheim a. d. Ruhr* (*Sammlung kurzer Grammatiken deutscher Mundarten* 4). Leipzig. [partial print, Marburg 1889; reprint Wiesbaden 1969]
- Meer, S. van der. 1949. *Venloer Stadt-Texte 1320–1543: eine lautliche und orthographische Untersuchung*. Nijmegen: Dekker & Van de Vegt.
- Nörrenberg, K. 1884. Studien zu den niederrheinischen mundarten. *Beiträge zur Geschichte der deutschen Sprache und Literatur* 9, 371–421.
- Oostendorp, Marc van. This volume. Tone, final devoicing and assimilation in Moresnet.
- Reitz, Guido. 1985. *Die Rheinische Akzentuierung im Morbacher Platt*. Manuscript.
- Sanders, Willy. 1968–1969. Zu den altniederfränkischen Psalmen. *Zeitschrift für deutsches Altertum und deutsche Literatur* 97, 81–107.
- Schmidt, Jürgen Erich. 1986. *Die mittelfränkische Tonakzente (Rheinische Akzentuierung)*. Stuttgart: Franz Steiner.

- Schmidt, Jürgen Erich. 2002. Die Sprachhistorische Genese der mittelfränkischen Tonakzente. In Peter Auer, Peter Gilles & H. Spiekermann (eds.) *Silbenschnitt und Tonakzente*, 201–233. Tübingen: Niemeyer.
- Tans, J.G.H. 1938. *Isoglossen rond Maastricht*. Doctoral dissertation, Katholieke Universiteit Nijmegen.
- Vaan, Michiel de. 1999. Towards an explanation of the Franconian tone accents. *Amsterdamer Beiträge zur Älteren Germanistik* 51, 23–44.
- Welter, Wilhelm. 1933. Die niederfränkischen Mundarten im Nordosten der Provinz Lüttich. The Hague: Martinus Nijhoff.
- Wijk, Nicolaas van. 1935. De klinkerrekking en de stoottoon vóór stemhebbende medeklinkers in het Limburgs en in andere dialekten en talen. *Nieuwe Taalgids* 29, 405–411.
- Wijk, Nicolaas van. 1939. De Rijns-Limburgse polytonie, vergeleken met de Kasjoebse. *Onze Taaltuin* 8, 146–152.

Cathryn Donohue

Tones and vowels in Fuzhou revisited*

1 Introduction

There has been considerable work on understanding phonetic effects of segments on tone and on the influence of tone on segments (e.g. Maddieson 1977, 1984, 1997; Zee 1984 and others). Such phonetic effects are often consequences of speech production and as such are relatively imperceptible. However, less attention has been given to effects of tone and segments that are not automatic phonetic changes, but rather changes that result from the phonology. In this paper I present data from the Fuzhou variety of Chinese, perhaps best known for its tone–vowel alternations. In previous analyses, the alternating vowel forms have been derived in the synchronic phonology. In this paper I claim that while the phonological category is responsible for the segmental effects, the exact form of the vowel is an historical accident, contemporarily maximizing the tonal distinctions, but not requiring synchronic derivation. I also suggest that the similarities between the register-based tone-vowel interaction that we see in Fuzhou and similar phenomena in Southeast Asia reflect a common areal tendency.

2 Fuzhou tones

Fuzhou (福州話) is a Min Dong (閩東) dialect of Chinese spoken by roughly eight million people in north-eastern Fujian province, China. There are seven citation tones in Fuzhou that can be described as shown in Tab. 1 (Donohue 2013), which lists not only the tones and their “values”, but also gives their Middle Chinese tonal category.

* Parts of this paper were developed from work presented at the Berkeley Linguistics Society Annual Meeting in February 2007 and the Tone-Segment workshop in Amsterdam in June 2007. I would like to thank the audiences at these conferences as well as Marc van Oostendorp, Wolfgang Kehrein, Björn Köhnlein, Paul Boersma, and Richard Wiese for their helpful comments on the paper. Any remaining errors are entirely mine.

Tab. 1: The seven citation tones in Fuzhou (Donohue 2013).

Tone	Tone 1	Tone 2	Tone 3	Tone 4	Tone 5	Tone 6	Tone 7
Value	44	32	21	<u>13</u>	51	231	<u>5</u>
MC category	Yin ping 陰平	Shang 上	Yin Qu 陰去	Yin Ru 陰入	Yang ping 陽平	Yang Qu 陽去	Yang Ru 陽入

The “values” consist of digits that refer to relative points on a scale of 1 (low) to 5 (high), and the transition between these points represents the tonal contour during the time course of the syllable (following Chao (1930)). Furthermore, as is the tradition in the description of Chinese tones, the underscoring indicates a syllable with an unreleased plosive in the coda (a “stopped” tone), which is a glottal stop in Fuzhou. The numbers presented in Tab. 1 are based on an acoustic quantification of the tones, using data elicited across the vowel paradigm for four speakers and then normalized (using a Z-score transform) to factor out between-speaker differences (following Rose 1987). The values represent a broad transcription, abstracting away from minor phonetic details, such as the slight rise that is present at the end of the high-level tone 1.

3 Fuzhou tone sandhi and the tone–vowel interaction

Like most varieties of Chinese, Fuzhou has massive tonal neutralization in sandhi. However, rather than the typical rightwards-spreading phenomenon, Fuzhou tone sandhi is right dominant, so it is the final syllable in a given domain which remains unchanged. Unlike other right dominant sandhi systems (e.g. Mandarin and Southern Min varieties), the changes are opaque: In addition to the neutralization there are some chain shifts as well as new sandhi forms that do not occur in isolation. One description of these sandhi forms in disyllables, taken from Donohue (2013), is given below in Tab. 2. The context for the change is the second syllable, given in the top row. This tone remains largely unchanged. The form that changes is the tone on the first syllable, whose underlying (=citation) form is given in the first column, and whose resulting sandhi form is given in the table cells underneath the relevant ‘context’, or the tone before which the syllable is occurring.

Tab. 2: Fuzhou tone sandhi forms (Donohue 2013).

Syllable 2 →	Tone 1 [44]	Tone 2 [32]	Tone 3 [21]	Tone 4 [13]	Tone 5 [51]	Tone 6 [231]	Tone 7 [5]
Syllable 1 ↓	<i>First syllable sandhi forms below</i>						
Tone 1 [44]	44	43	42	(53/31)	33	42	3
Tone 2 [32]	21	34	44	33	33	44	3
Tone 3 [21]	44	43	42	(53/31)	44	(42)	3
Tone 4 [13]	21	23	34 42	53 5	21 33	45 42	3 4
Tone 5 [51]	44	33	21	33	33	21	3
Tone 6 [231]	44	43	42	31	33	32	3
Tone 7 [5]	44	33	42	31	33	33	3

Fuzhou is perhaps most famous for its set of vowel alternations between citation (or isolation) and sandhi (in Fuzhou = non-prepausal) positions (e.g. Chao 1934; Maddieson 1976; Donohue 2013): the exact form of a vowel will vary depending on the tone with which it occurs in citation form. The vowel alternations are given below in Tab. 3, where the vowels are divided into two groups according to the tone they occur with. A given row constitutes a single phonological vowel. This grouping is justified both historically, and by the fact that the vowel differences are neutralized in sandhi position to the corresponding form from the Set A group.

Tab. 3: Examples of alternating vowel pairs in Fuzhou.

Set A: Tones 1 [44], 2 [32], 5 [51], 7 [5]	Set B: Tones 3 [21], 4 [13], 6 [231]
i	ei
ei	ai
u	ou
ou	au
y	øy
øy	æy
a	a

In words of two syllables or more, all the prepausal syllables retain their citation (isolation) tones and vowels. However, in sandhi (non-final) position, not only the tone changes: all Set B vowels become the correspondent vowel from Set A. The examples in (1)–(3) (Chao 1934: 41) illustrate how a syllable with an underlying tone from Set B (Tone 3, 4 or 6) in prepausal or citation position will maintain its Set B vowel in the (a) examples, but when they are followed by another syllable and are thus realized in sandhi position, we see that the vowel changes to the corresponding variant from Set A (in addition to the tone changing).¹

Input tones:		Resulting form:	
(1) a. Tone 3 [21]:	氣	[khei 21]	‘air’
b. Tone 3 [21] + Tone 4 [23]:	氣 壓	[khi 53 aʔ 23]	‘air pressure’
(2) a. Tone 4 [13]:	竹	[tøy ʔ 13]	‘bamboo’
b. Tone 4 [13] + Tone 4 [13]:	竹 節	[ty 5 ʒaiʔ 13]	‘bamboo section’
(3) a. Tone 6 [231]:	護	[hou 231]	‘protect’
b. Tone 6 [231] + Tone 1 [44]:	護 兵	[hu 44 βin 44]	‘guards’

While the vowel quality of a given *phonological vowel* is completely predictable by its tone, there are nonetheless lexical contrasts across the paradigm for certain vowels e.g. the [ei] occurring with a set A tone and the [ei] occurring with a set B tone. Interestingly, speakers ‘concede’ that these vowels are “a bit similar”, but claim greater similarity between the variants of the phonological vowel, that is, between [i]/Set A and [ei]/Set B and between [ei]/Set A and [ai]/Set B.

4 Previous analyses of the tone–vowel interaction

The alternating vowels have been a recalcitrant issue for phonologists. The following sections illustrate two important phonological analyses proposed to account for this alternation. What these accounts share is the assumption that the tones influence the vowels, causing the vowel shifts, which in turn are analyzed as either raising or lowering of the vowels.

¹ These examples continue to use Donohue (2013)’s tone numbers rather than Chao’s original values to avoid confusion.

4.1 Yip 1980

Yip (1980) is an extensive study of tonal phonological phenomena in a range of Chinese languages. Her analysis of Fuzhou is essentially that the Set B vowels are basic, and are raised when they co-occur with tones that are [+upper] register. To account for this, she provides a rule, shown in (4).

- (4) V[αlow] → [-low, -αhigh] / [+upper]

This elegant rule, however, fails to capture the simplification of diphthongs (as in the [i]~[ei] type pairs), nor does it readily account for the fact that [a] is held constant in ALL tonal contexts. Another shortcoming of this approach is that it results in a rather unusual vowel inventory, having [ei, øy, ou] but lacking [i, y, u] which are all derived vowels in this approach. While not all vowel inventories conform to what is typologically expected, there is no strong independent evidence to support this choice for Fuzhou (except for the formal appeal of the rule.).

4.2 Jiang-King 1999

Jiang-King (1999) is a study on the tone–vowel interaction in Northern Min, including Fuzhou.² Jiang-King, following Hyman (1988 and elsewhere), includes in her tonal representation the moraic structure of the syllable, and relates the vowel alternations to the tonal changes by appealing to the syllable weight. She refers to the difference, not in terms of “height” as Yip did, but rather in terms of “tightness”, whereby the Set A vowels are considered “tight syllables” and the Set B vowels, “loose”. Jiang-King’s Prosodic Anchor Hypothesis (p. 77) accounts for this covariation by postulating, relatively noncontroversially, that tight syllables have one mora, while loose syllables have two. The leftmost mora is considered the head, and it can host up to two tones, while non-head morae can only host one tone. This captures the bigger picture that Jiang-King is claiming, that the moraic structure determines tone–vowel possibilities. There are other rules included to change the actual quality of the vowel.

This proposal draws on previous typologically tested work to inform the hypothesis, but runs into difficulty accounting for vowels whose form, unlike a monophthong–diphthong pair (e.g. [i]–[ei]), does not change according to the

² Min dialects were originally divided into Northern and Southern groups. However, more recent studies argued that the coastal–inland division is more significant and explains certain key phonological developments in the dialect group better (Norman 1988, Branner 2000). After this, Fuzhou was reclassified as Eastern Min.

moraic structure of the syllable such as a diphthong pair which changes only the vowel quality (e.g. [ei]–[ai]), or the monophthong [a] which appears unchanged across all tones.

5 A new perspective of the tone–vowel alternations

Yip and Jiang-King both strive to capture the alternating vowels in the synchronic phonology, a goal shared by many addressing tone–vowel interactions (e.g. Köhnlein (this volume), but cf. Becker & Jurgec (this volume)). However, I claim that the vowel changes serve a perceptual function in that they enhance the phonological tone categories when needed.³ Contrary to previous analyses, I do not believe that their actual forms need to be *derived* in a synchronic phonology. Rather, I claim that the vowel alternations serve to keep the phonological categories distinct, thus (synchronically) enhancing these features.

An important finding of Donohue (2013) was that Fuzhou has a consistent non-modal phonation produced with tones 3, 4 and 6 in citation position (and occasionally a slight breathiness on tone 2). Indeed, recent studies have shown that this non-modal phonation is a significant factor in tonal identification in Fuzhou (e.g. Donohue 2010, 2011, 2012). The use of this creaky voice with tones 3, 4 and 6, together with the vowel changes also delineating this subset of the tones makes the assignment of tonal geometric features in Fuzhou relatively straightforward, as shown in Tab. 4, following standard practices of using the features for register ([±upper]) and tonal contour features ([±high] (e.g. Bao 1990; Snider 1999).

Tab. 4: Tonal features, phonation and vowels in Fuzhou.

Tone	Features: Register, Tone	Phonation	Vowel set
Tone 1 [44]	[+upper], [+high]	Normal	A
Tone 2 [32]	[+upper], [−high]	Normal/Breathy	A
Tone 3 [21]	[−upper], [−high]	Creaky	B
Tone 4 [13]	[−upper], [−high, +high]	Creaky	B
Tone 5 [51]	[+upper], [+high, −high]	Normal	A
Tone 6 [231]	[−upper], [−high, +high, −high]	Creaky	B
Tone 7 [5]	[+upper], [+high]	Normal	A

³ I use the word *enhance* here simply to mean that the distinctions are heightened, made greater.

As one might expect, there are degrees of how much non-modal phonation may be present in a syllable. The absence of non-modal phonation (in, e.g., high vowels) does not imply a Set A tone, but certainly the presence of it does imply a Set B tone. The fact that Donohue (2010, 2011, 2012) found that both the phonation as well as the slight rise/fall in tonal F0 are significant factors in tonal identification leads one to believe that they exist to enhance the phonological categories, along with the vowel changes. One can summarize the perceptual enhancements in the following way:

Tab. 5: Phonetic enhancements of tonal features in Fuzhou (Donohue 2012, 2013).

Vowels	[–upper] tones are produced with set B vowels ⁴
Phonation	[–upper, –high] tones have a (breathy/creaky) non-modal phonation
Phonetic contour⁵	[+high] tones rise a little [–high] tones fall a little

These enhancements interact in an expected way, resulting in some of the observed asymmetries in the tone–vowel interaction. As one would expect, a low, open vowel like [a] is easily produced with the breathy/creaky voice. There is thus no need for vowel alternation. Note that if the enhancement were one of lowering, not raising, then there is not much that [a] can do to “lower”, so a change in voice quality is the next best thing for making the lower register distinct. The higher vowels are less likely to carry breathy voice as well or for as long as [a], but they have the much greater shift in vowel quality (e.g. [i] is produced as [ei], or [ei] is produced as [ai]), so there is not as great a need for the phonation to endure on these syllables.⁶

As noted, these changes in vowel quality and voice quality only occur in citation/prepausal position, not in sandhi position. The reason for this is twofold: Tones in prepausal position (citation or non-sandhi tones) can be up to one and

⁴ Following the standard practice in the literature I continue to use [±upper] to refer to the two registers even though associating [lower] with creaky voice may make a more phonetically transparent link between the two.

⁵ These are apparent only in simplex contours – level tones expressed by a single tone, and not complex contours involving the movement between tones.

⁶ Note that one could also analyze the phonation changes as creak enhancing [–upper]. But the advantage of interpreting the data this way is the ability to generalize that low tones (e.g. [–high]) prefer non-modal phonation, which is either (optionally) breathy in the higher register ([+upper]) or creaky in the lower register ([–upper]).

a half times longer in duration. This affords much greater time to accommodate the additional vocal gestures necessary to invoke these changes in voice/vowel quality.

When spoken in isolation (e.g. citation tones) or when not surrounded by other syllables (e.g. sandhi tones) that provide syntactic or semantic information as well as phonological information to help disambiguate, there is a greater need to provide that additional information.

Another question that needs to be addressed is where the vowels come from – why are those vowel quality changes observed and not others (e.g. why [i]~[ei] and not [i]~[ɪ] or [i]~[e], for example)? This is the question that previous research has worked hard to address, but is a question that I will not attempt to answer by deriving the changes in a synchronic phonology. Instead, I claim that these vowel “pairings” exist as historical residue. At some point in the development of Chinese vowels split into “higher” and “lower” vowels. It is not the goal of the paper to investigate when or why, but rather to note that at some point in time, different dialects typically favoured one or other of these vowel types (higher or lower). Consider the examples in Tab. 6, with Cantonese and Mandarin showing the different reflexes. In these examples, Mandarin has the monophthongal variants where Cantonese has a ‘lowered’ vowel variant. These correspondences are not across the board between these two dialects, but there does appear to be a general tendency. Moreover, if we look beyond Fuzhou and northern Min, this type of vowel–register alternation can be also found elsewhere in South East Asia, so could well be best construed as an areal phenomenon changes (e.g. *Mpi* (Thailand; Ladefoged & Maddieson 1996, Denning 1989), *Hani* (Vietnam; Edmondson 2002). Perhaps in observing the greater, areal picture, the answer to the question of “why these forms” may find a more straightforward answer, though it will likely still be an answer drawing on the language history of the region, not a synchronic derivation.

Tab. 6: Some vowel correspondences across three varieties of Chinese.

Mandarin	Cantonese	Fuzhou	Fuzhou Tone	Word	
tshi	khei	khi	1 [44] Upper-H	期	‘period’
tu	tou	tu	2 [32] Upper-L	賭	‘gamble’
thu	thou	thu	5 [51] Upper-HL	徒	‘on foot’
tu	tok	tuʔ	7 [5] Upper-H	毒	‘poison’
tsi	kei	kei	3 [21] Lower-L	自	‘since’
ti	tek	teiʔ	4 [23] Lower-LH	滴	‘drip’
tu	tou	tou	6 [231] Lower-LHL	度	‘degree’

6 Concluding remarks

A general suggestion made here is that the tones are best conceptualized as an amalgam of features, which are kept distinct through various phonetic measures serving to enhance the distinctions where possible, and where necessary. These enhancements include both changes in voice quality (phonation) and vowel quality as well as slight rises or falls of F0 contours in so-called “level” tones. The involvement of all these factors is consistent with data from other South East Asian languages, such as Burmese (Bradley 1982), where either F0 or phonation can be manipulated to signal a tonal category. Eastern Cham (Brunelle 2005, 2009) is another example where phonological register is manifested by phonation as well as pitch. Furthermore, qualitatively similar vowel alternations may be observed in languages throughout South East Asia where there is known vowel–“register” interaction. These data further suggest that these different phonetic factors are bundled together phonologically for at least some languages and that a vowel–“register” alternation may best be approached as an areal phenomenon as opposed to a peculiar tonal phenomenon limited to northern Min varieties of Chinese. Rather than focusing on how to derive the exact vowel qualities in Fuzhou vowel alternations, it thus follows that it is preferable to conceptualize the phenomenon as part of a set of enhancements to the phonological category of tone, using those phonetic features as they are available and when they are necessary.

References

- Bao, Zhiming. 1990. *On the nature of tone*. Doctoral dissertation, MIT, Cambridge, MA.
- Becker, Michael & Peter Jurgec. This volume. Interactions of tone and ATR in Slovenian.
- Bradley, David. 1982. Register in Burmese. In David Bradley (ed.) *Papers in South-East Asian Linguistics*, No. 8. *Tonation* (Pacific Linguistics, A 62), 117–132. Canberra: Pacific Linguistics.
- Branner, David Prager. 2000. *Problems in comparative Chinese dialectology: the classification of Miin and Hakka*. Trends in Linguistics series 123. Berlin: Mouton de Gruyter.
- Brunelle, Marc. 2005. Register and tone in Eastern Cham: Evidence from a word game. *Mon-Khmer Studies* 35, 121–131.
- Brunelle, Marc. 2009. Contact-induced change? Register in three Cham dialects. *Journal of Southeast Asian Linguistics* 2, 1–22.
- Chao, Yuen-Ren. 1930. A system of tone letters. *Le Maître Phonétique* 45, 24–27.
- Chao, Yuen-Ren. 1934. On the non-uniqueness of phonemic solutions of phonetic systems. *Bulletin of the Institute of History and Philology, Academia Sinica* 4, 363–97. Reproduced in Martin Joos (ed., 1966) *Readings in Linguistics I*, 38–55. Chicago: University of Chicago Press.
- Denning, Keith. 1996. *The diachronic development of phonological voice quality, with special reference to Dinka and other Nilotic languages*. Doctoral dissertation, Stanford University.

- Donohue, Cathryn. 2010. Pitch height vs contour in tonal perception in Fuzhou. *BLS* 35, 95–98.
- Donohue, Cathryn. 2011. The significance of ‘secondary cues’ for tonal identification in Fuzhou. *Proceedings of ICPHS* 17, 607–610.
- Donohue, Cathryn. 2012. The role of phonation in Fuzhou tonal identification. In Cathryn Donohue, Shunichi Ishihara & William Steed (eds.) *Quantitative approaches to problems in linguistics* (LINCOM Studies in Phonetics 08), 63–75. Munich: LINCOM Europa.
- Donohue, Cathryn. 2013. Tones and vowels in Fuzhou. *BLS* 33, 97–105.
- Donohue, Cathryn. Forthcoming (2013). *Fuzhou tonal acoustics and tonology* (LINCOM Studies in Asian Linguistics 82). Munich: LINCOM Europa.
- Edmondson, Jerold A. 2002. The Central and Southern Loloish languages of Vietnam. *BLS 28S: Special Session on Tibeto-Burman and Southeast Asian Linguistics*, 1–13.
- Hyman, Larry M. 1988. Syllable structure constraints on tonal contours. *Linguistique Africaine* 1, 49–60.
- Jiang-King, Ping. 1996. *An optimality account of tone–vowel interaction in northern Min*. Doctoral dissertation, University of British Columbia, Vancouver.
- Köhnlein, Björn. This volume. Synchronic alternations between monophthongs and diphthongs in Franconian: A metrical approach.
- Ladefoged, Peter & Ian Maddieson. 1996. *The sounds of the world’s languages*. Oxford: Blackwell.
- Maddieson, Ian. 1977. Tone effects on consonants. *University of California Working Papers in Phonetics* 36, 91–110.
- Maddieson, Ian. 1984. The effects on F0 of a voicing distinction in sonorants and their implications for a theory of tonogenesis. *Journal of Phonetics* 12, 9–15.
- Maddieson, Ian. 1997. Phonetic universals. In W. Hardcastle & J. Laver (eds.) *Handbook of phonetic sciences*, 619–639. Oxford: Blackwell Press.
- Norman, Jerry. 1988. *Chinese*. Cambridge: Cambridge University Press.
- Rose, Philip. 1987. Considerations in the normalisation of the fundamental frequency of linguistic tone. *Speech Communication* 6, 343–352.
- Snider, Keith. 1999. *The geometry and features of tone*. Summer Institute of Linguistics and the University of Texas at Arlington.
- Yip, Moira. 1980. The tonal phonology of Chinese. Doctoral dissertation, MIT, Cambridge, MA.
- Zee, Eric. 1984. Peak intraoral air pressure in [p] as a function of F0 in Chinese. *Language and Speech* 27, 381–390.

Laura J. Downing

Grounding Nguni depressor effects*

1 Introduction

The Nguni group of Bantu languages (Guthrie number S.40, e.g., Ndebele, Phuthi, Swati, Xhosa and Zulu) are well known for their so-called ‘depressor consonants’: that is, sets of consonants, often voiced, which interfere with productive processes of High-tone realization by lowering the pitch of a following vowel in some way. The Nguni depressor effects, at first blush, appear to illustrate the typologically common pattern of phonologizing the phonetic lowering effect voiced obstruents have on the pitch of a following vowel (Hombert 1978; Hyman & Schuh 1974). To account for this pattern, theories in a variety of frameworks formalize an explicit link between laryngeal voicing and tonal features. Single-source approaches consider [voice] and Low tone reflexes of the same feature, with one realization when associated to a consonant and another when associated to a vowel: see e.g. Halle & Stevens (1971), Harris (1994), Halle (1995), Bradshaw (1999), and Pearce (2007). In contrast, multiple-source approaches consider [voice] and Low tone distinct features, and phonetically grounded implicational constraints (or the equivalent) account for their interaction: see e.g., Khumalo (1987), Peng (1992), Hyman & Mathangwane (1998), Cassimjee (1998), Mathangwane (1999), Hansson (2004), Hsieh & Kenstowicz (2008), Lee (2008), Tang (2008).

In this paper I show that Nguni depressor effects are best accounted for in a multiple-source approach, as they raise fundamental problems for single-source approaches. First, the set of depressor consonants includes phonetically voiceless stops: there is no necessary connection between pitch lowering and voicing. Further, the depressor consonants do not uniformly behave as if they

* The data in this paper comes from the sources cited as well as my own work on Nguni languages. I would like to thank James Khumalo, my first Zulu teacher, for introducing me to the intricacies of Nguni tone and the joy of depressors, and Audrey Mbeje, Joyce Sukumane, Galen Sibanda and Meritta Xaba for helping me learn about their languages. Earlier versions of some of this paper were presented at the Tone-Segment workshop in Amsterdam in June 2007 and at OCP5 in Toulouse in January 2008. I thank the audience at these workshops, along with Thilo Schadeberg, Mike Kenstowicz, Larry Hyman, Richard Wiese, the editors and four anonymous reviewers, for helpful comments on the paper. The usual disclaimers apply.

were associated with a Low tone. While they block High-tone spread or shift in some contexts, they are transparent for High-tone spread or shift in others. In contrast, we shall see that a grounding constraint approach to the depressor effects, along the lines of Cassimjee's (1998) Optimal Domains Theory (ODT) analysis of Xhosa, elegantly accounts for these properties of depressors. I show further that a problem for Cassimjee's (1998) analysis can be resolved by proposing that depressor consonants introduce a Low tonal register, rather than a simple Low tone.

2 Depressor effects in Nguni languages

As recent surveys by Cassimjee & Kisseberth (1992, 2001) show, several Southern and Eastern Bantu languages have consonants that are associated with depressor effects: that is, these consonants have some kind of lowering effect on the tone of a following syllable. In this section, I present some of the main depressor effects found in the Nguni group of Bantu languages, briefly summarizing parameters of variation discussed in more detail in Cassimjee & Kisseberth's (2001) recent survey article. For reasons of space, three languages – Ndebele, Swati and Xhosa – have been chosen to illustrate the depressor effects. We shall see in the next section why they are especially problematic for single-source theories of tone–segment interaction.¹

Before presenting the Nguni tone patterns of interest to the analysis, a bit of background on Nguni Bantu tone is in order. Nguni Bantu languages, like most Bantu languages, contrast two tone levels, High and toneless (surface Low), and tones, especially in verbs, are contrastive at the level of the morpheme, not the syllable. In Nguni languages, as in most Bantu languages, High tones commonly surface on syllables other than the one that they are underlyingly associated with. This is one argument, in fact, for considering non-High syllables to be toneless. These syllables are not a barrier to High-tone displacement. Only a High-toned syllable is. (See work like Chen (1992) and Kisseberth &

¹ The interested reader should consult Cassimjee & Kisseberth (2001), especially, and the references cited in that paper for more details about similar depressor effects in other Nguni languages as well as for discussion of other depressor effects which space does not permit presenting here. See, too, work like Cassimjee (1998), Cassimjee & Kisseberth (1998), Donnelly (2007), Downing (1990, 2001, 2003), Khumalo (1987), Malambe (2006), Rycroft (1980, 1983), Sibanda (2004) and references therein, for detailed exemplification and analysis of tone patterns in several Nguni languages.

Odden (2003) for thoughtful syntheses of these and other distinctive properties of Bantu tonal systems.)

A striking property of the Nguni tone system is that the rightmost High tone of words (especially verbs) in isolation is realized on the antepenultimate syllable, even though the underlying source of the High tone might be several syllables earlier in the word. This displacement of High tones to the antepenult is illustrated with the Xhosa data in (1). The only underlying High tone in these verbs is contributed by the subject prefix, *bá-*, as one can see by comparing with words in the same paradigm that have other subject prefixes, like *ndi-ya-fiika* ‘I am arriving.’ Yet, the High tone surfaces on the antepenultimate syllable of the following toneless verb stem, when the subject prefix is in pre-antepenultimate position. The High tone is said to shift to the antepenult in Xhosa, as only the antepenultimate syllable bears a High tone. The syllables between the source of the High tone (underlined) and the antepenult are Low-toned. (All data are cited in the Nguni orthography, except that tone and predictable phrase-penult vowel lengthening are indicated):

(1) High-toned subject prefix plus Low-toned verb

Xhosa (Cassimjee 1998: 26, 32)

<i>bá-yá-fiika</i>	‘they are arriving’ (cf. <i>ndi-ya-fiika</i> ‘I am arriving’)
<i>bá-yá-hleeka</i>	‘they are laughing’
<i>bá-ya-cáciisa</i>	‘they are explaining’
<i>bá-ya-balíseela</i>	‘they are narrating to’
<i>bá-ya-banekíseela</i>	‘they are illuminating for’

The data in (2a) show that we find identical tone patterns in Swati. The High tone underlyingly contributed by the subject prefix shifts to the antepenult. Zimbabwean Ndebele (2b) illustrates High-tone spread, rather than shift: all the syllables from the subject prefix through the antepenult are High-toned. Depressor consonants are bolded in the data, beginning with the data set below:

(2) High-toned subject prefix plus Low-toned verb

a. Swati (Ziervogel & Mabuza 1976)

<i>bá-yá-g<u>uub</u>ha</i>	‘they are digging out’
<i>bá-ya-cébuula</i>	‘they are skinning’
<i>bá-ya-namátseela</i>	‘they are sticking to’

b. Zimbabwean Ndebele (Rycroft 1983)

<i>ú-yá-kheetha</i>	‘s/he chooses’
<i>ú-yá-khéthiisa</i>	‘s/he helps choose’
<i>ú-yá-límísiisa</i>	‘s/he plows intensively’

Depressor consonants interfere with this process of High-tone displacement to the antepenult in almost all the Nguni languages (Cassimjee & Kisseberth 2001).

As shown by the data in (3a), (4a) and (5a), below, a High tone is not realized on the antepenultimate syllable as expected, if it has a depressor consonant in the onset. Instead, the High tone is “shifted” one mora rightward, resulting in a falling tone (*not* a level High tone) on the penult and a Low tone on the syllable containing the depressor. The data in (3b), (4b) and (5b) show that this process of Depressor High-Tone Shift (DHTS) is blocked, however, if the penult syllable also begins with a depressor consonant:

(3) Xhosa (Cassimjee 1998: 51–52)

a. DHTS to penult

<u>ba</u> -ya- da níisa	‘they are dancing’ (* <u>ba</u> -ya- dá níisa without DHTS)
<u>ba</u> -ya- va léela	‘they are locking in’
<u>ba</u> -ya- so mbulúula	‘they are solving a problem’
<u>ba</u> -ya- hla nganíisa	‘they are putting together’

b. DHTS blocked

<u>ba</u> -ya- bh údeela	‘they are talking nonsense’
<u>ba</u> -ya- g úzuula	‘they are scraping’

(4) Swati (Rycroft 1981)

a. DHTS to penult

<u>ku</u> - bha bhatíisa	‘to baptize’
<u>ku</u> - gu cúuka	‘to change, vary; turn around (intr.)’
<u>ku</u> - dli bhitéeka	‘to be dilapidated, untidy’
<u>ku</u> - vum éela	‘to allow, agree to’

b. DHTS blocked

<u>ku</u> - dli bhiita	‘to tear apart; rip to pieces’
<u>ku</u> - bh ádvuula	‘to lock’

(5) Ndebele (Sibanda 2004: 263ff)

a. DHTS to penult

<u>ú</u> kú- dli íiza	‘to demolish’
<u>ú</u> kú- gu giséela	‘to wear out for’
<u>ú</u> kú- bha daléela	‘to pay for’
<u>ú</u> kú- bha léela	‘to write to/for’

b. DHTS blocked

<u>ú</u> kú- vó dlooza	‘to smash’
<u>ú</u> kú- bh ádaala	‘to pay’

In Swati, depressor consonants also block High-tone plateauing. As shown in (4), above, Swati is a “shifting” language, if there is only one underlying High tone. That is, a High tone, if underlyingly pre-antepenultimate, will surface only on the antepenult, and syllables intervening between the source and the antepenult will

be Low-toned. If there is more than one underlying High tone, we find High-tone plateauing: “a principle that bars the occurrence of toneless syllables, if those toneless syllables are flanked by High tones on either side” (Cassimjee & Kisseberth 2001: 345). Plateauing is found both within words and in certain phrases in Swati, as shown by the data below.² In (6) and (7), underlying High tones are underlined, and the starred forms show the pronunciation expected if plateauing did not occur:

(6) Swati High-tone plateauing

a. Within words (Cassimjee & Kisseberth 2001: 345–346, citing Creissels 1999)

u-yá-sébéénta ‘s/he is working’ (*u-yá-sebéénta)

ba-yá-búlálaana ‘they are killing each other’

ba-yá-phékélétélaana ‘they are accompanying each other’

b. Phrasally (Bradshaw 1999: 95; Creissels 1999: 176)

u-bálá tì-cátfuulo ‘s/he counts shoes’ (*u-bála tì-cátfuulo)

u-válá ímí-nyaango ‘s/he closes the doors’

ba-hlakulísá sibiili ‘they are really helping each other to weed’

If a depressor consonant intervenes between the two High tones, plateauing is entirely or partially blocked. As we can see in the data below, some syllables preceding and/or following the depressor consonant (bolded) are Low-toned in the plateauing context:

(7) Swati plateauing blocked by depressors

a. Total blocking within words (Cassimjee & Kisseberth 2001: 354)

kú-sundvúúla ‘to push aside’

kú-tjengíisa ‘to point out’

kú-gocóóta ‘to fold’

b. Total blocking phrasally (Bradshaw 1999: 95)

u-bándza tì-cátfuulo ‘s/he chops up shoes’

u-bilísa **bha**tááta ‘s/he boils sweet potatoes’

u-géza bá-ntfaana ‘s/he bathes the children’

² High tones target the penult syllable rather than the antepenult when a word is not phrase-final. See work like Downing (1990), Cassimjee (1998), Creissels (1999) and Cassimjee & Kisseberth (2001), and references therein, for further discussion of the role of phonological phrasing in determining the target of rightward tone displacement in Nguni languages. High tones underlyingly on the antepenult displace to the penult in both phrase-medial and phrase-final position. High tones on the subject prefix of High-toned verbs shift one syllable to the right. High tones do not displace to syllables that bear an underlying High tone. Analyses of these patterns are presented below.

c. Partial blocking of plateauing

u-boléká sí-**bh**anyáana ‘s/he lends a little gun’
 (*u-boléka sí-**bh**anyáana)
ba-klavúlá lí-**bh**ubéesi ‘they pierce the lion’

It is uncontroversial, then, that depressor consonants are associated with tone lowering in Nguni languages. However, depressor consonants do not uniformly block High-tone displacement, as we might expect based on the data in (3) through (7). Indeed, the attentive reader might have noticed in this data that depressor consonants are transparent to the process of High-tone displacement to the antepenult. Further examples of depressor transparency to this process in Xhosa and Swati are provided by the data in (8a, b). As we can see, the High tone from the subject prefix regularly surfaces on the antepenult, even if a depressor consonant occurs between the subject prefix and the antepenult target for High-tone shift (depressor consonants continue to be bolded in the data, and underlining indicates the source position of High tones):

(8) Depressors transparent to antepenult High-tone shift

a. Xhosa (Cassimjee & Kisseberth 2001: 351)

<u>ba</u> -ya- gi biseela	‘they are throwing’
<u>ba</u> -ya- gu zuula	‘they are scraping off’
<u>ba</u> -ya- ga bha- ga ebha	‘they are hitting again and again’

b. Swati (Rycroft 1981)

ku-**dlībhi**iita ‘to tear apart; rip to pieces’
ku-**gacá**teela ‘to creep, crawl’
ku-**goló**teela ‘to stare at; await’

Strikingly, depressor consonants are also transparent to antepenult High-tone displacement in spreading languages, like Ndebele. As shown by the data in (9), the High tone contributed by the infinitive prefix *úku-*, the only underlying source of a High tone in these words, is realized on all the syllables from the source through the antepenult, *except* on the syllables with depressor onsets, which are Low-toned:

(9) Ndebele (Sibanda 2004: 263ff)

úkú-**b**haliseela ‘to cause to write to/for’
 úkú-**d**ilíkisa ‘to cause to fall down (of building)’
 úkú-**v**ódlooza ‘to smash’

As work like Bradshaw (1999), Cassimjee & Kisseberth (1992, 2001), Hyman & Mathangwane (1998), Kisseberth (1984) and Kisseberth & Volk (2007) has demonstrated, one of the central challenges that depressor consonants in Nguni and other Bantu languages pose to phonological analysis is that it is common for them to be transparent to some High-tone displacement processes while opaque to others. We return to this problem in sections 3 and 4, below.

To sum up, the data presented in this section show that depressor effects – i.e., blocking of some High-tone displacement processes by a set of depressor consonants and a Low tone on a depressor syllable in contexts where we would otherwise expect a High tone – are robustly attested in Nguni Bantu languages. In the next sections we shall see why these depressor effects cannot easily be accounted for in single-source theories of tone–segment interactions.

3 Disassociating [voice] and Low tone from Nguni depressors

Single-source theories of consonant–tone interaction make the strong claim that: “Depressor effects [...] always indicate a special relationship between voicing and L tone” (Bradshaw 1999: 43). As work like Halle & Stevens (1971), Halle (1995) and Harris (1994) argue, the same laryngeal configuration that favors vocal fold vibration (slack vocal cords) also lowers fundamental frequency. And, conversely, work like Bradshaw (1999: 163) claims that Low tone implies vocal fold vibration. These theories implement the strong correlation between depressor effects and phonetic voicing of a preceding consonant by proposing that [voice] and Low tone are reflexes of a single laryngeal feature, with different realizations depending on whether the feature is linked to a consonant or a vowel. As I show in this section, the Nguni depressor effects surveyed in section 2 are problematic for single-source theories for two reasons. First, they cannot be uniformly linked to phonetic voicing of a preceding consonant. Further, they cannot be uniformly accounted for by associating the depressed syllable with a Low tone.

3.1 Phonetically voiceless depressors

It has been well known since Schachter (1976) that the depressor consonants in the Nguni group of Bantu languages form an “unnatural class,” as they include both voiced and voiceless consonants:

- (10) Depressor consonants in Swati (Schachter 1976; Traill 1990)³
- a. Voiceless, unaspirated stops: p, t, k (orthographic *bh, d, g*)
 - b. Voiceless unaspirated affricates: tf, ts, tʃ (orthographic *dv, dz, j*)

³ The complete Zulu consonant inventory, which is also applicable for the other Nguni languages discussed, is given in the Appendix.

- c. Voiced clicks
- d. Voiced fricatives
- e. Velar nasal (in some Nguni languages) and NC sequences (in cases where the C is phonetically voiced after a nasal, as the orthography suggests, e.g., *mb*, *nd*)

Even though Nguni orthography misleadingly suggests that the stops and affricates listed in (10a, b) are voiced, traditional descriptions and phonetic studies agree that these sounds are voiceless. The following selection of references to phonetic studies and careful descriptions emphasizes this point. Doke (1931: 10) describes orthographic *bh*, *d* and *g* in Zulu as “devoid of voicing during the ‘stop’” based on a kymographic study. Schachter’s (1976) claim that the Swati segments listed in (10a, b) are voiceless is based on an unpublished phonetic study by Louis Goldstein. While Rycroft (1980) misleadingly characterizes depressor stops as “breathy voiced”, his Swati Dictionary (Rycroft 1981) defines them more precisely as “voiceless during occlusion” with a breathy voice release. Sibanda (2004) provides a similar impressionistic description of Ndebele depressor stops. Traill et al. (1987) and Traill’s (1990) phonetic studies show these sounds are voiceless, with no special breathy voice configuration at closure or release in Zulu and Swati; instead, they identify a special laryngeal configuration – a “depression gesture” – independent of voicing. Subsequent phonetic studies of depressor stops in various Nguni languages confirm that these segments are phonetically voiceless: Maddison (2003) for Swati; Giannini et al. (1988), Strazny (2003) and Chen & Downing (2011) for Zulu; and Jessen & Roux (2002) for Xhosa. None of these studies find systematic breathy voice associated with the release of the voiceless depressors.

Synchronically, then, some Nguni depressor consonants are phonetically voiceless during closure, disconfirming the necessary link between voicing and Low tone posited by single-source theories.⁴ One might, though, propose that the voiceless depressors represent the result of tonogenesis like that found in South(-east) Asian languages (Haudricourt 1954; Matisoff 1973; Svantesson 2001; Svantesson & House 2006) and in Chadic languages (Pearce 2007). Indeed, one motivation for the close relationship between [voice] and Low tone comes from languages like Kammu, a Mon-Khmer language spoken in northern Laos, where Svantesson & House (2006: 310) show that voicing contrasts have been

⁴ Clements (2003) and Clements & Khatiwada (2007) discuss other languages where voiceless obstruents are associated with pitch lowering on a following vowel, and suggest that breathy voicing on the vowel is responsible for the pitch lowering. The descriptions of the voiceless Southern Bantu depressors are contradictory on this point, and it must remain as a subject for future research to investigate their phonetic properties more carefully.

lost in some dialects, replaced by tonal contrasts. For example, Eastern Kammu, *taan* ‘pack’ vs. *daan* ‘lizard,’ has the following cognates in Northern and Western Kammu: *tāan* ‘pack’ vs. *tàan*/*ᵀàan* ‘lizard.’ Could a similar tonogenesis process account for voiceless depressors in these Southern Bantu languages?

Work like Clements (2003) and Schachter (1976) suggests that it does, and that Nguni orthography reflects some earlier stage of Nguni languages where the voiceless depressors in (10a, b) were, in fact, voiced. Contrastive Low tone on depressor syllables has replaced an earlier voicing contrast. This claim is, however, not supported by a careful study of the reflexes of Proto-Bantu consonants in modern Nguni languages like Zulu or Xhosa. Indeed, work since Guthrie (1967–1971) has noted that depressor stops, along with ejectives and clicks, have no Proto-Bantu source. And, as Schadeberg (2009) demonstrates, voiced stops of Proto-Bantu have implosive stops or voiced fricatives as their modern Nguni reflexes. One can only speculate on an alternative source for the depressor effects associated with voiceless depressors, but it is at least suggestive that neighboring Khoisan languages are described as having depressed tone patterns following certain consonants (Louw 1974, Haacke 1999) or on breathy voiced vowels (Traill 1985). Clicks, then, might not be the only phonological feature that entered Nguni Bantu languages through borrowing.

Instead of voicing, what we find is that another synchronic phonetic feature is systematically associated with both voiced and voiceless Nguni depressors. Traill et al. (1987) shows, based on a laryngoscopic study of the articulation of depressor consonants by three Zulu speakers, that, in Zulu at least, depression correlates with what Maddieson (2003: 30) terms a ‘special laryngeal posture’. Strazny (2003) proposes a new laryngeal feature, [lax vocal fold tension], to characterize this laryngeal posture.⁵

3.2 Depressors are both transparent and opaque to High tones

The single-source hypothesis (Bradshaw 1999, Halle & Stevens 1971, Halle 1995, Harris 1994) claims further that depressor consonants affect the pitch of a following vowel because they are associated with the feature [voice], which necessarily introduces a phonological Low tone. One problem with linking depressor consonants

⁵ See Downing & Gick (2005) and Lee (2008) for discussion of other Bantu languages with depressor consonants which are neither historically nor synchronically voiced. And see Yip (2002), Svantesson (2001) and Lee (2008) for recent cross-linguistic surveys of laryngeal properties besides [voice] that condition tone raising and lowering.

with a Low tone, noted in previous phonological analyses of Southern Bantu depressors (Bradshaw 1999, 2003; Cassimjee 1998; Cassimjee & Kisseberth 2001; Hyman & Mathangwane 1998; Strazny 2003), is that depressor consonants are transparent to High-tone shift or spread in some contexts, but are opaque (i.e., block High-tone shift or spread) in other contexts in the same language. We saw examples of this in section 2, above.

Cases of depressor consonant opacity – like for DHTS, (3b) – (5b), above – are expected if the depressor introduces a Low tone. As illustrated below, the Low tone associated with a depressor should uniformly block processes of High-tone shift or spread due to Goldsmith's (1976) line-crossing constraint (Cassimjee & Kisseberth 1992; Hyman & Mathangwane 1998; Bradshaw 1999):

(11) Depressor should block High-tone spread

However, the data in (8) and (9) show this is not the case. High tones consistently cross depressors to target the antepenult in all Nguni languages. Nguni languages are not unique in this regard. As work like Kisseberth (1984), Cassimjee & Kisseberth (1992), Hyman & Mathangwane (1998), Mathangwane (1999), Odden (2007) and Kisseberth & Volk (2007) shows, it is rather common, in fact, for depressor consonants to be transparent for some tonal processes and opaque for others.

Hyman & Mathangwane (1998) and Cassimjee & Kisseberth (1992) show that derivational phonological theories provide a simple mechanism to account for why depressors block some High-tone displacement processes but not others. The Low tone associated with the depressor can be underspecified, inserted only after some High-tone shift or spread processes have applied. Depressors would be transparent to processes that apply before the underspecified Low tone is inserted and opaque to processes that apply after the Low tone is inserted. The schematic derivation below illustrates how this would work:

(12) Rule ordering and depressor transparency

- a. Depressor consonants are underspecified for tone
- b. High-tone spread or shift process 1 – depressor transparent
- c. Insertion of Depressor Low tone
- d. High-tone spread or shift process 2 – depressor opaque

While ordering depressor Low-tone insertion after some tonal processes can account for some depressor transparency effects, this strategy is not always

available to single-source theories, as Bradshaw (1999) notes. Low tone cannot be underspecified in languages where [voice] is contrastive, as it is the vocalic reflex of [voice].⁶ Even in Nguni languages, where [voice] is not contrastive for stops, it is difficult to underspecify the laryngeal feature which defines depressors because the depressor consonants participate in a phonotactic process of root-bound laryngeal harmony. As Khumalo (1987:26) states, in Zulu:

In most cases, when a morpheme is made up of non-click stops, such stops will have the same laryngeal feature specification, i.e. they will either all be [+aspirated] or all will be [+depressed] or all will be unspecified.⁷

Hyman (1999) confirms that these generalizations also hold for Ndebele. Note that Khumalo (1987) does not consider the depressors to be the unspecified laryngeal type in Zulu. In a single-source theory, if the laryngeal depression feature is lexically specified, then the concomitant Low tone is also lexically specified.

What Bradshaw proposes instead is that depressors are transparent for some processes but opaque for others because High-tone spreading (or shifting) processes can target different levels of the representation, either the prosodic plane or a segmental tier. Plane-sensitive tonal processes, which target the moraic plane, ignore tonal information specified on the laryngeal tier, like the Low-tone reflex of the [voice/Low] feature. Depressor consonants are transparent, then, for plane-sensitive processes, as spreading across a depressor Low tone does not violate the line-crossing constraint:

(13) Plane-sensitive H tone spread

In contrast, tier-sensitive processes of High-tone spread, which target the laryngeal tier, are blocked by depressor consonants. Spreading across their [voice/Low] specification on the laryngeal tier would violate the line-crossing constraint (see (11)).

⁶ See Bradshaw (1999: ch. 4) and Cassimjee & Kisseberth (1992) for more detailed discussion of why underspecifying Low tone cannot provide a general account of depressor transparency.

⁷ In Khumalo's (1987) analysis, the unspecified laryngeal feature combination is [aspirated, ±ejective].

As Bradshaw's (1999: 71) analysis of depressor effects in Swati shows, this proposal accounts well for some of the Nguni depressor effects illustrated in section 2, above. Three tonal processes were presented: antepenult shift, DHTS, and plateauing. Antepenult shift is transparent to depressors, so it is plane-sensitive in Bradshaw's (1999: 80) analysis of Swati. However, depressors block DHTS and plateauing, so these processes must be tier-sensitive. Proposing that DHTS is tier-sensitive also captures the generalization, found in most of the work cited on Nguni depressors, that DHTS is a local process. It displaces a High tone minimally rightward to avoid associating a High tone with a depressed syllable.

Bradshaw (1999: 96) notes, though, that it is difficult to classify plateauing as either tier-sensitive (depressor opaque) or plane-sensitive (depressor transparent). Recall from (7c), above, that depressors do not always totally block plateauing. These data are problematic for Bradshaw's (1999: 94) formalization of plateauing, which crucially refers to two adjacent High tones on the tonal tier: "H spreads rightwards to the next adjacent H on the tonal tier". Given this definition, depressors are opaque to plateauing, in the sense that the first High tone does not spread past a depressor towards the second triggering High tone. Yet, depressors must be transparent to plateauing, in the sense that they do not prevent the two triggering High tones from being considered adjacent on the tonal tier. This paradox is not resolved in her analysis.⁸ As we can see, accounting for the transparency of depressors is a problem for single-source theories, even in languages where [voice] is not contrastive.

3.3 Depression as a low register in Nguni

Rycroft (1980: 17) proposes that Nguni languages should be characterized as tone-register languages, rather than simple tone languages, because depression prosody imposes a register distinction in the realization of both High and Low tones. Traill et al. (1987: 262) and Traill (1990) concur with this proposal. Their phonetic studies show that depression involves dramatically lowering the pitch of both High- and Low-toned syllables: depressed syllables are "lower than low." For this reason, they assert that "there is no phonetic reality" to the proposal that depressor consonants are associated with a normal Low tone. This dramatic lowering effect on the realization of both High and Low tones of a syllable following a depressor (in

⁸ Kisseberth's (1984) analysis of Digo shows that a process displacing certain High tones to the stem-initial syllable is blocked by depressors in some contexts but not in others. The problem of classifying High-tone displacement processes as tier-sensitive vs. plane-sensitive is thus not limited to Swati (and other Nguni Bantu languages).

most contexts) can be clearly seen in Fig. 1, below, from a recent phonetic study by Chen & Downing (2011), which compares the effect depressors have on the *f*0 of the following syllable with the effect on *f*0 of the two other contrastive voiceless stop types (aspirated and unaspirated non-depressor) found in Zulu:⁹

Fig. 1: Effect of aspirated, unaspirated (or ejective) and depressor consonants on the pitch of the target syllable in Zulu (Chen & Downing 2011).

Maddieson (2003) and Strazny (2003), based on Traill et al. (1987) and their own phonetic studies, also propose that depression lowering is best considered a change in register, similar to what one finds in Southeast Asian languages (Svantesson 2001), due to the dramatic effect it has on the realization of both High and Low tones.

As Anderson (1978: 163) argues in critiquing the Halle & Stevens (1971) variant of the single-source approach, a featural theory which equates some laryngeal property (like [voice]) with a single tone level (like Low tone) cannot account for cases of register lowering imposed on all tone levels (e.g., both High and Low). The problem is that a Low tone (the tonal equivalent of the [voice] feature) should

⁹ It is puzzling that depressors have no noticeable effect on Low tone in the Low–Low context illustrated in the lower right graph of Fig. 1. See Chen & Downing (2011) for discussion of this point.

have no effect on another Low-toned syllable, and it should replace a non-Low tone on the following vowel (or create a rise). This critique generalizes to all single-source theories: they cannot account for the lowering in register of both High and Low tones that characterizes depression in Nguni, as it does not follow from simply inserting a Low tone.

3.4 Depressor High-Tone Shift is minimal

As Cassimjee (1998) shows, the derivational analysis sketched in (12) faces another problem in attempting to account for all Nguni depressor effects by introducing a Low tone, namely, the output of DHTS is different from “normal” High-tone shift to the penult. As shown in (1) and (2), above, pre-antepenultimate High tones in Nguni languages regularly shift to the antepenult. However, High tones underlyingly sponsored by the antepenult regularly shift to the penult (Cassimjee 1998; Cassimjee & Kisseberth 1998; Downing 2001, 2003; Khumalo 1987). This process of “normal” shift to the penult is illustrated below for Xhosa:

(14) Xhosa (Cassimjee & Kisseberth 1998)

si-ya-b _a -kháába	‘we kick them’
si-ya-z _i -bííla	‘we boil them’
si-ya-f _u máána	‘we get’
si-ya-f _i nyéeza	‘we shorten’
si-ya-l _a lééla	‘we are listening’

If DHTS results simply from associating a Low tone with the “depressed” antepenult, the output should be identical to normal High-tone shift to the penult in (14). In both cases, the antepenult comes to be associated with a Low tone, as the High tone originally on the antepenult shifts to the penult. However, as we can see in the Xhosa data in (3a), repeated below for convenience, DHTS results in a falling tone on the penult, not a level High tone:

(3) Xhosa (Cassimjee 1998: 51–52)

a. DHTS to penult

b _a -ya-d _a niísa	‘they are dancing’ (*b _a -ya-dániisa without DHTS)
b _a -ya-valéela	‘they are locking in’
b _a -ya-sombulúula	‘they are solving a problem’
b _a -ya-hlanganíisa	‘they are putting together’

While analyses of DHTS which model depressor effects with a Low tone can account for this difference by stipulating that DHTS targets moras while ‘normal’ High-tone shift targets syllables, these analyses miss the generalization that the difference in target is connected to the different sources of tone shift.

To sum up this section, pitch lowering found with Nguni depressors cannot straightforwardly be accounted for by proposing that Low tone and [voice] are reflexes of a single feature. One phonetic problem with this proposal is that some depressor consonants are phonetically voiceless. Further, depressor prosody in Nguni phonetically involves register lowering of both Low and High tones, not simple association of a Low tone to a syllable. A phonological problem is that depressor consonants are transparent for some High-tone displacement processes, which is unexpected if they are uniformly associated with a Low tone. A final problem is that depressor-induced shifting of High tones has a different output from ‘normal’ shifting of High tones. This is unexpected if both processes simply involve displacing a High tone from the antepenult to the penult.

4 Multiple sources of depressor effects: an ODT account

In this section, I present an Optimal Domains Theory (ODT) analysis of these depressor effects that avoids the problems faced by single source accounts. The analysis is developed as follows. First, I briefly introduce ODT, taking the analysis of Xhosa High-tone shift in non-depressor contexts developed in Cassimjee (1998) and Cassimjee & Kisseberth (1998) as a concrete case study illustrating the approach. Then I develop in turn analyses of the following Nguni tone processes discussed in section 2 that interact with depressors: antepenult High-tone displacement, (8) and (9); DHTS (3); and Swati plateauing (7).

4.1 Basics of ODT and High-tone shift in Nguni¹⁰

Optimal Domains Theory (Cassimjee 1998; Cassimjee & Kisseberth 1998) – ODT – aims to replace autosegmental representations as a way of formalizing in an Optimality Theoretic framework the realization of features on segments.

¹⁰ Space does not permit a detailed presentation of ODT. Since Tone Domains are prosodic constituents subject, for the most part, to familiar constraints defining prosodic constituents, the brief introduction here should suffice to allow readers to follow the analysis. Interested readers can find thorough introductions to ODT in Cassimjee (1998) and Cassimjee & Kisseberth (1998), and Leben (2006), Donnelly (2007) and Downing (2001, 2003, 2009) provide further detailed exemplification. McCarthy’s (2004) Headed Span theory is similar enough to ODT that this work also provides a useful introduction to the motivations for adopting a domains approach to feature representation.

The similarities and differences between the two approaches are highlighted in the representations in (15), below, which compare the autosegmental representation and ODT representation of a single High tone realized on two syllables.

In the autosegmental representation in (15a), a High tone is linked by association lines to two vowels. Each vowel the High tone is associated with realizes the High tone. That is, the association lines linking a single High tone to a contiguous sequence of vowels (more precisely, moras or syllable heads) can be said to define the domain of realization of the High tone. In ODT, the (potential) realization of a feature on segments is mediated, not by association lines, but rather by parsing segments into the relevant featural domain, indicated with parentheses. In this case, the relevant feature is High tone, and in the representation in (15b), the two vowels are parsed into a High tone domain:

(15) Tone spread in two theories

In the unmarked case, each vowel within a feature's domain realizes the feature.

ODT featural domains are prosodic constituents, with the following prosodic properties: they can be either binary or unbounded in size; they are subject to minimality; they are subject to nonfinality (i.e., they can exclude the final syllable); they are headed. These prosodic properties are typical of Bantu tone systems, as Cassimjee (1998) and Cassimjee & Kisseberth (1998) show. Because of this similarity, many of the constraints parsing strings into optimal domains are identical to those defining the optimal parse of segmental strings into other types of prosodic constituents.

These prosodic properties also characterize the Nguni tonal processes presented in section 2, above. Let us begin the analysis by presenting the constraints which previous ODT analyses of Nguni tone (Cassimjee 1998; Cassimjee & Kisseberth 1998; Downing 2001, 2003; Donnelly 2007) have proposed optimize the process of High-tone displacement to the antepenult, illustrated by the data in (1) and (2), above. The first parameter of domain parsing to be defined is whether domains are bounded or unbounded in size. Since High tones displace to the antepenult over any number of syllables, this is an unbounded process. We can define the antepenult as the alignment target for an unbounded tonal domain through the interaction of the following constraints. ALIGNTD accounts for the generalization that High tones spread (or shift) as close to the right edge of a word as possible:

(16) ALIGNTD [ALIGN TONE DOMAIN]: ALIGN-R (TD, Word)

The right edge of the tone domain (TD) is aligned with the right edge of the word.

As work since Hyman (1989) has argued, one can account for the generalization that High tones target the antepenult in Nguni languages by proposing that the stressed penult must lie outside the domain of High-tone displacement.¹¹ (See Kanerva (1990) for a similar proposal to account for a similar constraint on the rightmost target of High-tone displacement in Chichewa.) AVOIDPROM formalizes this generalization in ODT terms:

(17) AVOIDPROM[INENCE]: Do not parse the stressed (penult) syllable into a TD.

AVOIDPROM must outrank ALIGNTD to account for the generalization that the antepenult – not the final syllable – is the target of High-tone displacement.

The analysis of High-tone displacement to the antepenult is exemplified by the tableau in (18). Note that, following Cassimjee & Kisseberth (1998) and other work in ODT, the left edge of the tone domain is aligned with the left edge of the syllable that underlyingly sponsors the High tone by an undominated constraint (in the tableaux, parentheses indicate the tone domain; square brackets, the stress foot):

(18) High-tone shift to antepenult

/ bá-ya-balisela /	AVOIDPROM	ALIGNTD
☞ a. (ba-ya-bali)[seela]		***
b. (ba-ya-bali[seelá])	*!	
c. (bá)-ya-bali[seela]		****!***

Candidate (18a), with the rightmost high tone on the antepenult, is optimal because the tone domain (TD) edge is as far to the right as possible without violating AVOIDPROM. Candidate (18b) is non-optimal, as it violates AVOIDPROM by parsing the stressed penult into the TD. In candidate (18c), the TD edge is not far enough to the right, violating ALIGNTD more than the optimal candidate. Note that violations of ALIGNTD count moras, and alignment constraints are evaluated gradiently in this framework.

MINIMALITY (19) explains why the penult is included in the tone domain when the input High tone is on the antepenult, as illustrated by the data in (14). MINIMALITY is satisfied if High tones optimally spread or shift at least one syllable to the right, as it optimizes a minimally binary tonal domain:

(19) MINIMALITY

Prosodic constituents (e.g., tone domains) must be minimally bimoraic.

¹¹ The penult syllable is stressed (expressed as penult lengthening) in the Nguni Bantu languages and many other Bantu languages (Downing 2004).

Ranking MINIMALITY above AVOID PROMINENCE optimizes parsing the stressed penult into the TD to satisfy minimality. Disyllabic Xhosa verb stems like *si-ya-bóóna* ‘we are seeing’ show that the final syllable is never included in the tone domain, even though the TD remains, in this case, subminimal. NONFINALITY must then outrank MINIMALITY:

(20) NONFINALITY: *ALIGN-R (Word, TD)

The right edge of the tone domain (TD) is not aligned with the right edge of the word.

The tableaux in (21) show how the interaction of NONFINALITY and MINIMALITY accounts for the data where the rightmost High tone surfaces on the penult:

(21) High-tone shift to penult

/ si-ya-bá-khaba /	NONFINALITY	MINIMALITY	AVOIDPROM	ALIGNTD
☞ a. si-ya-(ba- [kháá]ba]			*	*
b. si-ya-(bá- [khaaba]		*!		***
c. si-ya-(ba- [khaabá])	*!		*	
d. si-ya-(ba- [khá]aba]			*	**!

/ si-ya-bóna /	NONFINALITY	MINIMALITY	AVOIDPROM	ALIGNTD
☞ e. si-ya- ([bóó]na]		*	*	*
f. si-ya- ([booná])	*!		*	

The tone domain in (21a) – which places the rightmost High tone on the penult – is optimal because it satisfies MINIMALITY. Not extending the TD to the penult, as in (21b), leaves it sub-minimal. Extending it beyond the penult, as in (21c), violates NONFINALITY, while a Falling tone on the penult, as in (21d), incurs more ALIGNTD violations than the level High tone found in the optimal candidate. The second candidate set demonstrates why NONFINALITY outranks MINIMALITY: candidate (21e) is optimal, in spite of having a subminimal TD.

Even though the optimal candidates in the above tableaux show tone shift as the optimal output, the analysis so far does not actually account for why shift is optimal in some languages, like Xhosa (1) and Swati (2a), while spread is optimal

in others, like Ndebele (2b).¹² I adopt Cassimjee & Kisseberth's (1998: 57) proposal that the distinction between tone shift and tone spread grammars can be formalized through the relative ranking of the constraints below, if we assume that the rightmost syllable in a High-tone domain is the domain head. This assumption formalizes the generalization that tone assimilation is overwhelmingly anticipatory (Hyman 2007):

(22) Constraints distinguishing tone spread versus tone shift

a. EXPRESSH

All syllables of the High-tone domain must realize a High tone.

b. HEADPROM: *(High tone, non-head)

Do not realize a High tone on a non-head syllable of the tone domain.

If EXPRESSH outranks HEADPROM, as in (23a), then spread is clearly optimal, as it is defined as a string of High tones from the sponsor through the target. The reverse ranking, in (23b), optimizes shift, as it penalizes High tones on syllables other than the rightmost, the head of the tone domain:

(23) Rankings optimizing tone spread versus tone shift

a. Ranking for spread language: NONFINALITY >> MINIMALITY >> AVOIDPROM >> **ALIGNTD** >> **EXPRESSH** >> **HEADPROM**

b. Ranking for shift language: NONFINALITY >> MINIMALITY >> { AVOIDPROM, **HEADPROM** } >> **ALIGNTD** >> **EXPRESSH**

The following tableau, which adds these constraints to the tableau in (18), completes the analysis of antepenult tone shift in Xhosa:

(24) Antepenult tone shift in Xhosa – ranking (23b)

/ bá-ya-balisela /	NON-FINALITY	AVOID PROM	HEAD PROM	ALIGN TD	EXPRESS H
☞ a. (ba-ya-balí) [seela]				***	***
b. (bá-yá-bálí) [seela]			*!	***	
c. (bá)-ya-bali [seela]				****!*	

¹² See Cassimjee & Kisseberth (1998, 2001), Kisseberth & Odden (2003), and Hyman (2007) for more detailed justification for the formal similarity between tone spread and tone shift.

Candidate (24a), which illustrates tone shift, is optimal given the ranking in (23a), as HEADPROM penalizes realizing High tones on non-head syllables (i.e., any syllable except the rightmost in the domain). This is why the tone spread candidate, (24b), which satisfies EXPRESSH, is not optimal: it violates the tonal prominence asymmetry defined by HEADPROM. Candidate (24c) shows that ALIGNTD must outrank EXPRESSH, as a subminimal domain is not optimal even though it necessarily satisfies HEADPROM.

The next sections extend this analysis to account for the depressor effects highlighted above, namely, that depressor consonants are transparent in some contexts and opaque in others, and that the output of depressor High-tone shift (DHTS) is different from “normal” High-tone displacement to the penult exemplified in (21), above.

4.2 Transparency of depressor consonants

As Cole & Kisseberth (1994) and Cassimjee (1998) show, transparency in assimilation processes like vowel harmony or High-tone spread can be accounted for in ODT through the interaction of feature domain alignment and phonetic grounding constraints. Grounding constraints are an alternative to single source representations for formalizing the phonetic enhancement and incompatibility relationships between features that are revealed by phonological processes. For example, in many West African ATR harmony systems, [i] does not participate in the harmony; it is either transparent or opaque. Archangeli & Pulleyblank (1994) argues that this can be accounted for through constraints that formalize that Hi/RTR is a phonetically antagonistic feature combination. The high, front position of the tongue required for [i] is in conflict with the low, retracted position that defines [RTR]. Transparency of [i], like its harmonic opacity, follows from a grammar that penalizes vowels for realizing this antagonistic combination.

The transparency of depressor syllables to High-tone displacement to the antepenult in Nguni Bantu languages can be given a similar account. As work like Peng (1992), Cassimjee (1998), Hansson (2004) and Hsieh & Kenstowicz (2008) argues, tone-segment interactions are best formalized in terms of grounding constraints which define both enhancing and inhibiting interactions between tone and particular consonantal features. Following Cassimjee (1998: 53), I adopt the grounding constraint in (25) to define the basic interaction between depressor syllables and tone:

- (25) *(DEPRESS, H): If depressor syllable, then not High tone.

A depressor syllable is defined as one with an Onset consonant that has a phonetic property which demonstrably correlates with lowered fundamental

frequency: negative VOT (Pearce 2007); vibrating vocal cords (Halle & Stevens 1971); breathy voice release (Clements & Khatiwada 2007); long frication duration (Downing & Gick 2005); lax vocal fold tension (Traill et al. 1987; Strazny 2003). Recall from Fig. 1, above, that the depressor effect lasts well into the syllable following the depressor consonant. The grounding constraint in (25) has two important advantages in accounting for Nguni depressor effects. First, it divorces depressor effects from [voice], as the lowered pitch is grounded not just by consonant voicing but also by other phonetic properties that correlate with pitch lowering. Crucially, it also captures the generalization that High tones are not optimally realized on a syllable with a depressor onset without directly associating a Low tone with the depressed syllable.¹³ Notice that this means that the association of a Low tone to some level of representation plays no role in this approach in accounting for why depressors are opaque for some tonal processes, yet transparent for others in the same language. Instead, it is the relative ranking of the grounding constraint with other constraints that accounts for this variability.

As shown by the data in (8) and (9), depressor consonants are transparent for the process of High-tone displacement to the antepenult, both in shifting languages and in spreading languages. Some of this data is repeated below for convenience:

(26) Depressor transparency for High-tone displacement to antepenult

a. Swati (Rycroft 1981) – shifting language

<u>ku</u> - dl ĩbhiita	‘to tear apart; rip to pieces’
<u>ku</u> - g acáteela	‘to creep, crawl’
<u>ku</u> - g olóteela	‘to stare at; await’

b. Ndebele (Sibanda 2004: 263ff) – spreading language

<u>ú</u> kú- b halíseela	‘to cause to write to/for’
<u>ú</u> kú- dl ĩkiisa	‘to cause to fall down (of building)’
<u>ú</u> kú- v ódlóoza	‘to smash’

As Cassimjee (1998) shows, the transparency of depressor consonants falls out from the following constraint ranking: ALIGNTD (16) >> *(DEPRESS, H) (25) >> EXPRESSH (22a). This ranking optimizes parsing depressed syllables in the High-tone domain. And this ranking optimizes not realizing a High tone on the depressor syllable, even though it falls in a High-tone domain. The analysis is exemplified by the tableau

¹³ See Archangeli & Pulleyblank (1994) for detailed motivation of Grounding Constraints, and see Peng (1992) and Hansson (2004) for a more detailed comparison of the grounded constraint approach to depressor effects with representational approaches like Bradshaw (1999).

in (27), which accounts for the Ndebele data in (9), repeated as (26b) (NONFINALITY and MINIMALITY are omitted from these tableaux, as they are too high-ranked to play a crucial role in choosing the optimal candidates):¹⁴

(27) Ndebele depressor transparency – see ranking (23a)

/ úku- b halisela /	AVOID PROM	ALIGN TD	*(DEPRESS, H)	EXPRESS H	HEAD PROM
☞ a. (úkú- b hálí) [seela]		***		*	*
b. (úkú- b hálí) [seela]		***	*!		*
c. (uku- b hálí) [seela]		***		**!*	
d. (ukú)- b hali [seela]		****!*		*	

In this tableau, we only consider candidates which best satisfy the three highest ranked constraints in (23a) by realizing the rightmost High tone on the antepenult. Candidate (a) is optimal, as it realizes the High tone on every syllable in the High-tone domain, except the depressed syllable (**b**ha). Candidate (b), which perfectly satisfies EXPRESSH, is not optimal, as it violates the higher ranked constraint penalizing High tones on depressed syllables. Tone shift (i.e., realizing the High tone only on the head syllable of the tone domain) is not optimal, as shown by candidate (c) because this incurs gratuitous violations of EXPRESSH (note that EXPRESSH is a gradiently ranked constraint in this framework). Candidate (d) justifies ranking ALIGNTD above *(DEPRESS, H). The opposite ranking would optimize depressor opacity, with the High-tone domain stopping short of the depressed syllable in order to satisfy the grounding constraint.

The analysis of Swati and Xhosa is analogous, except that, since Swati and Xhosa are tone shift languages, rather than spreading languages, the relative ranking of EXPRESSH and HEADPROM is reversed (see (23), above). The analysis of the Swati data in (26a) is exemplified in the following tableau:

¹⁴ Recall from (23) that since Ndebele is a spreading language, the ranking EXPRESSH >> HEADPROM is relevant.

(28) Swati depressor transparency – see ranking (23b)

/ kú- g acatela /	HEAD PROM	AVOID PROM	ALIGN TD	*(DEPRESS, H)	EXPRESS H
☞ a. (ku- g acá) [teela]			***		**
b. (kú- g acá) [teela]	*!		***	*	
c. (kú- g acá) [teela]	*!		***		*
d. (kú)- g aca [teela]			****!*		

To sum up this section, this analysis of depressor transparency shows off one of the advantages of the ODT approach to feature assimilation. Since not every syllable in a feature domain is required to express the feature (that is, EXPRESSFEATURE can be violated if outranked), a featural domain can include elements with antagonistic features, without violating any representational well-formedness constraint equivalent to no line crossing illustrated in (11). Underspecification and rule ordering – both of which are not available in a classic OT account, in any case – therefore need not be appealed to, in order to account for transparency. This is a welcome result, since, as argued in section 3.2, above, underspecification and rule ordering cannot account for all cases where depressors are transparent for some processes but opaque for others.

4.3 Depressor High-Tone Shift (DHTS) and register domains

As Cassimjee (1998: 53ff) argues, the grounding constraint in (25) should also motivate Depressor High-Tone shift (DHTS). The data in (3) through (5), above, show that, in all the Nguni languages, the output of DHTS satisfies the grounding constraint by realizing a Low tone on the antepenult, the expected target of High-tone displacement. However, as shown in (29), the constraint ranking motivated in (28) for tone shift languages like Swati and Xhosa does not optimize the correct output of DHTS:

(29) Failed analysis of DHTS in Xhosa (3a)

/ bá-ya- da nisa /	HEAD PROM	AVOID PROM	ALIGN TD	*(DEPRESS, H)	EXPRESS H
a. (ba-ya- da [ní]sa)		*!	*		***
☞ b. (ba-ya- dá [ni]sa)			***	*	**
☞ c. (ba-ya- da [ní]sa)		*!	**		***
d. (ba-yá-)- da [ni]sa)			****!		*

The problem is that $\ast(\text{DEPRESS}, \text{H})$ must be ranked below ALIGNTD (16) in order to account for depressor transparency, as demonstrated in (27), above. But, as Cassimjee notes, this means it is too low-ranked to optimize shifting the High-tone domain rightwards towards the penult. As a result, the correct output, candidate (c), is not optimal. Instead, incorrectly maintaining the High tone on the depressed antepenult, as in candidate (b), is.

The tableau in (30) shows that simply re-ranking the grounding constraint above AVOIDPROM (17) also does not optimize the correct output:

(30) Another failed analysis of DHTS in Xhosa (3a)

/ bá-ya- da nisa /	HEAD PROM	$\ast(\text{DEPRESS}, \text{H})$	AVOID PROM	ALIGN TD	EXPRESS H
a. (ba-ya- da [ní]sa)			*!	*	***
b. (ba-ya- dá)[niisa]		*!		***	**
c. (ba-ya- da [ní]isa)			*!	**	***
d. (ba-yá-) da [niisa]				****	*

One problem with this ranking is that ALIGNTD (16) is best satisfied in this tableau, as in tableau (21), if the penult has a level High tone, as in (30a), not a falling contour, as in (30c). In short, the ODT analysis so far has the same problem as the derivational one sketched in section 3.3, above: the output of tone shift should be the same whatever the motivation for shift. Another problem with this ranking, as shown by candidate (d), is that it optimizes not parsing the depressor consonant in the tone domain. That is, it optimizes opacity – not transparency – of the depressor consonant.

Cassimjee (1998) resolves this problem by proposing a serial OT analysis. The output of the first derivational stage is to shift the High tone to the antepenult, as in (29b). The second stage implements the generalization that (25) is satisfied by minimally shifting the High tone away from the depressed syllable, to derive a falling contour, not a level High tone as the output of shift.¹⁵ This analysis follows closely in spirit the one proposed in Bradshaw (1999, 2003) for Swati.

I propose that we can straightforwardly optimize the contour tone in a non-serial way by formalizing the observation, motivated in section 3.3, above, that Nguni depression has the properties of a Low register, not a Low tone. In the

¹⁵ As Cassimjee (1998: 53–57) does not give any tableaux illustrating how the serial OT analysis works, the details of the approach are somewhat vague. The interested reader should consult Cassimjee (1998) for further discussion of her approach.

spirit of ODT, the depressor register is realized in a Depressor Domain (DD), initiated by the left edge of every depressor syllable:

(31) ALIGN-L (DEPRESSOR, DD):

Align the left edge of every depressor syllable with the left edge of a Depressor Domain (DD).

The register domain can be considered the ODT equivalent of a register node or tier that has been argued for in accounting for Chinese tone systems and for register shifts, such as downstep, in African languages (see Yip (2002) for a recent overview of feature-geometric representations of register).

The constraint in (32) expresses the generalization, found in work such as Traill et al. (1987), Peng (1992), Cassimjee (1998), Strazny (2003) and Sibanda (2004), that depressor effects are local:

(32) ALIGN-R (DD, Dσ):

Align the right edge of every Depressor Domain with the right edge of a depressed syllable.

That is, in the unmarked case, the depressor domain encompasses only the syllable that begins with the depressor consonant.

Because depression is a tonal register, it is parasitic on simple tones and affects their realization. In other words, Depressor Domains and High-Tone Domains overlap, and, I propose, their right edges coincide to satisfy the alignment constraint in (33):

(33) ALIGN-R (DD, HD):

Align the right edge of every Depressor Domain with the right edge of a High-Tone Domain.

These new constraints are ranked as follows. ALIGN-L (DEPRESSOR, DD) (31) and ALIGN-R (DD, HD) (33) are high ranked because they are never violated in optimal candidates. ALIGN-R (DD, Dσ) (32) must be outranked by the grounding constraint, *(DEPRESS, H) (25), because it is minimally violated in the case of DHTS: the depressor domain and parasitic High-tone domain extend one more mora to the right of the depressed syllable to satisfy the grounding constraint. The Depressor Domain alignment constraints in (32) and (33) must outrank AVOID-PROM (17), as the output of DHTS realizes a High tone on the prominent penult syllable. By transitivity, then, the grounding constraint, *(DEPRESS, H) (25), must also outrank AVOID-PROM. That is, the ranking for the grounding constraint given in (30), above, is the correct one.

Incorporating these rankings into the ones motivated in section 4.1 yields:

- (34) Summarizing constraint rankings accounting for depressor effects
- (a) Ranking for shift languages such as Xhosa and Swati
 NONFINALITY, ALIGN-L (DEPRESSOR, DD), ALIGN-R (DD, HD)
 >> MINIMALITY >> *(DEPRESS, H) >> ALIGN-R (DD, Dσ) >> HEADPROM,
 AVOIDPROM >> ALIGNTD >> EXPRESSH
 - (b) Ranking for spread languages such as Ndebele
 NONFINALITY, ALIGN-L (DEPRESSOR, DD), ALIGN-R (DD, HD)
 >> MINIMALITY >> *(DEPRESS, H) >> ALIGN-R (DD, Dσ) >> AVOIDPROM >>
 ALIGNTD >> EXPRESSH >> HEADPROM

Tableau (35) shows that these constraints and rankings correctly optimize a falling tone on the penult as the output of DHTS in Xhosa. The tableau also shows that depressor transparency is correctly optimized in the revised analysis, as it satisfies high-ranked ALIGN-R (DD, HD). Note that Depressor Domains are indicated with “{” in the tableaux in this section:¹⁶

(35) – cf. (30) – DHTS in Xhosa

/ bá-ya- da nisa /	ALIGN-R (DD, HD)	*(DEPRESS, H)	ALIGN-R (DD, Dσ)	HEAD PROM	AVOID PROM	ALIGN TD
a. (ba-ya-{ da [ní])sa]			***!		*	*
b. (ba-ya-{ dá })[niisa]		*!				***
☞ c. (ba-ya-{ da [ní])isa]			*		*	**
d. (ba-yá)-{ da }[niisa]	*!					****

Candidate (35c) is optimal because it satisfies the two highest ranked constraints, and it incurs fewer violations of ALIGN-R (DD, Dσ) (32) than candidate (35a), which was incorrectly optimized in tableau (30). Note, too, that high-ranked ALIGN-R (DD, HD) optimizes including the depressor consonant in a High-tone domain, as candidate (35d) shows. Transparency of depressor consonants correctly remains optimal, then, in the revised analysis.

Tableau (36) shows the analysis also accounts for why DHTS is blocked if the penult begins with a depressor, the generalization illustrated by the data in (3b)–(5b):

¹⁶ To save space, the first two constraints in the ranking in (34) plus MINIMALITY (19) and EXPRESSH are omitted in the tableaux in this section. EXPRESSH is too low ranked and the others are never violated in these data. As a result, they never crucially choose the optimal output.

(36) – DHTS blocked in Xhosa

/ bá-ya- guzula /	ALIGN-R (DD, HD)	*(DEPRESS, H)	ALIGN-R (DD, Dσ)	HEAD PROM	AVOID PROM	ALIGN TD
a. (ba-ya{ gu }{[zúú])la]	*	*			*!	*
☞ b. (ba-ya- gú){[zuu]la]	*	*				***
c. (ba-ya-{ gu){[zú]ula]	*	*	*!		*	**

In non-optimal (36a, c), we see that if both the penult and the antepenult begin with a depressor consonant, it is impossible to satisfy the Depressor Domain constraints (32) and (33) and the grounding constraint *(DEPRESS, H) (25) by shifting the High tone to the penult. As a result, the High tone surfaces on the antepenult in optimal (36b), even though it begins with a depressor.

To complete the analysis, the tableaux in (37) and (38) show that this approach accounts for DHTS and DHTS blocking in spreading languages like Ndebele:¹⁷

(37) DHTS in Ndebele (5a)

/ úku- diliza /	ALIGN-R (DD, HD)	*(DEPRESS, H)	ALIGN-R (DD, Dσ)	AVOID PROM	ALIGN TD	HEAD PROM
a. (úkú-{ di [lí])za]			**!	*	*	*
b. (úkú-{ dí)[liiza]		*!			***	*
☞ c. (úkú-{ di [lí])iza]			*	*	**	*
d. (úkú)-{ di }[liiza]	*!				****	*

(38) DHTS blocked in Ndebele by a second depressor (5b)

/ úku- vodloza /	ALIGN-R (DD, HD)	*(DEPRESS, H)	ALIGN-R (DD, Dσ)	AVOID PROM	ALIGN TD	HEAD PROM
a. (úkú-{ vo){[dlóó])za]	*	*		*!	*	*
☞ b. (úkú-{ vó){[dloo]za]	*	*			***	*
c. (úkú-{ vo){[dló]oza]	*	*	*!	*	**	*
d. (úkú)-{ vo){[dloo]za]	**!				****	*

¹⁷ Recall from the rankings in (23) and surrounding discussion, that HEADPROM is crucially lower ranked in tone spread languages such as Ndebele than in tone shift languages such as Xhosa and Swati. The same constraints have been included in the Ndebele tableaux as in the Xhosa tableaux just above them for ease of comparison.

In these tableaux the equivalent candidates are optimal for the same reasons discussed in presenting the tableaux for Xhosa: cf. (35) and (36).

To sum up this section, the analysis of DHTS proposes that the phonetic register lowering effect of depressor consonants motivated in section 3.3 plays a role in the tonal phonology of Nguni languages. As we have seen, the interaction of constraints on depressor register alignment and High-tone domain alignment best accounts for the minimal displacement of High tones found with DHTS. The grounded ODT analysis also provides a new explanation for why depressor consonants block DHTS. As we can see in (36) and (38), DHTS is optimal when it satisfies a grounding constraint on the realization of tones on depressor syllables. It is blocked when the shift leads to no improvement in the satisfaction of the grounding constraint. Association of Low tones and line-crossing – at the plane or tier level – play no role in the analysis.

4.4 Opacity of depressor consonants: Swati High-tone plateaus

The final problem to be addressed in this analysis is why depressor consonants are both transparent and opaque to plateauing in Swati. The relevant data are repeated below for convenience:

(39) Swati High-tone plateauing

- a. Within words (Cassimjee & Kisseberth 2001: 345–346, citing Creissels 1999)

u-yá-sébéénta ‘s/he is working’ (*u-yá-sebéénta)

bá-yá-búlálaana ‘they are killing each other’

bá-yá-phékélétélaana ‘they are accompanying each other’

- b. Phrasally (Bradshaw 1999: 95; Creissels 1999: 176)

u-bálá tì-cátfuulo ‘s/he counts shoes’ (*u-bála tì-cátfuulo)

u-válá ímí-nyaango ‘s/he closes the doors’

bá-hlakulísá síbiili ‘they are really helping each other to weed’

(40) Swati plateauing blocked by depressors

- a. Total blocking within words (Cassimjee & Kisseberth 2001: 354)

kú-sundvúúla ‘to push aside’

kú-tjengíisa ‘to point out’

kú-gocóóta ‘to fold’

- b. Total blocking phrasally (Bradshaw 1999: 95)

u-bándza tì-cátfuulo ‘s/he chops up shoes’

u-bilísa bhatááta ‘s/he boils sweet potatoes’

u-géza bá-ntfaana ‘s/he bathes the children’

c. Partial blocking of plateauing

- u-boléka sí-**b**hanyáana ‘s/he lends a little gun’
 (*u-boléka sí-**b**hanyáana)
 ba-klavúlá lí-**b**hubéesi ‘they pierce the lion’

Recall from section 3.2 that the problem raised by plateauing for an analysis in which depressors are associated with a Low tone is that depressors appear to be opaque for this process, in the sense that plateauing does not extend beyond the depressor in any of the data. Yet, the data in (40c) show that depressors are also transparent, in the sense that the two High tones which trigger plateauing can be separated by a depressor consonant.

Before presenting the analysis of the interaction of depressor consonants with plateauing, we first need to motivate a plateauing constraint for the simplest cases, namely, plateauing within words with no depressors. Recall that Swati is a High-tone shift language when there is only one High tone in a word. In ODT terms, shift is accounted for by proposing that the ranking in (23b) is relevant: HEADPROM >> ALIGN TD >> EXPRESSH. For High tones to be realized on non-head syllables, as we find in plateauing, some constraint must outrank HEADPROM (22b), the constraint that optimizes realizing High tones only on the head syllables of tone domains. I propose that we can account for plateauing by adopting the constraint Hyman (1998: 49) motivates for vowel harmony ‘plateaus’ in Yaka, modifying it to refer to tones rather than vowel height features:

- (41) PLATEAU (adapted from Hyman 1998: 49, fig. (14b)): * H (non-High
 A High tone at the end of one tone domain (indicated by the parentheses)
 cannot be followed by a toneless syllable (e.g., the absence of High tone) at
 the beginning of an adjacent tone domain.

This constraint, like EXPRESSH, evaluates the realization of tone within a tone domain. Unlike EXPRESSH, PLATEAU crucially refers to two tone domains (or more precisely, two tone domain edges).

The tableau in (42) shows that simply ranking PLATEAU above HEADPROM in the existing analysis of antepenult shift exemplified in (24) optimizes the correct output:

(42) Word-internal plateauing

/ bá-ya-búlalaana /	NON- FINAL	PLATEAU	HEAD PROM	AVOID PROM	ALIGN TD	EXPRESS H
a. (ba-yá)-(búlá)[laana]			*		***	*
b. (ba-yá)-(bulá)[laana]		*!			***	**

Candidate (42a) is optimal even though the High tone on the non-head syllable of the second tone domain violates HEADPROM, as it satisfies higher-ranked PLATEAU. Candidate (42b), with the expected High-tone shift in both tone domains is not optimal, as it violates PLATEAU: a High tone at the end of the first tone domain is followed by a Low tone at the beginning of the adjacent tone domain.

The tableau in (43) shows that this analysis straightforwardly extends to account for phrasal plateauing in non-depressor contexts, if we assume that the extraprosodic final syllable of the initial word in the phrase is parsed into a recursive tone domain with the tone domain to its right. Indeed, this is the only way to parse this syllable into a tone domain without violating high-ranked NONFINALITY (20).¹⁸ In the tableaux for phrasal plateauing, word boundaries in the candidates are indicated by “||”:

(43) Phrasal plateauing – no depressors

/ ú-bala tí-catfulo /	NON-FINAL	PLATEAU	HEAD PROM	AVOID PROM	ALIGN TD	EXPRESS H
☞ a. (u-bá)(lá (tí-cá)[tfuulo]			*		* ***	*
b. (u-bá)(la (tí-cá)[tfuulo]		*!			* ***	***
c. (u-bá)(lá (tí-cá)[tfuulo]		*!	*		* ***	**
d. (u-bálá) (tí-cá)[tfuulo]	*!		*		***	*

Candidate (43a) is optimal, as it satisfies the two highest ranked constraints. Candidates (43b) and (43c) violate PLATEAU, as their outputs contain High tones at the end of a tone domain which are followed by a non-High syllable at the beginning of the following tone domain. Candidate (43d) shows that an alternative parse of the final syllable of the first word violates NONFINALITY.

As we saw in section 3.2, above, an unresolved problem for Bradshaw’s (1999) analysis is to account for why depressors totally block plateauing in some phrasal contexts – (40b) – but not in others – (40c). This paradoxical behavior makes it hard to determine whether plateauing is a plane-sensitive or tier-sensitive process: the key to her approach to depressor transparency. In the analysis developed here, however,

¹⁸ TDs do not extend beyond the penult, whether words are phrase-medial or phrase-final, as this would violate NONFINALITY. I am assuming that syllables cannot be left unparsed phrase-internally, between two tone domains, so no candidates are considered where the final syllable of the first word is extraprosodic. As mentioned above, penult lengthening is a reflex of phrasal prominence. This is why only the second word in the phrase shows lengthening. This is also why AVOID-PROM is not violated by the TD of the first word of a phrase, which extends through the penult.

this paradoxical behavior falls out straightforwardly from incorporating PLATEAU >> HEADPROM into the constraints and ranking motivated for DHTS in (34a), above. The crucial partial ranking is: $*(\text{DEPRESS}, H) \gg \text{PLATEAU} \gg \text{HEADPROM}, \text{AVOIDPROM}$. The generalization that emerges in the ODT analysis, exemplified in the next tableaux, is that depressors block phrasal plateauing when they fall at a tone domain (TD) edge:¹⁹

(44) Phrasal plateauing – depressors block at TD edge (40b)

/ ú- bandza tí-catfulo /	*(DE- PRESS, H)	PLA- TEAU	HEAD PROM	AVOID PROM	ALIGN TD	EXPRESS H
☞ a. (u-bá){ ndza } (tí-cá) [tfulo]		*			* ***	***
b. (u-bá){ ndzá } (tí-cá) [tfulo]	*!				* ***	*
c. (u-bá){ ndza } (tí-cá) [tfulo]		*	*!		* ***	**

Candidate (44a) is optimal as it satisfies the high-ranked grounding constraint. It also satisfies HEADPROM, which, as we can see from non-optimal candidate (44c), penalizes incomplete plateauing within a recursive domain. Candidate (44b) is not optimal, as it violates the grounding constraint by realizing a High tone on the depressor syllable.

Depressors fail to block plateauing, when they fall in the middle of a tone domain, rather than at the edge of one:

(45) Phrasal plateauing – depressors do not block when TD-internal (40c)

/ ú-boleka sí- bh anyana /	*(DE- PRESS, H)	PLA- TEAU	HEAD PROM	AVOID PROM	ALIGN TD	EX- PRESS H
☞ a. (u-bolé)(ká (sí- bha [nyá]) ana]			*	* DHTS	* ***	***
b. (u-bolé)(ka (sí- bha [nyá]) ana]		*!		* DHTS	* ***	*****

¹⁹ The Depressor Domain constraints have been omitted from these tableaux to save space. The tableaux only consider candidates that optimally satisfy those constraints in order to concentrate on how depressors interact with plateauing. The curly brackets in these tableaux continue to indicate Depressor Domains. As one can see, I am assuming that Depressor Domains are word-bound, while tone domains are not.

Candidate (45a) is optimal, as it does not violate PLATEAU: the High–Low tone sequence does not fall at a tonal domain boundary. In the middle of a tonal domain, that is, depressors continue to be transparent to High-tone shift. Candidate (45b) is non-optimal because it violates PLATEAU: a High–Low tone sequence across a tone domain. Note that all of the candidates in the tableau violate AVOID-PROM, as DHTS is optimal in the second word (cf. tableau (35), above).

There remains one set of data that has not yet been accounted for, namely, blocking of plateauing in the first two word-internal examples in (40a). Since the depressor consonant is tone-domain-internal, we expect the analysis to be identical to the one in (45), above, with no blocking. However, as the tableau in (46) shows, the analysis fails:

(46) Depressors can block word-internal plateauing

/ kú-sú ndv ula /	MINIMALITY	*(DEPRESS, H)	PLATEAU	HEAD PROM	AVOID PROM	ALIGN TD	EXPRESS H
☞ a. (kú)- (su[ndvúú])la]	*	*	*!		*	* ****	*
☛ b. (kú)- (sú[ndvúú])la]	*	*		*	*	* ****	
c. (kú)-(sú) [ndvuu]la]	**!					**** ****	

Candidate (a) is the correct output, but it is not the optimal candidate because it violates PLATEAU.

There is, however, one difference between the first two word-internal examples in (40a) and the phrasal examples where blocking does not occur, namely, when the depressors do not block plateauing, they are in stem-initial position (hyphens indicate boundaries between prefixes and stems in the data). When they do block plateauing, they are not stem-initial, yet the lowering effect of the depressor domain extends leftward to the stem-initial syllable in these contexts: e.g. (kú)-({**sundvúú**})la. This generalization helps us to see parallels with other Nguni languages. For example, in Phuthi, a spreading language, Cassimjee & Kisseberth (2001: 352), citing data from Donnelly (2007), note that stem syllables preceding a depressor syllable in the stem do not realize a High tone. Similarly, Sibanda (2004: 268) notes that for Ndebele, also a spreading language, stem syllables preceding a depressor do not realize a High tone, at least in longer stems.

It seems to be a general property of Nguni languages, then, that the depressor register can align with stem edges in certain contexts rather than with the left edge of the depressor syllable only. We leave the proper formalization of this generalization as a topic for future research.

To sum up this section, the OTD analysis of Nguni tone allows us account for the seemingly paradoxical behavior of depressor consonants for plateauing in Swati. In an OTD account, tonal realization – whether to satisfy EXPRESSH or PLATEAU – is defined within tone domains. This allows us to see that depressors block plateauing when they are at a tone domain edge, and do not block plateauing when they are tone domain internal. The alignment of depressor register domain edges with stem edges in some contexts is a complicating factor that deserves more systematic description and analysis.

5 Conclusion

This paper has developed an ODT analysis of the interaction of depressor consonants and selected High-tone displacement processes in Nguni languages. This analysis improves on previous analyses of Nguni depressors in the following ways. First, in contrast to work like Bradshaw (1999) or Lee (2008), it proposes that the depressor effect of certain consonants on tone is optimized by a phonetically grounded constraint. This constraint correctly allows depressor lowering to be divorced from the feature [voice], as Nguni depressor consonants include voiceless stops. Another advantage of the grounding constraint approach to depressor–tone interaction is that it also allows depressors to lower pitch without having to be associated with a Low tone. This helps explain why depressors are transparent for some High-tone displacement processes: there is no Low tone present in the representation to block High-tone displacement. The ODT analysis makes it possible to formalize explicitly why depressors are transparent in some contexts but block High-tone spread or shift in others in a non-serial way. Depressors block High-tone displacement only when the output would violate the tone–laryngeal grounding constraint (or some other high-ranked constraint on High-tone realization). Finally, the analysis proposes that depression involves a register shift, implemented formally by a register domain. The register domain formalizes that depressor lowering is both phonetically and phonologically more compatible with low register than Low tone. It also captures the generalization that depressor effects on High tone are local and minimal. It must remain as a topic for future research to see whether depressor consonants in other Bantu languages also induce a change of register, and whether any such register effects have been phonologized.

Appendix: The Zulu consonant inventory

Zulu has a rich consonant inventory, as shown in the table below (Schadeberg 2009). The spelling in this table follows the representation used in citing the data in this paper. Depressor consonants are shaded and in bold.

	LAB	ALV	LAT	PAL	VEL
aspirated voiceless plosives	ph	th			kh
ejective plosives	p	t			k
prenasalized	mp	nt			nk
ejective voiceless affricates		ts		tsh	kl
prenasalized				ntsh	nkl
voiceless unaspirated plosives	bh	d			g
prenasalized voiced	mb	nd			ng
voiceless unaspirated affricates				j	
prenasalized voiced				nj	
implosive ɓ	b				
partially voiced (“soft”) k					<ɕ>
voiceless fricatives	f	s	hl	sh	h
prenasalized affricates	mf	ns	nhl		
voiced fricatives	v	z	dl		hh
prenasalized affricates	mv	nz	ndl		
glides	w			y	
depressor glides	w			y	
trilled and lateral sonorants		r	l		
nasal sonorants	m	n		ny	[ŋ]
depressor nasals	m	n			
voiceless clicks		c	x	q	
prenasalized = nasal		n(k)c	n(k)x	n(k)q	
aspirated clicks		ch	xh	qh	
voiceless unaspirated clicks		gc	gx	gq	
prenasalized voiced		ngc	ngx	ngq	

References

- Anderson, Stephen R. 1978. Tone features. In Victoria A. Fromkin (ed.) *Tone: a linguistic survey*, 133–175. New York: Academic Press.
- Archangeli, Diana & Douglas Pulleyblank. 1994. *Grounded phonology*. Cambridge, MA: MIT Press.
- Bradshaw, Mary. 1999. *A crosslinguistic study of consonant-tone interaction*. Doctoral dissertation, Ohio State University, Columbus.
- Bradshaw, Mary. 2003. Consonant-tone interaction in Siswati. *Studies in Phonetics, Phonology and Morphology* 9(2), 277–294.
- Cassimjee, Farida. 1998. *Isixhosa tonology: an Optimal Domains Theory analysis*. Munich: Lincom Europa.
- Cassimjee, Farida & Charles W. Kisseberth. 1992. The tonology of depressor consonants: evidence from Mijikenda and Nguni. *BLS 18S: Special Session on Typology of Tone Languages*, 26–40.
- Cassimjee, Farida & Charles W. Kisseberth. 1998. Optimal Domains Theory and Bantu tonology: a case study from Isixhosa and Shingazidja. In Larry M. Hyman & Charles W. Kisseberth (eds.) *Theoretical aspects of Bantu Tone*, 33–132. Stanford, CA: CSLI.
- Cassimjee, Farida & Charles W. Kisseberth. 2001. Zulu tonology and its relationship to other Nguni languages. In Shigeki Kaji (ed.) *Proceedings of the symposium, cross-linguistic studies of tonal phenomena: tonogenesis, Japanese accentology and other topics*, 327–359. Tokyo: ILCAA.
- Chen, Matthew. 1992. Tone rule typology. *BLS 18S: Special Session on Typology of Tone Languages*, 54–66.
- Chen, Yiya & Laura J. Downing. 2011. All depressors are not alike: a comparison of Shanghai Chinese and Zulu. In Sónia Frota, Gorka Elordieta & Pilar Prieto (eds.) *Prosodic categories: production, perception and comprehension*, 243–265. Dordrecht: Springer.
- Clements, G. N. 2003. Feature economy in sound systems. *Phonology* 20, 287–333.
- Clements, G. N. & Rajesh Khatiwada. 2007. Phonetic realization of contrastively aspirated affricates in Nepali. *Proceedings of ICPhS XVI* (Saarbrücken, 6–10 August 2007), 629–632.
- Cole, Jennifer & Charles W. Kisseberth. 1994. An Optimal Domains Theory of harmony. *Studies in the Linguistic Sciences* 24, 101–114.
- Creissels, Denis. 1999. Bimoraic syllables in a language without length contrast and without consonants in coda position: the case of SiSwati (S.43). In Jean A. Blanchon & Denis Creissels (eds.) *Issues in Bantu tonology*, 153–196. Köln: Rüdiger Köppe Verlag.
- Doke, Clement M. 1931. *Textbook of Zulu grammar*. London: Longmans, Green and Co.
- Donnelly, Simon. 2007. *Aspects of tone and voice in Phuthi*. Doctoral dissertation, University of Illinois at Urbana-Champaign.
- Downing, Laura J. 1990. Local and metrical tone shift in Nguni. *Studies in African Linguistics* 21, 261–317.
- Downing, Laura J. 2001. How ambiguity of analysis motivates stem tone change in Durban Zulu. *UBC Working Papers in Linguistics* 4, 39–55.
- Downing, Laura J. 2003. Compounding and tonal non-transfer in Bantu languages. *Phonology* 20, 1–42.
- Downing, Laura J. 2004. What African languages tell us about accent typology. *ZAS Papers in Linguistics* 37, 101–136.

- Downing, Laura J. 2009. Optimality Theory and African language phonology. In M. Matondo et al. (eds.) *Selected Proceedings of ACAL 38*, 1–16. Somerville, MA: Cascadilla Proceedings Project.
- Downing, Laura J. & Bryan Gick. 2005. Voiceless tone depressors in Nambya and Botswana Kalang'a. *BLS* 27, 65–80.
- Giannini, Antonella, Massimo Pettorino & Maddalena Toscano. 1988. Some remarks on Zulu Stops. *AAP* 13, 95–116.
- Goldsmith, John A. 1976. *Autosegmental phonology*. Doctoral dissertation, MIT, Cambridge, MA. [Published by Garland Publishing, New York, 1979].
- Guthrie, Malcolm. 1967–1971. *Comparative Bantu*. Farnborough: Gregg Press.
- Haacke, Wilfrid H. G. 1999. *The tonology of Khoekhoe (Nama/Damara)*. Köln: Rüdiger Köppe Verlag.
- Halle, Morris. 1995. Feature geometry and feature spreading. *Linguistic Inquiry* 26, 1–46.
- Halle, Morris & Ken Stevens. 1971. A note on laryngeal features. *RLE [MIT] Quarterly Progress Report* 101, 198–213.
- Hansson, Gunnar Ólafur. 2004. Tone and voicing agreement in Yabem. *WCCFL 23 Proceedings*, 318–331. Somerville, MA: Cascadilla Press.
- Harris, John. 1994. *English sound structure*. Oxford: Blackwell.
- Haudricourt, André-Georges. 1954. De l'origine des tons en vietnamien. *Journal Asiatique* 242, 69–82.
- Hombert, Jean-Marie. 1978. Consonant type vowel quality and tone. In Victoria A. Fromkin (ed.), *Tone: a linguistic survey*, 77–112. New York: Academic Press.
- Hsieh, Feng-fan & Michael Kenstowicz. 2008. Phonetic knowledge in tonal adaptation: Mandarin and English loanwords in Tibetan. *Journal of East Asian Linguistics* 17(4), 279–297.
- Hyman, Larry M. 1989. Accent in Bantu: an appraisal. *Studies in the Linguistic Sciences* 19(2), 111–128.
- Hyman, Larry M. 1998. Positional prominence and the 'prosodic trough' in Yaka. *Phonology* 15, 41–75.
- Hyman, Larry M. 1999. Aspiration and voicing harmony in Nguni? (Xhosa, Zulu, Swati, Ndebele). ms., University of California, Berkeley.
- Hyman, Larry M. 2007. Universals of tone rules: 30 years later. In Tomas Riad & Carlos Gussenhoven (eds.) *Tones and tunes*, vol. 1, 1–34. Berlin: Mouton De Gruyter.
- Hyman, Larry M. & Russell G. Schuh. 1974. Universals of tone rules: evidence from West Africa. *Linguistic Inquiry* 5, 81–115.
- Hyman, Larry M. & Joyce T. Mathangwane. 1998. Tonal domains and depressor consonants in Ikalanga. In Larry M. Hyman & Charles W. Kisseberth (eds.) *Theoretical aspects of Bantu tone*, 195–230. Stanford, CA: CSLI.
- Jessen, Michael & Justus C. Roux. 2002. Voice quality differences associated with stops and clicks in Xhosa. *Journal of Phonetics* 30, 1–52.
- Kanerva, Jonni. 1990. *Focus and phrasing in Chichewa phonology*. Doctoral dissertation, Stanford University.
- Khumalo, James S.M. 1987. *An autosegmental account of Zulu phonology*. Doctoral dissertation, University of the Witwatersrand, Johannesburg.
- Kisseberth, Charles W. 1984. Digo tonology. In G. N. Clements & John A. Goldsmith (eds.) *Autosegmental studies in Bantu tone*, 105–182. Dordrecht: Foris.
- Kisseberth, Charles & David Odden. 2003. Tone. In Derek Nurse & Gérard Philippson (eds.) *The Bantu languages*, 59–70. London: Routledge.

- Kisseberth, Charles W. & Erez Volk. 2007. Theoretical implications of depressor consonants. Paper presented at the Segments and Tone Workshop, Amsterdam, 8 June 2007.
- Leben, William R. 2006. Rethinking autosegmental phonology. In John Mugane (ed.) *Selected Proceedings of ACAL 35*, 1–9. Somerville, MA: Cascadia Proceedings Project.
- Lee, Seunghun J. 2008. *Consonant-tone interactions in Optimality Theory*. Doctoral dissertation, Rutgers University, NJ.
- Louw, J. A. 1974. The influence of Khoe on the Xhosa language. *Limi* 2(3), 45–62.
- Maddieson, Ian. 2003. The sounds of Bantu languages. In Derek Nurse & Gérard Philippson (eds.) *The Bantu languages*, 15–41. London: Routledge.
- Malambe, Gloria. 2006. Palatalization and other non-local effects in Southern Bantu Languages. Doctoral dissertation, UCL, London.
- Mathangwane, Joyce T. 1999. *Ikalanga phonetics and phonology: a synchronic and diachronic study*. Stanford, CA: CSLI.
- Matisoff, James A. 1973. Tonogenesis in Southeast Asia. In Larry M. Hyman (ed.) *Consonant types and tone. Southern California Occasional Papers in Linguistics* 1, 71–95. http://www.usc.edu/dept/gsil/SCOPILS_1_3_4/consonant_types_and_tone.pdf
- McCarthy, John J. 2004. Headed spans and autosegmental spreading. ROA 685-0904.
- Meeussen, A. E. 1967. Bantu grammatical reconstructions. In *Africana Linguistica* 3, 79–121. (Annales, 61.) Tervuren: Musée royal de l'Afrique Centrale.
- Meinhof, Carl & Nicolaas J. van Warmelo. 1932. *Introduction to the phonology of the Bantu languages*. Berlin: Dietrich Reimer / Ernst Vohsen.
- Odden, David. 2007. The unnatural tonology of Zina Kotoko. In Tomas Riad & Carlos Gussenhoven (eds.), *Tone and tunes*, Vol. 1, 63–89. Berlin: Mouton de Gruyter.
- Pearce, Mary. 2007. *The interaction of tone with voicing and foot structure: evidence from Kera phonetics and phonology*. Doctoral dissertation, UCL, London.
- Peng, Long. 1992. *A unified theory of tone-voice*. Doctoral dissertation, University of Arizona, Tucson.
- Rycroft, David K. 1980. *The 'depression' feature in Nguni languages and its interaction with tone*. Communication no. 8, Dept. of African Languages, Rhodes University, Grahamstown.
- Rycroft, David K. 1981. *Concise SiSwati Dictionary*. Pretoria: J.L. van Schaik.
- Rycroft, David K. 1983. Tone-patterns in Zimbabwean Ndebele. *Bulletin of the School of Oriental and African Studies* 46, 77–135.
- Schachter, Paul. 1976. An unnatural class of consonants in SiSwati. *Studies in African Linguistics, Supplement* 6, 211–220.
- Schadeberg, Thilo C. 2009. Appendix: On the origin of Zulu depressor consonants. In Michael Kenstowicz (ed.) *Data and theory: Papers in phonology in celebration of Charles W. Kisseberth*. Special issue, *Language Sciences* 31, 179–198.
- Sibanda, Galen. 2004. *Verbal phonology and morphology of Ndebele*. Doctoral dissertation, University of California, Berkeley.
- Strazny, Philipp. 2003. Depression in Zulu: tonal effects of segmental features. In Jeroen van de Weijer, Vincent J. van Heuven & Harry van der Hulst (eds.) *The phonological spectrum, vol 1: Segmental structure*, 223–239. Amsterdam: John Benjamins.
- Svantesson, Jan-Olof. 2001. Tonogenesis in Southeast Asia – Mon-Khmer and beyond. In Shigeki Kaji (ed.) *Proceedings of the symposium, cross-linguistic studies of tonal phenomena: tonogenesis, Japanese accentology and other topics*, 45–58. Tokyo: ILCAA.
- Svantesson, Jan-Olof & David House. 2006. Tone production, tone perception and Kammu tonogenesis. *Phonology* 23, 309–333.

- Tang, Katrina E. 2008. *The phonology and phonetics of consonant-tone interaction*. Doctoral dissertation, UCLA, Los Angeles.
- Traill, Anthony. 1985. *Phonetic and phonological Studies of !Xôô Bushman*. Hamburg: Helmut Buske Verlag.
- Traill, Anthony. 1990. Depression without depressors. *South African Journal of African Languages* 10, 166–172.
- Traill, Anthony, James S. M. Khumalo & Paul Fridjhon. 1987. Depressing facts about Zulu. *African Studies* 46, 255–274.
- Yip, Moira. 2002. *Tone*. Cambridge: Cambridge University Press.
- Ziervogel, Dirk & Enos J. Mabuza. 1976. *A grammar of the Swati language*. Pretoria: J.L. van Schaik.

Wolfgang Kehrein

There's no tone in Cologne: against tone-segment interactions in Franconian*

Abstract: Central and Low Franconian dialects seem to provide counterevidence to alleged universals of unattested correlations of (a) tone and postvocalic voicing, and (b) tone and vowel height. I argue that none of these cases are real counterexamples because contrary to standard analyses in the literature Franconian dialects *do not have* lexical tones. I propose the contrast to be based on foot structure instead: so called accent 1 is a “true” moraic trochee, i.e. a single heavy syllable with stress on the first mora; and accent 2 is a syllabic trochee. I discuss contemporary Franconian dialects as well as the historical origin of the contrast (“accentogenesis”) and show how the apparent segment-tone interactions developed from prosodic changes that have little to do with consonant voicing and nothing with vowel height – let alone tone.

1 Introduction: apparent segment-tone interactions in Franconian

Most Central and (Eastern) Low Franconian dialects (see Fig. 1) possess a binary prosodic contrast on stressed, heavy syllables, known as *Stoßton/stoottoon* vs. *Schleifton/sleeptoon*, *Schärfung* vs. *Trägheitsakzent*, acute vs. circumflex, or simply accent 1 vs. accent 2 (Schmidt 1986). While phonetically complex (see §3), most recent work assumes the contrast to be primarily tonal in nature, realized

* This work was financially supported by the Netherlands Organisation for Scientific Research (NWO-project “Tone and intrasegmental structure in West-Germanic dialects”). I would like to thank Paul Boersma, Carlos Gussenhoven, Ben Hermans, Björn Köhnlein, Marc van Oostendorp, Jörg Peters, Maïke Prehn, Jürgen Erich Schmidt, and Richard Wiese as well as the participants of phonological workshops in Amsterdam, Nijmegen, Marburg, and Toulouse. Though few of these people share(d) my views, and none of them can be made responsible for remaining errors, they all contributed greatly to this paper (or earlier versions of it) by making highly valuable and constructive suggestions. Special thanks go to my perfectly anonymous informant B.H. from Maasbracht.

Fig. 1: Approximate location of Franconian tonal accent dialects and different rule areas (top); enlarged area of Limburgian dialects (bottom) [maps based on Schmidt 2002, Schmidt & Künzel 2006; Peters 2006b, 2008].

(roughly) as a falling tone (accent 1) vs. a high level tone (accent 2) in “unmarked position”¹. Franconian dialects are thereby identified as TONAL ACCENT LANGUAGES (or RESTRICTED TONE LANGUAGES; Yip 2002).

The tonal accent system can be traced back to historical “tone rules” (now phonologized by changes to be discussed below) that seem to rely on natural correlations with segmental properties. The first “tone rule” describes a split within the class of Old Franconian (OF) long vowels and diphthongs: nuclei that ended in a *non-high* vowel in OF have a falling tone (= accent 1) in contemporary dialects (1a), but those ending in a *high* vowel have a high level tone (= accent 2) (1b). Thus, a high tone on the second mora apparently developed under a high vowel in this position.

(1) Tone and vowel height in monosyllables of Roermond and Cologne²

	OF	Roermond (Rule A2)	Cologne (Rule A)	
a.	*â	[ʃɔ̃p]	[ʃɔ̃f]	‘sheep’
	*â	[ʁɔ̃ðt]	[jɔ̃ðs]	‘great’
	*ê	[déèp]	[déèf]	‘deep’
	*ô	[bóðk]	[bóðx]	‘book’
b.	*î	[íis]	[íis]	‘ice’
	*û	[úút]	[úús]	‘out’
	*ei	[bléik]	[bléiç]	‘pale’
	*ɔu	[kóúk]	[kóúx]	‘smoke’

The rule holds generally true for original monosyllabic and (preserved) bisyllabic words³ in the so called Rule A2 area (see Fig. 1). It also holds true for Rule A dialects, though with an important twist in bisyllabic words: as shown in (2), words with OF *VV_{-hi} nuclei have the expected falling tone, regardless of the following consonant (a, b); and those with OF VV_{+hi} nuclei have the expected level tone before *voiceless* consonants (c). Before *voiced* consonants (d), however, we

1 That is in focus, non-final position under declarative intonation. See §3 for a detailed description of tonal realizations in different contexts.

2 Unless stated otherwise data are from Kats 1985, Boersma 2006 (Roermond), and Münch 1904 (Cologne). A circumflex (â) denotes OF long vowels. OF ê, â, ê, ô correspond to Old High German (OHG) ê, ô, ie, uo (see Frings 1913, Bach 1921, Boersma 2006, against diphthongal reflexes of Westgermanic (WG) *ê₂/*eo and *ô in OF). Modern reflexes of OF *ê also have accent 1, e.g., [zêè] (Roermond), [zîi] (Cologne) ‘sea’, but due to the limited distribution of this sound (OF *ê goes back to WG *ai before {r, w, h, #}) I will generally disregard it here.

3 Terms like “monosyllabic” and “bisyllabic” are to be understood as counting from the stressed syllable.

find an unexpected falling tone.⁴ Thus, it seems as if the tone raising effect of high-ending nuclei be overruled by a lowering effect of *postvocalic* voiced consonants in Cologne (but not in Roermond).

(2) Tone and postvocalic voicing in bisyllabic words of Cologne (Münch 1904)

$\star C_{-voi}$		$\star C_{+voi}$		
a. $\star \hat{a}$	[ʃlɔ̀ðfə̀]	‘to sleep’	b. [ʃɛ́ɔ̀ðɣə̀]	‘to ask’
$\star \hat{\eta}$	[jɛ́ɔ̀ðsə̀]	‘great-fem’	[ɔ̀ðɛ́ɛ̀]	‘ears’
$\star \hat{e}$	[ʃéè̀sə̀]	‘to shoot’	[fléè̀jə̀]	‘to fly’
$\star \hat{o}$	[ɛ́ɔ̀ðfə̀]	‘to call’	[blóðmə̀]	‘flowers’
c. $\star \hat{i}$	[bíisə̀]	‘to bite’	d. [blíivə̀]	‘to stay’ (cf. Rm. [blíivə̀])
$\star \hat{u}$	[búúsə̀]	‘outside’	[ʃɛ́úuvə̀]	‘to screw’ (Rm. [ʃɛ́úuvə̀])
$\star \epsilon i$	[líífə̀]	‘to drag’	[ɛ́éizə̀]	‘to travel’ (Rm. [ɛ́éizə̀])
$\star \text{ɹu}$	[lóúfə̀]	‘to run’	[óùɣə̀]	‘eyes’ (Rm. [júɣə̀])

The two historical “tone rules” may be summarized as in (3).

(3) Apparent segment-tone interactions in Franconian dialects

- (A) $V\acute{V}_{hi}$ high vowels and high tones co-occur on the second mora of long nuclei
 (B) $\acute{V}C_{voi}$ voiced consonants co-occur with a low tone to their left (Rule A dialects)

(3A) and (B) follow well-known acoustic ties between pitch and segmental properties; and yet, they go against standard assumptions in the literature that regard such correlations as phonologically unattested (4).⁵

(4) Alleged universal restrictions on segment-tone interactions

U1: Vowels and tones cannot determine each other’s quality (Hombert 1977, 1978; Hombert, Ohala & Ewan 1979).

U2: Consonant voicing cannot determine the tone of a segment on its left (Hombert, Ohala & Ewan 1979; Maddieson 1978, 1997)

⁴ “Voiceless obstruents” are unaspirated in Low Franconian and Ripuaric, and “voiced obstruents” are fully voiced, hence [t, s] and [d, z].

⁵ Fuzhou Chinese (Donohue, this volume), U (Mon-Khmer, Svantesson 1988), and Slovenian (Becker & Jurgec, this volume) are among the possible exceptions to U1. See Becker & Jurgec for further discussion.

At first sight, then, it seems that Franconian dialects are able to fill the gaps in the typology of segment–tone interactions. In the following sections, however, I will attempt to show that none of the “tone rules” in (3) are real counterexamples to (4), for the ultimate reason that Franconian dialects are *not* tonal.

The rest of the paper is structured as follows: I start by discussing some general problems with the assumed Franconian “tone rules” in (3). I argue against the standard tonal analysis of Franconian tonal accents in §3 and propose my foot-based alternative in §4. §5 sketches the historical developments that led to the contemporary contrast and uncovers the (largely) prosodic nature of the assumed segmental factors. §6 summarizes the findings and discusses some theoretical consequences.

2 Some problems

A closer look at apparent segment–tone interactions in Franconian reveals a number of problematic facts for the “tone rules” in (3). I discuss three sets of phenomena in this section: (2.1) additional data uncovering the assumed segmental factors (vowel height, C-voicing) as oversimplifications; (2.2) conflicting data, i.e. phenomena seemingly pointing to opposite, hence “unnatural”, correlations; and (2.3) tonal variability, adding to the impression of arbitrariness in the relation of segments and tone, and raising doubts on the very nature of the tonal system.

2.1 Segmental factors

Starting with the conditioning segmental factors in (3), the first thing to observe is that OF *î, *û, *ÿ, *ei *ɔu, and *œy are but a subset of the “tone raising” nuclei in Franconian. Sequences of short vowel+sonorant (VR) and historically lengthened vowels (see §5 for further discussion) behave in exactly the same ways: just as *VV_{+hi} nuclei, they come with a high level tone in original monosyllabic words (Rule A/A2 dialects) (5), and with a voice-dependent split in bisyllabic words (Rule A dialects) (6).

- (5) *VR and *V (>V:) nuclei in Roermond and Cologne monosyllables

	OF	Roermond (A2)	Cologne (A)	
a.	*aR	[dámp]	[dámp]	‘steam’
	*iR	[déŋk]	[déŋ]	‘thing’
	*uR	[kómp]	[kómp]	‘bowl’
b.	*a	[dáák]	[dááx]	‘roof’
	*i	[bléék]	[blééc]	‘tinplate’
	*o	[lólót]	[lólós]	‘lock’

(6) *VR and *V (>V:) nuclei in Cologne bisyllables

OF	*C _{-voi}		*C _{+voi}	
a. *aR	[fʰám̥pə]	‘to stamp’	b. [kál̥və]	‘calves’
*eR	[déh̥kə]	‘to think’	[βéh̥ndə]	‘to turn’
*iR	[dʰéh̥kə]	‘to drink’	[kéh̥dè]	‘children’
*oR	[bóh̥tsə]	‘bolts’	[óβ̥jə]	‘organ’
*uR	[bʰóh̥kə]	‘to attend the bride’	[hón̥dèt]	‘100’
c. *a	[mááxə]	‘to make’	d. [jááɣə]	‘to hunt’
*e	[lééfə]	‘spoon’	[féh̥jə]	‘to sweep’
*o	[hóófə]	‘to hope’	[bóóβ̥ə]	‘to drill’

Obviously, vowel height cannot be the answer to why the nuclei in (6) should have developed a high tone on their second mora; and unless the parallel behavior of *VV_{+hi}, *VR, and *V (>V:) is purely accidental, vowel height is presumably not the right answer to “tone raising” under *VV_{+hi} either.

Consonant voicing in (3B) does much better as a potentially tone-inducing property. The data in (6), for instance, are perfectly in line with this assumption. And yet, (3B) must be incomplete, for if tone lowering were an effect of voiced consonants alone, it should be found with original monosyllabic words, too. But this is not the case, as shown by the examples in (7), all of which have a high level tone in Roermond *and* Cologne, despite the fact that they end in a (voiced) sonorant.⁶

(7) Monosyllables with final voiced C in Roermond and Cologne

	Roermond (A2)	Cologne (A)	
a. *î	[líim]	[líim]	‘glue’
*û	[fúúm]	[fúúm]	‘foam’
*ei	[béin]	[béin]	‘leg’
*ɔu	[bóúm]	[bóúm]	‘tree’
b. *aR	[kβáí ^h m]	[kβáí ^h m]	‘smoke’
*eR	[hæí ^h m]	[hæí ^h m]	‘helmet’
*uR	[βóí ^h m]	[βóí ^h m]	‘worm’
c. *a	[káál]	[káál]	‘bald’
*e	[ɣéél]	[jéél]	‘yellow’
*o	[hóóɫ]	- ⁷	‘hollow’

⁶ Underlyingly voiced obstruents are preceded by level tones, too, cf. Roermond [βíit] ‘wide’, [húús], ‘house’, [dóm̥p] ‘dumb’, [dááx] ‘day’, [fíóf] ‘court’. Due to final devoicing, however, the argument is not as strong as with sonorants.

⁷ Only *a was regularly lengthened before sonorants in Cologne (with a few exceptions even here, e.g. [fmáɫ] ‘narrow’). Whether the words for ‘bald’ and ‘yellow’ were actually monosyllabic in Middle Franconian is uncertain (cf. OHG kalô, gelô; Boersma 2006: 33).

A look at apocopated words suggests the *loss of a following syllable* as a historical precondition to (3B). Some examples of originally bisyllabic words from Roermond are given in (8): those in (a) are bisyllabic to the present day and thus have a level tone in Rule A2 dialects (cf. (2) and (6)); the words in (b), on the other hand, have dropped their final syllable since Middle Franconian times and come with a falling tone (as they do in Rule A dialects). A2 dialects thus do well show effects of postvocalic voicing, though *only* under syllable loss.⁸

(8) Postvocalic voicing and apocope in Roermond

a. *ī	[bliivə]	'to stay'	b. [βiis]	< *βiizə	'melody'
*û	[dúúmə]	'thumbs'	[dʁúuf]	< *dʁuuvə	'grape'
*ei	[éiyə]	'own (adj.)'	[aléin]	< *aléinə	'alone'
*ɔu	[júyɔ]	'eyes'	[ʒux]	< *ɔuyə	'eye'
*aR	[ɣánzə]	'geese'	[æʒm]	< *æxmə	'arms'
*e/iR	[pélzə]	'furs'	[ɣəbélt]	< *ɣəbeldə	'formation'
*o/uR	[búnzə]	'bumps'	[βœœet]	< *βœœedə	'words' ⁹
*a	[jááyə]	'to hunt'	[náam]	< *naamə	'name'
*o	[bóɔvə]	'above'	[kɔɔl]	< *kɔɔlə	'coal'
*u	[vóoyəl]	'bird'	[ftóðf]	< *ftoovə	'stove'

Many classical descriptions of Rule A dialects point out that accent 1 occurs in the respective contexts *even* in words that lost an earlier second syllable.¹⁰ The data from Rule A2 dialects, however, suggest that these “secondary” falling tones appeared *first* under syllable loss (as in the Rule A2 area) and were only later (analogically) extended in the Rule A area to words that maintained their second syllable (Wrede 1895; see de Vaan 1999 and Boersma 2006, this volume, for recent discussion). The monosyllabic words in (7) would then naturally receive (and maintain) their level tone in both areas since they never had a second syllable to lose. If true (3B) needs to be amended by a prosodic precondition of syllable loss, a well-known factor in the history of tonal accent systems (see, e.g., Kiparsky, this volume, on Livonian).

⁸ Loss of medial vowels (ə) and consonants (-d-, and -ɣ-, in particular) leads to falling tones as well (Baltes 1895, Ramisch 1908, Frings 1916, Boersma 2006, and many others).

⁹ The original plural form is *woort* [βɔœt]. Plural suffix (-ə) and umlaut as well as the later loss of -ə are secondary developments (Boersma 2006: 54).

¹⁰ This position goes back to Frings (1913, 1916) who regarded accent 1 as a *precondition* to apocope, something that cannot be true, for apocope affected accent 1 and accent 2 words alike. Thus, accent 2 *pīpə > píip/píif (Rm/Co) ‘pipe’, *zeipə > zéip/zéif ‘soap’, *apə > aapə > áap/ááf ‘ape’, and so on.

2.2 Conflicting data

Other data are in direct conflict with the “tone rules” in (3). One type concerns diphthongizations and monophthongizations of OF long high vowels and closing diphthongs that appear to be induced by tones, but in ways *opposite* to what one would expect from (3A). In Maastricht, for instance, OF *î, *û changed into closing diphthongs (ɛi, ɔu), though *only* under a falling tone (9). And in Dülken, OF *ɛi, *œy (i.e. umlauted *ɔu) monophthongized to mid vowels (e:, ø:), though *only* under a level tone (10).

- (9) Maastricht (Welter 1929; Endepols 1955): *î, *û > ɛi, ɔu under a falling tone

*î	[βɛ̃is]	‘wise’	(cf. Rm. [βĩis])	[prĩis]	‘price’
*û	[drɔ̃uf]	‘grape’	(cf. Rm. [dʁúuf])	[vúús]	‘fist’

- (10) Dülken (Frings 1913): *ɛi, *œy > e:, ø: under a level tone

*ɛi	[dɛ̃ilə]	‘to share/divide’	[ʃβɛ̃étə]	‘to sweat’	(cf. Rm. [ʃβɛ̃itə])
*œy	[dœ̃ɛ̃mə]	‘to dream’	[dø̃øpə]	‘to baptize’	(cf. Rm. [dœ̃éipə])

It is obvious that these splits were caused by the different accent classes somehow; but is not at all obvious how to bring them in line with (3A), for in both cases a high vowel appears to undergo lowering under a high tone (rather than under a low tone). From an output-oriented perspective it seems that falling tones favour closing diphthongs (ɛ̃i, ɔ̃u), and level tones favour monophthongs (íi, úú, éé, øø), but again this goes directly against (3A) and the data in (1) that led to the apparent correlation of high vowels and high tones.

Rule B dialects (see Fig. 1) carry “unnaturalness” to extremes by paralleling Rule A in (almost) every aspect – except for having opposite tones (at least in declarative intonation; see Köhnlein 2011). Thus, monosyllabic words in Arzbach (Bach 1921) have a level tone with old *non-high* vowels (11a), and a falling tone under *high*-ending nuclei (b).

- (11) Tone and vowel height in Arzbach (Bach 1921)

a.	*â	[ʃɔ̃ɔf]	‘sheep’
	*ĥ	[gʁóús]	‘great’
	*ê	[dĩif]	‘deep’
	*ô	[fúús]	‘foot’
b.	*î	[ɛ̃is]	‘ice’
	*û	[báũx]	‘belly’
	*ɛi	[wáĩf]	‘soft’
	*ɔu	[ʁáũx]	‘smoke’

Polysyllabic words, just as in the Rule A area, show a consonant-induced tonal split with high-ending nuclei, but here voiceless consonants follow a falling tone (12c), and voiced consonants follow a high level tone (12d).

(12) Tone and postvocalic voicing in Arzbach (Bach 1921)

	*C _{-voi}			*C _{+voi}		
a.	*â	[ʃlɔ́ɔfə̀]	‘to sleep’	b.	[jɔ́ɔmɐ̀]	‘misery’
	*ô	[óústə̀ɐ̀]	‘Easter’		[bóúnə̀]	‘beans’
	*ie	[gíísə̀]	‘to pour’		[bííɐ̀]	‘to bid’
	*uo	[ɕúúfə̀]	‘to call’		[bɕúúɐ̀]	‘brother’
c.	*î	[béísə̀]	‘to bite’	d.	[bléíwə̀]	‘to stay’
	*û	[sáúfə̀]	‘to booze’		[dáúmə̀]	‘thumbs’
	*ei	[háísə̀]	‘to be called’		[háílə̀]	‘to heal’
	*ɔu	[láúfə̀]	‘to run’		[glááwə̀]	‘to believe’

Summarizing apparent segment–tone correspondences in Arzbach yields the surprising result of (original) high-ending nuclei favouring low tones (13A), and originally voiced consonants favouring high tones to their left (13B).

(13) Apparent segment-tone interactions in Rule B dialects

- (A) $V\hat{V}_{hi}$ high vowels and low tones co-occur on the second mora of long nuclei
- (B) $\acute{V}C_{voi}$ voiced consonants co-occur with a high tone to their left

2.3 Tonal variability

The examples above are suggestive of a certain arbitrariness in the relation of segments and tone. A brief look at the tonal realizations (see §3 for a more detailed description) adds to this impression because the phonetics of accent 1 and 2 differ considerably from dialect to dialect, and, more importantly, *within single dialects* as a result of “sentence intonation”. Thus, Cologne and Roermond realize accent 1 words with a falling tone and accent 2 words with a level tone under *declarative* intonation (see fn. 1); but the same words, when uttered in *questions*, show up with a rising tone (accent 1) and a low level tone (accent 2), respectively, on their stressed syllables (14). Tonal contours similar to those from Cologne interrogatives are also found in the dialect of Hasselt (Rule A2); but here, rising tone and low level tone characterize accent 1 and 2 in declaratives *and* interrogatives (Peters 2006c, 2008).

(14) Broad realizations of tones under different sentence types (Cologne)

		declarative	interrogative	
a.	accent 1	$*\hat{o}$ [bóðx]	[bòðx]	‘book’
	accent 1	$*\hat{o}$ [jɕóðsə̀]	[jɕòðsə̀]	‘great-FEM’
b.	accent 1	$*ɔu$ [ɕóúvə̀]	[ɕòúvə̀]	‘to rob’
c.	accent 2	$*ɔu$ [ɕóúx]	[ɕòùx]	‘smoke’
	accent 2	$*ɔu$ [lóúfə̀]	[lòùfə̀]	‘to run’

We know nothing about the intonation system of Franconian dialects by the time the tonal accent contrast arose. But if we took present day Hasselt as our starting point, or assumed interrogative intonation in Roermond and Cologne as the basic pattern, we would end up with a system not unlike that of the Rule B dialects, with nuclei ending in non-high vowels favouring high tones (14a), and high-ending nuclei favouring low tones (14c), unless followed by a (tone raising) voiced consonant (14b). Apart from adding yet another dimension of arbitrariness to the system, examples as in (14) make clear that contemporary accent 1 and 2 are anything but the “invariant tonal contours on accented syllables” that Hayes (1995: 49) assumes as an essential property of tonal accent languages. Thus, the tonal system as such is called into question.

Considering the data presented in this section it seems very unlikely that segments and tones interact (or once interacted) *directly* in Franconian, as claimed in (3). The existence of opposing correlations suggests an indirect (or abstract) relation at best. There is some evidence for prosodic structure being involved: the “tone lowering” effect of voiced consonants (3B) seems to be bound to historical changes reducing the number of syllables (apocope, syncope); and the natural class of OF $*VV_{hi}$, $*VR$, and $*V(>V:)$ not only argues against vowel height triggering “tone raising” (3A) – it also hints at the involvement of another prosodic change, for “lengthened vowels” (e.g. Cologne [ʃlɔ́s] ‘lock’, [hɔ́fə] ‘to hope’) are treated differently from originally long (non-high) vowels ([ʃɔ́f] ‘sheep’, [ʃlɔ́fə] ‘to sleep’; see §5 for discussion). Finally, the variability of the tonal realizations raises doubts on the tonal side of (3).

In the following sections I will argue that contemporary Franconian dialects do not have lexical tones. Rather, the contrast between accent 1 and 2 is one of foot structure, and tonal differences are but a consequence of how intonational melodies are associated with prosodic structure.

3 Where’s tone? Contemporary Cologne and beyond

3.1 Introduction

We have seen above that the tonal realizations of accent 1 and 2 can vary across dialects (Cologne vs. Hasselt), or within dialects as a function of “sentence

intonation” (declarative vs. interrogative¹¹). Other contextual factors of variation that have been identified in the literature are (a) “information structure” (broadly: focus vs. non-focus position) and (b) the position of the stressed syllable with regard to a prosodic boundary (IP-final vs. non-final position). None of these are remarkable on their own, for we find the same factors in every ordinary intonation language (see, e.g., Gilles 2005, on pitch accents and regional variation in German). The special property of Franconian dialects (and other “European-type” tonal accent languages) is that each intonation melody comes in *two different shapes*, depending on whether it is realized on a syllable labelled accent 1 or accent 2. The obvious questions are: In which ways do these melodies differ? And: What makes the difference?

Following earlier work on tonal accents in Swedish and Norwegian, most scholars nowadays assume lexical tone to be the answer. The opposition of accent 1 and 2 is regarded as privative in all dialects: accent 1 melodies are lexically unmarked (i.e. pure intonation), and accent 2 melodies are composed of intonation tones (H, L) *plus* a lexical tone (H, L).¹² Moreover, in both Franconian and Scandinavian, lexical tones and intonation tones are claimed to operate at the same prosodic level (or tier), i.e. they are juxtaposed, rather than superimposed, as typically found in “unrestricted” tone languages (see, e.g., Xu 1999, on Mandarin). As a consequence, intonation tones (i.e. pitch accents T* and boundary tones T_i) and lexical tones T are phonologically ordered, but free to interact in qualitative ways (assimilation) and positional ways (block TBUs, switch places; see below). In reality, however, this freedom is severely restricted, for only pitch accents rule on melody (i.e. they target assimilation), and only lexical tones rule on position (by associating with a specific TBU and “pushing” intonation tones to the right or left). If we look at the actual tonal realizations of accent 1 and 2 in different contexts and dialects, however, the evidence for the alleged lexical tones is not particularly strong, for the two accents most typically differ in *timing* rather than *melody*. In this section I discuss the tonal realizations of accent 1 and 2 in different contexts in turn.

11 “Declarative” and “interrogative” are to be understood as intonation patterns, not syntactic constructions. WH-questions, for instance, are produced with a declarative intonation in Franconian dialects; thus “interrogative” (intonation) refers to yes/no questions.

12 Throughout this paper I use underscores to distinguish lexical tones (H, L) from intonation tones (H, L).

3.2 Focus, non-final position

A timing difference of accent 1 and 2 is most obvious for focussed realizations in so called non-final position, i.e. where the stressed syllable is followed by at least one more syllable within an Intonation Phrase (IP)¹³, or, in other words, where tonal realizations are devoid of interfering boundary tones. By way of illustration, I give some stylized pitch contours for declarative and interrogative intonation from various Franconian dialects in Fig. 2.¹⁴

Fig. 2: Tonal realizations of accent 1 and 2 in focus, non-final position (rectangles visualize stressed syllables).

13 The posttonic syllable can be the first syllable of a following word (e.g. accent 1 [bòòx jà(ze:n)] ‘book seen’ vs. accent 2 [bòúx jà(ze:n)] ‘smoke seen’ in Cologne declaratives), or the second syllable of a bisyllabic word (e.g. [bòùvə] vs. [lóúfə]). Stressed syllables of bisyllabic words are thus categorically precluded from “IP-final position”.

14 Cologne (Gussenhoven & Peters 2004; Peters 2006a), Venlo (Gussenhoven & van der Vliet 1999), Roermond (Gussenhoven 2000), Sittard (Hanssen 2005), Maasbracht (Hermans 1994; p.c.), Maastricht (Gussenhoven & Aarts 1999), Neerpelt (Peters 2006b), Hasselt (Peters 2006c, 2008), Tongeren (Heijmans 1999b).

Interdialectal differences in Fig. 2 are of two major types: first, Cologne, Roermond, Sittard, Maasbracht, and Neerpelt have falling pitch accents and rising pitch accents as a function of sentence intonation (declarative and interrogative, respectively), while Venlo, Maastricht, and Hasselt have invariant pitch accents in these contexts.¹⁵ Second, dialects differ to the overall timing of tonal contours with regard to the stressed syllable: Cologne, Venlo, Roermond, Sittard, and Maasbracht have early declarative peaks under accent 1, but if one travels south and west (or down the list), peaks appear more and more delayed. Since accent 2 contours follow the same trend, these differences must have their source in the respective intonation systems. I follow the experts (see fn. 14) and assume that (declarative) pitch accents are low (rising) in Hasselt and Tongeren, but basically high (falling) in the other dialects.

Crucially, accent 1 and 2 do not differ in melodic terms anywhere. What matters is timing: accent 1 words show early peaks (or troughs) and fast tone movements within the stressed syllable, while accent 2 words are characterized by extended peaks (or troughs) and delayed tone movements.¹⁶ This is sketched in Fig. 3.

Fig. 3: Generalized pitch contours of accent 1 (solid line) and accent 2 (dotted line) in focus, non-final position.

Tonal approaches assume lexical tones to lurk behind the lengthened peaks and troughs under accent 2, i.e. they analyze the long tones [**H**] and [**L**] of accent 2

¹⁵ Declaratives and interrogatives are marked by different boundary tones in Venlo and Maastricht. They are apparently not distinguished by intonational means in Hasselt. In Tongeren, sentence type might in fact have a minor impact on pitch accents: as shown in Fig. 2, declaratives display a slightly greater amount of lowering on the stressed syllable (Heijmans 1999b).

¹⁶ Notice that accent 1 and 2 in Maastricht seem to differ in pure peak timing (early peaks and late peaks, respectively) rather than peak extension. Since Gussenhoven & Aarts (1999) analyze Maastricht like all other H* dialects (see below), I will not discuss the question of whether this pattern should be treated as a third category.

as composed of two tones, [HH*] and [LL*], respectively.¹⁷ The fact that the alleged lexical tones (H, L) always surface as a melodic copy of an adjacent pitch accent requires some additional machinery, a constraint against lexical tones and pitch accents having different tonal values, for instance.

In any case, if lexical tones are indeed responsible for the difference between accent 1 and 2 in focus, non-final position, their tonal nature remains untold. The melodic dominance of pitch accents, it seems, prevents them from showing their real faces.

3.3 Non-focus, non-final position

Surprisingly, placing accent 1 and accent 2 words in non-focus (non-final) position does not help to unveil the nature of lexical tones. Instead, we find tonal neutralization of accent 1 and 2 in some dialects, and pitch movements very similar (if somewhat reduced) to focus position in others.

Venlo, Roermond, and Neerpelt are representatives of the former type: in these dialects words in non-focus position are devoid of intonational markings. Instead of being sponsored by a free-standing lexical tone, however, the tonal distinction of accent 1 and 2 is neutralized in this position. This is shown in Fig. 4 for postnuclear [bein¹] ‘legs’ vs. [bein²] ‘leg’ in Roermond declaratives. Notice that the same words would have high tones throughout under interrogative intonation because in this case the melody stays high after the nuclear rise all the way to the last stressed syllable of the IP (Van de Ven & Gussenhoven 2011: 226).¹⁸

Fig. 4: Postfocal [bein¹] ‘legs’ (left) vs. [bein²] ‘leg’ in Roermond declaratives.

¹⁷ Lexical tones are claimed to either precede (Cologne, Neerpelt, Hasselt, Tongeren) or follow pitch accents (Venlo, Roermond, Maastricht), for reasons not relevant at this point.

¹⁸ Sound files of all dialects except Maasbracht are from <http://www.let.ru.nl/gep/carlos/carloslimburg.html>. Acoustic analysis is done with PRAAT (Boersma & Weenink 1992–2007).

Tonal analyses of Venlo (Gussenhoven & Van der Vliet 1999) and Roermond (Gussenhoven 2000) assume that lexical tones are licensed only in particular environments, either adjacent to intonational tones, or in metrically prominent positions (see Gussenhoven 2000 for an OT analysis). Whatever the analysis, the facts once more demonstrate the melodic weakness of the alleged lexical tones.

“Deaccented” realizations of accent 1 and 2 occur in other dialects, too. But next to these, we find cases in which accent 1 and 2 are kept tonally distinct. Figure 5 shows prefocal realizations of accent 1 and 2 in Cologne declaratives; Fig. 6 exemplifies postfocal forms of accent 1 and 2 in interrogatives, as produced by a speaker from Maasbracht.¹⁹ As can be seen, accent 1 and 2 differ in timing, but not melody: pitch falls are early and steep within the stressed syllable of accent 1 words, but late and moderate (with falls extending over the posttonic syllable) in accent 2 words.

Fig. 5: Prefocal [lu:¹s] ‘clever’ (left) and [lu:²s] ‘louse’ (right) in Cologne declaratives.

Fig. 6: Postfocal [zε:¹ç] ‘saw’ (left) and [va:²te] ‘water’ (right) in Maasbracht questions.

¹⁹ Similar postfocal pitch contours are reported from Cologne (Peters 2006a: 115) and Sittard (Hanssen 2005: 90, 103).

The pitch contours in Fig. 5 and Fig. 6 are reminiscent of those in focus position described above, albeit somewhat reduced in magnitude and apparently lacking the function of marking sentence type.²⁰ Whatever their source, be it rhythmic accentuation (as suggested by Peters 2004, Boersma p.c.) or some minor focus (so called “echo accents”, Gussenhoven & Peters 2004),²¹ none of these contours show any sign of an independent melodic component under accent 2.

Non-focussed accent 2 words with lexical tones have been claimed to occur in Maastricht and Hasselt; but the evidence is inconclusive at best. For accent 2 in Maastricht, Gussenhoven & Aarts (1999: 163) state that “the pitch contour shows a peak in the post-focal contour, indicating the presence of the lexical H”. This late peak is shown by the dotted line in Fig. 7. The same late peak, however, is characteristic of accent 2 words in focus position (solid line; cf. Fig. 2), suggesting that the postfocal contour in this case is but a reduced focal accent (“echo accent”), too.

Fig. 7: [spø:ʔlə] ‘to play’ in focus (solid) and postfocus (dotted) position in Maastricht.

In Hasselt, accent 2 words apparently surface with their lexical tone (L) in post-focal position: “In postnuclear position, accent 2 words are realized with low F₀, whereas accent 1 words follow the course of the overall F₀ contour” (Peters 2006c: 121). This is shown in Fig. 8 (reproduced from Peters 2006c). It is disputable, however, which of the two contours actually represents “the course

²⁰ Cf. the tonal *fall* in interrogatives, Fig. 6, with the rise in focus position, Fig. 2.

²¹ Eliciting really “deaccented” examples of accent 1 and 2 can be a difficult task in classical interview situations, simply because informants are well aware of which words are relevant (for the researcher) and often cannot help giving them some prominence (Fournier 2008: 86; Köhnlein 2011: 28).

of the overall F0 contour". There is some evidence suggesting that the accent 1 word 'hen' [hɪn¹] (left) is realized with a minor pitch accent in the sentence at hand: relatively high intensity (visible from the wave form) is one, the *indefinite* article [ə] preceding 'hen' is another. If true, the difference between accent 1 and 2 in these examples has nothing to do with lexical tones but with different intonational markings: an "echo accent" on an accent 1 word (left) and an ordinary postfocal fall on a "deaccented" accent 2 word (right).

Fig. 8: [hɪn¹] 'hen' (left) and [hɪn²] 'them' (right) in postfocal position in Hasselt declaratives.

I conclude that unambiguous cases of an independent melodic component of accent 2 do not exist for NON-FINAL POSITION (FOCUS *and* NON-FOCUS) in Franconian dialects. The tonal difference of accent 1 and 2 amounts to a difference in how intonation melodies are timed with respect to stressed syllables. If lexical tones are behind this, they only come to light in form of their positional effects (lengthening of intonation tones). If true, there is no evidence for a learner of any Franconian dialect to detect the substance (H or L) of lexical tones on any *bisyllabic* accent 2 word.

3.4 Final position

IP-final monosyllables are expected to show deviating pitch contours due to the presence of a boundary tone (or boundary tones). For focussed constituents this may result in tonal crowding, and intonation languages display different strategies to deal with this situation (compression and truncation, in particular; Grabe 1998; Gilles 2005; Hanssen et al. 2007, and many others). For Franconian dialects, we expect accent 2 monosyllables to show even more dramatic effects because, as we have seen above, they do not even manage to realize their "ordinary" pitch movements within the stressed syllable (the fall or rise being postponed to the posttonic syllable).

As far as I see, Franconian dialects use three different strategies (besides truncation) to deal with boundary tones on final stressed syllables: T_i is realized at the very end (Fig. 9a), it extends over the entire syllable (Fig. 9b), or it shows up at the center of the syllable (Fig. 9c). It goes without saying that my views differ sharply from those put forward in tonal analyses.

Fig. 9: Pitch accents and boundary tones on accent 2.

Cologne represents the first type: in this dialect, accent 2 monosyllables show a “disproportionate amount of final lengthening” (Gussenhoven & Peters 2004: 258), as indicated by the dotted rectangles in Fig. 10.²²

Fig. 10: IP-final realizations of accent 1 (solid) and accent 2 (dotted) in Cologne.

Whether cause or consequence, all pitch movements of accent 2 are realized within the stressed syllable, with the effect that IP-final accent 1 and 2 differ in tonal timing alone.²³ IP-final accent 2 words in Cologne, then, are as inexpressive as regards their tonal nature as they are in non-final position (cf. Figs. 2 and 5).

22 Both accent 1 and 2 monosyllables undergo IP-final lengthening, but accent 2 rhymes are 44% longer on average, while accent 1 rhymes are only some 30% longer than their IP-internal counterparts (Gussenhoven & Peters 2004: 258).

23 Notice that the final low tone (L_i) of questions (cf. the postfocus realizations) is truncated under focus for *both* accent types.

Acknowledging that Cologne lacks positive evidence for the melodic substance of its lexical tone, Gussenhoven & Peters (2004) and Peters (2006a) claim that accent 2 words are lexically marked with an *underspecified* tone ($\underline{\text{T}}$) on the first mora of their stressed syllable. This $\underline{\text{T}}$ serves two functions: it prevents pitch accents from attaching to the first TBU of the stressed syllable, and it assimilates to a following intonation tone, yielding declarative $[\underline{\text{H}}]\text{H}^*\text{L}$ and interrogative $[\underline{\text{L}}]\text{L}^*\text{H}$. Gussenhoven & Peters' (2004) analysis is sketched in Fig. 11.

Fig. 11: A tonal analysis of accent 1 and 2 in Cologne (Gussenhoven & Peters 2004).

If true, the tonal system of Cologne is absolutely minimal: rather than introducing independent tonal material, lexical tones exclusively serve as a blocking device (for assimilation could easily be done by spreading, of course). And this blocking device requires (a) juxtaposition of lexical tones and focus tones, and (b) a tonal position without content, i.e. something like an empty tonal node.

Hasselt (Peters 2006c, 2008) exemplifies the second pattern of IP-final melodies (Fig. 12).²⁴ As in Cologne, accent 2 monosyllables are disproportionately lengthened in IP-final position – and yet accent 2 words lack the final fall that shows up under accent 1. Peters (2008: 1005) states that IP-final focussed accent 2 syllables are produced with a “mid level pitch”, something he attributes to a “phonetic realization rule” by which LH^*L_i (i.e. a rising pitch accent followed by a low boundary tone) become mid (M) throughout, if preceded by a lexical low

²⁴ A similar system is found in the Rule AB dialect of Morbach (Schmidt & Künzel 2006).

tone $\underline{L}$, thus: $\underline{L}LH^*L_i \rightarrow \underline{L}MMM$. However, the same mid tone can be attributed to phonetic overlap of focus tone (H^*) and boundary tone (L_i), assuming that both are assigned to different prosodic levels (superimposition).²⁵

Fig. 12: IP-final realizations of accent 1 (solid) and accent 2 (dotted) in Hasselt.

The third pattern of IP-final realizations is found in Roermond (Fig. 13), Sittard, and Maasbracht.²⁶ Accent 1 monosyllables are realized with a final fall everywhere, even after a rise in questions (where Cologne shows truncation, cf. Fig. 10). The tonal realizations of accent 2 monosyllables, on the other hand, seem to have gone wild. Apart from the final rise in interrogatives (focus position), accent 2 words could be seen as rather level pitched, but with a medial dip, a dip that is particularly evident in high tone contexts (declarative focus, interrogative postfocus), and much less so in low toned contexts (declarative postfocus, interrogative focus).

²⁵ As a matter of fact, Peters' (2008: 1005) examples of IP-final *daa'x* 'days' and *daa'x* 'day' do not differ in pitch height at all, but in having and not having a final fall, respectively, and thus the difference could also be attributed to simple truncation of L_i under accent 2. At least in Morbach, however, level tones on final accent 2 monosyllables *do* have a lowered pitch compared to final accent 1 monosyllables (Schmidt & Künzel 2006).

²⁶ Mayen (Schmidt 1986), Cologne (according to Heike 1962, 1964, at least), and presumably other Central Franconian dialects show similar tonal patterns, though with additional durational differences.

Fig. 13: IP-final realizations of accent 1 (solid) and accent 2 (dotted) in Roermond.

Tonal approaches assume this dip to be the missing low boundary tone, and the following rise to be caused by the lexical tone $\underline{H}$. In a nutshell, accent 2 in Roermond is claimed to have lexical $\underline{H}$ associated with the second mora (rather than the first, as in Cologne), and this “late” $\underline{H}$ forces boundary tones to be realized earlier in the stressed syllable. Thus, the two-peaked contour in the upper left corner of Fig. 13 is represented as $H^*L_i\underline{H}$ at the surface. It seems then that the lengthened peaks and troughs ($[H^*]$, $[L^*]$) we saw in non-final position can be split up by another tone, a finding that would indeed present strong evidence to treat them as compounded of two tones, a pitch accent and a lexical tone.

However, the argument holds only under the assumption that tones are necessarily sequenced (juxtaposed). If pitch accents and boundary tones were assigned to different prosodic levels, the same effect could be achieved by aligning L_i with the center of final syllables. This would produce a salient dip within an overall high level tone, and a much less salient dip within a low level tone (cf. Fig. 9c). Franconian dialects, in this view, would use three different strategies to deal with boundary tones on final accent 2 monosyllables: (a) linearization by way of lengthening, as in Cologne, (b) superimposition with overall lowering, as might be the case in Hasselt and Morbach, and (c) superimposition with medial lowering (Roermond).

3.5 Markedness of Accent 1

Whatever the correct analysis of the various pitch contours found with IP-final accent 2 monosyllables, there is crucial evidence, I think, that lexical tones cannot be the answer. The evidence comes from surrounding dialects that use accent 2-like contours on final monosyllables *without displaying a tonal accent*

contrast. Overlength with final pitch movements, as in Cologne, is found in Low Franconian dialects north of the tonal accent area (Neuse 1915, Hanenberg 1915, Welter 1938, Schmidt 1986). This so called “Kleverlandisch accent” occurs on all final monosyllables with a long vowel or diphthong, regardless of whether they have accent 1 or 2 in the nearby “tonal” dialects, e.g. [wééèk] ‘soft’ and [ááâp] ‘monkey’ (“accent 2”), next to [ʃtʁóóòt] ‘street’ and [zááàx] ‘saw’ (“accent 1”; examples from Aldenrade; Neuse 1915). Final two-peaked accents are described for Freudenberg (Reuter 1903: 4), a Moselle-Franconian dialect situated East of the tonal accent area;²⁷ and Gilles (2005) reports final overlong monosyllables with early falls and (possible) late rises²⁸ that yield the “auditory impression of two-peakedness” (Gilles 2005: 214; my translation) from regional variants of German. In Mannheim, for instance, such melodies can occur on every final monosyllable with a long vowel or diphthong, e.g. [ʃtʁóóóʃs] ‘street’. Since Rhine Franconian dialects, in all likelihood, never had a tonal accent contrast in the first place, Gilles (2005: 115) supposes that such accent 2-like contours are an areal feature of a “[...] large Westcentral German area. While used as part of a tonal accent opposition in Central Franconian, it has a (phonologically) non-distinctive status in Mannheim.” (Gilles 2005: 115; my translation).

These findings argue against lexical tones as the source of two-peaked contours on final monosyllables – unless, of course, we assume that dialects (or regional variants) without a tonal accent contrast mark *all* long vowels and diphthongs in final monosyllables with some extra (lexical?) tone. What these findings do suggest is that accent 2, while sounding peculiar to a non-native ear (especially on final monosyllables), might actually display the normal, i.e. unmarked, melody of Franconian dialects.

There is some evidence supporting this assumption. First, restricted dialectal competence leads to generalized *accent 2* realizations, rather than *accent 1* (Peters 2006a: 272, for Cologne). Second, unmarkedness of accent 2 coincides

²⁷ “Der mit bestimmten Bedingungen verknüpfte ripuarische cirkumflektierte oder gestoßene Akzent [...] ist der Siegerländer Ma. fremd. Die Mundart von Freudenberg im Westen des Siegerlandes wird zwar von den übrigen Siegerländern bereits als ‘singend’ empfunden, doch ist hier lediglich die allgemein bei emphatischer Betonung **besonders am Satzende hervortretende schleifende zweitönige zweigipflige Betonung** stärker ausgeprägt.” (Reuter 1903: 4; emphasis mine).

²⁸ Gilles calls them “Knickkontur”. The variants without final rise end in a long low tone after the fall, a contour reminiscent of final accent 2 realizations in Venlo (Gussenhoven & van der Vliet 1999).

with native speakers' intuitions, as pointed out already by Grootaers & Grauls (1930).²⁹

Als wij onze accenten met de Nederlandsche vergelijken is zeker de sleeptoon de merkwaardigste van beide: hij is het die onder de meest beschaafde Nederlandsche uitspraak dikwijls den Limburger verraaft; ***hij wordt als de normale toon van het dialect gevoeld***, de stoottoon daarentegen komt in bepaalde gevallen voor en zijn gebied kan gemakkelijk worden afgebakend. (Grootaers & Grauls 1930: 129; emphasis mine)

Third, phonetic markedness of accent 1 becomes evident from features other than pitch. In many dialects, accent 1 rhymes are consistently shorter than accent 2 rhymes in *all* sentence positions (Maastricht, Neerpelt, Cologne, Mayen etc.); and in some dialects, accent 1 rhymes are realized with a “relatively fast decay of the intensity envelope” (Gussenhoven & Peters 2004: 252, on Cologne).³⁰ Virtually all classical descriptions of Franconian dialects regard shortening and intensity drops as characteristic properties of a phonetically marked accent 1.³¹

Tonal approaches treat these properties of accent 1 as means to enhance the primary tone contrast; and in the case of sentence-internal durational differences, they break with traditions and assume (“tonal”) lengthening under accent 2 instead of shortening under accent 1 (Gussenhoven & Peters 2004: 264). However, long vowels under accent 1 do not only sound rather short, they also show a tendency to merge with short vowels, a merger which can eventually lead to the collapse of tonal accent systems (Heijmans 1999a, 2003, on the Central

²⁹ Native speakers of Central Franconian dialects share this intuition (see, e.g., Peters 2004, 2006a; Gussenhoven & Peters 2004, for Cologne).

³⁰ Nörrenberg 1884 (on Dormagen), Müller 1900 (on Aegidienberg), and Engelmann 1910 (on Moselle-Franconian Vianden) assume intensity drops to go along with (or be caused by) a glottalization gesture that can even culminate in a glottal stop. Engelmann (1910) describes glottal closure as the most extreme form of accent 1, occurring only with final monosyllables. He says (p. 384): “Durch laryngoskopische beobachtungen konnte ich bei *ā'* [= accent 1, W.K.] eine plötzliche bewegung nach innen mit darauf folgender trennung der stimmbänder, bei *ā* [= accent 2] hingegen ein langsames auseinandergehen derselben festgestellt werden.” Intensity drops with less extreme glottal activity are reported from many more places, e.g. Dülken (Frings 1913), Echternach (Moselle-Franconian, Palgen 1931), and Cologne (Heike 1962, 1964, undated).

³¹ As a matter of fact, many of these descriptions, while devoting long passages to the phonetics and historical distribution of accent 1 (*Schärfung*, *Stoßton/stoottoon*, *Rheinische Akzentuierung* etc.), do not even mention accent 2 (*Schleifton/sleeptoon*).

Limburgian dialect of Weert; Bruch 1954, on Moselle-Franconian dialects in Luxembourg).³²

3.6 Summary

To sum up, the evidence for lexical tones in Franconian dialects is meager for accent 2 syllables outside IP-final position (which includes all bisyllabic words), and only apparently conclusive for final monosyllabic words. If we look at how melodies are timed with respect to prosodic structure, the generalization seems to be that the tonal domain for a complete rise or fall is monosyllabic for accent 1, but bisyllabic for accent 2. To take the words from Cologne in (14), monosyllabic accent 1 [bóðx] ‘book’ equals bisyllabic accent 2 [lóúfə] ‘to run’. Bisyllabic accent 1 words like [xóùvə] ‘to rob’ have more structure than needed, for all the tonal action is already completed by the end of the stressed syllable. A monosyllabic accent 2 word like [xóúx] ‘smoke’, on the other hand, even though being phonetically longer than accent 1 [bóðx], falls short of the necessary number of TBUs, and thus requires a following syllable to complete the tonal contour (see above for the different strategies employed if no such syllable is available). In the next section I develop a model of tonal accents that accounts for these findings without making use of lexical tones.

4 A foot-based approach of tonal accents in Franconian

4.1 The proposal

The alternative to tonal approaches I propose here treats the melodies of *both* accent 1 and 2 as pure intonation and regards the timing differences as *direct* manifestations of an alignment contrast. Early peaks and fast movements under

³² Riparian dialects have many words with short vowels before originally single voiced consonants, such as (Cologne) *bɛ'də* ‘to pray’, *bɔ'dəm* ‘floor’, *fpe'lə* ‘to play’ (Münch 1904). If we follow Welter (1929) and Wiesinger (1983: 1092), these vowels were originally lengthened in open syllables (cf. Standard German *b[e:]ten*, *B[o:]den*, *sp[i:]len*), and only later re-shortened under the influence of accent 1, thereby merging with short vowels as in, e.g., *bɛ'dɛ* ‘beds’, *fɛ'lə* ‘to put, to place’ (< **bɛd:v*, **fɛl:ə*). See §4 for tonal accents on so called “monomoraic syllables”.

accent 1 suggest that H* (or L*) are associated with the first mora of the stressed syllable, as proposed by Gussenhoven & Peters (2004) for Cologne. This is shown in Fig. 14 (left) for Cologne [ʃlɔ̃ʃə] ‘to sleep’ and [ʃɔ̃ʃ] ‘sheep’. Long tones and late movements in accent 2 words like [hɔ̃ʃə] ‘to hope’ and [ʃtɔ̃ʃ] ‘fabric, cloth’ leave two options, both sketched in Fig. 14: (a) a pitch accent (the same as for accent 1) attaches to the second mora of the stressed syllable (and spread regressively) or (b) it associates with the entire stressed *syllable* rather than with a particular mora.

Fig. 14: Pitch accent alignment under accent 1 and 2 in Cologne (declarative).

Either way, pitch accents attach to prominent (= stressed) elements; so if accent 1 and 2 differ in the alignment of pitch accents, the basic contrast has to be described in terms of stress, i.e. foot structure: accent 1 is stressed on its first mora, accent 2(a) has second mora stress, and accent 2(b) has syllabic stress. The respective foot structures are given in Fig. 15: accent 1 turns out to be a “true” **MORAIC TROCHEE**, i.e. a monosyllabic foot with first mora prominence (‘μμ’); and accent 2(b) corresponds to a **SYLLABIC TROCHEE**, bisyllabic (‘σσ’) in the case of [‘hɔ̃.ʃə]), and monosyllabic (‘σ’) with [‘ʃtɔ̃ʃ].

Fig. 15: A foot-based analysis of accent 1 and 2.

Most earlier structural analyses of tonal accent systems went for accent 2(a), i.e. they assumed a “moraic accent” contrast of accent 1 = ($\mu\mu$) and accent 2 = ($\mu\dot{\mu}$).³³ While initially attractive for its symmetry, this analysis is fraught with problems once we try to interpret accent 2(a) from the perspective of stress and foot structure. First, second mora stress would have to accept mismatches of stress and sonority for words with closing diphthongs (e.g., [ble'iç] ‘pale’, [fle'i.fə] ‘to drag’) and VR nuclei ([ma'n] ‘man’, [ʃta'm.pə] ‘to stamp’ etc.). Second, it would create bizarre foot types: [(ftɔ'ɔf)] in Fig. 15 corresponds to a MORAIIC IAMB ($\mu'\mu$), a foot type hardly compatible with the overall trochaic structure of Franconian (or Germanic, for that matter); and [(hɔ'ɔ.fə)], which could be termed a MORAIIC AMPHIBRACH, seems to be universally unattested.³⁴

Treating accent 2 as a syllabic trochee (accent 2(b)) suffers from none of these problems: it allows for an overall trochaic system, it avoids mismatches of stress and sonority (because stress is assigned to syllables rather than moras), and it is also the most direct way to account for the realizations of pitch accents (because it does not require spreading).

I propose then that Franconian dialects possess a surface contrast of MORAIIC TROCHEES (“accent 1”) and SYLLABIC TROCHEES (“accent 2”). The contrast can be perceived by means of (intonational) pitch movements as well as (for some dialects, at least) duration and intensity, i.e. the usual suspects in the field of stress.³⁵ Strong-weak relations in a syllabic trochee ($\sigma\sigma$) are expressed in familiar ways, i.e. by intonational marking, e.g. H*L ($\hat{\sigma}\hat{\sigma}$), intensity ($\sigma\sigma$), and duration ($\sigma\sigma$). Its structural equivalent, the moraic trochee ($\mu\mu$), does the same, though at the moraic level, i.e. pitch ($\mu\dot{\mu}$), intensity ($\mu\mu$), and duration ($\mu\mu$). The specific phonetic properties of accent 1 – fast tone movements, rapid intensity drops, and shorter duration (due to second mora reduction³⁶) – thus follow from its prosodic structure, the moraic trochee.

³³ ‘Moraic accent’ approaches include Kiparsky 1973 (Ancient Greek and Lithuanian), Halle & Vergnaud 1978 (Lithuanian), Becker 1978 (Čakavian Croatian), and Reitz 1985, Kehrein 2007 (Franconian).

³⁴ Moraic amphibrachs have been proposed for Chugach Alutiiq Yupik (Rice 1988); but see Kager 1993 for an alternative.

³⁵ A number of authors have argued that tone must be the phonologically distinctive property of the accent contrast, because they found pitch to be the most important perceptual cue to accent 1 and 2 (see, e.g., Werth 2011, on the dialects of Mayen and Arzbach). This is not a valid conclusion, however, for pitch is well known to play a prominent role in perceiving stress, too (Fry 1955, 1958).

³⁶ Actual second mora shortening under accent 1 can only be observed for “diphthongal” nuclei of course. Münch (1904: 10), for instance, describes sonorants after short vowels as regularly long ([kan:²] ‘to be able’), but short under accent 1 ([kan'] ‘jug’). See also Schmidt (1986: 186) for final sonorants in monosyllabic [ʃal'²] ‘sound’ (225 ms) and [ʃal'] ‘sleeve’ (138 ms) in Mayen.

If my analysis is correct, a bisyllabic accent 1 word such as [ʃlɔɔfə] in Fig. 15 will consist of a moraic trochee followed by an unparsed syllable ($(\mu\mu)\sigma$ (see below for consequences). My representation of monosyllabic accent 2 [ʃtɔɔf] in Fig. 15 follows Hayes (1995: 102f), who treats stressed final syllables as regular syllabic trochees ((σ) , rather than degenerate feet. Monosyllabic accent 2 is indeed confined to final position in Franconian dialects (e.g., [(ʃtɔɔf)] or [(hɔɔf)] ‘I hope’), for if such forms are followed by another unstressed syllable,³⁷ the result will be an ordinary bisyllabic trochee ($(\sigma\sigma)$, as in [(hɔɔ.fə)] ‘to hope’ or [ɪɕ (hɔɔ.fət)] ‘I hope it’ (with a clitic -ət ‘it’).

Yet, the decision of whether accent 2 monosyllables are in fact regular syllabic trochees or degenerate feet will depend on the ultimate analysis of IP-final monosyllables: do final pitch contours as in Fig. 12 and Fig. 13 indicate that accent 2 monosyllables fall short of a full-fledged foot? And is “final overlength” (Figs. 10 and 12) a way to deal with “tonal crowding”, or is it a strategy to overcome structural deficiency? I see no evidence at present to decide this issue either way.³⁸

4.2 Some consequences

I will not discuss all consequences of my foot-based approach here (but see §6 for some general discussion), nor will I present the differences to tonal approaches in much detail. A few comments are in order, though. The first thing to notice is that tonal neutralization in non-focus position (see §3) comes for free if Franconian is just another intonation language. Without pitch accents, there will be no way to distinguish moraic and syllabic trochees by melodic means. If other cues (duration and intensity) are weak (or absent) as in Venlo and Roermond, the result will be perceptual neutralization. I do not say *structural* neutralization because under a foot-based approach accent 1 and 2 should differ in structure, regardless of their position in a sentence or whether they do or do not receive intonational

³⁷ Except for compounds, e.g. [(ʃtɔɔʔf)(baa'n)] ‘panel of fabric’, which consist of two prosodic words.

³⁸ Gussenhoven & Peters (2004) find relatively short durations for monosyllabic accent 2 rhymes in antepenultimate position (some 210 ms) as compared to IP-final monosyllables (almost 300 ms). The former, however, are always followed by an initially unstressed participle (e.g., ...¹kan² jə'sa:t ‘...can said’) in their material; so lack of overlength in these cases could well be a consequence of sentence rhythm creating a bisyllabic trochee (('kan.jə)). I am not aware of any systematic investigation dealing with the duration of accent 2 monosyllables before stressed syllables (e.g., ...¹kan² 'säät ‘... can says’) or in compounds like [(ʃtɔɔʔf)(baan)] ‘panel of fabric’.

markings. Crucial evidence that this is in fact true comes from dialects such as Neerpelt (Peters 2006b), which show *tonal* neutralization and yet keep accent 1 and 2 apart, in that accent 1 is consistently shorter than accent 2 in this (and every other) position. Tonal approaches assume durational differences to follow from “tonal lengthening under accent 2”; but it is not immediately evident why (and how) “accent 2 lengthening” should arise if no lexical tone is present at the surface.³⁹

Second, the foot-based approach is maximally restrictive in various ways: it ties tonal accent contrasts to stressed positions, it predicts a maximally binary contrast (for no more than two types of trochees are possible on a bimoraic syllable), and it claims that all tonal action can be traced to the respective intonation systems and the ways melodies are timed with respect to prosodic structure. The model thus cannot handle dialects with tonal contrasts in unstressed syllables, or ternary contrasts (accent 1, 2, 3); nor can it deal with unequivocally independent melodic substance of either accent 1 or 2. Tonal approaches, on the other hand, are able in principle to handle the first two (and they assume melodic substance anyway). Sure enough, they also postulate stressed syllables to possess a binary contrast of unmarked accent 1 and tonally marked accent 2 in all dialects, but none of this is a primary ingredient of the analysis. Considering that individual dialects are free to choose between two lexical tones $\underline{H}$, $\underline{L}$ (ignoring underspecified $\underline{T}$) and two moraic docking sites (first mora, second mora), ternary contrasts could easily be represented, either by using both lexical tones ($\emptyset$ vs. $\underline{H}$ vs. $\underline{L}$), or both docking sites (e.g., $\emptyset$ vs. $\underline{H}\emptyset$ vs. $\emptyset\underline{H}$). Future research will have to reveal whether the strong position of the foot-based approach can be maintained for the entire Franconian area. At any rate, the existence of ternary contrasts seems to be very unlikely from all we know about the various dialects. To put it in Welter’s (1933) words:

Tatsache ist aber auch, dass im Südniederfränkischen und Ripuarisch-Mittelfränkischen die beiden Affekt- und Akzenttypen nebeneinander gelten. Sie sind hier zugleich die beiden einzig vorhandenen. **Ein Drittes oder Mehreres gibt es nicht.** (Welter 1933: 46; emphasis mine)

Words with short stressed vowels followed by a coda obstruent (15a) or by a single intervocalic obstruent (b) or sonorant (c) require special comment, because such words are sometimes described as having melodies that fall *in between* accent 1

³⁹ But see Peters (2006a), for the assumption that *empty* tonal nodes may cause accent 2 lengthening in Cologne.

and 2 (Schmidt 1986; Gussenhoven & Peters 2004). They could thus be considered as representing a third, intermediate type of (presumably accentless) words.

(15) Words with “monomoraic” nuclei

a. VO	[kɑt]	‘cat’
	[bɛt]	‘bed’
	[ˈkɛstə]	‘chests’
b. VOə	[ˈkɑtə]	‘cats’
	[ˈbɛdə]	‘beds’
c. VRə	[ˈvɑlə]	‘to fall’
	[ˈbɛɲə, ˈbɛŋə]	‘to bind’

While it is true that accent 1 and 2 generally do not contrast on “monomoraic” stressed syllables (but see below), such words are by no means accentless. Rather, they receive accent 1 or 2 by the same rule as do words with VR nuclei ([βɛnˈdə] vs. [dɛŋˈkə]), or historically lengthened vowels ([jaːˈɣə] vs. [maːˈxə]) in Rule A dialects: they have accent 1 if the short vowel is followed by a voiced consonant, [bɛˈt] (/bɛd/), [bɛˈdə], [vɑˈlə], [bɛˈɲə, bɛˈŋə], and accent 2 before voiceless consonants [kɑˈt], [kɛˈstə], [kɑˈtə].⁴⁰

For bisyllabic words, the difference between accent 1 and 2 can be quite audible, especially under interrogative intonation. An example from Maasbracht is given in Fig. 16.

Fig. 16: Pitch contours of interrogative [bɛˈdə]? ‘beds?’ (left) and [pɛˈtə]? ‘sleep?’ (right) in Maasbracht.

⁴⁰ See Grootaers 1910 (Tongeren), Grootaers & Grauls 1930 on Hasselt, Jongen 1972 (Moresnet), Müller 1900 (Aegidienberg), Münch 1904 and Müller 1912 (Cologne), Welter 1933 (Montzen). See also Frings (1916: 95) on Central Franconian [duˈf] /duv/ ‘dove’ vs. [kɑˈt].

Due to final devoicing in words like [bɛˈt], the difference between accent 1 and 2 on monosyllabic words is threatened by perceptual neutralization;⁴¹ and for most dialects, there is indeed no audible tonal difference between [bɛt] and [kat] spoken in isolation. Sentence-internally, the distribution of accent 1 and 2 holds at the level of surface voicing in these dialects, i.e. [kɑˈt tə zɛ:n] and [bɛˈt tə zɛ:n] ‘cat/bed to see’, but [kɑˈd əs] and [bɛˈd əs] ‘cat/bed is’ (examples from Maasbracht; Boersma 2006, Hermans p.c.).

Dialects like Hasselt, Tongeren, and Moresnet, on the other hand, still keep monosyllabic [bɛˈt] /bɛd/ and [kɑˈt] /kat/ apart (or did so until recently). For these dialects, the complementary distribution of accent 1 and 2 holds at the level of underlying representation, /V¹D/ vs. /V²T/, with surface contrasts of [bɛˈt] vs. [kɑˈt], or [ʁɛˈp.kə] /ʁɛb-kə/ ‘small rib’ vs. [lɛˈp.kə] /lɛp-kə/ ‘small lip’ (examples from Moresnet; Jongen 1972: 51; see van Oostendorp, this volume).

As far as I can tell, no Franconian dialect contrasts accent 1 and 2 on words of the type /bɛd/, /bɛdə/ /kat/, /katə/. This is not to say, though, that the distribution is the same everywhere. In Rule B dialects (Arzbach; Bach 1921) “tone rules” usually work the other way round (16a),⁴² and thus accent 2 with words like [bɛˈdə] and [faˈlə] in (16b) does not come as a real surprise. What is surprising, though, is that no accent reversal seems to take place for VTə words (16c): [aˈpəl] has accent 2, just as in Roermond (and everywhere else).⁴³ In fact, I am not aware of a dialect that would have accent 1 with voiceless consonants following a short vowel (VT).

(16) Complementary distribution of accent 1 and 2 with “monomoraic” nuclei

OF	Roermond (A2)	Cologne (A)	Arzbach (B)	
a. *VDə	[jʁaːˈvə]	[jʁaːˈvə]	[jʁaːˈvə]	‘to dig’
*VTə	[ɛːˈtə]	[ɛːˈsə]	[ɛːˈsə]	‘to eat’
b. *VD:ə	[bɛˈdə]	[bɛˈdɐ]	[bɛˈdə]	‘beds’
*VR:ə	[vaˈlə]	[faˈlə]	[faˈlə]	‘to fall’
c. *VT:ə	[aˈpəl]	[aˈpəl]	[aˈpəl]	‘apple’

⁴¹ Notice that final devoicing in apocoped words, such as /bɛd/ ‘bed’ from earlier /bɛdə/ (OF */bɛd:ə/), is a relatively recent phenomenon in many dialects (Goossens 1977, 2006). According to Stevens (1955), the loss of accent 1 on words like /bɛt/ is indeed closely connected to this so called “second final devoicing”.

⁴² See also §2.

⁴³ Monosyllabic VT words also have accent 2, e.g. [miˈk] /mig/ ‘midge’ and [roˈk] /rok/ ‘skirt’ (Bach 1921: 276).

While VD(ə) words with accent 2 seem to be confined to Rule B (and Rule AB; Reitz 1985) dialects, VRə words with accent 2 are rather widespread: they exist as exceptional forms in many Limburgian dialects (e.g. [fɪø²mə] 'shirt' in Geleen and Maastricht; see Boersma 2006), but also rather systematically as descendents of earlier RD clusters ([bɛ²nə]/[bɛ²ŋə] 'to bind'), or earlier VRə words that failed to undergo "open syllable lengthening" (e.g. [ko²mə] 'to come', [nø²mə] 'to take'; Dols 1953, on Sittard; Frings 1913, on an area around Heinsberg).⁴⁴ Since all these dialects have "regular" accent 1 on words like [fa¹lə] (from *VR:ə), accent 1 and 2 are in fact contrastive on present-day VRə words.

Strict binarity aside, the data above bear a challenge for every theory about Franconian accents (be they tonal or structural), because they show that accents are not confined to nuclei with "two sonorant moras", as often stated in the literature. Distinctive (as in [va¹lə] vs. [bɛ²nə]) or predictable ([bɛ¹t] vs. [ka²t], [bɛ¹də] vs. [ka²tə]): every word in every Franconian dialect has one of the two tonal accents – and, from a crossdialectal perspective at least, both accents are generally possible on every type of stressed syllable, with the single notable exception of *V¹T(ə), i.e. */ka¹t/, */ka¹tə/.

I assume here that *all* stressed nuclei are bimoraic in Franconian dialects: syllable-final obstruents are moraic, [ka t_μ], [bɛ t_μ], [kɛ s_μ.tə], and so are intervocalic consonants after short vowels. The latter are "ambisyllabic" in a structural sense, i.e. they give weight to the stressed syllable: [kat_μ.tə], [bed_μ.də], [val_μ.lə], [bɛn_μ.nə], [fɪøm_μ.mə], and [kom_μ.mə].⁴⁵ Complementary distribution of accent 1 [bɛ¹də] (but *[bɛ²də]) and accent 2 [dɛŋ²kə] (but *[dɛŋ¹kə]) in the Rule A/A2 area is due to "historical accident" (see §5) and should be described by means of dialect-specific footing preferences – but *not* as a structural incompatibility of, e.g., accent 1 with VRTə, or accent 2 with VDə (see below for *V¹T(ə)).

I give some surface structures of accent 1 and 2 words from different dialects in Fig. 17. Foot structure is indicated by bracketing at the moraic (accent 1) and syllabic level (accent 2), respectively. The foot structures in (a) are predictable and thus to be assigned by rule; those in (b) have to be marked in the lexicon.

⁴⁴ The dialects of Mülheim (Maurman 1898) and Wermelskirchen (Hasenclever 1904) are claimed to have accent 2 on *all* words with short vowels followed by a intervocalic sonorant, even those going back to earlier geminates, such as [fa²lə] 'to fall'.

⁴⁵ Notice that these consonants can be rather long under accent 2, but short under accent 1 (Nörrenberg 1884, on Dormagen; Heike 1962, on Cologne; Peters 2004: 291 on 'lengthening' of intervocalic voiceless obstruents in the Cologne variety of Standard German).

Fig. 17: Accent 1 and 2 on monosyllabic VT, VD, and bisyllabic VTə, VDə, VRə in different Franconian dialects.

Tonal approaches run another path: they assume that lexical tones associate with syllables rather than moras in dialects that contrast accent 1 and 2 on “monomoraic” stressed syllables (H-to-¹σ in Neerpelt, Peters 2006b; L-to-¹σ in Hasselt, Peters 2008). They thereby predict pitch accents under accent 2 to be further removed from the stressed syllable in these dialects (because H blocks the entire syllable, rather than just one mora), something I fail to see in their data. Crucially, this cannot be the answer for dialects like Geleen ([vɑ¹lə] vs. [fɪø²mə]) and Sittard ([vɑ¹lə] vs. [bɛ²ɲə], [kɔ²mə]), because their tonal contours are virtually identical to those of Roermond and Maasbracht, dialects that do not possess such contrasts, and should thus have the mora as their TBU. “Surface accents” ([bɛ¹də], [kɑ²tə]) are equally problematic: they would either require TBU=σ for *all* dialects (with the same timing problems as above), or some second mora on accent 2 words (e.g. by way of ambisyllabicity as proposed above) in order to provide a structural position for the lexical tone. But this would require the association (if only by rule) of a tone with the second mora of words like [pɛ²tə], i.e. a mora heading a *voiceless* consonant.

Finally, by identifying tonal accents with particular foot types, my proposal makes predictions that go beyond those of tonal approaches. If accent 1 is a moraic trochee and accent 2 is a syllabic trochee, we expect to find distributional preferences for one or the other foot type as a function of the overall structure of words, or the internal composition of syllables. Secondary stress, for instance, should follow main stress on the next but one syllable if the head foot is a syllabic trochee (“accent 2”) ($(\sigma\sigma)(\sigma\dots)$), but on the next syllable, if it is a moraic trochee (“accent 1”) ($(\sigma)(\sigma\dots)$); and if foot-internal head-dependent relations are governed by sonority in some way (such that $\text{Son}(\text{Head}) \geq \text{Son}(\text{Dep})$), we expect to find such relations to hold between *syllables* for accent 2, but between *moras* within a single syllable for accent 1.

Data from Maasbracht (Hermans 1994, p.c., Bruce & Hermans 1999) suggest that the foot-based approach is on the right track.⁴⁶ As shown in (17), contrasts of accent 1 and 2 (on the main-stressed syllable) are generally possible on longer words (typically loans) with final stress (a) and penultimate stress (b). Words with antepenultimate main stress and secondary stress on the final syllable, however, do *not* have accent 1 (c, d);⁴⁷ and words with penultimate stress do not have accent 2 if the stressed vowel is less sonorous than the following unstressed vowel (e).

- (17) Stress and accent in Maasbracht (Hermans 1994: 353f, Bruce & Hermans 1999: 642f)

	accent 1		accent 2
a. ... σ	[medi'si:n ¹]	‘medicine’	[tæxpən'ti:n ²] ‘turpentin’
	[telə'fo:n ¹]	‘telephone’	[pæv'so:n ²] ‘person’
b. ... $\sigma\sigma$	[pi'ja:ma]	‘pajamas’	[ka'na:ʔi] ‘canary’
Son(σ) $\geq$ Son(σ)	[fo:'to]	‘foto’	[ho:ʔmo] ‘homo’
	[di'na:mo]	‘dynamo’	[pla:ʔto] ‘Plato’
	[som'bæ:ʔo]	‘sombbrero’	[maka'xo:ʔni] ‘macaroni’

⁴⁶ The stress system of Maasbracht (as other Limburgian dialects) is virtually identical with Standard Dutch: roughly, final superheavy syllables receive primary stress ([medi'si:n] ‘medicine’, [tæxpən'ti:n] ‘turpentin’), else primary stress is on the penult ([pi'ja:ma] ‘pajamas’, [kan'a:xi] ‘canary’), or on the antepenult, with secondary stress on a final heavy syllable ([a'me:xi,ka:] ‘America’, [pi'ta:yo,χas] ‘Pythagoras’).

⁴⁷ Words with main stressed VR syllables ([a'lyə,bæ:a] ‘algebra’, [zældə,xi:] ‘celery’ etc.) do not take accent 1 either; but since words of this type have a strong preference for accent 2 in the native vocabulary anyway (cf. the examples in (8)) their validity is not as strong. Words like [dæl.ta] ‘delta’ have accent 2 as well, making clear that the sonority requirements accounting for the data in (e) are in fact violable, i.e. they can be overruled by a strong lexical pressure for accent 2 in VR.TV words.

c. ... ¹ σσ,σ	—	[a: ² li.bi:]	‘alibi’
(σ = V:)	—	[a ¹ me: ² bi.ka:]	‘America’
	—	[‘ho: ² ʁə.ka:]	‘catering industry’
	—	[‘ko: ² li.bʁi:]	‘humming- bird’
d. ... ¹ σσ,σ	—	[pi ¹ ta: ² ʁo.ʁas]	‘Pythagoras’
(σ = VC)	—	[‘la: ² za.ʁəs]	‘Lazarus’
	—	[‘ho: ² ʁi.zən]	‘horizon’
	—	[‘lo: ² tə.bæɪ]	‘dummy (fem.)’
e. ... ¹ σσ	[a ¹ ʁe: ¹ na]	‘arena’	—
Son(¹ σ) < Son(σ)	[‘be: ¹ ta]	‘beta’	—
	[‘o: ¹ ma]	‘grandma’	—
	[‘ko: ¹ la]	‘Cola’	—
	[‘no: ¹ ta]	‘bill’	—

Both gaps make sense under a foot-based approach, the first because secondary stress suggests [(‘a.li)(bi:)], which literally is “accent 2” in the logic of the foot-based approach, the second because [‘o:.ma] would make a suboptimal syllabic trochee [(‘o:.ma)] from the perspective of sonority (de Lacy 2002).

In an optimal moraic trochee (“accent 1”), Son(μ_2) will be lower than Son(μ_1); but not *too* low, for μ_2 represents a structural position in the moraic trochee, if only the weak branch.⁴⁸ The tendency of long vowels to diphthongize under accent 1, as in Maastricht (9) and many other dialects, can be seen as an optimization strategy of the former type: after diphthongization, the second mora will be less sonorous than the first, regardless of whether this is achieved by initial lowering (Maastricht: *î, *û > ei, ou) or final raising (Sittard: *ê, *ô > ei, ou).⁴⁹ The absence of accent 1 on VT(ə) words ([kat], [kestə], [katə]), I assume, is an instance of Son(μ_2) *minimality*: voiceless consonants are illicit as the weak branch of a moraic trochee (“accent 1”) because they are not sonorous enough. Voiced consonants thus represent the bottom end of what counts as a well-formed weak branch of a moraic trochee in Franconian dialects.

In the next section I sketch the historical developments that led to the emergence of distinctive feet (accent 1 and 2) in Franconian dialects. My reconstruction

⁴⁸ Notice that syllabic consonants, also typically dependents rather than heads of feet, are also more likely the more sonorous they are.

⁴⁹ Accent 2 is compatible with whatever the sonority of its second mora; long vowels are thus no problem, and monophthongization cases as in Dülken (10) suggest that it is even aspired. See Köhnlein (this volume) for a different analysis of diphthongization in Maastricht and Sittard.

follows Boersma's (2006, this volume) in several major aspects: (a) the major prosodic changes that caused the present-day contrasts (open syllable lengthening, analogical lengthening, apocope); (b) the phonetic factors that underlie the phonologization process ("phonologized intonation"), and (c) the role of consonant voicing (perception-driven accent shift).

5 Accentogenesis: the emergence of tonal accents in Franconian

Prosodic structures may change over time: long vowels shorten (by, e.g., closed syllable shortening), and short vowels lengthen (open syllable lengthening, in particular); words may lose syllables (by apocope or syncope), or acquire new syllables (by epenthesis, for instance). When these prosodic newcomers enter "occupied territory" they sometimes merge with already existing structures, i.e. lengthened short vowels (*a > [a:]) become prosodically equivalent to old long vowels (*â), apocopated bisyllables (*σσ > σ) sound and behave like old monosyllables (*σ), and so on. Standard High German is a case in point, as illustrated by some examples in (18).

(18) Prosodic merger in Standard High German

a. V-lengthening:	*a > a:	=	*â
(open syllable lengthening)	['ma:lən] 'to grind'		['ma:lən] 'to paint'
(analogical lengthening ⁵⁰)	[ʁa:t] 'wheel'		[ʁa:t] 'advice'
b. ə-drop:	*σσ > σ	=	*σ
	[p ^h aɪn] 'pain'		[vaɪn] 'wine'
	[ʃpi:l] 'play!'		[ʃpi:l] 'game'

Surprisingly often, however, prosodic merger does *not* take place, i.e. old and new structures remain distinct, typically by means of pitch, duration, glottalization (stød) – or some combination of these. Lithuanian "acute" vs. "circumflex" accent, Norwegian-Swedish "accent 1" vs. "accent 2", Low Saxon and Estonian "long" vs. "overlong syllables", and Livonian stød vs. no stød (or "falling" vs.

⁵⁰ "Analogical lengthening" refers to a process of vowel lengthening in monosyllables under the pressure of paradigm uniformity. Thus, [ʁa:t] 'wheel', [ʃpi:l] 'game', [tʰa:k] 'day' etc. due to [ʁe:də] 'wheels', [ʃpi:lə] 'games', [tʰa:gə] 'days'. AL occurred in High German and Franconian (see below), but not in Low Saxon and Dutch, hence (Dutch) [ʁat] ~ [ʁa:dəʁə(n)], [ʃpɛl] ~ [ʃpɛ:lə(n)], [dax] ~ [da:ʁə(n)] etc.

“level tone”; see Kiparsky, this volume) are examples of tonal accent systems (in the broadest sense) that emerged from prosodic changes at the moraic (Lithuanian) or syllabic level (Scandinavian, Low Saxon, Estonian, Livonian).⁵¹ And Franconian is no exception to this. The Standard High German examples from (18), for instance, have the Limburgian cognates in (19).

(19) No prosodic merger in Franconian⁵²

a. V-lengthening:	*a > a:	≠	*â
(OSL)	['ma:ʔlə] ‘to grind’		['mɔ:ʔlə] ‘to paint’
(AL)	[ʁa:ʔt] ‘wheel’		[ʁɔ:ʔt] ‘advice’
b. ə-drop:	*σσ > σ	≠	σ
	[pi:nʔ] ‘pain’		[βi:nʔ] ‘wine’
	[ʃpe:lʔ] ‘play!’		[ʃpe:lʔ] ‘game’

Contrary to Standard High German then, vowel lengthening and apocope left “tonal traces” in Franconian: lengthened vowels (accent 2) differ from original long vowels (accent 1); and so do apocopated forms (accent 1) and original monosyllables (accent 2). The chronological order of OSL, AL, and apocope is sketched below for *hɔl ‘hollow-PRED’, *hɔlə(n) ‘to fetch’, and the shared inflected form *hɔlə, meaning both ‘hollow-FEM.SG’ and ‘fetch-1SG’.

(20) developments of *hɔl, *hɔlə, and *hɔlə(n) in Rule A2 dialects

<i>Old Franconian</i>	*hɔl	*hɔlə	*hɔlə(n)
a. OSL	–	hɔ:lə	hɔ:lən
b. AL	hɔ:l	–	–
c. ə-drop	–	hɔ:l	–
<i>Modern Limburgian</i>	[ɦɔ:ʔl]	[ɦɔ:ʔl]	[ʔɦɔ:ʔlə]

Considering the present-day contrast of [ɦɔ:ʔl] (<*hɔlə) and [ɦɔ:ʔl] (<*hɔl) alone, it is not hard to see why many scholars regarded apocope-induced accent 1 as the birth of the tonal accent contrast in Franconian,⁵³ especially since apocope

51 See Bremer (1927, on Low Saxon) and Kiparsky (this volume, on Livonian). Stress shift is another type of prosodic change that might have led to (or at least expand the range of already existing) tonal accent contrasts in, e.g., South Slavic, Latvian, and, presumably, Lithuanian.

52 Examples are taken from the “Algemeen Limburgs Woordenboek Online” (www.limburghuis.nl). [‘mɔ:ʔlə] ‘to paint’ might not be common in Limburgian dialects, but in the Low Franconian dialect of Dülken (Frings 1913), for instance, we find [‘ma:ʔlə] ‘to grind’ vs. [‘moəʔlə] ‘to paint’.

53 Wrede 1895, Leihener 1908, Lobbes 1915, de Vaan 1999, Schmidt 2002. The latter two assume an earlier phonetic “tonal” difference between lengthened vowels preceding voiceless and voiced consonants, but, too, assume that the difference was phonologized only after apocope.

introduced many minimal pairs within paradigms.⁵⁴ As pointed out by Boersma (2006), however, such an account crucially *disregards* the history of accent 2 in the non-apocoped forms: words like [ˈmaːʔlə], [ʁaːʔt], [ˈfɔːʔlə], [fɔːʔl], [daːʔx] etc. must have received distinctive accent 2 long before apocope, namely when lengthened vowels (from OSL and later AL) became bimoraic, but remained distinct from the original long vowels (19a). The present-day Limburgian contrast of accent 2 on lengthened vowels ([ˈfɔːʔlə] ‘to fetch’, [fɔːʔl] ‘hollow-PRED’) and accent 1 on OF long vowels ([ˈmɔːʔlə] ‘to paint’, [mɔːʔl] ‘time, occasion’) would be inexplicable, if both had merged into a single series. Following Boersma (2006; this volume), I thus assume the following chronological order of events:

- (21) The emergence of tonal accent contrasts in Franconian (Boersma 2006)
1. OPEN SYLLABLE LENGTHENING: lengthened vowels and OF long vowels form the first contrast in bisyllabic words: $hɔːʔlə, hɔːʔlə(n) \neq mɔːʔlə(n)$
 2. ANALOGICAL LENGTHENING: lengthened vowels and OF long vowels form the first contrast in monosyllabic words: $hɔːʔl \neq mɔːʔl$
 3. ə-DROP: accent 2 bisyllables (from 1.) change to accent 1 under apocope, thereby contrasting with older accent 2 monosyllables (from 2.): ($hɔːʔlə >$) $hɔːʔl \neq hɔːʔl$

Assuming vowel lengthening (OSL, AL) and apocope as the driving forces behind the emergence and spread of tonal accent contrasts makes perfect sense from the perspective of minimal pairs like those above. Recalling the examples from (§§1, 2), however, the full picture is more complicated, basically because (a) OF *î, û, ei, ou* (like *VR) go with the lengthened vowels rather than with the OF (non-high) long vowels (e.g. [βiːʔn] ‘wine’ in (19b))⁵⁵, (b) the apocope-induced change from accent 2 to accent 1 is sensitive to consonant voicing, e.g. [maːʔlə] > [maːʔl] ‘I grind’, but [aːʔpə] > [aːʔp] ‘ape’, and (c) in Rule A dialects, we find accent 1 not only on apocoped words of the type [maːʔl] ‘I grind’, but also on non-apocoped [maːʔlə] ‘grind-INF/1PL/3PL’. A fuller picture of the historical correspondences for Rule A2 *and* Rule A dialects is given in (22).⁵⁶

⁵⁴ Examples for the loss of inflectional schwa are: fem.sg. of adjectives (as in [hɔːʔl] above), 1.sg. of verbs ([dʁaːʔx] ‘carry-1SG’ vs. [dʁaːʔx] ‘carry!’), and plural of nouns ([daːʔx] ‘days’ vs. [daːʔx] ‘day’). See Boersma 2006, for a fuller account.

⁵⁵ [ʃpeːʔl] ‘game’ has accent 2 because it goes back to an analogically lengthened vowel *ʃpel (cf. *ʃpelən > ʃpeːlən ‘to play’).

⁵⁶ The Rule AB dialects of Morbach (Reitz 1985) and Beuren (Peetz 1989) follow Rule A and A2 dialects with respect to the spontaneous accent rule, but their “combinatory accents” are opposite to Rule A dialects. The Rule B dialect of Arzbach (Bach 1921; Köhnlein, this volume) is (almost) opposite to Cologne for both spontaneous and combinatory accents.

- (22) Historical distribution of accent 1 and 2 in Rule A and A2 dialects (Nörrenberg 1884)
1. SPONTANEOUS ACCENT: words with OF long non-high vowels have accent 1.
 2. COMBINATORY ACCENT: words with OF long high vowels, closing diphthongs, V+R, and lengthened vowels have accent 2, unless these nuclei were followed by a voiced consonant and ...
 - (a) another syllable that was lost (Rule A2)
 - (b) another syllable (Rule A)

Following Wrede 1895, de Vaan 1999, and Boersma 2006, I assume apocope-induced accent 1 (as in Rule A2) to represent the more archaic stage, and accent 1 in Rule A [ma:¹lə] to be a later development (cf. §2). If true, the general chronology in (21) can be maintained for both Rule A2 and Rule A dialects; the latter would simply require another step, presumably a process of analogical levelling that changes earlier [ma:²lə] to [ma:¹lə] under the influence of apocopated ['ma:¹l] 'I grind'. Since apocope itself follows vowel lengthening (20), the most natural assumption about the tonal accent system *before* apocope would be one with two "spontaneous accent rules".

- (23) Historical distribution of accent 1 and 2 before apocope
1. SPONTANEOUS ACCENT 1: words with OF long non-high vowels have accent 1.
 2. SPONTANEOUS ACCENT 2: words with OF long high vowels, closing diphthongs, V+R, and lengthened vowels have accent 2.

The scenario described so far raises (at least) three important questions:

- Q1: How exactly did accent 1 and 2 emerge from an earlier quantity contrast?
 Q2: Why did *VV_{hi} and *VR follow the development of lengthened vowels (receiving accent 2) rather than the OF (non-high) long vowels (accent 1)?
 Q3: What is the role of consonant voicing in the change from accent 2 to accent 1 under apocope?

As for Q3, I will have nothing to add to Boersma's (2006) analysis of a perception-based accent shift (as suggested already by Nörrenberg 1887): since tonal movements are realized after the stressed syllable under accent 2, older bisyllabic forms like [hɔ:²lə] 'fetch-1SG', [dʁa:²ʁə] 'carry-1SG', and [dʁu:²və] 'grape' (from *û) started their tonal fall (or rise) on the posttonic voiced consonant, a fall that remained audible even after final schwa was lost, i.e. [hɔ́ɔ̃l], [dʁááɔ̃], [dʁúúṽ].⁵⁷ Boersma

⁵⁷ Recall from §4 that final devoicing was *not* an automatic consequence of schwa-drop before voiced obstruents, but happened only much later.

argues that the final fall within the now monosyllabic words led learners to reinterpret these forms as accent 1, something that could obviously not happen with postvocalic *voiceless* consonants as in, e.g. accent 2 [hóʒpə] > [hóʒp] ‘hope-1SG’, [máákə] > [máák] ‘make-1SG’ etc. (Ripuaric [hóʒf] and [mááx], respectively), for no tones are audible during a voiceless sound.

As for Q1, Boersma (2006) describes pre-OSL Franconian as a language with first-mora accent, and pitch accent assignment from left-to-right on a moraic basis. Thus, a falling contour (H*L) will be realized *within* a single heavy syllable, e.g. *zē_μ ē_μ .lā_μ n̄ ‘souls’, but divided over two syllables in case of a monomoraic stressed syllable: *wē_μ .kā_μ n̄ ‘weeks’. With OSL, short vowels began to lengthen; but as long as the lengthened vowel, say [ɛː], was still interpreted as phonologically monomoraic, only a single tone could be assigned, in other words: H* lengthened along with the vowel [Hː]. At some point, the durational difference between long and lengthened vowels became so small that learners reinterpreted the difference between long and lengthened vowels as one of melodic timing rather than moraicity: *zē_μ ē_μ .lā_μ n̄ vs. *wē_μ ē_μ .kā_μ n̄. Thus, lengthened vowels became bimoraic, but the two moras were aligned with a single intonation tone. Accent 1 and 2 were born, a lexical-mora accent contrast (at this stage, at least) in Boersma’s view. Analogical lengthening (or “analogical prosodic levelling”), only had to transfer the contrast to monosyllabic forms, e.g. [fɔl] > [fɔːʔ], due to [ʰfɔːʔlə] (cf. (20)).

Boersma’s analysis is as elegant as it is simple. It takes but a single step (two, if we include AL) from pre-OSL Franconian to the present-day contrast of [zɛːʔlə] ‘souls’ and [βɛːʔkə] ‘weeks’. And it also accounts directly for the present-day distribution of accent 1 and 2 on *VC:ə words like *wɪl:ən ‘to want’, *wɪn:ən ‘to win’, *wɛg:ən ‘a wedge (of bread/butter)’, *wɛk:ən ‘to wake up’:⁵⁸ since medial geminates had to be moraic, the model predicts early forms like wí_μ n̄ n̄ n̄ n̄, i.e. “phonetic accent 1”. This is what they have today, with the exception of voiceless geminates (see §4). Boersma argues, along the lines of schwa-drop, that these forms were indeed structurally “accent 1-like” (wē_μ k̄_μ k̄_μ n̄), but perceptually ambiguous, because the tonal fall on [k] was of course inaudible. With the phonologization of accent 1 and 2, learners interpreted the posttonic pitch movements in the auditory form [wék:ən̄] as accent 2 (see Boersma 2006, for details).

⁵⁸ By way of illustration, I try to use near minimal pairs here and below. I do not expect that all these words were actual words in Early Middle Limburgian, nor do I claim that all of them are common words in all present-day dialects.

My sole objection to Boersma's analysis concerns his answer to Q2. Boersma claims that *ī, *û, *ēi, and *ōu were actually sequences of short vowel+glide (VG): *ij, *uw, *ej, *ow.⁵⁹ As such, they were prosodically equivalent to *VR rhymes: *wij.kən 'to give way' = *wēj.kən 'to smooth' = *wēl.kə 'which' = *wēn.kən 'to wave'. What they share with pre-OSL *wē.kən 'weeks' thus is a short vowel. So far, I absolutely agree. But Boersma goes one step further and regards *VG, *VR, and *V as *prosodically* identical, i.e. he assumes that all of them were monomoraic in pre-OSL times, and *VG and *VR became bimoraic only *after* OSL. Notice that this assumption is crucial for the analysis, for bimoraic $V G_{\mu}$ and $V R_{\mu}$ would have received both intonation tones on their stressed syllable (wījkə̃n, wējkə̃n), and thus should have accent 1 in contemporary dialects. But they have accent 2, of course.

If open syllables (hɔ.lə, wē.kən) did in fact become bimoraic *prior to* closed syllables (həl, wēn.kən), the Franconian chronology of the quantity shift would have been opposite from what is generally assumed for its Germanic neighbors ("Hesselman's law"). In pre-OSL Middle High German and Middle English at least, VV and VC counted as heavy, but short vowels in open syllables were light (see, e.g., Lahiri et al. 1999). I will thus take a more conservative position here and assume that Franconian developed like other Germanic dialects: in Early Middle Franconian times, all stressed syllables were heavy, except for short vowels in open syllables. OSL served to clear the last obstacle out of the way to generalized bimoraicity ("Prokosch's law").

As for Q2, I thus propose that *VG, *VR, and *V shared a short vowel, but *not* moraic equivalence. My ultimate historical accent rule is stated in (24).

(24) Complementary distribution of accent 1 and 2 (before apocope)

1. SPONTANEOUS ACCENT 1: words with OF long vowels receive accent 1.
2. SPONTANEOUS ACCENT 2: words with OF short vowels receive accent 2.

Notice that (24) makes one prediction different from Boersma's, namely that *VC:ə words (*wīl:ən, *wīn:ən, *wēg:ən, *wēk:ən) received accent 2 in the initial stage. Words of this type are reported to have accent 2 in Mülheim (Maurmann 1898) and Wermelskirchen (Hasenclever 1904; cf. fn. 44), two Rule A2 dialects at the northern periphery of the tonal accent area; a relic of the original situation is thus not unlikely. The change to accent 1 for words with medial *voiced* geminates could be another instance of a perception-based accent shift (due to phonetic shortening of medial geminates, for instance), or an outpost of Rule A invading the Rule A2 area (i.e. analogical levelling of [ʃtɛ'lən] 'to place' from apocopated

⁵⁹ See also de Vaan 1999 on Franconian; and Liberman 1999, 2002 on Germanic.

[ftɛ¹l] ‘place-1sg’). In Wermelskirchen, in any case, the distribution of accent 1 and 2 in these words is still perfectly in line with the Rules of A2, i.e. accent 1 with apocoped [ftɛ¹l] and [zo¹n] ‘sun’, but accent 2 with [ftɛ²lən] and [zo²nən] ‘suns’ (Hasenclever 1904: 16, 56).

The motivation for (24) (or my answer to Q1) can be found in work dealing with the temporal alignment of intonation peaks on different types of stressed syllables: peaks are aligned earlier in nuclei with long vowels as compared to short vowels (Ladd, Mennen & Schepman 2000, among others). The “pretonemic phase” (Schmidt 2002) in Franconian might thus have been as in Fig. 18: intonation peaks occurred early on (or towards the center of) long vowels (left), but later on short vowels, presumably towards the end of (phonetically lengthened) vowels in open syllables, and within the phase of postvocalic consonants in VG, VR, and VO nuclei (right). The right side of Fig. 18 is how declarative pitch accents are aligned in Neapolitan Italian words like [nɔːɔ] and [nɔːɔ], for instance (D’Imperio et al. 2007).⁶⁰ Peak timing is as yet fully predictable from the segmental and moraic composition of stressed syllables, a situation that changes with the event of lengthened vowels becoming bimoraic. I assume that the timing difference between (roughly) [zɛ̃_μ_ε̃_μ_lə] and [wɛ̃_μ_ɛ̃_μ_kə] was interpreted as a difference in foot structure right away, i.e. moraic [(zɛ̃_μ_ε̃_μ).lə] vs. syllabic [(wɛ̃_μ_ɛ̃_μ.kə)].⁶¹

After the completion of OSL, the closed syllables in Fig. 18 were not only phonetically similar to the lengthened vowels (late peaks), but also structurally identical (bimoraic); and so they followed [wɛ̃_μ_ɛ̃_μ.kə] and received accent 2, rather than [zɛ̃_μ_ε̃_μ.lə] with accent 1.

Fig. 18: peak alignment in stressed syllables with long vowels (left) and short vowels (right) [after Ladd, Mennen & Schepman 2000]

⁶⁰ The parallel is not perfect though, for Neapolitan Italian lacks phonemic long vowels.

⁶¹ Once the contrast was established, enhancement was not excluded of course, such as even earlier peaks under accent 1, or peak extension under accent 2. If the starting point was indeed as in Fig. 18, presentday Maastricht comes closest to the original situation.

To summarize, I follow Boersma's (2006) "accentogenesis" in its three major aspects: (a) tonal accent contrasts emerged from prosodic changes of vowel lengthening (OSL, AL), and further spread in the lexicon as a consequence of syllable loss (schwa drop, in particular); (b) the change from quantity to accents (whatever their appropriate analysis) is mediated by the phonologization of intonational timing differences; and (c) the change from accent 2 to accent 1 under apocope occurs with postvocalic voiced but not voiceless consonants, because tone movements are audible only during the former. A possible tone-lowering effect of voiced consonants plays no role. I deviate from Boersma's analysis in claiming that (a) closed syllables were bimoraic prior to OSL, and (b) phonetic differences as to how intonation peaks are timed with respect to short and long vowels formed the basis of the phonologization process, rather than moraic alignment of pitch accents.

6 Summary and conclusion

I started by presenting a number of apparent correlations that hold between "tonal accents" and segmental properties (vowel height, consonant voicing) in Franconian dialects. I argued that none of them present actual evidence for an interaction of tones and segments. I showed that the alleged correspondence of high vowels and high tones is but part of a broader picture of $*VV_{hi}$, $*VR$, and $*V$ rhymes receiving "accent 2" (§2), a historical process that has "open syllable lengthening" ($*V > V:$), but not vowel height, as its trigger (§5). I proposed to view diphthongization under "accent 1" as an optimization of foot-internal structure (head-dependence sonority); and I followed Boersma (2006, this volume) in regarding the apparent "tone-lowering effect" of voiced consonants as (a) historically connected to syllable loss and (b) based on the perceptibility of tone movements during vocal fold vibration.

The crucial and most controversial point of this paper will be, I guess, my claim that Franconian tonal accents have nothing to do with lexical tones. I argued in §3 that the tonal contours we find in different dialects, sentence types, sentence positions etc. do not support the idea of an independent melodic component of accent 2; and I presented an alternative approach in §4, according to which labels like "accent 1" and "accent 2" are but different names for distinctive foot structures, the "moraic trochee" and the "syllabic trochee", respectively. I am well aware of the fact that my foot-based approach is not in line with standard accounts of metrical theory. Hayes (1995) and Hyman (2006), for instance, deny the existence of stress below the syllabic level. And while it is clear that foot structure must be distinctive in lexical stress languages (simply

because stress is), I guess they would also deny the existence of distinctive foot structures of the type ('σ)σ vs. ('σσ) right away. (I can only guess here, because the question of whether foot structure can make the difference while stress is in the *same* place has never been asked to the best of my knowledge.)

Notice, however, that this is not an exclusive position, let alone the necessarily correct one. Halle (1990), Prince (1983), and Kager (1993), for instance, assume that moraic trochees are (nearly) universally stressed on their first mora; and Kager's analysis of Chugach Alaskan Yupik is an almost perfect iambic parallel to my trochaic analysis of Franconian, with the exception that syllabic iambs are underlyingly (LL), and only synchronically lengthen to (LH). From a crosslinguistic perspective, rule-based systems making use of "true" moraic trochees or iambs do not seem to be exceedingly rare.⁶² These systems assign alternating stresses to every other mora, even at the expense of violating syllable integrity. From the perspective of standard metrical theory, these languages are often classified as "pitch accent" languages (but different tonal contours are a necessary consequence of moraic stress, of course), or discussed away by assuming that moraic stress on, e.g. ['aa] vs. [a'a], results from bisyllabicity at some earlier derivational level (see Hayes 1995: 122, on Southern Paiute).

As for distinctive foot structure, I am convinced that other European tonal accent languages are similar to Franconian in contrasting things like ('σ)σ and ('σσ) (Swedish–Norwegian and Štokavian), or even ('μμ) vs. ('σ) (Lithuanian, Čakavian). While tonal approaches represent the standard views on these languages too, structural analyses have always been around, and some come very close to my foot-based approach of Franconian, e.g. Liberman's (1982) discussion of the "two-syllable law" (Swedish–Norwegian) and the "two-mora law" (Danish), Dogil & Williams' (1999) description of Lithuanian accent 1 ("acute") as a first-mora stress vs. accent 2 ("circumflex") as a syllabic stress, or Morén's (2007) foot-based analysis of Central Swedish accent 1 and 2.

I do not pretend to have solved all problems of Franconian tonal accents here. I hope to have shown though that lexical tones are not the only way to deal with these systems. In any case, if I had to think of a language that contrasts moraic trochees and syllabic trochees, it would certainly sound like the dialect of Cologne. And if Universal Grammar is right, there is a good chance that other languages out there do the same, for if you can do it in Cologne, you can do it everywhere.

⁶² Ponapeian (Kennedy 2003) and Proto-Micronesian (Rehg 1993); Southern Paiute (Sapir 1930, Cairns 2002) and Proto-Uto-Aztecan (Munro 1977), Banawá (Buller, Buller & Everett 1993), to name but a few.

References

- Bach, Adolf. 1921. Die Schärfung in der Moselfränkischen Mundart von Arzbach (Unterwesterwaldkreis). *Beiträge zur Geschichte der deutschen Sprache und Literatur* 45, 266–290.
- Baldes, Heinrich. 1895. *Die Birkenfelder Mundart. Ein Beitrag zur Kenntnis des Südmittelfränkischen*. Birkenfeld: Hoestermann.
- Becker, Michael & Peter Jurgec (this volume): Interactions of tone and ATR in Slovenian.
- Becker, Lee. 1978. *The effects of the fall of the jers on the prosodic system of Proto-Serbo-Croatian*. Urbana-Champaign, IL: University of Illinois dissertation.
- Boersma, Paul & David Weenink. 1992–2007. *Praat: doing phonetics by computer*.
- Boersma, Paul. 2006. *The history of the Franconian tone contrast*. Manuscript, University of Amsterdam.
- Boersma, Paul (this volume). The history of the Franconian tone contrast.
- Bremer, Otto. 1927. Der Schleifton im Nordniedersächsischen. *Niederdeutsches Jahrbuch* 53, 1–32.
- Bruce, Gösta & Ben Hermans. 1999. Word tone in Germanic languages. In Harry van der Hulst (ed.), *Word prosodic systems in the languages of Europe*, 605–658. Berlin: Mouton de Gruyter.
- Bruch, Robert. 1954. *Das Luxemburgische im Westfränkischen Kreis* (Publications Littéraires et Scientifiques du Ministère de l'Éducation Nationale 2). Luxemburg: P. Linden.
- Buller, Barbara, Ernest Buller & Daniel L. Everett. 1993. Stress placement, syllable structure, and minimality in Banawá. *International Journal of American Linguistics* 59(3), 280–293.
- Cairns, Chuck. 2002. *Foot and syllable in Southern Paiute*. Ms, City University of New York.
- De Lacy, Paul. 2002. *The formal expression of markedness*. Doctoral dissertation, University of Massachusetts, Amherst.
- D'Imperio, Mariapaola, Caterina Petrone & Noë Nguyen. 2007. Effects of tonal alignment on lexical identification in Italian. In C. Gussenhoven & T. Riad (eds.), *Tones and Tunes, vol. 2. Experimental studies in word and sentence prosody*, 79–106. Berlin/New York: Mouton de Gruyter.
- Dogil, Grzegorz & Briony Williams. 1999. The phonetic manifestation of word stress. In H. van der Hulst (ed.), *Word prosodic systems in the languages of Europe*, 237–334. Berlin/New York: Mouton de Gruyter.
- Dols, Willy. 1953 [1944]. *Sittardse difftongering*. Sittard: Alberts' Drukkerijen.
- Donohue, Cathryn (this volume). Tones and vowels in Fuzhou revisited.
- Endepols, Hubert J. E. 1955. *Woordenboek of Diksjenaer van 't Mestreechs*. Maastricht: Boosten & Stols.
- Engelmann, René. 1910. Ein mittelfränkisches Accentgesetz. *Beiträge zur Geschichte der deutschen Sprache und Literatur* 36, 382–394.
- Fournier, Rachel. 2008. *Perception of the tone contrast in East Limburgian dialects* (LOT dissertation series 196). Utrecht: LOT.
- Frings, Theodor. 1913. *Studien zur Dialektgeographie des Niederrheins zwischen Düsseldorf und Aachen* (Deutsche Dialektgeographie 5). Marburg: Elwert.
- Frings, Theodor. 1916. *Die Rheinische Accentuierung; Vorstudie zu einer Grammatik der Rheinischen Mundarten* (Deutsche Dialektgeographie 19). Marburg: Elwert.
- Fry, Dennis B. 1955. Duration and intensity as physical correlates of linguistic stress. *Journal of the Acoustical Society of America* 27(4), 765–769.

- Fry, Dennis B. 1958. Experiments in the perception of stress. *Language and Speech* 1(2), 120–152.
- Gilles, Peter. 2005. *Regionale Prosodie im Deutschen: Variabilität in der Intonation von Abschluss und Weiterweisung*. Berlin/New York: de Gruyter.
- Goossens, Jan. 1977. De tweede Nederlandse Auslautverscherping. *Tijdschrift voor Nederlandse Taal- en Letterkunde* 93(1–2), 3–23.
- Goossens, Jan. 2006. Historische und geographische Randbedingungen des Genker Tonakzentsystems. In Michiel de Vaan (ed.), 35–49.
- Grabe, Esther. 1998. Pitch accent realization in English and German. *Journal of Phonetics* 26(2), 129–143.
- Grootaers, Ludovik & Jan Grauls. 1930. *Klankleer van het Hasseltsch dialect*. Leuven: De Vlaamsche Drukkerij.
- Grootaers, Ludovik. 1910. *Het dialect van Tongeren: Eene phonetisch-historische studie*. Lier/Leipzig: Harrassowitz. (Reprint from Leuvense Bijdragen 8–9)
- Gussenhoven, Carlos & Flor Aarts. 1999. The dialect of Maastricht. *Journal of the International Phonetic Association* 29(2), 155–166.
- Gussenhoven, Carlos & Jörg Peters. 2004. A tonal analysis of Cologne Schärfung. *Phonology* 21(2), 251–285.
- Gussenhoven, Carlos & Peter van der Vliet. 1999. The phonology of tone and intonation in the Dutch dialect of Venlo. *Journal of Linguistics* 35(1), 99–135.
- Gussenhoven, Carlos. 2000. The lexical tone contrast of Roermond Dutch in Optimality Theory. In M. Horne (ed.), *Prosody: Theory and experiment. Studies presented to Gösta Bruce*, 129–167. Dordrecht/Boston/London: Kluwer.
- Halle, Morris. 1990. Respecting metrical structure. *Natural Language and Linguistic Theory* 8(2), 149–176.
- Halle, Moris & Jean-Roger Vergnaud. 1987. *An essay on stress*. Cambridge, MA: MIT Press.
- Hanenberg, Albert. 1915. *Studien zur niederrheinischen Dialektgeographie zwischen Nymegen und Ürdingen* (Deutsche Dialektgeographie 8, 177–277). Marburg: Elwert.
- Hanssen, Judith. 2005. *Tone and intonation in the dialect of Sittard*. Nijmegen: MA thesis.
- Hanssen, Judith, Jörg Peters & Carlos Gussenhoven. 2007. Phrase-final pitch accommodation effects in Dutch. Talk presented at ICPHS XVI, Saarbrücken.
- Hasenclever, Max. 1904. *Der Dialekt der Gemeinde Wermelskirchen*. Marburg: Inaugural-Dissertation.
- Hayes, Bruce. 1995. *Metrical stress theory*. Chicago: University of Chicago Press.
- Heijmans, Linda. 1999a. Lexical tone in the Dutch dialect of Weert? *Proceedings of the 14th International Congress of Phonetic Sciences*, 2383–2386.
- Heijmans, Linda. 1999b. The lexical tone contrast of the dialect of Tongeren. Paper presented at the Workshop on Tone, Schloss Freudental, December 1999.
- Heijmans, Linda. 2003. The relationship between tone and vowel length in two neighboring Dutch Limburgian dialects. In Paula Fikkert & Haike Jacobs (eds.), *Development in Prosodic Systems*, 7–45. Berlin/New York: de Gruyter.
- Heike, Georg. 1962. Suprasegmentale Merkmale der Stadtkölner Mundart. Ein Beitrag zur 'Rheinischen Schärfung'. *Phonetica* 8(1–3), 147–165.
- Heike, Georg. 1964. *Zur Phonologie der Stadtkölner Mundart. Eine experimentelle Untersuchung der akustischen Unterscheidungsmerkmale*. Marburg: Elwert.
- Heike, Georg (undated). *Tonakzente in der Stadtkölner Mundart – Merkmale und Funktion*. Ms.
- Hermans, Ben. 1994. *The composite nature of accent: with case studies of the Limburgian and Serbo-Croatian pitch accent*. Amsterdam: Free University of Amsterdam Dissertation.

- Hombert, Jean-Marie, John J. Ohala & William G. Ewan. 1979. Phonetic explanations for the development of tones. *Language* 55(1), 37–58.
- Hombert, Jean-Marie. 1977. Development of tones from vowel height. *Journal of Phonetics* 5(1), 9–16.
- Hombert, Jean-Marie. 1978. Consonant types, vowel quality and tone. In Victoria A. Fromkin (ed.), *Tone: A linguistic review*, 77–112. New York: Academic Press.
- Hyman, Larry. 2006. Word prosodic typology. *Phonology* 23(2), 225–257.
- Jongen, René. 1972. *Phonologie der Moersener Mundart. Eine Beschreibung der segmentalen und prosodischen Wortformdiakrise*. Assen: Van Gorcum.
- Kager, René. 1993. Alternatives to the iambic-trochaic law. *Natural Language and Linguistic Theory* 11(3), 381–432.
- Kats, Joannes C. P. 1985. *Remunjs waordeboek*. Roermond: Van der Marck.
- Kehrein, Wolfgang. 2007. Moraic stress in Franconian – and elsewhere. Talk presented at Phonetics & Phonology 4, Nijmegen.
- Kennedy, Robert. 2003. *Confluence in Phonology: Evidence from Micronesian reduplication*. Tucson, AZ: The University of Arizona dissertation.
- Kiparsky, Paul. 1973. The inflectional accent in Indo-European. *Language* 49(4), 794–849.
- Kiparsky, Paul (this volume). Livonian stød.
- Köhnlein, Björn. 2011. *Rule reversal revisited. Synchrony and diachrony of tone and prosodic structure in the Franconian dialect of Arzbach*. (LOT dissertation series 274). Utrecht: LOT.
- Köhnlein, Björn (this volume). Synchronic alternations between monophthongs and diphthongs in Franconian: a metrical approach.
- Ladd, Robert, Ineke Mennen & Astrid Schepman. 2000. Phonological conditioning of peak alignment in rising pitch accents in Dutch. *Journal of the Acoustical Society of America* 107(5), 2685–2696.
- Lahiri, Aditi, Tomas Riad & Haike Jacobs. 1999. Diachrony. In Harry van der Hulst (ed.), *Word prosodic systems in the languages of Europe*, 335–422. Berlin: Mouton de Gruyter.
- Leihener, Erich. 1908. *Cronenberger Wörterbuch mit ortsgeschichtlicher, grammatischer und dialectgeografischer Einleitung* (Deutsche Dialektgeographie 2). Marburg: Elwert.
- Liberman, Anatoly. 1982. *Germanic Accentology, Volume 1. The Scandinavian Languages*. Minnesota Publications in the Humanities. Minneapolis: University of Minnesota Press.
- Liberman, Anatoly. 1999. *Schärfung/stoottoon and trägheitsakzent/sleeptoon* in the Rhein-Limbourg area and their Scandinavian analogues. In Edgar C. Polomé & Carol F. Justus (eds.), *Language change and typological variation. In honor of Winfred P. Lehmann on the occasion of his 83rd birthday*, vol. I: *Language change and phonology*, 275–298. Washington: Institute for the Study of Man.
- Liberman, Anatoly. 2002. From the history of closed vowels in Germanic. In Irmengard Rauch, Gerald F. Carr (eds.), *New insights in Germanic linguistics III*, 137–176. New York et al.: Lang.
- Lobbes, Otto. 1915. *Nordbergische Dialektgeographie* (Deutsche Dialektgeographie 8, 1–80). Marburg: Elwert.
- Maddieson, Ian. 1978. Universals of tone. In Joseph H. Greenberg (ed.), *Universals of human languages, Volume 2: Phonology*, 335–366. Stanford: University Press.
- Maddieson, Ian. 1997. Phonetic universals. In William J. Hardcastle & John Laver (eds.), *Handbook of phonetic sciences*, 619–639. Oxford: Blackwell.
- Maurmann, Emil. 1898. *Grammatik der Mundart von Mülheim a. d. Ruhr*. (Sammlung kurzer Grammatiken deutscher Mundarten 4). Leipzig: Breitkopf & Härtel.

- Morén, Bruce. 2007. Central Swedish Pitch Accent: a retro approach. Talk presented at OCP4, Rhodes, Greece.
- Müller, Joseph. 1900. *Untersuchungen zur Lautlehre der Mundart von Aegidienberg*. Bonn: P. Hauptmann.
- Müller, Wilhelm. 1912. *Untersuchungen zum Vocalismus der stadt- und landkölnischen Mundart*. Bonn: P. Hauptmann.
- Münch, Ferdinand. 1904. *Grammatik der ripuarisch-fränkischen Mundart*. Bonn: Cohen.
- Munro, Pamela. 1977. Towards a reconstruction of Uto-Aztec stress. In L. Hyman (ed.), *Studies in Stress and Accent* (Southern California Occasional Papers in Linguistics 4), 303–326. Los Angeles: University of Southern California.
- Neuse, Heinrich. 1915. *Studien zur niederrheinischen Dialektgeographie in den Kreisen Rees, Dinslaken, Hamborn, Mülheim, Duisburg (OG Aldemede)* (Deutsche Dialektgeographie 8, 81–116). Marburg: Elwert.
- Nörrenberg, Constantin. 1884. Ein nieder rheinisches accentgesetz. *Beiträge zur Geschichte der deutschen Sprache und Literatur* 9, 402–412.
- Nörrenberg, Constantin. 1887. Review of Diederichs, *Unsere selbst- und schmelzlaute*. *Zeitschrift für deutsches Altertum und deutsche Literatur* 19(3), 376–388.
- Oostendorp, Marc van (this volume). Tone, final devoicing, and assimilation in Moresnet.
- Palgen, Helène. 1931. *Kurze Lautlehre der Mundart von Echternach*. (Beiträge zur Luxemburger Sprach- und Volkskunde 4.) Luxemburg: Linden und Hansen.
- Peetz, Anna. 1989. *Die Mundart von Beuren. Phonetik und Morphologie*. Stuttgart: Franz Steiner.
- Peters, Jörg. 2004. *Regionale Variation der Intonation des Deutschen. Studien zu ausgewählten Regionalsprachen*. University of Potsdam: Habilitationsschrift.
- Peters, Jörg. 2006a. The Cologne word accent revisited. In Michiel de Vaan (ed.), 107–133.
- Peters, Jörg. 2006b. The tones of Neerpelt. Talk given at the workshop *Tonal Dialects of Dutch: Structure, Perception, Function*, 17 February 2006, Radboud University Nijmegen.
- Peters, Jörg. 2006c. The dialect of Hasselt. *Journal of the International Phonetic Association* 36(1), 117–125.
- Peters, Jörg. 2008. Tone and intonation in the dialect of Hasselt. *Linguistics* 46(5), 983–1018.
- Prince, Alan. 1983. Relating to the grid. *Linguistic Inquiry* 14(1), 19–100.
- Ramisch, Jacob. 1908. *Studien zur niederrheinischen Dialektgeographie* (Deutsche Dialektgeographie 1). Marburg: Elwert.
- Rehg, Kenneth. 1993. Proto-Micronesian Prosody. In Jerold A. Edmondson & Kenneth J. Gregerson (eds.), *Tonality in Austronesian Languages*, 25–46. Honolulu: University of Hawaii Press.
- Reitz, Guido. 1985. *Die Rheinische Akzentuierung im Morbacher Platt*. Ms., Morbach.
- Reuter, Hermann. 1903. *Beiträge zur Lautlehre der Siegerländer Mundart*. Halle: Ehrhardt Karras.
- Rice, Curtis. 1988. Stress Assignment in the Chugach Dialect of Alutiiq. *Chicago Linguistic Society* (CLS) 24(1), 304–315.
- Sapir, Edward. 1930. *Southern Paiute: a Shoshonean Language*. (Proceedings of the American Academy of Arts and Sciences 65).
- Schmidt, Jürgen Erich & Herman J. Künzel. 2006. Das Rätsel löst sich: Phonetik und sprachhistorische Genese der Tonakzente im Regelumkehrgebiet (Regel B). In Michiel de Vaan (ed.), 135–163.
- Schmidt, Jürgen Erich. 1986. *Die mittelfränkischen Tonakzente (Rheinische Akzentuierung)*. Stuttgart: Franz Steiner.

- Schmidt, Jürgen Erich. 2002. Die sprachhistorische Genese der mittelfränkischen Tonakzente. In Peter Auer, Peter Gilles & Helmut Spiekermann (eds.), *Silbenschnitt und Tonakzente*, 201–233. Tübingen: Niemeyer.
- Stevens, André. 1955. Intonatieproblemen in en om West-Limburg I. *Taal en Tongval* 7, 135–142.
- Svantesson, Jan-Olof. 1988. U. *Linguistics of the Tibeto-Burman Area* 11, 64–133.
- Vaan, Michiel de. 1999. Towards an explanation of the Franconian tone accents. *Amsterdamer Beiträge zur Älteren Germanistik* 51, 23–44.
- Vaan, Michiel de (ed.). 2006. *Germanic tone accents*. (Zeitschrift für Dialektologie und Linguistik – Beihefte 131.) Wiesbaden: Franz Steiner.
- Ven, Marco van de & Carlos Gussenhoven. 2011. On the timing of the final rise in Dutch falling–rising intonation contours. *Journal of Phonetics* 39(2), 225–236.
- Welter, Wilhelm. 1929. *Studien zur Dialektgeographie des Kreises Eupen* (Rheinisches Archiv 8). Bonn: Ludwig Röhrscheid Verlag.
- Welter, Wilhelm. 1933. *Die niederfränkischen Mundarten im Nordosten der Provinz Lüttich*. Den Haag: Martinus Nijhoff.
- Welter, Wilhelm. 1938. Beobachtungen zum kleverländischen Akzent. *Beiträge zur Geschichte der deutschen Sprache und Literatur* 62(3), 437–454.
- Werth, Alexander. 2011. *Perzeptionsphonologische Grundlagen der Prosodie: Eine Analyse der mittelfränkischen Tonakzentdistinktion*. (Zeitschrift für Dialektologie und Linguistik – Beihefte 143.) Stuttgart: Steiner.
- Wiesinger, Peter. 1983. Dehnung und Kürzung in den deutschen Dialekten. In Werner Besch, Ulrich Knoop, Wolfgang Putschke & Herbert Ernst Wiegand (eds.), *Dialektologie. Ein Handbuch zur deutschen und allgemeinen Dialektforschung*. Zweiter Halbband, 1088–1111. Berlin: De Gruyter.
- Wrede, Ferdinand. 1895. Die Entstehung der nhd. Diphthonge. *Zeitschrift für deutsches Altertum und deutsche Literatur* 27, 257–301.
- Xu, Yi. 1999. Effects of tone and focus on the formation and alignment of f_0 contours. *Journal of Phonetics* 27(1), 55–105.
- Yip, Moira. 2002. *Tone*. Cambridge: University Press.

Paul Kiparsky
Livonian stød

1 Stød

During a brief encounter with a Livonian sailor on the Copenhagen waterfront, Vilhelm Thomsen noticed in his speech a prosodic feature, found in no other Balto-Finnic language, which he instantly identified with the stød of his own native Danish.¹ In the few hours that he was able to spend with the seaman, Thomsen accurately identified the essentials of the Livonian stød's distribution, noting that it occurs in heavy syllables that end in what he called a "sonant coefficient" and that it interacts with quantitative gradation in morphological paradigms. His observations, which appeared as a last-minute addendum to his famous *Berøinger* (Thomsen 1890: 58–63), were confirmed and extended through extensive work on Livonian by Finnish linguists in the interwar decades. They produced a magnificent Livonian dictionary, from which most of the data in my paper is drawn (Kettunen 1938), a series of instrumental phonetic studies (Kettunen 1925, Posti 1936, Posti 1937, Penttilä & Posti 1941), and two historical grammars (Posti 1942, Kettunen 1947). Vihman (1971) and Suhonen (1982) contributed additional observations on the phonetics of stød. Wiik (1989) summarizes all this previous research, and discusses the stød's phonological interpretation and origin. Unfortunately all further inquiry into Livonian prosody will have to make do with the existing data because the language is now on the brink of extinction.²

The Livonian stød appears on stressed VV or VC syllables, where C is a voiced consonant (the same configuration as the "stød base" of Danish). Following Wiik, I will write it with an apostrophe after the first vocalic mora, e.g. *ro'o* 'money', *ka'lla* 'fish' (part.sg.).

Stød is contrastive on stressed CVV and CVVC syllables, in monosyllabic as well as polysyllabic words. It is also contrastive on stressed nonfinal CVC syllables. A selection of minimal pairs is given in (1).³

1 This material was presented in 1995 at Konstanz and at the TREND phonology workshop in Santa Cruz.

2 In 2000 I had the opportunity of interviewing and recording three stalwart Livonian speakers, Elfrida Žagare, Viktors Bertholds, and Pauline Kļaviņa. I am grateful to Karl Pajusalu and Tiit-Rein Viitso for making this possible, and to the National Academy of Sciences for its financial support.

3 For another list of minimal pairs, see Posti 1936.

(1) Stød contrasts in CVV and non-final CVC syllables:

<i>No stød</i>		<i>stød</i>	
leed	'bullet'	le'ed	'leaf'
niiŋ	'bark strip'	ni'iŋ	'wide belt'
moo	'earth'	mo'o	'down, earthwards'
uudə	'to fry'	u'udə	'to strain'
puustə	'tree' (elat.sg.)	pu'ustə	'to clean'
puugə	'to hang (execute)'	pu'ugə	'to blow'
jùodə	'to drink'	ju'odə	'to lead'
kallə	'island' (part.sg.)	ka'llə	'fish' (part.sg.)
kwoñnə	'frog' (part.sg.)	kwo'nnə	'at home'
vañnə	'to swear'	va'nnə	'old' (part.sg.)
pa'llə	'to pray'	pa'llə	'piece' (part.sg.)

In monosyllabic CVC words, on the other hand, stød is obligatory, hence noncontrastive.

- (2) a. *va'l* 'light', *me'r* 'sea'.
 b. Impossible words: **val*, **mer*.

Uncontroversially, stød is manifested by a combination of phonetic cues, involving at least pitch, length, and voice quality (Kettunen 1938: XXI). According to Vihman (1971), intensity is also a factor.

- (3) Phonetic reflexes of stød
 a. Falling pitch contour.
 b. Markedly shorter duration of the stressed syllable or foot.
 c. Highly variable glottalization, ranging from no audible glottal effect up to, rarely, a complete glottal stop.
 d. Decreasing intensity.

The published data shows particularly clearly that syllables with and without stød contrast in pitch and duration. Figure 1 reproduces the Penttilä & Posti's (1941) cathode ray oscillograms of the minimal pair *leed*, 'sphere' (above) and *le'ed*, 'leaf' (below). Figure 2, from Wiik (1989), gives the average three-point F_0 contour for Penttilä & Posti's (1941) eight stød (*katkointonaatio*) and six non-stød ("rising", *nousuintonaatio*) cases, measured at the beginning of the stressed nucleus, at its highest point, and at its end.

However, pitch and duration have most often been considered secondary features of Livonian stød. Posti (1941) considered glottal constriction to be its distinctive feature. More recent structuralist approaches tend to shift the focus from the stød's phonological substance to its structural and functional role in the system. Vihman (1971: 76) argues that stød is "an inherent or underlying feature of Livonian, occurring in the lexical shape of roots". Wiik (1989), on the other hand, claims that is predictable

Fig. 1: *leed* versus *le'eq* (from Penttilä & Posti 1941).

Fig. 2: Averaged three-point contours of stød and non-stød nuclei (from Wiik 1989).

from underlying representations. He considers it a prosodic signal that serves to mark a syllable boundary, or the site of a former or underlying syllable boundary.⁴

The question of the phonetic and phonological nature of *stød* is of course intimately related to the question of its origin, and the notion of the phonological primacy of its glottal component may be rooted in hypotheses about its history. Thus, Kettunen and Vihman suggest that *stød* first arose as a reflex of *h* in words like *raha* > *ro'o* 'money'. And, in line with a popular account of Danish *stød*, Posti suggests that it developed as a glottal stop from rising pitch which arose when the following syllable was lost. On Wiik's account, *stød* arose by phonologization of syllable boundaries, though he is non-committal about exactly what phonological entities the syllable boundaries were phonologized as.

In my view, Livonian *stød* is a fundamentally tonal phenomenon. I analyze it as a falling (HL) tone, and show how it is regularly derived in any of several ways, the common thread of which is that a short High-toned syllable acquires a second, Low-toned mora. On this interpretation, the glottal constriction and shortening that often accompany *stød* are phonetic enhancements of the distinctive falling pitch contour. After showing how this hypothesis handles the simpler cases, I address the relation between *stød* and other prosodic alternations of Livonian, specifically the quantitative gradation processes which lie at the heart of the language's morphophonology.

Throughout this article, my transcription of Livonian essentially follows that of Wiik (1989).

- (4) – Length without *stød*: VV, CC. E.g. *uudā* 'to fry', *pəərānd* 'floor', *oppātta* 'teach'.
- Length with *stød*: V'V, V'C. E.g. *ro'o* 'money', *ka'llā* 'fish' (part.sg.).
- Half-length: $\hat{V}$, $\hat{C}$. E.g. *kalā* 'fish', *oppātta* 'teach', *vi'rbā* 'rod' (part.sg.), *vi'llā* 'wool' (part.sg.), *pəp* 'flax chaff'.
- Palatalization: $\check{s}, \check{z}, \check{d}, \check{t}, \check{n}, \check{l}, \check{r}$. E.g. /puu+d+i/ → *puuḑi* 'tree' (part.pl.), /puu+st+i/ → *puuṣṭi* (elat.pl.), /jalga+d+i/ *jaḷgži* 'foot' (illat.pl.).

2 Deriving *stød*: the simple cases

In this section I show that the core generalizations about the distribution of Livonian *stød* follow from three assumptions.

- (5) – A voiced moraic segment is tone-bearing.
- The *stød* is a falling tone (HL).

⁴ In an extensive treatment of the Danish *stød*, Liberman (1982: 286) comes to the conclusion that it marks a boundary between the two moras of a long syllable.

- It arises when a short stressed syllable, bearing High tone, acquires a second tone-bearing mora which bears Low tone.

Let us review the various paths by which the HL tone that constitutes the distinctive property of stød can come about. What syllables would be High, and what syllables would be Low? In what ways can a short syllable acquire a second tone-bearing mora? And how does this originally redundant tonal contour become contrastive?

I begin with the assumption that redundant tone is assigned to tone-bearing (voiced) segments on the basis of stress, which always falls on the first syllable.

- (6) A tone-bearing segment is High in a stressed syllable, Low otherwise.

Diachronically, the assignment of these tones took place before the operation of a series of sound changes that profoundly affected the syllable and foot structure of the language. These sound changes resulted in the reassignment of unstressed (and hence Low-toned) segments to stressed (and hence High-toned) syllables. *This is the origin of stød.*

Perhaps the simplest case is apocope, the loss of a word-final nonlow vowel. The rise of stød by apocope can be illustrated with the derivation of monosyllabic noun forms, such as Nom.Sg. *su'g* 'relative' and *pi'ŋ* 'dog'. They come historically from disyllabic bases, such as /sugu/, /pini/. A case can be made that they are underlyingly disyllabic synchronically as well. Their second syllable surfaces in inflected forms, e.g. Nom. Pl. *sugùd*, *piŋid* (where the palatalization of the nasal, and the half-length on the second syllable, are due to obligatory phonetic processes). However, nailing down this synchronic analysis would require a more thorough treatment of the morphophonological alternations than I am able to offer here. For now, what follows is intended primarily as a historical account of the genesis of Livonian stød.

The derivation of *su'g* according to the proposed analysis is given in (7).

- (7) Apocope: /sugu/ → *su'g*

The idea is that apocope causes the onset of the second syllable to become a coda, which is tone-bearing since it is voiced, and gets Low tone by default. The resulting HL combination is stød.

When the apocopated vowel is *-i*, a copy of it can be retained *before* the consonant if that consonant is a velar, labial, or palatal (Kettunen 1938: XXVIII).

- (8) a. **susi* > *su'iž* or *suž* 'wolf'
 b. **joki* > *jo'ig* or *jo'g* 'river'
 c. **lumi* > *lu'im* or *lu'm* 'snow'

In Livonian, coronals are palatalized before *-i*, and the resulting palatalized fricatives become ordinary palatals *š*, *ž*. Therefore the metathesis in (8) is probably really a migration of the palatal gesture from the *-i* to the palatalized consonant, and, when the consonant becomes depalatalized, optionally onward to the preceding nucleus as a transitional glide, viz. *lumi* → *lu'm̥* → *lu'im*. This of course assumes that palatalization at an earlier stage applied to labials and velars as well as coronals. On these assumptions, *stød* formation in "metathesis" reduces to the apocope case described above.

- (9) "Metathesis": *lumi* → *lu'm̥* → *lu'im*

Medial syncope works essentially in same way as final apocope. An example is the addition of the Partitive Plural ending */-idi/* to vocalic stems. The combination */sugu-idi/*, undergoes vowel contraction and the resulting medial vowel is optionally deleted: */sugu-idi/* → *sugidi* → *su'gḑi* ~ *sugiḑi* 'of relatives'. Let us consider the two pronunciations in turn. On the first option, where medial syncope applies, *stød* is obligatorily assigned to the first syllable. The reason is that, as a result of syncope, the first syllable contains two tone-bearing moras, of which the first has High tone and the second has Low tone.

- (10) Syncope: */sugu-idi/* → *sugidi* → *sugiḑi* ~ *su'gḑi*.

On the second option, where medial syncope does not apply, the first syllable remains monomoraic, and no stød occurs. In this variant, the second syllable is lengthened (it becomes “half-long”, in traditional Fennist terminology). The conditions that trigger this lengthening will be specified below.

Another way in which a Low-toned mora can become adjoined to a High-toned syllable is the deletion of a medial consonant. A medial *h* is regularly deleted, and contraction of the resulting hiatus yields a heavy syllable with stød:

- (11) *h*-deletion in medial onset: **raha* > *ro'o*, **mihet* > *mi'ed* ‘men’ (Nom.Pl.)

On this understanding, the stød is not at all a laryngeal reflex of the lost *h* (as Kettunen supposed), but rather a continuation of the word's pre-contraction tone contour.

It should now be obvious why an original long vowel *never* receives stød. Its two moras will always have the same pitch, which will be High in a stressed syllable:

- (12) Original long vowel: *maa*

Yet another source of stød is assimilation of coda *h* (or its deletion with compensatory lengthening of the nucleus):

- (13) *h*-deletion in coda: *puhdas* → *pu'udəz*, *vihma* → *vi'ima* (→ *vi'im*)

The *h* is unvoiced (at least phonologically), and therefore not tone-bearing. When it is replaced by the moraic *u* (whether this happens by assimilation or by deletion plus compensatory lengthening is immaterial for the analysis) it instantly becomes tone-bearing, at which point it acquires a default Low tone, which combines with the preceding *H* into *HL* as before.

Slightly more complex is the explanation for words of the type *ka'ggəl* 'neck', *a'ddərz* 'plow', *ka'ggər* 'oats', *ka'bbər* 'goat', *da'ggəl* 'tinder'. They are historically from CVCRV stems: **kagla*, **adra*, **kagra*, **kabra*, **tagla*. The -CR- cluster was apparently first syllabified as an onset, to which gemination then applied, accompanied by reduction of the second syllable.

(14) **kagla* → *ka'ggla* → *ka'gglə* → *ka'ggl* → *ka'ggəl*

Recall that CVC monosyllables have predictable *stød*. We now have the explanation for this regularity in hand. Balto-Finnic, like modern Finnish, had no monosyllabic /CVC/ nouns, verbs, or adjectives. The reason is that word-final -C was not weight-bearing, so that /CVC/ words could not satisfy foot minimality, hence could not bear lexical stress, as required for content words. Only function words, which need not bear a lexical stress, could have this shape. The existing CVC content words of Livonian are therefore not original, but derived from CVCV words by apocope. The apocope resulted in *stød* as just explained.

I now turn to the harder cases, which involve the interaction of *stød* with quantitative gradation in inflectional paradigms.

3 Quantitative Gradation

The examples in (15) show that a consonant after an originally short stem vowel is lengthened in the partitive singular.

(15)	Nom.Sg.	Part.Sg.	
a.	<i>vorà</i>	<i>vo'rrə</i>	'pin'
	<i>vadà</i>	<i>va'ddə</i>	'trawling net'
	<i>vigà</i>	<i>vi'ggə</i>	'fault, disease'
b.	<i>metsà</i>	<i>me'tsə</i>	'forest'
	<i>mustà</i>	<i>mu'stə</i>	'black'
	<i>vakkà</i>	<i>va'kkə</i>	'bushel'
c.	<i>viirba</i>	<i>vi'rbə</i>	'rod'
	<i>voontsa</i>	<i>von'tsə</i>	'forehead'
	<i>uurma</i>	<i>u'rmə</i>	'rapids, stream'
	<i>kùoltta</i>	<i>kwòl'ttə</i>	'shore'
d.	<i>siig</i>	<i>siigə</i>	'whitefish'
	<i>riist</i>	<i>riistə</i>	'dish'

When the postvocalic consonant is an onset, as in (15a), this lengthening takes the form of gemination: a moraic copy of it gets affiliated with the preceding syllable as a coda. Since all short intervocalic consonants in Livonian are voiced, the geminate is always voiced, and thus capable of bearing tone; hence the resulting heavy syllable gets stød. The postvocalic consonant is also lengthened when it is a coda. In a coda, the lengthening is manifested as so-called half-length, marked with the traditional grave accent in (15b,c).

In those forms where this consonant lengthening does not apply, such as the nominative in (15), a vowel lengthening process takes effect instead. In (15a,b), it applies to the word-final vowel, rendering it half-long (marked by a grave accent), and hence unreduced. A different site of vowel lengthening is seen in (15c), when the coda is a sonorant. Where the sonorant is not lengthened, as in the nominative, the vowel before it is lengthened instead.

The upshot is that any word whose stressed vowel is short gets lengthened phonetically somewhere. Which of the three sites of lengthening is chosen depends on the conditions just stated. Furthermore, every stressed CVR syllable (R = a sonorant) ends up lengthened phonetically, with the extra length residing either on the R or on the V, depending on the gradation environment.

After a long vowel, no consonant lengthening occurs, as illustrated in (15d).

To discern the processes that underlie these length alternations, and to see how they relate to the stød, let us examine the additional data in (16), where the original forms of the stems and endings are also indicated. The table gives the partial inflectional paradigms of some representative nouns (based on Kettunen 1938).

(16)			*kala	*jalka	*suku	*pini	*lampas
Sg.	Nom.	*-Ø	kalà	jaalga	su'g	piṇ	laambaz
	Dat.	*-na	kalàn	jaalgan	su'ggən	piṇṇən	laambən
	Part.	*-ta	ka'llə	jałgə	su'ggə	piṇ'ṇə	laambast
Pl.	Nom.	*-t	kalàd	jaalgad	sugùd	piṇid	laambəd
	Dat.	*-ten	kalàdən	jaalgadən	sugùdən	piṇidən	laambədən
	Part.	*-iti	ka'łḍi	jałg(ḍ)i	sugiḍi	piṇiḍi	laambiḍi
				su'gḍi			
			'fish'	'foot'	'relative'	'dog'	'lamb'

The data in (16) reveal two general processes, one of them morphophonological from the synchronic point of view, the other phonetic. Both are restricted to disyllabic and polysyllabic words whose first (stressed) syllable has a short vowel. By the morphophonological process, a consonant is lengthened immediately after a stressed short vowel if the following syllable has a long vowel, which is then itself reduced. This consonant lengthening process is manifested in two ways. If the consonant is intervocalic (and hence an onset), it is geminated, and if that geminate is voiced, it receives a stød (17a). If the consonant is a coda, it becomes “half-long”, always *without stød* (17b,c).

- (17) a. **kala-ta* → *kalaa* → *ka'llaa* → *ka'llə*
 b. **jalka-ta* → *jalgaa* → *jaļgaa* → *jaļgə*
 c. **lampase-na* → *lambazena* → *lambahena* → *lambaana* → *lambaan* → *laṁbən*

The second, phonetic lengthening process applies to vowels, *without ever causing stød*. This phonetic lengthening is superimposed on the output of the morphophonological processes described in the preceding paragraph. Unlike it, it is not motivated by foot structure. In fact, it tends to undo the prosodic regularities established by the morphophonological lengthening. Phonetic lengthening has again two manifestations. It applies to a stressed vowel before a tautosyllabic short sonorant. There is no vowel lengthening before half-long consonants such as (17).⁵

- (18) a. **jalka* → *jalga* → *jaalga*
 b. **jalka-na* → *jalgan* → *jaalgan*
 c. **lampas* → *lambaz* → *laambaz*

Otherwise, it applies to the next syllable, making its vowel half-long.

- (19) a. **kala* → *kalā*
 **kala-na* → *kalān*
 **pini-ten* → *piṁidən*

This lengthening applies mechanically regardless of whether the unstressed vowel is in a closed or open syllable, and regardless of whether it is word-final or medial. The following additional examples illustrate this prosodic indiscriminacy.

- (20) a. *pagānəz* 'heathen', *arāgəz* 'crow', *alābi* 'made of willow' (Nom.Sg.),
 sižālikīzi 'lizard' (Part.Pl.)
 b. *jumāl* 'god', *vazār* 'hammer', *agān* 'chaff', *parānttə* 'to heal', *perāst* 'afterwards'

Why does *stød* arise from lengthenings like those in (17a)? And why does it not arise from lengthenings such as those in (17b,c), (18), and (20)? The analysis presented above suggests an answer to these questions.

The prosodic system of Livonian (like that of the other Balto-Finnic languages, such as Finnish, Estonian, Votian, and Veps) is based on syllable weight. The basic foot in these languages is the MORAIC TROCHEE. All these languages also share the undominated constraint that words are stressed on the initial syllable. But the combination

⁵ In Estonian, this lengthening process applies not only to CVR syllables but also to CVV syllables, resulting in "overlong" vowels ("Q3"). While words of the shape *siigə* 'whitefish', *riistə* 'dish' are not lengthened in Livonian, their Estonian counterparts are.

of initial stress and moraic trochee parsing harbors a built-in conflict which becomes apparent, among other places, in every word-initial LH sequence. In such cases, something must give: either the prosodic structure, or the lexically specified quantity.⁶

- (21) a. RESOLUTION: standard Finnish and most dialects of Finnish form an initial $\acute{L}H$ foot, the RESOLVED MORaic TROCHEE;
 b. LENGTHENING: Southwestern Finnish dialects, Estonian, and Livonian lengthen $\acute{L}H$ to HH (two feet), e.g. SW Finnish *kalaa* → *kallaa*.

Thus, there are three forms of the moraic trochee, two basic ones shared by every language that uses this foot, and a third, the resolved moraic trochee, found only in some of them – for example, in Finnish, but not in Livonian.

Those languages which reject the third foot type, such as Livonian, cope with initial LH sequences in other ways, specifically by geminating the medial consonant so as to make the first syllable heavy. In Livonian, this lengthening has, among other effects, a tonal reflex: the occurrence of stød on syllables which are lengthened in response to the metrical parsing problem just described.

We are now in a position to explicate the quantitative alternations in (15) and (16). Starting with CVCV stems in *-a*, the derivation of Nom.Sg. /*kala*/ is straightforward. The final vowel is low, hence not subject to apocope. It becomes half-long at the phonetic level by the obligatory process described above (not indicated in the phonological representation).

- (23) CVCV: Nominative /*kala*/ → *kalà*

⁶ There is a third resolution, of sacrificing stress. An example is Malayalam, where words beginning LH receive stress on the second syllable, rather than on the first, as other words do (Mohanani 1986). As far as I know, no Balto-Finnic language resorts to this solution.

The Partitive /kala+a/, however, (which historically comes from **kala+da*) cannot be parsed as a canonical moraic trochee. The initial stressed syllable must either be a degenerate (one-mora) foot of its own, or the head of a resolved (three-mora) foot comprising the whole word. Either analysis will yield the desired result for us. Evidence from other Balto-Finnic languages indicates a resolved foot (Hanson and Kiparsky 1996), so let us assume that this is what Livonian originally started out with.

(24) CVCV+V: Partitive /kala+a/

What then happened in Livonian (as well as in some other Balto-Finnic dialects, such as South-western Finnish) is that this marked prosodic structure was repaired by stretching the word into two two-mora syllables, each of which is parsed as a moraic trochee.

(25) CVCV+V: Partitive /kala+a/ → ka'lla (first stage)

Here is the familiar scenario for derived HL contours again, reached by yet another route. The originally non-moraic onset consonant spawns a moraic coda, which, being voiced, is tone-bearing and so must be specified for tone. Having no High tone, it is assigned Low tone by default.

In Livonian, however, the new coda triggered an independently motivated constraint of the language which requires defooting after a heavy initial syllable.

(26) CVCV+V: Partitive /kala+a/ → ka'lla (second stage)

As an example of medial consonant clusters, we take /virba/ ‘stick, pole’. In the derivation of the nominative *viirba*, I assume that the bimoraic foot requirement imposes a non-moraic parse on the coda consonant.

(27) CVCCV: Nominative /virba/ → *viirba*

The stressed vowel is then lengthened at the phonetic level as outlined earlier (not indicated in the above phonological representation). The analysis correctly predicts that this phonetic lengthening does *not* trigger stød.

In the derivation of the partitive *viirbə*, from **virbaa* < **virba+da*), the second syllable is long. In this case, the bimoraic foot requirement is satisfied by making the first syllable's coda moraic, so that each syllable can be parsed as a foot. The coda consonant is then lengthened, and the second foot reduced, as discussed above.

(28) CVCCV+V: Partitive /virba+a/ → *viirbə*

Again, these changes have no tonal repercussions, as predicted. The derivation of Nominative *metsà* from /metsa/ and Partitive *meṭsa* from /metsa+a/ is entirely parallel as far as the morphophonology is concerned. The only difference is that here the postvocalic consonant is voiceless, so that the phonetic vowel lengthening applies to the second syllable rather than to the first. This lengthening has no tonal effect either.

The upshot is that quantitative gradation is the result of imposing the bimoraic foot template at the phonological level. This is achieved by parsing a syllable with a short vowel as

- monomoraic if the following syllable is light, and
- bimoraic if the following syllable is heavy.

The phonetic (half-)lengthenings mask this simple system of quantitative gradation on the surface.

Finally: what is the historical relationship between the Livonian stød and the identical or at least very similar “Stosston” intonation of the coteritorial Latvian language? Almost certainly one of them got it from the other. The languages have influenced each other in many ways, in both directions.⁷ But which way did the influence go in this case? Scholarly opinion on this question is divided. Thomsen (1890: 59) and Kettunen (1925: 4) thought that Livonian had borrowed the stød from Latvian, whereas Posti (1942: 325) thought that Latvian got it from Livonian. My conclusion that the Livonian stød is a tonal feature is more consonant with the former view. Livonian is the *only* Finno-Ugric language known to have a tonal or pitch accent, while it is a feature of several branches of Indo-European, including Balto-Slavic in particular. On the hypothesis that Livonian got its stød under the influence of Latvian, we account for the Livonian stød by language contact, and for the Latvian stød as a Baltic inheritance. On the reverse hypothesis, Livonian just happened to phonemicize its redundant falling pitch as stød, for no particular reason. This is, of course, possible. Tonal contrasts sometimes do arise by secondary split through syllable structure changes without either “priming” (Kiparsky 1995) or language contact — an example is Barra Gaelic (Bosch & de Jong 1997). However, the phonemicization of a redundant pitch contrast is not an everyday event, and a motive or trigger for such a change should always be sought.

References

- Bosch, A.R.K. & K.J. de Jong. 1997. The prosody of Barra Gaelic epenthetic vowels. *Studies in the Linguistic Sciences* 27, 1–16.
- Hanson, Kristin & Paul Kiparsky. 1996. A parametric theory of poetic meter. *Language* 72, 287–335.
- Kettunen, Lauri. 1925. *Untersuchung über die livische Sprache I. Phonetische Einführung. Sprachproben*. Tartu.
- Kettunen, Lauri. 1938. *Livisches Wörterbuch*. Helsinki: Suomalais-Ugrilainen Seura.
- Kettunen, Lauri. 1947. *Hauptzüge der livischen Laut- und Formengeschichte*. Helsinki: Suomalais-Ugrilainen Seura.
- Kiparsky, Paul. 1995. The phonological basis of sound change. In John Goldsmith (ed.) *Hand-book of phonological theory*, 640–670. Oxford: Blackwell.

7 The Livonians were a powerful nation in medieval times; on old maps, the entire Baltic region is labeled “Livonia”.

- Liberman, Anatoly. 1982. *Scandinavian accentology: Volume 1. The Scandinavian languages*. Minneapolis: University of Minnesota Press.
- Mohanan, K.P. 1986. *Lexical Phonology*. Dordrecht: Kluwer.
- Penttilä, Aarni & Lauri Posti. 1941. Über die steigende und sog. Stossintonation im Livischen. *Finnisch-Ugrische Forschungen* 27, 235–272.
- Posti, Lauri. 1936. Liivin kielen intonaatiosta. *Virittäjä* 40, 314–326. Posti, Lauri. 1937. Lisää liivin kielen intonaatiosta. *Virittäjä* 41, 189–200.
- Posti, Lauri. 1942. *Grundzüge der livischen Lautgeschichte*. Helsinki: Suomalais-Ugrilainen Seura.
- Suhonen, Seppo. 1982. Über die Quantität der livischen Vokale. *Voces amicorum Sovijärvi*. Helsinki: Suomalaisen Kirjallisuuden Seura.
- Thomsen, Vilhelm. 1890. *Berøringer mellem de finske og de baltiske (litauisk-lettiske) Sprog*. Copenhagen: Bianco Lunos Kgl. Hof-Bogtrykkeri (F. Dreyer).
- Vihman, Marilyn. 1971. Livonian phonology. With an appendix on stød in Danish and Livonian. Ph.D. Dissertation, University of California, Berkeley.
- Wiik, Kalevi. 1989. *Liivin katko*. Turku: Turun Yliopisto. Helsinki: Suomalaisen Kirjallisuuden Seura.

Björn Köhnlein

Synchronic alternations between monophthongs and diphthongs in Franconian tone accent dialects: a metrical approach

Abstract: This paper proposes a synchronic analysis of vowel splits between diphthongs and monophthongs in Franconian tone accent dialects (spoken in parts of Belgium, Germany, and the Netherlands). In some dialects, the tonal contrasts between Accent 1 and Accent 2 are accompanied by vocalic oppositions. On the basis of data from Maastricht and Sittard Franconian, I argue that a unified phonological analysis of these related phenomena (tone, vowel quality) is possible if we assume that the accents differ in their metrical structure: Accent 1 is represented as a disyllabic foot, Accent 2 as a monosyllabic foot.

1 Introduction

Diphthongization is a common process across languages. To this point, the phenomenon has mostly been studied from a diachronic or purely representational viewpoint: some relevant papers discuss which diachronic changes are possible and which are not from a theoretical point of view and / or how diphthongs might be represented synchronically (see e.g. Schane 1984; Booij 1989; Hayes 1990; Harris 1995; Pöchtrager 2006; Caratini 2009). Other contributions focus on phonetic correlates that may trigger diphthongization from a diachronic / functional perspective (see e.g. Dols 1953; Goossens 1998; Peeters & Schouten 1989; de Vaan 2002; the most elaborate proposals can be found in Gussenhoven & Driessen 2004 and Gussenhoven 2007).

The phonological treatment of synchronic alternations between monophthongs and diphthongs, however, has received little attention so far (yet see e.g. Chitoran 2002 for a detailed study of alternations between monophthongs and rising diphthongs in Romanian). This paper aims to contribute to our understanding of relevant phenomena: it discusses alternations between long monophthongs and falling diphthongs in the Franconian dialects of Maastricht and Sittard.

Björn Köhnlein, The Ohio State University, koehnlein.3@osu.edu

<https://doi.org/10.1515/9783110341263-008>

In both dialects, these processes correlate with a prosodic opposition between two tone accents, which I refer to as Class 1 and Class 2. In segmental environments that show vowel splits, Class 1 items prefer falling diphthongs while Class 2 items prefer monophthongs, as in the alternation between [bleif^{c1}] ‘stay, 1st ps. sg.’ vs. [bli:və^{c2}] ‘stay, inf.’ in Maastricht (see section 2 for further data).

I argue that these vowel splits can best be derived from a difference in the foot structure of the two accent classes (Class 1 has a syllabic trochee, Class 2 a moraic trochee; see 2.2 for further discussion). Based on a representational framework developed in Köhnlein (2011), and formulated in the framework of Optimality Theory (Prince & Smolensky 1993; McCarthy & Prince 1995), I demonstrate that both the tonal as well as the segmental surface differences between Class 1 and Class 2 can be related to the different (types of) feet of the accents; the analysis thus postulates an indirect relation between tones and segments that is mediated by metrical structure, rather than a direct tone-vowel interaction. This relates to well-established notions in the field, as both tone and segments have been shown to interact with foot structure independently: the mutual influence of segments and metrical structure is a well-established driving force for phonological processes, and synchronic phonological interactions between tone and stress have been reported repeatedly (see e.g. Yip 1989, 2002; de Lacy 2002, 2007). By postulating an indirect relation between tonal mapping and vowel quality, the proposal is in line with the claim that direct vowel-tone interactions are universally absent (as argued in e.g. Hombert 1977; Hombert, Ohala and Ewan 1979; de Lacy 2007; yet see Becker and Jurgec (this volume), Donohue (this volume) for possible counterexamples).

My analysis also contributes to a current theoretical debate on the representation of the accents: ‘traditional’ autosegmental analyses assume lexical tones to be responsible for the tonal surface contrasts between the accents (from now on: *tonal approaches*; see e.g. Gussenhoven 2000, 2012; Gussenhoven & Peters 2004; Hanssen 2005; Peters 2006, 2008; Fournier 2008). Yet in recent years, alternative proposals have been put forward, arguing that the accents may rather be regarded as a metrical opposition (from now on: *metrical approaches*) – see Boersma (this volume), where a metrical contrast is regarded as one step in the diachronic development of the accents, as well as Kehrein (2007, this volume); Hermans (2009); Köhnlein (2011, 2016) for synchronic analyses. This paper is relevant for the discussion as it not only suggests a metrical solution to the relevant patterns but also argues that tonal approaches have little if anything to say about the synchronic phonological properties of vowel splits. While my formalization of the splits follows the representational assumptions put forward in Köhnlein (2011), it should be noted that the basic insights concerning the vowel splits in question could equally be expressed in Hermans’ and Kehrein’s framework. Potential empirical differences between the

different approaches concern the tonal mapping across different dialects and dialect areas; see Köhnlein (2011) for discussion.

The paper is organized as follows: section 2 provides some background information on the tone accent opposition and introduces the relevant data. Section 3 presents a synchronic analysis of vowel splits between monophthongs and diphthongs in Maastricht and Sittard. In Section 4, I discuss why a metrical analysis of the patterns is to be preferred over a tonal one. Section 5 concludes the paper.

2 The Franconian tone accent opposition

2.1 General background

The Franconian tone accent area comprises Ripuarian, Moselle Franconian and Low Franconian dialects, situated in Germany, the Netherlands, Belgium, and Luxembourg. These dialects show an opposition between two tone accents, which can lead to accent minimal pairs with lexical and morphological function. In (1), I provide two lexical (a, b) and two morphological alternations (c, d) from Mayen (Schmidt 1986); the accent class is indicated by the superscripts ‘c1’ and ‘c2’:

- (1) Accent minimal pairs from Mayen Franconian
a. [man ^{c1}] ‘basket’	[man ^{c2}] ‘man’
b. [tʊʊf ^{c1}] ‘pigeon’	[tʊʊf ^{c2}] ‘baptism’
c. [haos ^{c1}] ‘house, dat. sg.’	[haos ^{c2}] ‘house, nom. sg.’
d. [ʃda:n ^{c1}] ‘stone, pl.’	[ʃda:n ^{c2}] ‘stone, sg.’

Pitch is usually regarded as the primary auditory correlate of the opposition (as shown in Werth 2007, 2011 in tests with signal-manipulated stimuli); further correlates are duration and intensity (see e.g. Heike 1962, 1964; Schmidt 1986, 2002; Gussenhoven & Peters 2004; Hanssen, 2005; Peters 2006). The tonal melodies in Franconian dialects show a remarkable amount of inter- and intradialectal variation: within dialects, the contours of each accent often differ under different intonations (declaratives, interrogatives, sometimes continuatives and others) as well as with respect to the focal condition (focus phrase-final and non-final position; pre-focal and post-focal position, non-final and final position). This leads to a rich set of distinctive tonal melodies. Out of focus, the contrast can be neutralized (see Fournier 2008; Köhnlein 2011 for empirical evidence from perception tests).

Across dialects, the most substantial realizational variation of the accents can be found in the final position of a phrase. Yet little variation occurs with regard to the tonal melodies in focus, non-final position. They are usually realized in similar ways across dialects that contrast declarative and interrogative intonation, leaving aside a tonal semi-reversal in so-called Rule B dialects, as opposed to the widespread Rule A(2), the dialect area to which the dialects under discussion belong. The precise differences between these different distributional rules are not relevant for this paper, and therefore I will not discuss them in further detail (for data and discussion on the different accent areas, see e.g. Schmidt 2002; Boersma this volume; Köhnlein 2011; Kehrein, this volume). In Rule A(2), Class 1 syllables have a falling tone in focused non-final declaratives and a rising tone in interrogatives, whereas Class 2 is realized as a high level tone versus a low level tone on the accent syllable (Tab. 1).

Tab. 1: Prototypical realizations of Class 1 and Class 2 in focused, non-final position (Rule A(2)).

Condition	Class 1	Class 2
Declaratives, non-final position
Interrogatives, non-final position

2.2 Vowel splits between monophthongs and diphthongs

The Limburgian dialects of Maastricht and Sittard (East Low Franconian) present two well-documented cases of vowel splits between monophthongs and diphthongs (see Dols 1953; Hermans & van Oostendorp 1999, 2001; Hanssen 2005 for Sittard, and Endepols 1955; Cajot 2006 and Gussenhoven 2012 for Maastricht). Below, I introduce the relevant patterns. Note that in diphthongizing dialects, not all vowels will necessarily be realized as monophthongs in Class 2 and as diphthongs in Class 1; these issues will be discussed in section 3.

Maastricht. In the Maastricht dialect, we find two vowel splits between monophthongs and diphthongs. First of all, in morphological alternations between Class 1 and Class 2, tense high vowels in Class 2 correspond to falling diphthongs in Class 1, as shown in (2a); examples are taken from Endepols (1955). Moreover, as reported in Gussenhoven (2012), mid high vowels in Class 2 have a

diphthongal realization in Class 1. Since Gussenhoven (2012) gives data for some tonal minimal pairs only, I cannot provide morphological alternations for splits of the type (2b); yet there is no reason to assume that the splits will not occur in morphologically alternating forms as well.¹

(2) Splits between monophthongs and diphthongs in Maastricht²

a.	[bli:və ^{c2}] ‘stay, inf.’	[bleif ^{c1}] ‘stay, 1 st ps. sg.’
	[du:və ^{c2}] ‘pigeon, pl.’	[dɔuf ^{c1}] ‘pigeon, sg.’
b.	/ɣəbe:t ^{c2} / [ɣəbe:t ^{c2}] ‘set of teeth’	/ɣəbe:t ^{c1} / [ɣəbeit ^{c1}] ‘territory’
	/spø: ^{c2} lə/ [spø: ^{c2} lə] ‘play’	/spø: ^{c1} lə/ [spøy ^{c1} lə] ‘rinse’

Sittard. The Sittard dialect has a more complex set of alternations than the Maastricht dialect: as described in Dols (1953), it has a vowel split between long tense mid vowels ([e:, o:, ø:], Class 2) and diphthongs ([ɛi^{c1}, ɔu^{c1}, œy^{c1}], Class 1). The process does not affect all closed mid vowels, though: there is a second class of mid vowels not showing diphthongal realizations under Class 1. Some relevant cases are provided in (3); data are taken from Dols (1953). I refer to the two groups of mid vowels as ‘diphthongizing’ and ‘non-diphthongizing’, respectively. As Dols works from an entirely diachronic perspective, he does not offer many examples of synchronic alternations; some are given in (3a).

(3) (Non-) splits between monophthongs and diphthongs in Sittard

- a. Diphthongizing mid vowels
[ze:f ^{c2}] ‘sieve’	[ɛɪf ^{c1} kə] ‘sieve-dim.’
[do:n ^{c2}] ‘to do’	[gəɔuns ^{c1}] ‘ado’
[ʃo:n ^{c2}] ‘shoe’	[ʃɔuns ^{c1} reim] ‘shoelace’
- b. Non-diphthongizing mid vowels
[be:s ^{c1}] ‘beast’
[drø:g ^{c1}] ‘dry’
[bo:n ^{c1}] ‘bean’

¹ The same holds for examples with /o:/, which are absent as well. Note also that a third vowel contrast is emerging: as Gussenhoven (2012) reports, the diphthongs /ɛi, ɔu, œy/ show more monophthongal realizations under Class 2, where they are realized as [e:^e, œ:^y, ɔ:^o]. As, however, this monophthongization process is not (yet) complete, I will leave the data out of the discussion.

² Before /r/, high vowels in Class 1 words are lowered to lax mid vowels rather than diphthongized. This is not surprising from a typological perspective, as vowels tend to behave differently before /r/ than in other contexts. For instance, in Dutch and German, diphthongs are prohibited before coda-/r/ (for overviews, see Booij 1995, van Oostendorp 2000 for Dutch, Wiese 1996 for German). At this point, however, I cannot see a straightforward synchronic phonological trigger for the lowering (yet see van Oostendorp 2005 for an analysis that regards the lowering as the outcome of a synchronic shortening process).

3 Analysis

3.1 Representational assumptions and tonal mapping

My analysis is based on a representational framework developed in Köhnlein (2011). I assume that the two accents differ in their foot structure: Class 1 has a syllabic trochee, Class 2 a moraic trochee. It is further assumed that all relevant dialects / dialect groups share this representation; cross-dialectal differences in the tonal melodies arise from computation: they are attributed to the (re-)ranking of constraints.

These differences in footing entail consequences at the moraic level: I claim that the two feet have *foot head domains* of different size for Class 1 (syllabic trochee, first syllable is the head) and Class 2 (moraic trochee, first mora is the head): Class 1 feet branch at the level of the syllable, whereas Class 2 feet branch at the mora level. Consider the surface representation of the two accents below:

(4) Metrical surface representation of Class 1 and Class 2

As is shown in (4), the head of a Class 2 foot is the initial mora, and the second mora is the dependent. Class 1 feet, on the other hand, are obligatorily disyllabic. Their head is the initial syllable, the second syllable is the dependent. The second syllable of a Class 1 foot can either contain a vowel, or alternatively, it can be empty-headed (with an unpronounced vowel). The assumption that Class 1 feet are disyllabic makes it possible to unite different accent-related phenomena in Franconian. As we shall see below, it allows us to analyze diverse tonal melodies and vowel splits in a similar way. Furthermore, it is in line with the fact that in morphologically related accent minimal pairs, Class 1 correlates with more complex structures than Class 2 (van Oostendorp 2005; Köhnlein 2011). It can also account for predictable interactions between the voicing quality of obstruents and the accent class the items belong to (van Oostendorp this volume). This difference in head dependent relations between Class 1 and Class 2 influences the prosodic strength of moras in the stressed syllables of both accents: I assume

that the foot head strengthens all lower-level metrical structure it dominates; it creates a *foot head domain*. The principle is stated in (5):

- (5) FOOT HEAD DOMAINS: Each foot head constitutes a foot head domain that comprises the foot head itself as well as all lower-level structure dominated by it.

The different foot structures of Class 1 and Class 2 lead to different head domains: in disyllabic Class 1 feet, the syllable is the foot head and thus creates a head domain. By virtue of (5), the two moras in a Class 1 syllable belong to the foot head domain, as the foot head dominates them both. This makes them prosodically ‘strong’ at the foot level albeit they are not heads themselves. This is shown in (4), where strong moras are marked with primes.

Crucially, the prosodic strength of moras is different in bimoraic Class 2 feet. Here, only the first mora of the accent syllable is strong, as it is the foot head. The second mora, however, is the dependent of the foot and prosodically weak. As demonstrated in (4), it does not form part of the foot head domain since it is neither a foot head itself nor dominated by a foot head. While the approach largely builds on well-established concepts concerning the prosodic hierarchy (see e.g. Hayes 1985, 1987, 1995, Hyman 1985, McCarthy & Prince 1995, Prince 1990, de Lacy 2002, 2006, among others), head domains are an addition to these traditional approaches. They are motivated in Köhnlein (2011) on the basis of the tonal melodies from different Franconian dialect areas.

The basic tenets of the tonal mapping for Rule A build on the assumption that there is a mutual attraction between tones and metrically strong moras; these are more appropriate ‘docking stations’ for tones than weak moras (based on de Lacy 1999, 2002).³ I assume that the basic requirement in Rule A(2) is that tones be licensed by a strong mora (= a mora that is part of a foot head domain):

- (6) $T \rightarrow \mu'$: Assign one violation mark for every tone that is not associated with a strong mora.

Given the tonal melodies H*L for declaration and L*H for interrogation, Class 1 (two strong moras) can host both tones of the respective tonal melodies; Class 2 (one strong and one weak mora) can only license the starred tones

³ For the mapping in Rule A, there is no need to differentiate between the prosodic strength of high and low tones, which can affect the tone-stress relation in some languages (see de Lacy 2002, 2007). Such differences, however, are relevant for the tonal mapping in Rule B, as argued in Köhnlein (2011).

while the trailing tones (L in declaratives, H in interrogatives) are realized in post-nuclear position.⁴

Tab. 2: Tonal mapping in Rule A for declaratives and interrogatives, focus, non-final position.

	Class 1	Class 2
Declarative, non-final position (H*L)	H^*L $\begin{array}{ c c } \hline \mu' & \mu' \\ \hline \end{array}$	H^* $\begin{array}{ c } \hline \mu' \\ \hline \end{array}$
Interrogative, non-final position (L*H)	L^*H $\begin{array}{ c c } \hline \mu' & \mu' \\ \hline \end{array}$	L^* $\begin{array}{ c } \hline \mu' \\ \hline \end{array}$

As shown in Tab. 2, the second mora of Class 2 receives its tonal content via spreading; this can be expressed with the following high-ranked constraint (based on Anttila & Bodomo 2000; Gussenhoven 2004):

- (7) $\mu \rightarrow T$: Assign one violation mark for every mora that is not associated with a tone.

This constraint outranks NoSPREAD, a standard constraint against tonal spreading (Goldsmith 1976). Lastly, a high-ranked constraint against the association of two tones to one mora (NoCONTOUR, Goldsmith 1976) excludes that both H* and L are realized on the strong first mora of the Class 2 syllable. Consider the corresponding tableau for the declarative melody H*L in (8); the computation for underlying L*H is identical, except for the tone values.

⁴ In most dialects, this will preferably be the next available syllable with word stress. In cases where no such syllable is available, the tone docks onto the head mora of the next unstressed syllable; this position is metrically stronger than the second mora of a Class 2 syllable, as the latter mora is neither in the head domain of a foot nor a syllable head. Furthermore, a high-ranked constraint against spreading across the boundaries of the nuclear syllable prohibits the migration of the high tone to the left or to the right of the syllable boundary.

(8) OT tableau of tonal mapping for Class 2, phrase-medial declaratives

$(\mu' \mu)$ H^*L	NoCONTOUR	$T \rightarrow \mu'$	$\mu \rightarrow T$	NoSPREAD
a. $(\mu' \mu)$ $\swarrow \searrow$ H^*				*
b. $(\mu' \mu)$ $ \quad $ $H^* L$		*!		
c. $(\mu' \mu)$ $\swarrow \searrow$ $H^* L$	*!			
d. $(\mu' \mu)$ $ $ H^*			*!	

In Class 1, the established constraint ranking results in a one-to-one association of the two tones with the two moras since, unlike in Class 2, both moras are metrically strong:

(9) OT tableau of tonal mapping for Class 1, phrase-medial declaratives

$(\mu' \mu')$ H^*L	NoCONTOUR	$T \rightarrow \mu'$	$\mu \rightarrow T$	NoSPREAD
a. $(\mu' \mu')$ $\swarrow \searrow$ H^*				*!
b. $(\mu' \mu')$ $ \quad $ $H^* L$				
c. $(\mu' \mu')$ $\swarrow \searrow$ $H^* L$	*!			
d. $(\mu' \mu')$ $ $ H^*			*!	

I shall end this section with a note concerning the morphological relation between the two accent classes: in morphologically related, segmentally identical accent minimal pairs, the morpho-semantically more complex form belongs to Class 1

across dialects. Furthermore, function words, which tend to be unmarked across languages, belong to Class 2. Following van Oostendorp (2005), I therefore assume that Class 1 is the marked member of the opposition: while Class 2 receives a default footing, a moraic trochee, Class 1 is represented as an underlying disyllabic foot template /σ'σ/. These templates can be part of a lexical form, or they can be stored independently as prosodic morphemes. For instance, the shared underlying segmental representation of the Mayen minimal pair [fda:n^{c2}] 'stone, sg.' versus [fda:n^{c1}] 'stone, pl.' is /fda:n/. The singular form receives the unmarked moraic trochee, which results in a Class 2 membership; in the plural form, the stem combines with a plural morpheme enforcing a disyllabic foot – this results in a Class 1 item. As this is not in the focus of this paper, I will always provide the input forms together with their accent markings and ignore the footing process itself.

3.2 Vowel splits: basics

In section 3.1, the basics of the tonal mapping for Rule A(2) have been demonstrated: it has been shown that Class 1, which contains two strong moras, can host two tones while Class 2, with one strong and one weak mora, can host only one tone. Below, I shall demonstrate that the vowel splits in Maastricht and Sittard can be understood along similar lines: strong moras prefer to license a root node on their own, while weak moras tend to receive their segmental content via spreading. I assume that (long) diphthongs are structurally more complex than monophthongs: the second element of a diphthong licenses a root node on its own plus – depending on the feature theory one uses – also segmental features. Therefore, Class 1 syllables prefer diphthongs over monophthongs as they prefer two tones to one tone, while Class 2 syllables favor monophthongs and license only one tone. This can be related to the notion that metrically strong positions attract structure, while weak positions avoid it, as argued in e.g. van Oostendorp (1995, 2000). As, for the purposes of this paper, the most crucial difference between Class 1 and Class 2 is not one of vowel quality in the diphthongs but one of monophthongs vs. diphthongs, I will largely sidestep the complex issue of the precise featural representation of diphthongs.⁵

⁵ The problems are manifold; they already start at the phonetic representation of the vowel quality in the two elements of diphthongs. In particular, but not only, the realization of the second element of diphthongs is often variable. For relatively recent studies on variability in diphthongal realizations of Standard Dutch diphthongs, see van der Harst et al. (2011).

I assume that synchronically, the vowel splits discussed in this paper derive from underlyingly bimoraic (Maastricht) or monomoraic (Sittard) monophthongs. In both dialects, the same constraint enforces diphthongization in Class 1; it is given in (10), adapted from Selkirk's (1995) requirement on prosodic headedness (see also Krämer 2009):

- (10) HEADEDNESS (μ' / ROOT): Assign one violation mark for every strong mora that does not dominate its own root node.

Notice that the structure of this constraint differs somewhat from the ones given for the tonal mapping, as e.g. $T \rightarrow \mu'$ in (6). That is, the tonal mapping associates the moras of the two accent classes with an underlying tonal melody, and the weakness of the second mora of Class 2 prohibits the association of underlying material with this mora (this would violate $T \rightarrow \mu'$). The diphthongization processes, on the other hand, are cases of strengthening rather than weakening: high-ranked HEADEDNESS (μ' / ROOT) enforces the insertion of a second root node in Class 1. Still, the tonal mapping and these segmental processes share the same core aspects, as metrical structure interacts with tones and segments in similar ways: two strong moras in the accent syllable correspond to two tones / two segments, and one strong mora corresponds to one tone and one segment.

3.3 Vowel splits in Maastricht

As shown in 2.2, Maastricht has synchronic vowel alterations between long tense high and mid vowels for Class 2 vs. falling diphthongs for Class 1; the relevant patterns are given in (11). I assume that these alternations can be attributed to a diphthongization of underlying tense high and mid monophthongs in Class 1. Note that other long vowels do not diphthongize in Class 1, viz. the long lax mid vowels $[\epsilon:]$, $[\ae:]$, $[\o:]$ and the long low vowel $[a:]$. This can be attributed to high-ranked faithfulness constraints, which preserve the structure of these vowels.

- (11) Synchronic alternations between underlying monophthongs (Class 2) and falling diphthongs (Class 1)
 $/i:, u:, y:/ \rightarrow [i:^{c2}, u:^{c2}, y:^{c2}]$ vs. $[\epsilon i^{c1}, \text{ɔ} u^{c1}, \text{æ} y^{c1}]$
 $/e:, o:, \emptyset:/ \rightarrow [e:^{c2}, o:^{c2}, \emptyset:^{c2}]$ vs. $[\epsilon i^{c1}, \text{ou}^{c1}, \emptyset y^{c1}]$

3.3.1 Underlyingly long high vowels

Class 1. Underlyingly long high vowels diphthongize in Class 1. As argued above, this can be attributed to the influence of high-ranked HEADEDNESS (μ' / ROOT). This constraint outranks a corresponding faithfulness constraint protecting underlying associations between underlying vowels and moras, MAXLINK- μ [V] (Morén 2000, 2001, 2003):

- (12) MAXLINK- μ [V]: Assign one violation mark for every vowel linked to a mora in the underlying representation that is not linked to that mora in the surface form.

Additionally, the insertion of a second root node for the newly created diphthong violates a low-ranked constraint against insertion (McCarthy & Prince 1995):

- (13) DEP-ROOT: Assign one violation mark for any root in the surface form that is not present in the underlying form.

Furthermore, we have to express that the delinked second mora associates with an inserted vowel instead of the word-final consonant. This can be expressed with a high-ranked constraint against moraic consonants (see Morén 2000, 2001, 2003, Krämer 2009):

- (14) $*\mu$ [C]: Assign one violation mark for every moraic consonant.

A tableau for the input /du:^fc¹/ ‘pigeon, pl.’ is given in (15):

- (15) OT tableau for /du:^fc¹/ ‘pigeon, pl.’

/du: _{$\mu\mu$} ^f c ¹ /	HEADEDNESS (μ' / ROOT)	$*\mu$ [C]	DEP-ROOT	MAXLINK- μ [V]
a. duf	*!			
b. dɔuf			*	*
c. duf		*!		*

Class 2. The monophthong surfaces faithfully in Class 2 since HEADEDNESS (μ' / ROOT) is not violated by the weak second mora: weak moras are not required to license a root node. Consider the tableau in (16) for the form /du:və^{c2}/ ‘pigeon, pl.’:

(16) OT tableau for /du:və^{c2}/ ‘pigeon, pl.’

/du _{μμ} və ^{c2} /	HEADEDNESS (μ' / ROOT)	DEP-ROOT	MAXLINK-μ[V]
☞ a. duvə ^{c2} $\begin{array}{c} \diagdown \\ \mu' \mu \end{array}$			
b. dɔuvə ^{c2} $\begin{array}{c} \diagdown \diagdown \\ \mu' \mu \end{array}$		*!	*

3.3.2 Underlyingly long closed mid vowels

Class 1. Like underlyingly long high vowels, underlyingly long tense mid vowels diphthongize in Class 1 since the strong second mora is required to license a root node. The computation works along the same lines as for high vowels; tableaux for the inputs /yəbe:t^{c1}/ and /yəbe:t^{c2}/ are given in (17) and (18), respectively:

(17) OT tableau for /yəbe:t^{c1}/ ‘territory’

/yəbe _{μμ} t ^{c1} /	HEADEDNESS (μ' / ROOT)	*μ[C]	DEP-ROOT	MAXLINK-μ[V]
a. yəbet ^{c1} $\begin{array}{c} \diagdown \\ \mu' \mu' \end{array}$	*!			
☞ b. yəbeit ^{c1} $\begin{array}{c} \diagdown \diagdown \\ \mu' \mu' \end{array}$			*	*
c. yəbet ^{c1} $\begin{array}{c} \diagdown \diagdown \\ \mu' \mu' \end{array}$		*!		*

(18) OT tableau for /yəbe:t^{c2}/ ‘set of teeth’

/yəbe _{μμ} t ^{c2} /	HEADEDNESS (μ' / ROOT)	*μ[C]	DEP-ROOT	MAXLINK-μ[V]
☞ a. yəbet ^{c2} $\begin{array}{c} \diagdown \\ \mu' \mu \end{array}$				
b. yəbeit ^{c2} $\begin{array}{c} \diagdown \diagdown \\ \mu' \mu \end{array}$			*!	*
c. yəbet ^{c2} $\begin{array}{c} \diagdown \diagdown \\ \mu' \mu \end{array}$		*!		*

3.4 Vowel splits in Sittard

The Sittard data given in 2.2 show a more complex diphthongization pattern than the Maastricht case, as only some long tense mid vowels diphthongize in Class 1 while other tense mid vowels surface as monophthongs in both accent classes. A summary of the underlying representations and the corresponding phonetic realizations are given in (19):

- (19) Synchronic alternations between underlying monophthongs (Class 2) and falling diphthongs (Class 1)
- a. Underlyingly short tense monophthong → monophthong in Class 2, diphthong in Class 1
 $/e, o, \emptyset/ \rightarrow [e^{c:2}, o^{c:2}, \emptyset^{c:2}]$ vs. $[ei^{c1}, ou^{c1}, \emptyset y^{c1}]$
 - b. Underlyingly long tense monophthong → always monophthong
 $/e:, o:, \emptyset:/ \rightarrow [e^{c:1,2}, o^{c:1,2}, \emptyset^{c:1,2}]$

As (19) indicates, the difference between diphthongizing and non-diphthongizing mid vowels is attributed to an underlying length contrast; I adopt this from an earlier analysis by Hermans & van Oostendorp (1999, 2001): the diphthongizing vowels derive from an underlyingly short vowel that is lengthened under stress, the non-diphthongizing ones are underlyingly bimoraic. The main difference between the approach advertised here and that of Hermans & van Oostendorp is to be found in the representation of the accent opposition: unlike the foot-based approach presented in this paper, Hermans & van Oostendorp postulate an underlying lexical tone for Class 2. I will discuss this question in section 4, which contains a comparison between tonal and metrical approaches.

Lastly, note that for the analysis I will assume that diphthongization only changes the second part of vowel to create a diphthong, and that the first part stays phonologically tense. That is, I regard the surface forms as $[ei^{c1}, ou^{c1}, \emptyset y^{c1}]$ and attribute the more open / lax pronunciation of the first element to phonetic implementation.

3.4.1 The diphthongizing monophthongs: underlyingly short tense mid vowels

In Sittard, underlyingly short tense mid monophthongs surface as long tense vowels in Class 2 and as falling diphthongs in Class 1. Among the vowels that exhibit an accent opposition, tense mid vowels are the only vowels in the

Sittard vowel system that do not have a short counterpart (Hanssen 2005: 48): high tense vowels and lax mid vowels can be short or long; furthermore, long tense [a:], which cannot be short, corresponds to short lax [a], which is never long. The non-diphthongizing short vowels as well as non-diphthongizing [a:] will be treated in 3.3.3; for the moment, I will focus on mid tense vowels only.

We can conclude that only mid vowels are always long on the surface without having some short correspondent; in Sittard, this length must be phonological, as the accent contrast can be realized only on syllables with two sonorant moras (see Hanssen 2005).⁶ For our purposes, this observation can be translated into a high-ranked constraint stating that tense mid vowels should not be followed by a moraic coda:

- (20) *V[TENSE, MID]C_μ: Assign one violation mark for every tense non-high vowel that is followed by a moraic coda consonant.

Admittedly, this constraint is of rather complex nature (as it involves a comparison between neighboring segments). Yet at least, the generalization can be extended to stressed syllables in Standard Dutch (e.g. Gussenhoven 2009) and Standard German (e.g. Mangold 1999), albeit in these varieties, the restriction also holds for high tense vowels: all of these can never be followed by a moraic consonant. Next to *V[TENSE, MID]C_μ, another unviolated constraint in the Sittard dialect is the STRESS-TO-WEIGHT principle (Kager 1989, Prince 1990):

- (21) STRESS-TO-WEIGHT: Assign one violation mark for every stressed syllable that is not bimoraic

The combination of high-ranked *V[TENSE, MID]C_μ and STRESS-TO-WEIGHT prohibits short tense mid vowels in stressed syllables. For underlyingly monomoraic tense vowels, the necessary insertion of a second mora violates low-ranked DEP-μ. While the abovementioned constraints affect the two accent syllables in similar ways (a second mora will be inserted in each case), the crucial difference lies in the segmental content of that mora (long monophthong for Class 2 vs. diphthong for Class 1): vowel lengthening in Class 2 is the default option in Sittard, as no additional root node has to be inserted, and DEP-ROOT

⁶ The restriction holds for most Franconian dialects (see Gussenhoven 2000; Schmidt 2002; Peters 2006; Köhnlein 2011).

does not need to be violated. Consider the Class 2 tableau in (22) for the form /don^{c2}/ ‘do’:

(22) OT tableau for /don^{c2}/ ‘do’

/do _μ n ^{c2} /	*V _μ [TENSE, MID]C _μ	STRESS-TO-WEIGHT	DEP-ROOT	DEP-μ
a. $\begin{array}{c} \text{doun}^{c2} \\ \quad \backslash \\ \mu' \mu \end{array}$			*!	*
b. $\begin{array}{c} \text{don}^{c2} \\ \backslash \\ \mu' \mu \end{array}$				*
c. $\begin{array}{c} \text{don}^{c2} \\ \quad \backslash \\ \mu' \mu \end{array}$	*!			*
d. $\begin{array}{c} \text{don}^{c2} \\ \\ \mu' \end{array}$		*!		

In Class 1, we find insertion of a high vowel instead of lengthening. Like in Maastricht, insertion is driven by HEADEDNESS (μ' / ROOT), which equally satisfies *V_μ[TENSE, MID]C_μ and STRESS-TO-WEIGHT, but leads to a violation of lower-ranked DEP-ROOT and DEP-μ. A tableau for /gəðons^{c1}/ ‘ado’ is given in (23):

(23) OT tableau for /gəðons^{c1}/ ‘ado’

/gəðo _μ ns ^{c1} /	HEADEDNESS (μ' / ROOT)	*V _μ [TENSE, MID] C _μ	STRESS- TO-WEIGHT	DEP-ROOT	DEP-μ
a. $\begin{array}{c} \text{gəðouns}^{c1} \\ \quad \quad \\ \mu' \mu' \end{array}$				*	*
b. $\begin{array}{c} \text{gəðons}^{c1} \\ \backslash \\ \mu' \mu' \end{array}$	*!				*
c. $\begin{array}{c} \text{gəðons}^{c1} \\ \quad \quad \\ \mu' \mu' \end{array}$		*!			*
d. $\begin{array}{c} \text{gəðons}^{c1} \\ \\ \mu' \end{array}$			*!		

3.4.2 The non-diphthongizing tense mid vowels

As indicated above, not all tense mid vowels show diphthongization under Class 1: unlike the diphthongizing short monophthongs, underlyingly long tense mid vowels surface faithfully. The constraint enforcing diphthongization in Class 1, HEADEDNESS (μ' / ROOT), is outranked by MAXLINK- μ [V], which also captures that other underlyingly long vowels do not diphthongize in Class 1. The ranking of the two constraints differs between Maastricht and Sittard, which reflects the different nature of the diphthongization processes (underlyingly long vowels diphthongize in Maastricht, underlyingly short vowels diphthongize in Sittard). A tableau for the form /be:s^{c1}/ ‘beast’ is provided in (24):

(24) OT tableau for /be:s^{c1}/ ‘beast’

/be _{μμ} s ^{c1} /	MAXLINK- μ [V]	HEADEDNESS (μ' / ROOT)
a. beis ^{c1} $\begin{array}{c} \backslash \\ \mu' \mu' \end{array}$	*!	
b. bes ^{c1} $\begin{array}{c} \backslash \\ \mu' \mu' \end{array}$		*

3.4.3 The non-diphthongizing vowels

As indicated in 3.3.1, there are several underlyingly short vowels that show an accent opposition but do not trigger lengthening / vowel splits in the Sittard dialect. Leaving the opposition between [a] and [a:] aside for another moment, all long vowels that show an accent contrast have short counterparts, which indicates that the short variants do not lengthen under stress but rather contain a moraic coda. This can be expressed with a constraint that enforces coda consonants to be moraic, WEIGHT BY POSITION (e.g. Morén 2000, 2001, 2003):

(25) WEIGHT BY POSITION (WbYP): Assign one violation mark for every non-moraic consonant

This constraint outranks $\ast\mu$ / C and Dep- μ , yet WbYP is lower-ranked than $\ast V_{\mu}$ [TENSE, MID]C_μ; thus, for underlyingly monomoraic tense mid vowels in the input, lengthening / diphthongization will still be preferred over assigning a mora to the coda consonant. Consider the tableau in (26) for the input /mes/ ‘mass’:

(26) OT tableau for /mɛs/ ‘mass’

/mɛ _μ s/	*V _μ [TENSE, MID]C _μ	WBYP	*μ / C	DEP-μ
a. mɛs μμ			*	*
b. mɛs \ μμ		*!		
c. mɛs μ		*!		*

The situation is somewhat more complex with respect to the low tense vowel [a:], which is always long (similar to tense mid vowels), and contrasts Class 1 and Class 2. Given ‘Richness of the Base’ in OT, this implies that an underlyingly monomoraic /a/ in the input could trigger lengthening but would have to block diphthongization in Class 1. Two possible explanations could be given to account for this difference: one the one hand, it might be argued that underlying /a/ in fact results in [a] on the surface, and the quality difference between predictably long [a] and predictably short [a] would thus be phonetic rather than phonological.

If one wanted to maintain a phonological quality contrast between the two vowels, then monomoraic tense /a/ would be prohibited on the surface, and one would have to account for predictable lengthening in both accent classes, thus also for non-diphthongization in Class 1. Bimoraicity could be enforced by e.g. changing *V_μ[TENSE, MID]C_μ to *V_μ[TENSE, NON-HIGH]C_μ. The most straightforward explanation for blocking of diphthongization, then, would arguably be to state that [ai] and [au] are prohibited diphthongs in the Sittard dialect. This holds beyond the lengthening cases: the dialect only allows diphthongs with a mid vowel as the first element and high vowels as the second one.⁷

⁷ A more abstract generalization might be made under the assumption that the representation of vowel height in mid vowels is a combination of that for high and low vowels: using elements instead of ‘traditional’ features, the facts could be expressed by stating that the second mora of a syllable can license a root node on its own but not a feature. Under this assumption, [ei] would be allowed, as both parts of the diphthong share the element [I]; [ai], however, would be prohibited since the second part of the diphthong would have to license the element [I] on its own: [a] only contains the element [A], and [i] contains the element [I]. [ae] or [ao] would be ruled out as well, since the second position would still have to license [I] on its own (for further discussion of diphthong representation in element theory, see Harris 1995). The same effect could be achieved by assuming that mid vowels contain both a feature [high] and a feature [low].

4 Some arguments against a synchronic tone-vowel interaction in Franconian

In the previous section, I have developed a synchronic analysis of vowel splits between diphthongs in Class 1 and monophthongs in Class 2 in the Maastricht and the Sittard dialects. The essence of the analysis is that the synchronic trigger of the splits can be traced to different foot structures of the two accent classes. Alternatively, one could attribute the segmental processes to the influence of a lexical tone; such an analysis has been presented by Hermans & van Oostendorp (1999, 2001) for the Sittard dialect, albeit, as we shall see, they assume that the influence is indirect (yet see more recent work by Hermans 2009 for a metrical analysis of the accents; see also van Oostendorp, this volume, for a metrical approach to predictable voicing alternations in the Moresnet dialect).

The authors assume that Class 2 has two high tones (HH, intonational H followed by lexical H): the lexical tone is always aligned with the right edge of the syllable, i.e. the second mora; the intonational H precedes it on the first mora. Class 1, on the other hand, has a high tone and a low tone (HL, both tones intonational). In my analysis, I have adapted Hermans & van Oostendorp's idea that the diphthongizing mid vowels in Sittard are underlyingly short: these vowels lengthen in Class 2 but diphthongize in Class 1. In Hermans & van Oostendorp's approach, diphthongization is regarded as the unmarked option, which is blocked under Class 2. In a nutshell, the authors argue that high tones require to be linked to segments that are dominated by a syllable head, i.e. the first mora of a syllable. The second component of a diphthong has its own root node. This root node is linked to the second mora, and is therefore not sponsored by the syllable head (the first mora). As the second mora of Class 2 has to license a high lexical tone, which itself must be connected to the syllable head, diphthongization is blocked, and lengthening occurs: this way, the lexical high tone can be linked to the (bimoraic) monophthong, and is still licensed by the syllable head. In Class 1, on the other hand, the underlyingly short vowels can diphthongize, as there is no lexical tone blocking the process. The second mora receives a default low tone, which does not require to be linked to segmental material sponsored by the first mora. As a consequence, a high tone on the second mora corresponds to a monophthong (HH, Class 2), and a low tone on the second mora corresponds to a diphthong (HL, Class 1).

The approach provides a feasible solution for the tonal melodies in declaratives; however, some difficulties may arise with respect to the tonal contours in interrogatives. As can be observed from data provided in Hanssen (2005), the interrogative contours in Sittard are the mirror image of those in declaratives, at least in non-final focus position (see also Tab. 1). That is, for Class 1, HL in declaratives

corresponds to LH in interrogatives; likewise, for Class 2, HH corresponds to LL. These facts seem problematic for any approach that relates diphthongization to a direct influence of tonal quality (even when, as is the case of Hermans & van Oostendorp's analysis, the interaction is mediated by metrical structure): if a high tone on a second mora blocks diphthongization, but a low tone allows it, one might expect that there could be opposite diphthongization patterns for declaratives (Class 2 has H on the second mora, and Class 1 has L) and interrogatives (Class 2 has L on the second mora, and Class 1 has H): that is, diphthongization would be blocked in Class 2 declaratives (blocking high tone on the second mora), but it would be possible in Class 2 interrogatives (non-blocking low tone on the second mora). Similarly, diphthongization in Class 1 would be allowed in declaratives (non-blocking low tone on the second mora) but prohibited in interrogatives (blocking high tone on the second mora).⁸

Furthermore, recall that the tonal contrast between the accents can often be neutralized outside of focus. Empirically, this has been confirmed in perception tests for the dialects of Roermond (Fournier 2008) and Arzbach (Köhnlein 2011). If the presence of a lexical tone could influence segmental structure (either directly or indirectly), one could imagine the existence of dialects where tonal contrasts as well as vowel splits are neutralized outside of focus. To this point, however, there are no indications that such patterns may exist. Instead, vowel splits seem to be retained throughout all prosodic contexts, even when the tonal opposition is neutralized. Under my metrical approach, this asymmetry is not at all surprising but rather follows from the analysis. First of all, tonal neutralization in non-focus positions is expected to be possible: since tonal contrasts are solely due to the mapping of intonational tones, neutralization will occur when there is a 'lack' of intonational tones. Accordingly, the opposition will first be neutralized in contexts where no pitch accents or boundary tones are present, as for instance in non-focus, non-final position of an intonational phrase.

While the metrical approach thus predicts the possibility of tonal neutralization in non-prominent positions in a phrase, it also predicts that (phonologized) vowel splits between the accents should be maintained. Unlike intonational tones, which can or cannot be present on accent syllables (depending on the relative phrasal prominence of that syllable), segmental structure and metrical structure should always interact: they are not dependent of the position of the

⁸ One may try to solve this issue by postulating a derivational analysis, e.g. by assuming that the tonal change from H to L occurs after diphthongization has applied. Yet this would still involve a complex interaction of lexical tones, intonational tones, and vowel quality at different levels of representation. Furthermore, as far as I can see, this would still not rule out the possibility of unattested dialects with reversed diphthongization patterns across different pragmatic contexts.

accent item in an intonational phrase. Therefore, in dialects with vowel splits, we expect to find segmental correlates of the accent opposition, even when the tonal contrast is neutralized, which is borne out by the facts.

Since in metrical approaches, such as the one advertised here, tone and segmental structure interact with prosodic structure independently, the analysis makes another prediction that seems to be correct: it predicts that an underlying metrical contrast may be expressed at the segmental level only (but not tonally). This indeed seems to be possible: for Franconian, Cajot (2006) reports several dialects to the South of Maastricht that have undergone vowel splits which correlate with the tone accent opposition; yet according to Cajot, these dialects have given up the tonal contrast between Class 1 and Class 2. As, however, Cajot's data are based on auditory judgments only, and the set of presented data is too small to draw any firm conclusions, these facts could not be considered in more detail. More empirical research on these dialects is needed.

5 Conclusion

In this paper, it has been shown that synchronic alternations between monophthongs and diphthongs in the Franconian dialects of Maastricht and Sittard can be analyzed as the segmental manifestation of foot-based oppositions between two accent classes. With respect to the ongoing discussion concerning the autosegmental analysis of the Franconian tone accent opposition (tonal approaches vs. metrical approaches), it has been argued that the possibility of synchronic vowel splits in Franconian is to be expected under a metrical approach while it seems much more difficult to incorporate the facts in a tonal framework. One possibility could be to deny the phonological status of these oppositions and solely regard them as a matter of phonetic implementation, as may be concluded from the discussions in Gussenhoven & Driessen (2004) and Gussenhoven (2007). In cases of subtle phonetic contrasts, this may be a reasonable explanation (and in this paper, it has been as well with respect to the phonetic implementation of diphthongs in Sittard, albeit not to account for a predictable contrast); yet for synchronic alternations that extend the limits of what would usually be regarded as a purely phonetic phenomenon, such as the one between high vowels and falling diphthongs in Maastricht, this does not seem to be a favorable approach. Indeed, Gussenhoven (2012) does not attribute the avoidance of Class 1 on high vowels in Maastricht to phonetic implementation but to other functional considerations: essentially, as Gussenhoven argues, making a tonal contrast on high vowels would jeopardize the vocalic contrast. Such functional considerations, however, do not necessarily tell us anything about the synchronic phonological organization of the phenomenon.

References

- Anttila, Arto & Adams Bodomo. 2000. Tonal polarity in Dagaare. In Vicky Castens & Frederick Parkinson (eds.) *Trends in African Linguistics*, vol. 4: *Advances in African Linguistics*, 119–134. Trenton, NJ: African World Press.
- Boersma, Paul. This volume. The history of the Franconian tone contrast.
- Booij, Geert. 1989. On the representation of diphthongs in Frisian. *Journal of Linguistics* 25, 319–332.
- Booij, Geert. 1995. *The phonology of Dutch*. Oxford: Clarendon Press.
- Cajot, José. 2006. Phonologisch bedingter Polytonieverlust – eine tonlose Enklave südlich von Maastricht. In Michiel de Vaan (ed.) *Germanic Tone Accents. Proceedings of the First International Workshop on Franconian Tone Accents, Leiden, 13–14 June 2003*. Zeitschrift für Dialektologie und Linguistik – Beiheft 131, 11–24. Stuttgart: Franz Steiner Verlag.
- Caratini, Emilie. 2009. *Vowel and consonantal quantity in German: synchronic and diachronic perspectives*. Doctoral dissertation, Université de Nice, Universität Leipzig.
- Chitoran, Ioana. 2002. The phonology and morphology of Romanian diphthongization. *Probus* 14:2, 205–246.
- de Lacy, Paul. 1999. *Tone and prominence*. Ms., Amherst: University of Massachusetts.
- de Lacy, Paul. 2002. The interaction of tone and stress in Optimality Theory. *Phonology* 19, 1–32.
- de Lacy, Paul. 2006. *Markedness: reduction and preservation in phonology*. Cambridge: Cambridge University Press.
- de Lacy, Paul. 2007. The interaction of tone, sonority, and prosodic structure. In Paul de Lacy (ed.), *The Cambridge handbook of phonology*, 281–307. Cambridge University Press.
- Dols, Willy. 1953. *Sittardse diftongering*. Sittard.
- Donohue, Cathryn. This volume. Tones and vowels in Fuzhou revisited.
- Endepols, Joseph. 1955. *Woordenboek of diksjenaer van 't Mestreechs*. Maastricht: Boosten & Stols.
- Fournier, Rachel. 2008. *Perception of the tone contrast in East Limburgian dialects*. Doctoral dissertation. Radboud Universiteit Nijmegen (= LOT Dissertation series 196).
- Goldsmith, John. 1976. *Autosegmental phonology*. Doctoral dissertation, MIT. [Published 1979, New York: Garland].
- Goossens, Jan. 1998. Stoottoon en diftongering van Wgm. I en u in Limburg. *Taal en Tongval* 8, 99–112.
- Gussenhoven, Carlos. 2000. On the origin and development of the Central Franconian tone contrast. In Aditi Lahiri (ed.) *Analogy, levelling, markedness: principles of change in phonology and morphology*, 213–260. Berlin: Mouton de Gruyter.
- Gussenhoven, Carlos. 2004. *The phonology of tone and intonation*. Cambridge: Cambridge University Press.
- Gussenhoven, Carlos. 2007. A vowel height split explained: compensatory listening and speaker control. In Jennifer Cole & Jose Ignacio Hualde (eds.) *Laboratory Phonology 9*, 145–172. Berlin/New York: Mouton de Gruyter.
- Gussenhoven, Carlos. 2009. Vowel duration, syllable quantity, and stress in Dutch. In Kristin Hanson & Sharon Inkelas (eds.) *The nature of the word. Essays in honor of Paul Kiparsky*, 181–198. Cambridge, MA/London, UK: MIT Press.

- Gussenhoven, Carlos. 2012. Asymmetries in the intonation system of the tonal dialect of Maastricht Limburgish. *Phonology* 29, 39–79.
- Gussenhoven, Carlos & Wilske Driessen. 2004. Explaining two correlations between vowel quality and tone: The duration connection. *Proceedings of the Speech Prosody 2004 Conference (Nara, Japan)*, 179–182.
- Gussenhoven, Carlos & Jörg Peters. 2004. A tonal analysis of Cologne Schärfung. *Phonology* 21, 251–285.
- Hanssen, Judith. 2005. *Tone and intonation in the dialect of Sittard*. MA thesis, University of Nijmegen.
- Harris, John. 1994. *English sound structure*. Oxford: Blackwell.
- Harst, Sander van der, Hans van de Velde & Roeland van Hout. 2011. The diphthongal vowel space paradox. *ICPHS XVII*, 827–830. Hong Kong, International Conference on Phonetic Sciences XVII.
- Hayes, Bruce. 1985. *A metrical theory of stress rules*. New York: Garland.
- Hayes, Bruce. 1987. A revised parametric theory of stress. *Proceedings of the Northeastern Linguistics Society* 17, 274–269.
- Hayes, Bruce. 1990. Diphthongization and coindexing. *Phonology* 7, 31–71.
- Hayes, Bruce. 1995. *Metrical stress theory: Principles and case studies*. Chicago: University of Chicago Press.
- Heike, Georg. 1962. Suprasegmentale Merkmale der Stadtkölner Mundart. Ein Beitrag zur “Rheinischen Schärfung.” *Phonetica* 8, 147–165.
- Heike, Georg. 1964. *Zur Phonologie der Stadtkölner Mundart. Eine experimentelle Untersuchung der akustischen Unterscheidungsmerkmale*. Marburg: Elwert.
- Hermans, Ben. 2009. The phonological structure of the Limburg tonal accents. In Kuniya Nasukawa & Phillip Backley (eds.) *Strength relations in phonology*, 325–380. Berlin/New York: Mouton de Gruyter.
- Hermans, Ben & Marc van Oostendorp. 1999. *The derivational residue in phonological Optimality Theory*. Amsterdam: John Benjamins.
- Hermans, Ben & Marc van Oostendorp. 2000. Synchrone beperkingen op de Sittardse diftongering. *Taal en tongval* 51 (2), 166–186.
- Hermans, Ben & Marc van Oostendorp. 2001. Voice–tone interaction in a Limburg dialect. Evidence for feature licensing. In Ton van der Wouden & Helen de Hoop (eds.) *Linguistics in the Netherlands*, 81–91. Amsterdam: John Benjamins.
- Hombert, Jean-Marie. 1977. Development of tones from vowel height. *Journal of Phonetics* 5, 9–16.
- Hombert, Jean-Marie, John J. Ohala & William G. Ewan. 1979. Phonetic explanations for the development of tones. *Language* 55, 37–58.
- Hyman, Larry M. 1985. *A theory of phonological weight*. Dordrecht: Foris.
- Jurcic, Peter & Michael Becker. This volume. Interactions of tone and ATR in Slovenian.
- Kager, René. 1989. *A metrical theory of stress and destressing in English and Dutch*. Dordrecht: Foris Publications.
- Kehrein, Wolfgang. 2007. Moraic stress in Franconian – and elsewhere. Talk presented at *Phonetics and Phonology* 4, Nijmegen.
- Kehrein, Wolfgang. This volume. There’s no tone in Cologne: against tone segment interactions in Franconian.
- Köhnlein, Björn. 2011. *Rule reversal revisited: Synchrony and diachrony of tone and prosodic structure in the Franconian dialect of Arzbach*. Doctoral dissertation: Leiden. (= LOT Dissertation series 274).

- Köhnlein, Björn 2016. Contrastive foot structure in Franconian tone accent dialects *Phonology* 33.1, 87–123.
- Krämer, Martin. 2009. *The phonology of Italian*. Oxford: Oxford University Press.
- McCarthy, John & Alan Prince. 1995. Faithfulness and reduplicative identity. In Jill Beckman, Laura Walsh-Dickey & Suzanne Urbanczyk (eds.) *University of Massachusetts occasional papers in linguistics*, vol. 18, 249–384. Amherst, MA: GLSA Publications.
- McCarthy, John & Alan Prince. 1996. Prosodic morphology 1986. *Technical Report #32*, Rutgers University Center for Cognitive Science.
- Morén, Bruce. 2000. The puzzle of Kashmiri stress: Implications for weight theory. *Phonology* 17, 365–396.
- Morén, Bruce. 2001. *Distinctiveness, coercion and sonority: A unified theory of weight*. New York: Routledge Publishers.
- Morén, Bruce. 2003. Danish stød and Eastern Norwegian pitch accent: the Myth of lexical tones. Talk presented at the 13th *Manchester Phonology Meeting*.
- Oostendorp, Marc van. 1995. *Vowel quality and phonological projection*. Doctoral dissertation, Tilburg University.
- Oostendorp, Marc van. 2000. *Phonological projection*. Berlin: Mouton De Gruyter.
- Oostendorp, Marc van. 2005. Expressing inflection tonally. *Catalan Journal of Linguistics* 4 (1), 107–127.
- Oostendorp, Marc van. 2012. Quantity and the three-syllable window in Dutch word stress. *Language and Linguistics Compass* 6, 343–358.
- Oostendorp, Marc van. This volume. Tone, final devoicing and assimilation in Moresnet.
- Peters, Jörg. 2006. The Cologne word accent revisited. In Michiel de Vaan (ed.) *Germanic tone accents. Proceedings of the first international workshop on Franconian tone accents, Leiden, 13–14 June 2003*. Zeitschrift für Dialektologie und Linguistik – Beiheft 131, 107–133. Stuttgart: Franz Steiner Verlag.
- Peters, Jörg. 2008. Tone and intonation in the dialect of Hasselt. *Linguistics* 46, 983–1018.
- Peeters, Wim & Bert Schouten. 1989. Die Diphthongierung der westgermanischen î- und û-Laute im Limburgischen. *Zeitschrift für Dialektologie und Linguistik* 56, 309–331.
- Pöchtrager, Markus. 2006. *The structure of length*. Doctoral dissertation, University of Vienna.
- Prince, Alan. 1990. Quantitative consequences of rhythmic organization. In K. Deaton, M. Noske & M. Ziolkowski, (eds.), CLS 26-II, *Papers from the parasession on the syllable in phonetics and phonology*, 355–398. Chicago: Chicago Linguistic Society.
- Prince, Alan & Paul Smolensky. 1993. *Optimality theory: Constraint interaction in generative grammar*. New Brunswick: RuCCS-TR-2, Rutgers Center for Cognitive Science, Rutgers University.
- Schane, Sanford A. 1984. The fundamentals of particle phonology. *Phonology Yearbook* 1, 129–156.
- Schmidt, Jürgen E. 1986. *Die mittelfränkischen Tonakzente (Rheinische Akzentierung)*. Stuttgart: Steiner (Mainzer Studien Zur Sprach- und Volksforschung 8).
- Schmidt, Jürgen E. 2002. Die sprachhistorische Genese der mittelfränkischen Tonakzente. In Peter Auer, Peter Gilles & Helmut Spiekermann (eds.) *Silbenschnitt und Tonakzente*, 201–233. Tübingen: Niemeyer (Linguistische Arbeiten 463).
- Selkirk, Elisabeth. 1995. Sentence prosody: Intonation, stress and phrasing. In John Goldsmith (ed.) *The handbook of phonological theory*. London: Blackwell.
- De Vaan, Michiel. 2002. WGm. *î en *û voor r in Zuid-Limburg. *Taal en Tongval*, 54, 171–182.
- Werth, Alexander. 2007. Perzeptionsphonologische Studien zu den mittelfränkischen Tonakzenten. *Zeitschrift für Dialektologie und Linguistik* 74 (2), 292–316.

- Werth, Alexander. 2011. *Perzeptionsphonologische Grundlagen der Prosodie: Eine Analyse der mittelfränkischen Tonakzentdistinktion*. Zeitschrift für Dialektologie und Linguistik – Beihefte, Band 143. Stuttgart: Franz Steiner Verlag.
- Wiese, Richard. 1996. *The phonology of German*. Oxford: Oxford University Press.
- Yip, Moira. 1989. Feature geometry and cooccurrence restrictions. *Phonology* 6, 349–374.
- Yip, Moira. 2002. *Tone*. Cambridge: Cambridge University Press.

Marc van Oostendorp

Tone, final devoicing, and assimilation in Moresnet

Abstract: In the Franconian dialect of Moresnet, accentuation shows up non-contrastively on short vowels followed by an obstruent. The tone is determined by the underlying voicing of the following obstruent, not by its surface realization. Neither Final Devoicing nor Voicing Assimilation seem to affect the accentuation on the vowel. We explore the theoretical implications of this opacity and demonstrate, first, that it requires a phonological model which is derivational involving at least two different levels, and that this in turn implies that the apparent interaction between voicing and tone in this dialect is not problematic for recent accounts which posit that Franconian dialects do not have a tonal, but rather a prosodic contrast.

1 Tone-voicing interaction in Moresnet

Several authors have argued in recent years that the ‘tonal’ Franconian dialects of West Germanic are not really tonal at all (see Boersma, this volume; Kehrein, this volume, and references cited there), but display a prosodic contrast instead, although the authors mentioned do not agree as to what this contrast would be. Yet some modern dialects still display phenomena which seem problematic for such a view. One of these is that the contrast on short vowels in Moresnet is determined by the laryngeal phonology of the following obstruent. Typologically, this points in the direction of the contrast being tonal, since tone-voicing interaction is quite common in languages of the world, while prosody-voicing interaction (at least of this type) is not.

However, the Moresnet phenomenon interacts with the phonology in a complicated way, since it isn’t the surface but the underlying specification of the laryngeal features which interacts with the tones, and this in turn happens in complicated ways which defy a representational solution, as we will show below, requiring instead a rather complicated derivational pattern. We will discuss in what way this sheds light on the underlying representation.

2 Moresnet tonology

Moresnet, currently part of the municipality Bleyberg (Plombières), is a village of about 1300 inhabitants in the Belgian province of Liège. French is the most important official language in this area. The local dialect of Moresnet is however Germanic, and usually considered to be intermediate between Limburgian and Ripuarian; it is located to the west of Bernrather Linie, so that it has not undergone the spirantization typical for Ripuarian dialects (Jongen, 1972a,b, 2010; Goossens, 2009):

- (1) a. Moresnet: [ut, ap, ma:kə]
- b. Aachen: [us, af, ma:xə]

Like dialects in the neighboring region, Moresnet makes a lexical distinction between Accent 1 and Accent 2. In the case of long vowels (or short vowels followed by sonorants), this leads to minimal pairs such as the following (I denote Accent 1 and 2 with superscripts):

- (2) *doof*¹ ‘deaf’ (F.SG.), *doof*² ‘deaf’ (M.SG.), *leep*¹ ‘lip’, *kreep*² ‘cradle’,
*zèès*¹ ‘scythe’, *zèès*² ‘six’

Short vowels before obstruents also take part in this opposition, yet the accent is not phonemic in this context, but always determined by the voicing of the obstruent following it: if this obstruent is voiced, we have Accent 1, and if it is voiceless, we get Accent 2.

- (3) a. voiced obstr. = Acc. 1 ([bɛde¹] ‘beds’)
- b. voiceless obstr. = Acc. 2 ([tɛpəx², kɛs²] ‘carpet’, ‘cash’)

This correlation between voicing on the obstruent and tonal accent in itself is not surprising. It is known that obstruent voicing has a lowering effect on F0. Therefore, having a word end in voiced obstruent will turn a level tone into a falling tone quite naturally at the phonetic level.

We can find the same correlation in many Limburgian dialects (Hermans and van Oostendorp, 2001), at least at the phonetic level. It is a challenge for approaches which claim that synchronically the relevant contrast is prosodic rather than tonal, such as those mentioned above.

However, even more interestingly, this particular tonal opposition is not entirely phonetic in Moresnet, as it is ‘opaque’ – the tone is not dependent on the surface voicing of the obstruent, but rather on its underlying value for the feature [voice]. What is more, it is opaque in two different ways, i.e. it interacts with two different processes changing the underlying value. First, the process of final

devoicing has no influence, so that phonetically voiceless obstruents sometimes trigger Accent 1 (viz. when they are devoiced):¹

(4) [bɛt¹] (</bɛd/ ‘bed’).

Secondly, voicing assimilation – a process which voices an obstruent when it precedes a voiced plosive – also has no influence, so that phonetically voiced obstruents sometimes combine with Accent 2 (viz. when they are underlyingly voiceless). Examples are voicing of a stem-final obstruent before the past-tense ending *-de* (5a), before the derivational (nominalizing) suffix *-de* (5b), and before the 2nd person plural enclitic *der* (5c):²

- (5) a. [stɔbdə²] ‘stopped’ (</stɔp/ ‘to stop’ + /də/ PAST)
 b. [nɛdzdə²] ‘wetness’ (</nat/ ‘wet’ + /də/ N)
 c. [brʊg²dərdat²] ‘do you need that’ (</brʊk/ ‘need’ + /dər/ ‘you’ + /dat/ ‘that’)

In most other varieties of Franconian, the tone-voice correlation is not opaque but completely surface-true: e.g. Maasbracht Limburgian has [bɛt²], [stɔbdə¹] (Ben Hermans, p.c.). Such an interaction is probably more easy to understand from a prosodic point of view than the one in Moresnet: all the approaches mentioned above would at some point assign tones to the different prosodic structures in all Franconian dialects, simply because they are present at that level, and such surface tones could then interact with the laryngeal features of the consonants. It is the fact that there seems to be interaction with underlying laryngeal features which makes the Moresnet case more challenging.

3 Opacity

Opacity is the application of processes to a phonological form which refer not to surface properties of the form in question, but to ‘deeper’, more ‘underlying’ properties. Since it plays an important role in the discussion, we should devote some attention to it.

¹ Two further types of opacity, mentioned in Jongen (2010), are that Imperative Singular always has Accent 2, and that the same is sometimes true for the first member of compounds. I will not go into this phenomenon here, interesting as it may be for a variety of reasons, because it does not involve the purely phonological type of opacity discussed here.

² There is also assimilation to a following underlying voiceless obstruent, e.g. in the diminutive *-kə*.

Opacity is a problem for phonological theories which orient themselves on the surface representation exclusively, like (classical) Optimality Theory (Prince and Smolensky, 1993). The definition most cited is by Kiparsky:

(6) *Opacity* (Kiparsky, 1968, 1973)

“A phonological rule R of the form $A \rightarrow B / C_D$ is opaque, if there are surface forms, which show one of the following:

- a. A in the context C_D
- b. B derived from A , which appears in contexts different from C_D ”

The interaction between tone and voicing in Moresnet shows both types of opacity. Let us assume for a moment that Accent 2 is always underlying (or that it is the default) and that the relevant rule is informally as follows:

(7) $V \rightarrow \text{Acc. 1} / __ [+voice]$ (Accentuation rule)

(4) corresponds to (6b): the rule has applied in a ‘wrong’ context, while (5) corresponds to (6a): the rule seems to have not applied, even though its context is met. (Assuming that Accent 1 is underlying and that there is a rule converting it to Accent 2 in $[-voice]$ contexts leads to the same double opacity.)

Rule-based analyzes have no problem with this type of situation: we just need to stipulate that (7) precedes the two other processes involved, final devoicing and voicing assimilation:

(8) a. $[+voice] \rightarrow [-voice] / __ \#$ (Final devoicing)

b. $C \rightarrow [+voice] / __ [+voice]$ (Assimilation)

If rules (8a) and (8b) apply after (7) in Moresnet, the Accentual rule just does not feel the presence of these other processes. In other dialects the order could be the other way around.

In constraint-based systems, such as OT, the issue becomes more difficult since processes are never ordered, and they are supposed to be all sensitive only to the surface. There are two ways one could deal with opacity in these cases (see McCarthy, 2007, for an overview): one could mimic the derivation and organize the phonology into several steps, or alternatively one could enrich the representation. The latter is an approach I have defended in previous work (van Oostendorp, 2005, 2007, 2009), but I think it is untenable in this case. I will try to show this, by working out a representational account first, discussing what its problems are, and then moving to a derivational solution.

4 A representational solution

A representational solution to an opacity problem typically implies that we show that the two opaque processes are not different, or at least that they are not independent, so that they do not have to be ordered. In the case at hand, if we could establish for instance that final devoicing and the accent shift are really two sides of the same coin, they can happen at the same time and we do not have to establish an ordering relation between them.

We can draw the relation if we accept the hypothesis that Low and Voice are instances of the same feature. One implementation of this is to accept that both the low tone on vowels and sonorants and voicing on obstruents can be phonologically marked with the feature ‘L’ (Bradshaw, 1999); the precise phonetic implementation of this feature would thus depend partially on the segment on which it is realized – but that is not uncommon (the [high] vowel [u] in a given language is not necessarily exactly as high as [i]) (Bradshaw, 1999).

Furthermore, we have to claim that it is impossible to completely *delete* this feature in Moresnet; final devoicing would be able to move it away, but not to take it out of the representation altogether. It would therefore move to the tonal node, accounting for the falling tone on a short vowel followed by an underlyingly voiced consonant.

Note that this solution only works if we assume that the accentual contrast is somehow tonal. Here is a concrete way of working out this solution. We assume that having Accent 1 implies the presence of a low tone, whereas Accent 2 is underlyingly toneless. Other surface tones would be added by phonetic realization rules or are due to intonation. Drawing the distinction in this way seems warranted for independent reasons (van Oostendorp, 2006); for instance, Accent 1 is morphologically more marked than Accent 2 (the former can morphologically mark the plural, and furthermore in many minimal pairs the Accent 1 form is a lexical word, while Accent 2 marks a function word).³

³ The fact that the imperative is marked by Accent 2 in Moresnet seems to run counter to this observation, because it implies that Accent 2 can be used to actively mark a contrast, but notice that it is exactly the imperative which in many languages is expressed by truncation (D’Alessandro and van Oostendorp, 2016).

We can now analyze the normal, non-opaque effect as an instance of autosegmental spreading of the feature L:

In Optimality Theory, we can see this as the interaction between three constraints”

- (10) a. MAX-L: The feature L should not be deleted
b. IDENT-L: The feature L should not be realized on a different segment than that on which it has been underlyingly specified
c. AGREE: vowels and adjacent voiced obstruents share the feature L

(11)

	bεdə	AGREE	MAX-L	IDENT-L
a.	bε ¹ tə			**!
b.	☞ bε ¹ də			*
c.	bε ² tə		*!	
d.	bε ² də	*!		

Two configurations satisfy AGREE: one in which a vowel is followed by a voiceless consonant, and one in which the voicing (the feature L) of the consonant is shared by the vowel. If a vowel is followed by an underlyingly voiced consonant, this can be resolved in one of two ways: by delinking the voicing (violating MAX) or by spreading to the vowel (violating IDENT). The choice is resolved in the familiar way: by ranking of the two relevant constraints.

The interaction with Final Devoicing can now be easily captured by ranking the constraint responding for it on top of the subhierarchy we have already established:

- (12) FINDEV: L is not allowed on a word-final (syllable-final) obstruent

(13)

	bεd	FINDEV	AGREE	MAX-L	IDENT-L
a.	☞ bε ¹ t				*
b.	bε ¹ d	*!			*
c.	bε ² t			*!	
d.	bε ² d	*!	*		

The fact that FINDEV is high ranked, forces delinking of voicing on the final consonant. Given that MAX requires the feature to be preserved, this delinking at the same time leads to a linking of the feature to the vowel.

This representational analysis has several advantages. First, of course, the ‘opaque’ interaction is not really opaque, but a consequence of the representations involved, plus the independently established constraint ranking. Secondly, all constraints involved are independently motivated for Moresnet as well as for other dialects.

Unfortunately, however, there are also some disadvantages. First, there is no formal relation between spreading and the tonal effect of final devoicing: the latter is not really spreading but a movement of the feature to a different position. This implies that one would also expect language systems – for instance, other Franconian dialects – without spreading but with the tonal effect of final devoicing; those have not been attested.

Other dialects possibly have a different ranking of IDENT and MAX:

(14)

	bɛd	FINDEV	AGREE	IDENT-L	MAX-L
a.	bɛ ¹ t			*!	
b.	bɛ ¹ d	*!		*	
c.	☞ bɛ ² t				*
d.	bɛ ² d	*!	*		

In addition, and possibly even more importantly, the representational approach does not offer a solution of the other opacity problem, viz. the one involving assimilation. Under autosegmentalist assumptions, assimilation should be analyzed as spreading of the L feature, which can be depicted as follows:

Assimilation is a problem for our account, because it is not clear why an obstruent which is voiced as a result of assimilation should not have the same effect on the preceding vowel as an obstruent that is ‘underlyingly’ voiced. In verbs with an underlyingly voiced obstruent, accentuation is possible:

(16) [tɔ^hbde] (</tɔb/ ‘fretted’)

We would have to assume, for instance, that L cannot spread more than once, so that e.g. we have to adopt a constraint such as:

(17) DOMAIN: The domain of L is binary at most (one L feature cannot be linked to more than one position).

There is, however, no independent evidence for such a constraint in the Moresnet dialect, and its status as a universal constraint is questionable at best (Jurgec, 2011).

Finally, there is no conceptual relationship between the constraints DOMAIN and MAX-L, the two constraints which are responsible for the opacity effects: this obviously makes the factorial typology become bigger, and one might argue that it becomes too big: we predict languages like Moresnet which are opaque only in the context of final devoicing, or only in the context of assimilation, whereas all we have in reality is a system which features both types of opacity at the same time.

It seems difficult to solve any of these problems, since they all seem inherent to the representational approach. The issue is that the L feature works as a memory device: even though it is no longer there on the surface, it still affects the vowel in the same way as a voiced consonant would. Similarly, ‘derived’ voicing somehow has to behave in a different way.

5 A derivational solution

If we cannot find the solution within one representation, we may try to find it in the assumption that there are two representations: one in which the underlying specifications for voice are untouched and Accentuation can play an unlimited role, and one in which devoicing and assimilation have worked before Accentuation.

In the course of the past 15 years, many suggestions have been offered as to the solution of opacity problems within Optimality Theories. The most influential current ideas are both derivational: in our case, we would say that we apply the accent shift first, and then final devoicing and assimilation, just as in the rule-based solution sketched above.

The first such proposal is so-called Stratal Optimality Theory (Bermúdez-Otero, forthcoming; Kiparsky, 2006; Rubach, 2003), which distinguishes between (typically) three levels of phonology: stem-level, word-level and sentence-level. Those phonologies apply serially. If we say for instance that the accent shift rule applies at stem-level, we can say that the other two processes are postlexical. The alternative proposal would be found in so-called OT-CC (Optimality Theory with Candidate Chains; McCarthy (2007)) in which there is also extrinsic rule ordering, but without the link to morphological status.

Of these two, Stratal OT seems the more attractive, for instance since it is more restrictive, and it allows for an explicit relationship with syntax and semantics. (That also differentiates such an approach from the rule-based one in which

no such link is necessary.) Let us for the sake of concreteness adopt a standard SOT model with three levels of representation:

Assuming that none of the processes involved here are postlexical (they all seem to work within the word, although some more work would need to be done on the special status of the clitic *der*), we could propose the following stratal phonology of Moresnet, working with the constraints already introduced above:

(19) ASSIM: Two adjacent obstruents need to share L.

(20) a. Root-level Phonology: AGREE $\gg$ IDENT-L $\gg$ FINDEV:

- /bɛd/ → /bɛ¹d/
- /stɔp/ → /stɔp/

b. Word-level Phonology: FINDEV, ASSIM $\gg$ IDENT-L $\gg$ AGREE:

- /bɛ¹d/ → /bɛ¹t/
- /stɔpɔə/ → /stɔbɔə/

At the root level, AGREE is dominant, forcing the vowel to agree with the following consonant, but otherwise all changes to an underlying specification of L are blocked by a highranking IDENT-L constraint (so that no spontaneous accentuation could happen in other words). At the word-level, things work the other way around: the constraints in favour of devoicing and assimilation outrank the faithfulness constraint.

Furthermore, we can assume that at the root-level, the relevant affixes are not yet visible to the phonology, so that the relative ranking of the constraint ASSIM is irrelevant at this level (there will be no context for this constraint).

In transparent dialects, on the other hand, all the relevant constraints apply at the same level. This needs to be the word-level since also in these dialects the inflectional suffixes need to be present before ASSIM will take any relevant effect.

(21) a. Root-level Phonology: IDENT-L $\gg$ FINDEV, AGREE:

- /bɛd/ → /bɛd/
- /stɔp/ → /stɔp/

b. Word-level Phonology: FINDEV, AGREE, ASSIM $\gg$ IDENT-L:

- /bɛd/ → /bɛ²t/
- /stɔpɔə/ → /stɔ¹bɔə/

Some interesting predictions follow from a ‘stratal’ analysis, which can readily be tested. In particular, the relation between tone and voicing should be part of the ‘deep phonology’ in Moresnet, i.e. it should apply at an early lexical level. Given this, there might be lexical exceptions. Such exceptions are indeed mentioned by Jongen (2010), who claims to have found ‘about fifty’ words with a short vowel followed by a voiced consonant and Accent 2. Most of these have a sonorant following the stressed vowel (22a), but there also are some words with a voiced fricative (22b) (there seem to be no exceptions with a plosive):

- (22) a. *kastan*²əl ‘chestnut’, *mœr*²əjə ‘tomorrow’, *hu*²məl ‘bumblebee’
 b. *ɔ*²vənt ‘evening’, *brœ*²zələ ‘talk nonsense’

Similar exceptions do not seem to be attested in other Franconian dialects, and this on its own is an argument in favour of a derivational approach, as a representational account seems unable to make a similar prediction.⁴

Another consequence of pursuing the derivational account is that the initial motivation for equating Low tone and voice disappears: we needed the abstract L feature as a ‘memory device’ when we set up a representational account. Such representational accounts will typically build representations which are slightly more complex and/or abstract (because one representation has to do the work which several representations together can do in a derivational account). In this particular case, we needed the L to mark the fact that the voicing was there on the consonant, even though it is no longer expressed there. Furthermore, the account is elegant because it allows us to express the purely phonetic influence in other Franconian dialects in a similar way.

However, given that we no longer need the representation to work as a memory device, we can wonder whether other representations cannot also do the work. As I mentioned at the outset of this paper, several papers in this volume argue that the phonological representation of the accentual difference is not tonal, but rather prosodic.

⁴ Derivational synchronic accounts usually have something in common with diachronic approaches of the same data, in that they posit an irreversible order in which phenomena are supposed to occur. Translating the present account one-on-one to diachrony would imply saying that in Moresnet the accentuation occurred before (any) final devoicing or assimilation. That seems rather far-fetched. This in turn means that the diachronic account cannot reach the same level of simplicity as the one proposed here.

The precise implementation differs from one proposal to the next, but it seems to me that they have certain aspects in common, in particular the assumption that Accent 1 has a more complex structure than Accent 2. For the sake of concreteness, let us suppose that Accent 1 involves somehow a bisyllabic structure, whereas Accent 2 is monosyllabic:

- (23) Accent 1 Accent 2
doof (F.SG.) *doof* (N.SG.)
-

Combining these representations with the Stratal approach just outlined would mean that at the root level words ending in a voiced obstruent would have a different representation from those ending in a voiceless obstruent:

- (24) a. Accent 1 b. Accent 2
-

What kind of constraint could be responsible for this division? The syllabification of Accent 2 seems to make most sense: the obstruent is put in a coda, and we could assume that this follows from ordinary constraints on syllabification. So why don't stems ending in a voiced obstruent satisfy these same constraints? I propose that the reason for this is Final Devoicing: voiced obstruents should not be in a coda. At the root level of Moresnet, this problem is not solved by devoicing the obstruent but by syllabifying the obstruent in an onset (van Oostendorp, 2015, argues that also Standard French satisfies Final Devoicing in this way at the end of the word).

In this way, then, the connection between voicing and accentuation becomes a different one: a final voiced plosive causes a different accentuation since it triggers a different syllable structure. In terms of constraint-ranking, we have to add one more constraint to the set we entertained above: *EMPTY, disallowing empty-headed syllables such as the one in (24a). This constraint will thus be responsible for putting a consonant in a coda by default, i.e. in words ending in

a voiceless consonant.⁵ If we sandwich FINDEV in between IDENT and *EMPTY, we get the desired result (parentheses denote syllable boundaries):

(25) a.

	bɛd	IDENT-Vc	FINDEV	*EMPTY
a.	(bɛt)	*!		
b.	(bɛd)		*!	
c.	[☞] (bɛ)(d)			*
d.	(bɛ)(t)	*!		*

b.

	zɛs	IDENT-Vc	FINDEV	*EMPTY
a.	[☞] (zɛs)			
b.	(zɛ)(s)			*!

Obviously, at the next (Word-)level, the laryngeal phonology will have to interact with these structures. The technical difficulty is that now we will want the word-final consonants to devoice after all, while leaving the accentual distinction in place. One possible way in which this might happen is that at this point the prosody is replaced by tones – but as working this out would require a rather elaborate theory of faithfulness, I will not pursue this here. Alternatively, it might be the case that now a different type of final devoicing becomes available. It has been suggested that language typology provides for two kinds of final devoicing languages (Lombardi, 2001): those like Dutch which devoice at the end of the syllable, and those like Yiddish, which devoice only at the end of the word. This may be taken to imply that there are two devoicing constraints and one (the ‘Dutch’ one) operates at the earlier root level, whereas the other (the ‘Yiddish’ one) works at the later level. Even though the final consonant of /bɛd/ is not syllable-final, it is word-final and it will therefore devoice:

(26)

	(bɛ)(d)	FAITH-PROSODY	FINDEV-Wd	IDENT-Vc
a.	(bɛt)	*!		*
b.	(bɛd)	*!	*	
c.	[☞] (bɛ)(t)			*
d.	(bɛ)(d)		*!	

⁵ We have to assume that the prosodic structure of (Accent 1) words ending in a long vowel or a sonorant is determined by other factors, for instance those described in the other papers in this volume.

Notice that it is absolutely important that this analysis is derivational and uses two levels. If we would try to mix them, the fact that the final obstruent gets devoiced would still make accentuation opaque.

Voicing assimilation is completely unproblematic under the approach advocated here, as it will not interact with accentuation at all:

(27)

	(stop)(də)	FAITH-PROSODY	ASSIMILATION	IDENT-VC
a.	(stob)(də)			*
b.	(stop)(də)		*!	

Since Assimilation does not interact, it could actually apply already at the Root level; but given that the relevant contexts are still only created by affixation, it seems that the Word level is the earliest relevant level.

Under the current assumptions, there will also some work to be done at the Postlexical level, since the intonational tones will presumably have to be assigned here. I refer again to the work of my colleagues in this volume for several ideas as to how to do it. However, it is interesting to note that it seems to be the case that the realization of Accent 1 and Accent 2 differs under different intonational patterns, such as declarative vs. interrogative contour (Jongen, 1972b, p. 154). This is seen by the other authors as a strong argument in favour of a prosodic analysis, since it is easily analyzed if we assume that the tones are provided by the intonational contour.

6 Conclusion and predictions

It is always difficult to compare models. In the analysis of a seemingly rather simple phenomenon such as the allophonic alternation between Accent 1 and Accent 2 on short vowels in Moresnet, depending on the underlying voicing of the following obstruent, several different theoretical assumptions play a role and interact: the representation of the accentual distinction, that of voicing, and the issue whether or not we allow ourselves to refer to different levels of representation.

Since the space of choices is very large in particular in the domain of representations, it seems impossible to prove that a representational solution to the opacity of the accentuation rule in Moresnet is impossible: maybe the theoretical machinery is just insufficient. But I feel confident to claim that with the fairly standard toolbox which I have used here, a monostratal solution is impossible. But, surprisingly given this fact, we can change our assumptions on the representation: the original phonetic correlation between tone and voicing may have been reanalyzed as an abstract response to voiced obstruents in codas.

I believe that the result presented here is of theoretical importance also for another reason. I am not aware of many examples of ‘real’ opacity in West-Germanic dialects in which it seems absolutely necessary to posit two (or more) levels of representation; most of them can be representationally reanalyzed. The interaction between tone and final devoicing and assimilation in Moresnet seems however truly opaque, in particular since there are *two* processes at work, which both interact independently. This can be elegantly explained in a derivational framework using two representations, but giving a monorepresentational account would involve an unknown machinery.

References

- Bermúdez-Otero, Ricardo. forthcoming. *Stratal Optimality Theory*. Oxford: Oxford University Press.
- Boersma, P. This volume. The history of the Franconian tone contrast.
- Bradshaw, M. 1999. A crosslinguistic study of consonant-tone interaction. Doctoral dissertation, Ohio State University.
- D'Alessandro, R. van Oostendorp, M. 2016. Prosody, phi-features and deixis in Southern Italian: what vocatives can tell us on the architecture of language. In Ernestina Carrilho, Alexandra Fiéis, Maria Lobo, Sandra Pereira (eds.) *Romance Languages and Linguistic Theory 10. Selected Papers from ‘Going Romance’ 28*, Lisbon, pp. 56–78. John Benjamins, Amsterdam.
- Goossens, J. 2009. De Genker toonaccenten en hun dialectgeografische inbedding. Koninklijke Commissie voor Toponymie en Dialectologie, Tonrgeren.
- Hermans, B. Manuscript. Tone and voicing in Limburg.
- Hermans, B. van Oostendorp, M. 2001. Voice-tone interaction in a Limburg dialect: evidence for feature licensing, pp. 81–92. In H. de Hoop & T. van der Wouden (eds.) *Linguistics in the Netherlands*. John Benjamins, Amsterdam/Philadelphia.
- Jongen, R. 1972a. Phonologie der Moresneter Mundart; Eine Beschreibung der Phonologie der Moresneter Mundart. Eine Beschreibung der segmentalen und prosodischen Wortformdiakrise. Van Gorcum, Assen.
- Jongen, R. 1972b. Rheinische Akzentuierung und sonstige prosodische Erscheinungen, vol. 83. *Rheinisches Archiv*, Bonn.
- Jongen, R. 2010. De Rijnlandse toonaccenten in het Zuid-nederfrankisch dialect van Moresnet. *Handelingen van de Koninklijke Commissie voor Toponymie en Dialectologie* 82.
- Jurjec, P. 2011. *Feature Spreading 2.0: A Unified Theory of Assimilation*. Ph.D. thesis, University of Tromsø.
- Kehrein, W. This volume. There’s no tone in Cologne: against tone segment interactions in Franconian.
- Kiparsky, P. 1968. Tense and mood in Indo-European syntax. *Foundations of language* 4, 30–57.
- Kiparsky, P. 1973. Abstractness, opacity, and global rules. In Fujimura, O. (Ed.), *Three dimensions of linguistic theory*, 57–86. Tokyo: Taikusha.
- Kiparsky, P. 2006. *Paradigms and Opacity*. CSLI, Stanford.
- Köhnlein, B. 2011. *Rule Reversal revisited: Synchrony and diachrony of tone and prosodic structure in the Franconian dialect of Arzbach*. Doctoral dissertation, Leiden University.

- Lombardi, L. (Ed.), 2001. *Segmental phonology in Optimality Theory: Constraints and Representations*. Cambridge University Press, Cambridge; New York.
- McCarthy, J. 2007. Hidden generalizations. *Phonological opacity in Optimality Theory*. Equinox, Los Angeles.
- van Oostendorp, M. 2005. The theory of faithfulness. Unpublished manuscript.
- van Oostendorp, M. 2006. Expressing inflection tonally. *Catalan Journal of Linguistics* 4, 107–126.
- van Oostendorp, M. 2007. Derived Environment Effects and Consistency of Exponence. In Blaho, S. Bye, P. Krämer, M. (eds.) *Freedom of Analysis?*, pp. 123–148. Mouton de Gruyter, Berlin.
- van Oostendorp, M. 2009. Dutch diminutives and the question mark. In Rice, C. Blaho, S. (eds.) *Ineffability in Optimality Theory*. Equinox.
- van Oostendorp, M. 2015. Final Devoicing in French. In H. van Riemsdijk and M. van Oostendorp (eds.) *Representing Structure in Phonology and Syntax*. Mouton De Gruyter.
- Prince, A. Smolensky, P. 1993. *Optimality theory: Constraint interaction in generative grammar*. Manuscript, Rutgers University and University of Colorado at Boulder. Available at ROA and published 2004 at Blackwell.
- Rubach, J. 2003. Duke-of-York derivations in Polish. *Linguistic Inquiry* 29, 601–629.

Keywords index

- accent 30, 37, 38–97, 147–194, 203, 208,
211–235, 237–251, 253
– 1 and 2 6, 9, 83–84, 93, 147–194, 211–235,
237–251
– combinatory 30, 183–184
– spontaneous 36, 183–186, 245
accentogenesis 147, 181–188 [*see also*
tonogenesis]
acute accent 6, 27, 29–31, 41–52, 58–95,
147, 181, 189
acquisition 39
alternation 61, 64, 66, 70, 75–76, 87, 91–92,
99, 101–107, 198–205, 217–235, 249
analogical lengthening 29, 31, 61–65, 67, 71,
75, 89, 91, 181–185
areal effect 99, 106–107, 168
[ATR] 11–26, 128
autosegmental phonology 1, 123–124, 212,
231, 243

bimoraicity 38–39, 45–61, 72–73, 77, 81,
86, 125, 174, 177, 183–188, 207, 217,
221–229
blocking 113–115, 135–140, 165, 228–230

circumflex accent 6, 27, 29–31, 43–95, 147,
149, 181, 189 [*see also* Trägheitsakzent,
Accent 2, Schleifton, sleeptoon]
citation form 30, 42, 99–106
coda 9, 44–51, 56, 60–61, 100, 143, 174,
199–207, 225, 227, 247–249
consonant
– cluster 41, 57, 67, 70, 79, 177, 202, 207
– voiced 4–13, 33–97, 109, 147–156, 170,
175, 183–188, 195, 241–250
– voiceless 4–13, 33–97, 175–180, 242–250
contour 9, 14, 27–30, 40, 46, 48–49, 58–59,
68, 73, 84, 87, 100, 104–107, 121,
132, 155–163, 167–178, 185, 188–189,
196–201, 206, 213, 218–219, 229, 249

deaccentuation 161–163
defooting 206
degemination 27, 56–67, 78, 86–87

depressor 109–146
diphthong 6–8, 27–38, 42, 47–51, 54–56,
61, 64, 70, 74–75, 83, 94, 103–104, 149,
154, 168, 172, 180, 184, 188, 211–235
diphthongization 7, 38, 94, 154, 180, 188,
211, 214–215, 215–228
displacement 110–115, 118–129, 136, 141
disyllable 3, 30, 61, 126, 199, 203,
216–217, 220
dragging tone 6
duration 13–14, 27, 43–51, 83, 106, 166,
169–174, 181, 185, 196, 213

enhancement 9, 45, 104–107, 128, 187, 198
epenthesis 181 [*see also* schwa insertion]

falling tone 6–9, 14, 28, 30, 89, 99, 112, 122,
126, 132, 134, 149–159, 181, 185, 196, 198,
208, 211–214, 221, 224, 231, 238, 241
final devoicing 27, 30, 36–37, 74, 78, 80, 85,
91, 152, 176, 184, 193, 237–251
floating tone 16–19
focus 27–29, 40–41, 68, 86, 107, 149,
157–167, 173, 196, 211–214, 218,
229–230
foot
– head 45, 47, 196
– structure 8, 147–194, 199, 204, 211–235
fricative 30–31, 35, 37, 69, 72, 85, 115–117,
129, 142–143, 200, 246
front vowels 34–36, 65, 85, 128, 195

geminate 50–51, 58–60, 64, 77–81, 87, 177,
185–186, 202–205
glottalization 9, 169, 181, 196
gradation 195, 198, 202–203, 207

half-length 44–51, 60, 198–208
headedness 221–227
high vowels 4, 6, 11–25, 27–97, 215,
222–226, 231, 241

implosive 117, 142
intensity 14, 30, 163, 169, 172–173, 190, 213

- intonation
 – declarative 27–31, 40–41, 58–59, 84, 149, 154–167, 171, 187, 213–219, 229–230, 249
 – interrogative 28–29, 40–41, 83–84, 155–167, 175, 213–214, 218, 229–230, 249
- laryngeal features 4–6, 109, 115–121, 142, 201, 237–239, 248
- lax vowels 8, 11–13, 15, 20–21, 53, 117, 129, 198, 215, 221, 224–225
- length 13, 15, 27, 39, 44–45, 196, 198–199, 224–225
- lengthening 30, 46–50, 52–53, 74, 81–83, 89–90, 111, 125, 138, 151–152, 156, 159, 163–173, 175, 182, 184–185, 187, 189, 201–208, 226–229
 – analogical 61–65, 69, 71, 75, 181, 183, 188
 – compensatory 35, 202
 – open syllable 29, 31, 33–34, 36, 66–68, 70, 83, 92, 94–95, 177, 181, 183, 188
- level tone 6–7, 9, 12, 28–29, 48–50, 72, 89, 100, 105, 107, 110, 112, 119, 121–122, 126, 132, 149, 151–157, 165–167, 182, 214, 238
- loanword phonology 11, 14, 19–21
- low vowels 2, 4, 13, 19–21, 34, 36, 103, 105, 228
- markedness 11–15, 18–21, 60, 149, 157, 165, 167–170, 174, 177, 206, 220, 229, 241
- metrical phonology 1–3, 8–9, 29, 39, 95, 161, 188, 205, 211–235
- merger 32, 38, 40, 69, 85, 169, 180–184
- mid vowels 6, 11, 13–15, 18–21, 35–38, 94, 154, 165, 215, 221, 223–229
- monophthong 8, 34–36, 38, 48–49, 94, 103–104, 106, 154, 180, 211–235
- monosyllable 30, 46, 52, 64, 72, 149, 151–152, 163–169, 173, 181, 183, 195–196, 202
- moraic trochee *see* trochee
- neutralization 31, 82–83, 90–92, 94, 100, 160, 173–176, 213, 230
- obstruent 10–12, 27, 31, 37–38, 63, 66–68, 74, 77–78, 85, 88, 109, 116, 150, 152, 174, 177, 184, 237–249
- opacity 118, 128, 130, 132, 136, 237, 239–244, 249–251
- open syllable lengthening 29, 31, 33–34, 36, 66–68, 70, 83, 92, 94–95, 177, 181, 183, 188
- Optimal Domains Theory 110, 123, 143–144
- peak 159, 162, 167–170, 187–188
- phonation 13, 21, 104–108
- pitch 4, 6, 8–9, 12–14, 18, 30, 51, 59–60, 78–79, 83–84, 87–90, 107–109, 116–117, 120–123, 129, 141, 150, 157–181, 185, 187–189, 196, 198, 201, 208, 213, 230
- plateauing 112–124, 120, 123, 136–141
- polysyllables 30, 43, 46, 52, 64, 72, 149, 151–152, 163–169, 173, 181, 183, 202
- postvocalic voicing 147, 150, 153, 155, 188
- prefix 40, 111–114, 140
- raising 4, 11–12, 102, 105, 117, 150–152, 156, 180
- register 99, 103–107, 110, 120–123, 131–133, 136, 140
- root 15–16, 18, 22, 30, 119, 196, 221–229, 245, 247–249
- [RTR] 128
- rule
 – A and A2 30–32, 61, 64–65, 82–84, 88–90, 93–95, 148–149, 152–153, 177, 182–184, 187, 217–218, 220
 – B 83–84, 148, 154–156, 176–177, 183, 214
 – ordering 118, 131, 240
- sandhi 100–102, 105–106
- Schärfung 6, 29, 147, 169 [*see also* Accent 1, acute accent, Stoßton, stoottoon]
- Schleifton 6, 29, 147, 169 [*see also* Trägheitsakzent, Accent 2, circumflex accent, sleeptoon]
- schwa 27, 29–34, 37–38, 46, 50, 56–58, 60, 62–63, 65–94, 183–188
- schwa insertion 88 [*see also* epenthesis]
- sleeptoon 6, 147, 169 [*see also* Trägheitsakzent, Accent 2, circumflex accent, Schleifton]

- sonorant 6–7, 29–31, 51, 56–58, 63, 66–67, 72, 75, 78–79, 88, 108, 142, 151–152, 172, 174, 177, 203–204, 225, 238, 241, 246, 248
- sonority 2–3, 172, 179–180, 188
- spreading *see* tone spreading
- stoottoon 6, 147, 169 [*see also* Schärfung, Accent 1, acute accent, Stoßton]
- Stoßton 6, 29, 147, 169 [*see also* Schärfung, Accent 1, acute accent, stoottoon]
- Stratal Optimality Theory 244–246
- stress 1–4, 8, 14–18, 27, 28, 33–34, 37, 40, 42, 44, 46, 51, 60–61, 65, 67, 81, 125–126, 147, 149, 155–182, 184–189, 195–196, 199, 201–207, 212, 216–218, 224–227, 246
- stød 9, 181, 195–209
- syllable
 - closed 12, 44–47, 55–56, 60–62, 181, 186–188, 204
 - loss 153, 188
 - open 12, 27, 29–70, 77, 82, 87, 89, 91–92, 94, 105, 170, 177, 181, 183, 186–188, 196, 204, 209, 224
 - weight 48, 103, 177, 202, 204, 225–227, 233–234 [*see also* weight by position]
- tense vowels 2, 11–15, 20–21, 41–42, 53–54, 69, 214–215, 221–228, 239
- timing 39, 80, 157–170, 178, 185, 187–188
- tonal
 - accent 30, 37, 38–97, 147–194, 203, 208, 211–235, 237–251
 - contour 9, 14, 27–30, 40, 46, 48–49, 58–59, 68, 73, 84, 87, 100, 104–107, 121, 132, 155–163, 167–178, 185, 188–189, 196–201, 206, 213, 218–219, 229, 249
 - prominence 3, 126, 128, 162, 171, 230
 - variability 129, 151, 156, 220
- tone
 - boundary 14, 28–29, 40, 71–72, 86, 88, 95, 140, 157–159, 163–167, 230
 - level 6–7, 9, 12, 28–29, 48–50, 72, 89, 100, 105, 107, 110, 112, 119, 121–122, 126, 132, 149, 151–157, 165–167, 182, 214, 238
 - movement 40, 44, 46, 51, 59–60, 78, 83, 87–88, 105, 159–160, 163–164, 168, 170–172, 185, 188, 243
 - shifting 112, 119, 123, 129, 132, 135
 - spreading 4–5, 100, 114, 119, 129–130, 135, 140, 159, 172, 218, 220, 242–243
- tonogenesis 27–97, 116–117 [*see also* accentogenesis]
- tonelessness 82, 110–111, 113, 137, 241
- Trägheitsakzent 29, 96, 147, 192 [*see also* Accent 2, circumflex accent, Schleifton, sleeptoon]
- transparency 114, 118–120, 128–138
- trochee 147, 171–174, 179–180, 188–189, 204–206, 212, 216, 220
- umlaut 34–37, 54–55, 66, 70, 80, 84–86, 153–154
- upper register 103–105
- vocal fold vibration 115, 188
- voice 4–13, 33–97, 109, 147–156, 170, 175–180, 183–188, 195, 241–250
- voicing
 - assimilation 237–251
 - postvocalic 147, 150, 153, 155, 188
- vowel
 - front *see* front vowels
 - high *see* high vowels
 - lax *see* lax vowels
 - low *see* low vowels
 - mid *see* mid vowels
 - tense *see* tense vowels
- vowel split 8, 34, 37, 58–61, 64–65, 106, 149, 151, 154, 167, 208, 211–216, 220–221, 224–228, 231–232
- weight
 - by position 227–228 [*see also* syllable weight]

Languages index

- Ayutla 3
- Awad Bing 12
- Burmese 107
- Cham
 - Eastern 107
 - Western 12
- Chinese
 - Cantonese 12–13, 106
 - Fuzhou 9, 11, 13, 99–108, 150
 - Mandarin 1, 100, 106, 151
- Croatian 172
- Danish 183, 195, 198
- English 13, 19, 33, 40, 42, 44, 49, 61, 186, 233
- Estonian 181–182, 204–205
- Finnish 202, 204–206
- Franconian 27–97, 147–192, 211–235, 237–250
 - Low Franconian (Limburgian)
 - Dülken 6, 38, 154, 169, 180, 182
 - Geleen 22, 32–38, 47, 79, 87, 177, 178
 - Hasselt 84, 148, 155–163, 165–167, 175–178
 - Maasbracht 35–38, 147–148, 158–161, 166, 175, 178–179, 239
 - Maastricht 38, 88, 93, 148, 154, 158–162, 169, 177, 180, 187, 190, 211–215, 220–221, 224, 226–231
 - Moresnet 9, 47, 76, 78, 175–178, 229, 237–250
 - Roermond 6–7, 28, 32, 35–38, 43, 47, 51, 76, 79, 86, 148–161, 166–167, 172, 176, 178, 230
 - Sittard 6–8, 32, 38, 42–43, 47, 52, 79, 88, 148, 158–161, 166, 177–180, 211–215, 220–221, 224–231
 - Venlo 32, 35–36, 38, 42, 55, 57–60, 65, 79, 148, 158–161, 168, 173
 - Weert 35, 38, 88, 147, 170
 - Ripuarian
 - Aachen 6, 238
 - Cologne 148–152, 156, 158–171, 174–177, 183, 189
 - Kerkrade 6, 35
 - Moselle Franconian
 - Arzbach 148, 154–155, 172, 176, 183, 230
 - Mayen 166, 169, 172, 213, 220
- Fuqing 13
- Gaelic 208
- Greek (Ancient) 29, 84, 172
- Hu 12
- Italian 187
- Japanese 68–69
 - Kanazawa 12–13
 - Matsue 12
- Kinande 12
- Lahu 12
- Latvian 6, 84, 182, 208
- Limburgian *see* Franconian
- Lithuanian 6, 29, 48–49, 71–72, 76–77, 84, 95, 172, 181–182, 189
- Livonian 1, 9, 153, 181–182, 195–210
- Low Franconian *see* Franconian
- Madurese 12–13
- Maninkakan 12
- Moselle Franconian *see* Franconian
- Ngizim 4–5, 10, 12
- Nguni (Ndebele, Swati, Xhosa) 109–146
- Norwegian 6, 157, 181, 189
- Rengao 12
- Ripuarian *see* Franconian

Slovenian 1, 11–26, 150, 233
Swedish 6, 61, 157, 181, 189

Taiwanese 12
Takia 2, 10
Thai 13, 106
Turkana 13, 22
Tupuri 12–13

U 12

Veps 204
Vote 204

Yupik 172, 189