Against the sonority scale: evidence from Frankish tones

Ben Hermans and Marc van Oostendorp
Meertens Institute, Amsterdam
ben.hermans@meertens.knaw.nl/marc.van.oostendorp@meertens.knaw.nl

1 Introduction

While there is widespread agreement that sonority is a major force driving a wide variety of phonological phenomena, there are at least two very different opinions as to the implementation of this concept into the grammar. One view holds that sonority is to be defined in terms of a scale; it is an independent theoretical notion, in the sense that a segment's degree of sonority is read off from the scale, which functions as an external look-up table. The scale may have an independent phonetic motivation, as in Wright (2004). The opposing view claims that sonority does not deserve the status of an independent theoretical notion, but is defined solely in terms of representations that can be motivated on independent grounds.

It is not so easy to solve this issue on conceptual grounds, because, obviously, deriving sonority from representations goes at the cost of complicating these representations, while, conversely, relying on an external scale implies that the representations can be simplified. Fortunately, however, it is possible to decide this question on empirical grounds, and this is what we set out to do in this article.

Our argument runs as follows. It is an essential characteristic of the sonority scale that rules, or constraints for that matter, always refer to a *contiguous* range of positions defined on it. We show that Contiguity of Reference, as we will call it, does not always hold; phenomena do exist that refer to discontinuous positions on the scale. This is a fundamental problem for all approaches of sonority that are based on a scale, but, interestingly, this problem does not exist for the representational approach, which precisely predicts that certain discontinuity effects should exist. This, then, is an important argument against the sonority scale and in favour of a representational approach, which holds that sonority is an epiphenomenon.

The phenomenon we will study comes from the historical phonology of Frankish tone. At the point in time when the tones came into existence in the Frankish dialects, falling tones could only occur on vowels of relatively high sonority (mid vowels and low vowels) and also on certain sonorant consonants (velar nasal and rhotic liquid). Crucially, high vowels could not have a falling tone. This, then, constitutes a case where *Contiguity of Reference* is not respected. Far from being a problem, the distribution of the falling tone in Frankish dialects is exactly what is predicted by a representational approach towards sonority, which claims that the |A|-element adds to sonority. Here, we follow Scheer (1999) and particularly Van der Torre (2003) in claiming that segments carrying the |A|-element have a relatively high degree of sonority. Interestingly, the latter author also suggests, following Smith (2000), that the velar nasal and the rhotic liquid are specified for this element. Adopting this proposal we are able to define low vowels, mid vowels, /ŋ/ and /r/ as a natural class.

2 Approaches toward sonority

Regarding the representation of sonority two fundamentally different positions exist: there are those claiming that sonority is an epiphenomenon, and that it can be read off from the representations, and there are those claiming that sonority deserves the status of an independent theoretical tool, the sonority scale.

2.1 Representational approaches

Among the representational approaches we can make a further division. According to one view, sonority is determined by absolute complexity. This means that a segment's sonority increases with *every* individual feature it contains. This view has been popular among some supporters of Government Phonology. Particularly interesting proposals in this tradition are Harris (1994) and Brockhaus (1992), to name but a few. It has been critized both within (Scheer 2004) and outside of Government Phonology (Crosswhite 1999), and it is fair to say that it is too restrictive. (This position actually entails Contiguity of Reference: since all segments can be put on a scale ranging from the least complex to the most complex, we expect sonority effects to be sensitive to whole classes of segments of some size of complexity. Our arguments against sonority scales will thus also translate to this approach.)

The second subtype holds that *only certain* properties of a segment's structure determine sonority. In this view sonority is determined by relative complexity. Influential proposals in this tradition are Clements (1990), working in a traditional feature theory, and Rice (1992), based on the notion Spontaneous Voicing. Element-based versions of this approach have been developed by Scheer (1999), and, independently, Van der Torre

(2003). Both authors claim that the |A|-element adds to sonority. Formally, this is implemented by stating that segments containing this element favour prominent positions (like the rhyme and the nucleus, or the stressed syllable), and avoid non-prominent positions (like the onset of a syllable, or unstressed syllables).

Since this proposal will turn out to be crucial in our account of the Frankish facts in section 3, it deserves some extra attention. In Element Theory (Harris 1994, Harris and Lindsey 1995) mid vowels and low vowels carry the |A|-element, whereas high vowels lack it. To illustrate we give the relevant parts of the five cardinal vowels.

(1)	high vowels	I = [i]	U = [u]
	mid vowels	{I,A} = [e]	{U,A} = [o]
	low vowel	A = [a]	

It is well known that in many languages mid and low vowels attract stress from high vowels (cf. De Lacy 2002 for a typology of stress attraction). This shows, according to De Lacy, that these vowels favour prominent positions. In terms of Element Theory this is tantamount to saying that the |A|-element favors prominent positions. In this interpretation stress moves until it reaches a segment carrying |A|, thereby satisfying |A|-'s desire to occupy a prominent position.

Another widespread phenomenon is vowel reduction. Very frequently, vowel reduction takes the form of raising of mid and low vowels to high vowels (cf. Crosswhite 1999 for a typology of reduction). In terms of elements, this type of reduction can be understood as |A|-'s desire to avoid an unstressed (non-prominent) position. In this interpretation a segment loses its |A| when it happens to occur in an unstressed, i.e. non-prominent, position.

What is crucial to us here is the observation by Van der Torre (2003) that /ŋ/ and /r/ behave as if they are more sonorous than the other segments of their manner class. To account for this, he proposes that both segments contain the element |A| (cf. Smith 2000). Interestingly, this uncovers a parallel with the behaviour of the |A|-element in stress patterns; what is true for |A| at the suprasyllabic level (where foot structure or stress is located) also holds at the subsyllabic level; /ŋ/ and /r/ favour prominent positions in the syllable (like the rhyme) and shun non-prominent positions)like the onset).

Evidence that /ŋ/ is favoured in the rhyme comes from a wealth of data showing that in many languages nasals tend to velarize in the rhyme position. A dialect where this happens, at least under certain conditions, is Antwerp Dutch. In (2) we contrast Standard Dutch with this dialect (Taeldeman 1980, Van Oostendorp 2001, Van der Torre 2003:107).

(2)	Standard Dutch	Antwerp	
	[ɣrun]	[ɣryŋ]	‘green’
	[sχun]	[sχuŋ]	‘shoe’
	[zo:n]	[zøŋ]	‘son’

Velarization of nasals in the Antwerp dialect can be seen as a close relative of stress attraction. If there is no |A| in the stressed syllable then the phonology corrects this by moving the stress. Likewise, if there is no |A| in the rhyme then the phonology corrects this by velarizing a nasal.

Evidence that the velar nasal avoids subsyllabic non-prominent positions (the onset in particular) is very easy to find. There are many languages were /ŋ/ is not allowed in onsets (Anderson 2005). This is equivalent to |A|-’s behaviour at the suprasyllabic level, where it typically takes the form of vowel reduction, as we have seen.

The rhotic exhibits the same behaviour; it favours prominent positions and shuns non-prominent ones. Vocalization of /r/ to an *ɑ*-like vowel can be seen as an instance of the former: |A| moves from a marginal coda position to a syllabic peak. This process applies in Standard German (Wiese 2000), but also in the Dutch dialect of The Hague (cf. Elias and Goeman 2003; Van der Torre 2003:160). In (3) we compare this dialect with Standard Dutch.

(3)	Standard Dutch	The Hague	
	[ɔndər]	[ɔndɑ]	‘underneath’
	[dɪxtər]	[dɪxtɑ]	‘poet’
	[vɛr]	[vɛɑ]	‘far’

Corroboration of the hypothesis that /r/ shuns non-prominent positions at the subsyllabic level is a bit harder to find. Indicative, perhaps, is the fact that in Campidanian Sardinian /r/ is avoided at least in word initial onsets, though not in word internal ones (Bolognesi 1998).

In this subsection we have reviewed one particular version of a representational approach towards sonority. According to this theory the

|A|-element contributes to sonority. Obviously, there is no scale in this theory. Instead of this we have constraints expressing that |A| favours prominent positions and disfavours non-prominent positions, both at the suprasyllabic and the subsyllabic level. The former accounts for frequently attested patterns of stress attraction and vowel reduction; the latter explains the rather striking behaviour of /ŋ/ and /r/ with respect to syllable structure.

2.2 The scalar approach

From a quantitative bibliographical point of view, representational theories of sonority are somewhat marginal in the literature. By far the most dominant position is that segments are 'extrinsically' ordered according to their degree of sonority (see Wright 2004, for a recent overview). The segment classes we are interested in here are usually ordered in the following way:

(4) The sonority scale: obstruents < nasals < liquids < high vowels < mid vowels < low vowels

The segment's internal structure is immaterial as far as sonority is concerned in this approach. (Of course, a segment must be identifiable in terms of the sonority scale, and for this purpose we presumably need some representational residue.)

Here, we are interested in a particularly important general property of scalar approaches. This is the property we have termed Contiguity of Reference: suppose we have a constraint stating that a segment of a certain degree of sonority avoids a stressed syllable because its sonority is too low. Then, according to Contiguity of Reference, it is the case that *any* segment of lower sonority is not favoured in that position either. This would mean, for instance, that if a mid vowel avoids a stressed syllable, then surely, high vowels and (syllabic) nasals would also avoid stressed syllables, and a situation where mid vowels and nasals avoid stress but high vowels do not, is unimaginable. The converse is also true: suppose that a segment avoids a non-prominent position because its sonority degree is too high. Then it should be the case that *any* segment of greater sonority also avoids that position.

We do not know of any work within the scalar paradigm that puts Contiguity of Reference into question and it is presumably correct as far as stress-related phenomena are concerned. In other areas, however, there is some reason to be sceptical about it. In the next section we will study the distribution of falling tone in Frankish dialects where Contiguity of

Reference breaks down, causing a problem for the scalar approach and supporting the representational approach relying on the particular status of the |A|-element.

3 Frankish tone and its analysis

The dialects of the border area of the Netherlands, Belgium, Luxembourg and Germany are polytonic. In the traditional terms of historical dialectology they can be classified as South East Frankish (the dialects of Belgian and Dutch Limburg and also an small area in Germany around the city of Dülken) and Central Frankish, the latter consisting of Ripuarian in the north and Moselle Frankish in the south. Synchronically, the dialects have two contrastive tones, traditionally called a 'bumping' (falling) tone and a 'dragging' tone (*Schleifton* and *Stosston*). The latter has a variable realization in modern dialects, but phonologically it is a high tone. We assume that this was also the case when the tones came into existence. At the initial stage of their development the distribution of the two tones was entirely predictable. It is this historical stage we are interested in. This stage begins in the 7^{th} century and ends in the 9^{th}.[1]

The data in this section are taken from Maasbracht, a (tonally) very conservative dialect in the heartland of what is now the Dutch province of Limburg. This is the native dialect of the first author (see also Hermans 1994). We refer the interested reader to the following important sources for confirmation as to the historical distribution of the tones: Frings (1913, 1916), Welter (1929), Dols (1953), Schmidt (1986) and De Vaan (1999). For the sake of brevity we will only discuss monosyllabic forms. This does not do any harm, because at the initial stage of the tonogenesis, polysyllabic and monosyllabic forms behaved identically.

Long vowels that were either mid or low in West Germanic received a falling tone. This is illustrated in (5). The falling tone is indicated with an HL-superscript over the vowel.

[1] The tones developed no later than the 7^{th} century because monophthongization of the Germanic falling diphthongs must have applied before they did, and we know that monophthongization started to work in the 7^{th} century. Also, the tones must have existed before Open Syllable Lengthening started to work. There is evidence suggesting that this rule was active already before the beginning of the 10^{th} century (Kyes 1969).

(5) Long mid and low vowels received falling tone

		WGM e:	
e: < e:		e: < eo	
[bre:^{HL}f]	'letter'	[le:^{HL}f]	'nice'
		WGM o:	
[ho:^{HL}t]	'hat'	[vrø:^{HL}x]	'early'
		WGM ɛ: (< ai)	
[sniə^{HL}]	'snow'	[iə^{HL}r]	'honor'
		WGM ɔ: (<au)	
[bruə^{HL}t]	'bread'	[luə^{HL}n]	'wage'
		WGM a:	
[drɔ:^{HL}t]	'thread'	[zwɔ:^{HL}r]	'heavy'

Short vowels followed by /r/ or a velar nasal also received a falling tone, as shown in (6).

(6) /ŋ/ and /r/ received falling tone

[vɑŋ^{HL}]	'to catch'	[stoŋ^{HL}]	'stand$_{past}$'
[bɑŋ^{HL}]	'afraid'	[brɪŋ^{HL}]	'bring'
[rɑŋ^{HL}]	'rank'	[hoŋ^{HL}]	'hang$_{past}$'
[bɑr^{HL}]	'severe'	[vær^{HL}]	'far'
[hɑr^{HL}]	proper name	[stær^{HL}]	'star'
[hɔr^{HL}]	'wire gauze'	[kær^{HL}]	'cart'

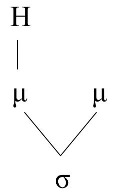
If a short vowel is followed by an obstruent, then the level high tone appeared. A few examples illustrating this are given in (7).

(7) Short vowels followed by an obstruent have a level high tone

[kɔ^{H}p]	'head'	[lɑ^{H}f]	'cowardly'
[bu^{H}k]	'billy goat'	[vo^{H}x]	'fluid'
[wɪ^{H}t]	'white'	[mo^{H}s]	'must'

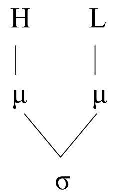
The level high tone consists of a simple tonal element, phonologically; we represent this with H. It is inserted to satisfy a (hard) constraint requiring that the head mora of the word carry the tonal segment H. The high tone of the first mora is not allowed to spread to the second mora, due to another constraint according to which a non-head mora should not have a high tone (cf. De Lacy 2002b for the family of constraints regulating the relations between tonal structure and prosodic structure). Accordingly, the schematic representation of a bimoraic word with a level high tone is as in (8).

(8) The level high tone



The falling tone consists of two tone segments, H and L; we assume that the latter segment is inserted to ensure that a mora is not toneless. The schematic representation of a falling tone is therefore as follows:

(9) The falling tone



Now the question is, of course, why not all bimoraic words received a low tone. It is here that sonority becomes relevant: apparently, the second mora could only carry a tone if it was sufficiently sonorous.

Here we reach the critical point in our argumentation. Notice now that the low tone is allowed in words ending in a velar nasal, as the examples in (6) show. This being the case, the scalar approach to sonority makes the following prediction: if a (velar) nasal is sufficiently sonorous to carry a tone, then surely any segment of greater sonority also licenses a tone. The prediction is correct for the rhotic liquid, as we have seen in (6). However, it is blatantly wrong in other cases. Let us have a closer look at them.

High vowels and falling diphthongs did not receive a falling tone. Examples illustrating this are given in (10).

(10) Long high vowels and falling diphthongs received a level high tone

WGM i:/u:/ai/au

[wi:^{H}t]	'far'	[ti:^{H}t]	'time'
[vu:^{H}l]	'dirty'	[lɛi^{H}t]	'grief'
[klɛi^{H}t]	'dress'	[bɔu^{H}m]	'tree'

Short vowels followed by a non-velar nasal, or by a lateral liquid also got a level high tone. This is exemplified in (11).

(11) short vowels followed by a tautosyllabic sonorant consonant received a level high tone

[mɑ^{H}n]	'man'	[mɪ^{H}n]	'nasty'
[klɑ^{H}m]	'hardly'	[slɑ^{H}m]	'coal mud'
[mɔ^{H}l]	'mole'	[væ$^{H:}$l]	'skin'
[vɔ$^{H:}$l]	'full'	[brɪ$^{H:}$l]	'glasses'

Although the velar nasal is sufficiently sonorous, the other nasals are not, and neither are the lateral liquid or the high vowels. Perhaps it is possible to redistribute the consonants over the scale, such that the two liquids become separated by the velar nasal. This would create a scale of the following type:

(12) An attempt at a solution: obstruents < n,m < l < ŋ < r < high vowels < mid vowels < low vowels

In this scale we can locate the cut off point between ŋ and the lateral liquid. To the left of this point falling tones are no longer allowed. While this correctly accounts for the consonants it still does not solve the problem of the gap constituted by the high vowels. To explain this in a scalar approach, we would need the following absurd scale:

(13) An absurd scale: obstruents < n,m < l < high vowels < ŋ < r < mid vowels < low vowels

This scale makes many strange predictions. Let us briefly look at just one. It has been well documented that syllable peaks are sympathetic to relatively highly sonorous segments (cf. Prince and Smolensky 1993). Now the sonority scale in (13), in tandem with Contiguity of Reference, predicts that if high vowels are sonorous enough to occupy a syllable's peak, then surely rhotic liquids and velar nasals are able to do the same. This certainly is an absurd prediction from a typological point of view. Further, (13) is also unprincipled, in the sense that there is absolutely no reason why it is structured the way it is. We can conclude, then, that the distribution of the falling tones at the initial stage cannot be accounted for within a scalar approach of sonority. The main problem is that it either violates Contiguity of Reference, or an absurd scale must be adopted.

In strong contrast to this, the Representational Approach we have sketched before can explain the distribution of the tones quite easily. We just have to say that a low tone must be linked to an |A|-bearing element. The representation in (14a) is rejected by this constraint, whereas the one in (14b) is accepted.

```
(14)  a.  H    L            b.  H    L
          |    |                |    |
          μ    μ                μ    μ
                                     |
                                     A
```

The licit structure in (14b) represents mid and low vowels, but also the velar and the rhotic liquid. These segments constitute the class of |A|-carrying segments, as we have seen in the preceding section.

One might object that this kind of approach makes the same kind of crazy predictions as the scalar approach. We know that syllable peaks favour high sonority, so one might consider a constraint stating that a syllable peak must contain an |A|-element. This would predict the existence of a language that allows mid and low vowels in the peak, and in addition to that the velar nasal and the rhotic liquid, but not high vowels.

Clearly, we are in need of a principled theory of visibility. We suggest that prosodic heads, like the peaks of syllables and feet, can only see those place elements that are heads. This would imply that they only access major category features and those place features that are heads. According to Van der Torre, the |A|-element is not a head in the domain of a consonant; in /r/, the element |I| is the head, and the velar nasal has no heading place element. If this is true, then peaks can only see the |A|-elements of low vowels and of mid vowels, but the latter is only true if the mid vowels are |A|-headed. Other subsyllabic positions, like the onset and the dependent position of the rhyme, should be able to access further details of segmental structure as we have seen in the second section. This allows a constraint that excludes a velar nasal in onset position, or a constraint that favors a velar nasal in the dependent position of the rhyme. Tone, as we have seen in the preceding section, must also be allowed to have access to further details of segmental structure.

The fact that we have to rely on a visibility theory that still must be developed can admittedly be considered as a weak point, but we want to point out that something similar is true for the scalar approach. It has been pointed out by Clements (1990) that the major class features provide sufficient information to explain what is allowed in peaks. In fact, this was his main reason to get rid of the traditional sonority scale and to derive it from the major class features. While it has been established by now that Clements' claim is too restrictive in its details, it still is true in spirit; for certain phenomena, like the phonology of prosodic peaks, the sonority scale is far too rich. Peaks can only see a modest subpart of the richly structured sonority scale. Clearly, then, proponents of scalar approaches to sonority must equally rely on some kind of visibility criterion, which still remains to be developed.

4 Motivating |A| on /ŋ/ and /r/

We now turn to a further interesting consequence of our proposal; if it is true that /ŋ/ and the rhotic liquid carry the |A|-element, it is predicted that they exhibit lowering effects on adjacent vowels. In this section we will show that this is indeed the case.

Veatch (1991) observes that in certain dialects of Alabama vowels are lowered by a velar nasal: in words like *spring*, *finger*, *thing*, etc. the vowel is realized as [æ]. Veatch refers to this process as 'Alabama Lowering'. Interestingly, in his view this is 'an unnatural, anticoarticulatory effect' (Veatch 1991: chapter 9). It might be true that Alabama Lowering cannot be understood phonetically, but it can be understood phonologically given the point of view just developed; it is a case where the |A|-element seeks the peak position of the nucleus, thereby lowering the vowel.

Something similar happens in Shiaoxing Chinese. According to Zhang (2005), a constraint is active in this language, stating that high vowels, or glides, are not tolerated after a velar nasal:

(15) *[ŋ][+high]: [ŋ] cannot occur before any [+high] (semi-)vowel

We believe that this constraint would be more profitably formulated in terms of Element Theory, as a case where the |A|-element spreads to the peak, providing independent motivation for the hypothesis that a velar nasal carries such an element.[2]

The lowering effects of /r/ are well known. Lindau (1985) observes that /r/ frequently lowers a preceding vowel. In Canadian English, for instance, [ɛ] is lowered to [æ] before /r/, resulting in neutralization. There is no distinction, for instance, between *merry* and *marry* (Woods 1993). Phenomena like this provide independent motivation for the hypothesis that the phonological representation of the rhotic liquid contains the |A|-element.

Another piece of evidence in favour of the same assumption comes from so-called non-rhotic varieties of English. The literature on this topic is vast; we cite Kahn (1976), Broadbent (1991), Ortmann (1998), Bakovic (1999) and Krämer (2005) as examples of work from many different theoretical backgrounds that are all compatible to a view which takes /r/ to have an |A| element.

Many varieties of English avoid vowel hiatus with an intrusive /r/, but only if the preceding vowel is *not high*. This is an entirely productive process, which happens for instance also in English accented pronunciation of foreign languages and in loanwords. Some examples illustrating this are given in (16).

(16) j'etais déjà[r] ici (Wells 1982:226)
UEFA[r] officials (Sebregts 2001:25)

---

[2] Although he does not say this explicitly, it also seems true in Zhang's (2005) view of syllable rhymes that the velar nasal in a coda can only be preceded by a non-high vowel.

The scholars mentioned all note that these phenomena find a parallel in the fact that after high vowels hiatus is resolved by the insertion of a homorganic glide:

(17) the key[j] is
the zoo[w] is

Although implementations differ, /r/ is a glide for the non-high vowels, according to the scholars just cited. This allows them to formulate both types of hiatus resolution in a uniform way; both instrusive /r/ and homorganic glide insertion are cases where the vowel's features spread to the right to fill the empty onset. In terms of Elements this is independent motivation that the rhotic liquid carries an |A|-element.

5 Conclusion

Obviously, several questions remain open. For one thing, it would be interesting to know whether similar asymmetries between velars and other places of articulation can be observed within other manner classes. At present, we have no evidence that velar obstruents would display a lowering effect similar to the velar nasal, for instance, although a logical extension of the claims made here would lead to such a prediction. Another, more theory-internal, issue is *why* it is that |A|, rather than |I| or |U|, makes the segment more sonorous. In principle, Element Theory would treat these elements as completely symmetrical, but that does not seem to conform our analysis of the facts.

Leaving these questions open for future research, we think we have still reached a conclusion of some general theoretical importance. We have contrasted two views of sonority effects: one which is based on sonority as a scale (which may be motivated either in terms of phonetics or in terms of phonological complexity), and one in which specific phonological elements contribute to the sonority of a segment. In particular, we have seen that |A| is part of the representation of the liquid /r/ and the nasal /ŋ/, and this makes these segments behave as more sonorous than other liquids and nasals in their tone licensing capacity. This predicts that these two segments will interact with low vowels in another way, and we have provided some evidence for that as well.

References

Anderson, Gregory. 2005. Areal and phonotactic distribution of N. In: Marc van Oostendorp and Jeroen van de Weijer (eds.), *The internal structure of the phonological segment.* Berlin: Mouton de Gruyter, 217-134.

Bakovic, Eric. 1999. Deletion, insertion, and symmetrical identity. Manuscript, Harvard University.

Bolognesi, Roberto. 1998. The phonology of Campidanian Sardinian: A unitary account of a self-organizing structure. Doctoral dissertation, University of Amsterdam.

Broadbent, Judith. 1991. Linking and intrusive r in English. *University College London Working Papers in Linguistics* 3: 281-302.

Brockhaus, Wiebke. 1992. Final devoicing: principles and parameters. Doctoral dissertation, University College, London.

Clements, George, N. 1990. The role of the sonority cycle in core syllabification. In: J. Kingston and M. Beckman (eds.), *Papers in Laboratory Phonology I: Between the grammar and physics of speech*. Cambridge: Cambridge University Press, 283-333.

Crosswhite, Katherine. 1999. Vowel reduction in Optimality Theory. Doctoral dissertation, University of California, Los Angeles.

Dols, Willy. 1953. *Sittardse diftongering*. Sittard.

Elias, Michael, and Ton Goeman. *Haags.* Den Haag: Sdu.

Frings, Theodor. 1913. *Studien zur Dialektgeographie des Niederrheins zwischen Düsseldorf und Aachen*. Marburg.

Frings, Theodor. 1916. *Die Rheinische Accentuierung: Vorstudie zu einer Grammatik der Rheinische Mundarten*. Marburg.

Harris, John. 1994. *English sound structure*. London: Blackwell.

Harris, John, and Geoff Lindsey (1995). The elements of phonological representation. In: J. Durand and F. Katamba (eds.), *Frontiers of Phonology*, 34-79. Harlow, Essex: Longman.

Hermans, Ben. 1994. The composite nature of accent. With case studies of the Limburgian and Serbo-Croatian pitch accent. Doctoral dissertation, Free University Amsterdam.

Kahn, Daniel 1976. Syllable-based Generalizations in English Phonology. Doctoral dissertation, MIT.

Krämer, Martin. 2005. English schwa insertion before liquids and phonological opacity. Manuscript, University of Tromsø.

Kyes, Robert, L. 1969. *The Old Low Franconian Psalms and Glosses*. Ann Arbor: University of Michigan Press.

Lacy, Paul de. 2002a. The formal expression of markesness. Doctoral dissertation, University of Massachusetts, Amherst.

Lacy, Paul de. 2002b. The interaction of tone and stress in Optimality Theory. *Phonology* 19, 1-32.

Lindau, Mona. 1985. The story of /r/. In: Victoria Fromkin (ed.), *Phonetic Linguistics: Essays in honour of Peter Ladefoged*. Orlando: Academic Press, 157-168.

Oostendorp, Marc van. 2001. Nasal consonants in Dutch and some related systems. *Neerlandistiek.nl* 2001.08. http://www.neerlandistiek.nl/publish/articles/000049/article.html

Ortmann, Albert 1998. Consonant epenthesis: Its distribution and phonological specification. In: Wolfgang Kehrein and Richard Wiese (eds.), *Phonology and Morphology of the Germanic Languages*. Tübingen: Niemeyer, 51-76.

Prince, Alan, and Smolensky, Paul. 1993. Optimality Theory: Constraint interaction in Generative Grammar. Report no. RuCCS-TR-2. New Brunswick, NJ: Rutgers University Center for Cognitive Science.

Rice, Keren. 1992. On deriving sonority: A structural account of sonority relationships. *Phonology* 9, 61-99.

Sebregts, Koen. 2001. English [r]—Liaison: Rule based theories, Government Phonology and Optimality Theory. M.A. thesis, University of Utrecht.

Scheer, Tobias. 1999. A theory of consonantal interaction. *Folia Linguistica* 32, 201-237.

Scheer, Tobias. 2004. *A Lateral Theory of Phonology*. Berlin: Mouton de Gruyter.

Schmidt, Jürgen, E. 1986. *Die mittelfränkische Tonakzente (Rheinische Akzentuierung)*. Stuttgart.

Smith, Norval. 2000. Dependency Theory meets OT. A proposal for a new approach to segmental structure. In: Joost Dekkers, Frank van der Leeuw and Jeroen van de Weijer (eds.), *Optimality Theory. Phonology, syntax and acquisition.* Oxford: Oxford University Press, 234-278.

Taeldeman, Johan. 1980. Inflectional aspects of adjectives in the dialects of Dutch-speaking Belgium. In: Wim Zonneveld et al. (eds.), *Studies in Dutch Phonology*. Den Haag: Martinus Nijhoff, 265–292.

Torre, Erik Jan van der. 2003. Dutch sonorants: The role of place of articulation in phonotactics. Doctoral dissertation, University of Leiden.

Vaan, Michiel de. 1999. Towards an explanation of the Franconian tone accents. *Amsterdamer Beiträge zur Älteren Germanistik* 51, 23-44.

Veatch, Thomas, C. 1991. English vowels: Their surface phonology and phonetic implementation in vernacular dialects. Doctoral dissertation, University of Pennsylvania.

Wells, John. 1982. *Accents of English*. Cambridge: Cambridge University Press.

Welter, W. 1929. *Studien zur Dialektgeographie des Kreisen Eupen*. Bonn.

Wiese, Richard. 2000. *The Phonology of German.* Oxford: Oxford University Press.

Woods. Howard. 1993. A synchronic study of English spoken in Ottawa. In: Sandra Clark (ed.), *Focus on Canada*. Amsterdam: Benjamins, 151-178

Wright, Richard. A review of perceptual cues and cue robustness. In: Bruce Hayes, Robert Kirchner, and Donca Steriade (eds), *Phonetically Based Phonology*. Cambridge: Cambridge University Press, 34-57.
Zhang, Jisheng. 2005. The Phonology of Shaoxing Chinese. Doctoral Dissertation, Leiden University.