Voice–tone interaction in a Limburg dialect

Evidence for feature licensing*

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1. Introduction

In the Limburg dialect of Maasbracht the quality of tone is, under certain conditions at least, determined by the voice specification of the adjacent obstruent. This instance of voice–tone interaction seems strange in two respects. First of all the obstruent influences the tonal quality of the segment *on its left*. From the perspective of phonetically grounded constraints this is a problem, since a constraint accounting for the influence of voice on its left neighbor seems to have no phonetic basis. Secondly, it seems that the active value determining tonal quality is [−voice]. To most phonologists this comes as a surprise since they would hold that Voice is a monovalent feature.

In this article we will propose an analysis of the Limburgian case of voice–tone interaction in terms of the theory of feature licensing proposed in Itô, Mester and Padget (1995). This theory enables us to solve both problems in one swoop: no reference needs to be made to [−voice], neither do we need to refer to the position to the left of the relevant obstruent.

The structure of this article is as follows. In the second section we present the facts. In the third section we propose an analysis based on feature licensing. Finally we present a list of problems and we offer solutions to these problems.

2. Voice–Tone interaction: The facts

The dialect of Maasbracht has a contrast between a falling and a dragging tone in bimoraic stressed syllables. Examples of the contrast are given in (1).

(1) *falling tone* *dragging tone*

falling tone		dragging tone	
bii	'bee'	bii	'at'
buu	'to build'	buu	'construction'
mɪn	'minus'	mɪn	'vile'

The dragging tone has two realizations; it is level high if it is non-final and falling-rising if it is final. The falling tone has just one realization.

The two tones freely contrast in stressed syllables. However, there is one environment where a contrast is not possible. Our first attempt to characterize this environment is as follows: if the second mora contains a *sonorant consonant* followed by a *voiceless obstruent*, then only a dragging tone is possible. The following examples are illustrative:

(2) *only dragging tone in the environment: sonorant + voiceless obstruent;*

a. *second mora contains a liquid*		b. *second mora contains a nasal*	
balkan	'the Balkans'	ræntə	'interest'
hælp	'to help'	wɪŋkəl	'shop'
spærtəl	'to sprawl'	lomp	'ungainly'
dœrp	'village'	laŋk	'long'

If either condition is not met, tone contrast is possible, as is shown in (3).

(3) a. *sonorant consonant + voiced obstruent;*

falling tone		*dragging tone*	
ærɣər	'worse'	ærɣər	'to annoy'
rotondə	'rotunda'	dondər	'thunder'

b. *long vowel followed by any type of consonant;*

falling tone		*dragging tone*	
paatər	'father'	waatər	'water'
eedər	'every'	eedər	'earlier'

One last fact that is important to us concerns the role of morphological structure. If the voiceless obstruent is separated from the preceding mora by a morpheme boundary, the dragging tone is not required anymore. This morphological restriction is illustrated by the following forms.

(4) kɪn + t^j 'know', 3PL:SG
kɪn + s 'know', 2PL:SG

It has frequently been observed that [voice] interacts with tone. Voiceless obstruents favour high tones, whereas voiced obstruents favour low tones. For a comprehensive overview of the literature we refer to Hombert, Ohala and Ewan (1979). The interaction seems to be unidirectional, in the sense that an obstruent only interacts with the tone on the *following* vowel. According to Hombert, Ohala and Ewan the explanation of this rightward orientation is rooted in phonetic considerations. It runs as follows. In normal speech F_0 positively correlates with larynx elevation. Larynx elevation also correlates with voice quality of stops, with a high larynx position for voiceless stops. Elevation is greatest at the end of the consonant closure, and it persists well into the following vowel. Together these phenomena account "…for the effect of consonants being evident only on the F_0 of the following, not the preceding, vowel" (Hombert, Ohala and Ewan 1979:44). We have just seen, however, that in Limburg the obstruent determines the tone of the segment *on its left.* This then raises the following problem. If leftward tone-voice interaction cannot be understood in terms of phonetic considerations, and if, furthermore, phonological constraints are phonetically grounded, then how are we going to account for the Limburg facts?[1] This is the first problem we will try to solve in this article.

The second problem concerns the valency of [voice]. In the recent literature there is a growing concensus that [voice] is a monovalent feature (cf. in particular Lombardi 1991, 1996).[2] Notice now that the facts we have just laid out seem to suggest that it is [−voice] requiring the presence of a dragging tone on the preceding mora. The opposing value does not seem to exercise any influence on its left, as is suggested by the facts in (3a), which show that both tones can occur before a voiced obstruent. In the next section we will propose an analysis that solves both problems. Our analysis is cast in the theory of feature licensing proposed in Itô, Mester and Padgett (1995).

3. Limburg Voice–Tone interaction and feature licensing

3.1 Feature licensing

In Itô, Mester and Padgett (1995) (henceforth IMP) the question to what extent segments are underspecified is put in the perspective of Optimality Theory. IMP convincingly show that the specificational behavior of redundant features can be explained as the result of the interaction of conflicting constraints. In Japanese, for instance, it is clear that in certain environments nasal consonants are unspecified for Voice, because they do not interact with Rendaku/Lyman's Law. However, if an obstruent follows a nasal, the former is voiced in (the Yamoto vocabulary of) Japanese. Obviously, voicing is caused by the nasal. It is clear, then, that in pre-obstruent position, nasals must be voiced.

The antagonistic constraints that are at work here are the following. First of all there is a structural constraint (5) requiring that sonorants be voiced, and the opposing constraint (6) requiring that a feature be licensed:

(5) SonVoi: Son $\supset$ Voice

(6) License(Φ): A phonological feature Φ must be licensed.

Exactly when a feature is licensed is determined by Feature Cancellation:

(7) *Licensing Cancellation*: If $F \supset G$, then $\neg (F\lambda G)$
"If the specification [F] implies the specification [G], then it is not the case that [F] licenses [G]"

This principle states that a feature is only licensed in a non-redundant (i.e. contrastive) environment. Licensing Cancellation thus gives us a form of 'underspecification at the surface': only unpredictable features are licensed.

Due to Licensing Cancelation, SonVoi and License are in direct conflict. In Japanese the latter is ranked above the former. As a result the nasal in a word like *kami* 'paper' comes out as unspecified for Voice. The following tableau demonstrates this.[3]

(8) License » SonVoi

kami	License	Sonvoi
kami | v	*!	
☞ kami		*

Things change, however, if an obstruent follows a nasal. In this environment, Voice can be inserted in the nasal without violating License, provided it is also linked to the obstruent. If that is the case it is licensed, because in obstruents Voice is contrastive. This explains why in Japanese nasals have a voicing effect on a following obstruent. This is illustrated in the tableau in (9). The same tableau also makes explicit that Ident must be ranked below SonVoi. The example is *tombo* 'dragonfly'.

(9) License » SonVoi » Ident

tompo	License	SonVoi	Ident
☞ to mb o \\ / v			*
tompo		*!	

We thus see that underspecification is not categorically true or untrue for a given segment. It rather is an emergent property of the output; exactly how a segment comes out is determined by violable, and possibly conflicting output constraints.

We close this necessarily sketchy review of IMP with a short note on liquids and vowels. In Japanese only nasals have a voicing effect on a following obstruent. IMP propose that there is a family of constraints which penalize lines that are drawn between any consonant and an adjacent vowel (V), liquid (L) or nasal (N). These linking constraints are universally ordered in the following way: No-VC-Link » No-LC-Link » No-NC-Link. In Japanese SonVoi is located in between No-LC-Link » No-NC-Link.

(10) No-VC-Link » No-LC-Link » SonVoi » No-NC-Link

This hierarchy explains why in Japanese neither liquids, nor vowels have a voicing effect on an adjacent consonant. Having sketched the characteristics of imp's licensing theory we can return to the problem of tone-voice interaction in Limburg.

3.2 Tone-Voice Interaction in terms of feature licensing

Recall that we are dealing with two problems: [−voice] seems to be active, and [−voice] seems to influence the segment on its left. An analysis based on the idea that [−voice] is the trigger has to assume the following implication.

(11) VoiTone: [−voice] ⊃ H

For a case like *rente* (cf. 2b), the analysis would say that *t* triggers a high tone (the dragging tone). Why insertion takes place in the sonorant on its left is a mystery. As explained before, the constraint taking care of this is not phonetically grounded.

As a first step towards a solution to both problems we note that the constraint in (11) is logically equivalent to its contrapositive (if we assume that a segment in the relevant position is necessarily either H or L):

(12) ToneVoi: L ⊃ [+voice]

Now consider a case like *rotonde* (cf. 3a), with a low tone on the nasal. According to ToneVoi L triggers Voice in the nasal. But is there a Voice? It depends, as we have seen before. If Limburg resembles Japanese, then there is, because Voice is licensed by the obstruent. Notice that if we look at tone-voice interaction in this way, then the two problems vanish; (1) we refer to [+voice]; (2) we do not rely on an ungrounded constraint. Let us see, then, to what extent Limburg is like Japanese.

First we note that Limburg allows a voice contrast after all sonorants, including nasals. To see this compare (2) with (3a), and the first half of (3b) with its second half. To account for this difference between Limburg and Japanese we rely on positional faithfulness. In particular we rank SonVoi in between the specific faithfulness constraint Ident(Voice)-*Onset* and the general Ident(Voice). Due to this hierarchy an onset consonant cannot undergo spreading of Voice from the left in order to license an instance of Voice triggered by SonVoi. On the other hand, Voice in the onset does spread to the left in order to assist the sonorant in satisfying SonVoi. In other words, Limburg has spreading of Voice from the onset to the coda sonorant, rather than spreading from a coda sonorant to the onset obstruent. To see this consider the forms *rente* (cf. (2b)) and *rotonde* (cf. (3a)). In *rente t* cannot undergo spreading from the left. In *rotonde*, on the other hand, the nasal undergoes spreading from the voiced onset obstruent. The following tableaux illustrate this.

(13) Ident(Voi)-*Ons* » SonVoi » Ident(Voi)

<table>
<tr><th></th><th>ræntə</th><th>License</th><th>Ident(Voi)-Ons</th><th>SonVoi</th><th>Ident(Voi)</th></tr>
<tr><td>☞</td><td>ræntə</td><td></td><td></td><td>*</td><td></td></tr>
<tr><td></td><td>ræntə
|
v</td><td>*!</td><td></td><td></td><td></td></tr>
<tr><td></td><td>ræn də
\ /
v</td><td></td><td>*!</td><td></td><td>*</td></tr>
</table>

(14)

<table>
<tr><th></th><th>rotondə
|
v</th><th>License</th><th>Ident(Voi)-Ons</th><th>Sonvoi</th><th>Ident(Voi)</th></tr>
<tr><td>☞</td><td>roton də
\ /
v</td><td></td><td></td><td></td><td>*</td></tr>
<tr><td></td><td>rotondə
|
v</td><td></td><td></td><td>*!</td><td></td></tr>
</table>

In this analysis a sonorant is voiced before a voiced, but not before a voiceless obstruent. In principle we now have the tools to explain why a low tone cannot appear in a sonorant consonant that precedes a voiceless obstruent. A low tone requires Voice, as a consequence of ToneVoi. The required voice specification can appear in a sonorant if the sonorant is followed by a voiced obstruent, since in this environment Voice spreads to the left from the obstruent to the preceding sonorant. Consequently, ToneVoi is satisfied. On the other hand, Voice is not present in a sonorant preceding a voiceless obstruent, simply because in this environment there is no Voice to spread to the left. Consequently, ToneVoi cannot be satisfied if a sonorant is followed by a voiceless obstruent. The ingredients are therefore clear. We only have to rank the relevant constraints in the appropriate way.

First of all Ident(Voi)-*Ons* must dominate ToneVoi. If the ranking were reversed the low tone would trigger insertion of Voice in the postsonorant obstruent. Secondly, in its turn ToneVoi must dominate Ident(T). With the reverse order an underlying low tone would maintain its position, even if the sonorant carrying it would be followed by a voiceless obstruent. This is not in accordance with the facts, as we have shown in (2). Both rankings are demonstrated in the following tableau.

(15) IDENT(VOI)-*ONS* » TONEVOI » IDENT(T)

H L ræ n tə	IDENT(VOI)-*ONS*	TONEVOI	IDENT(T)
☞ H H ræ n tə			*
H L ræ n tə		*!	
H L ræ n də \ / v	*!		

Our analysis makes an important prediction about the tonal quality of a sonorant consonant followed by another sonorant. Consider forms of the type given in (16).

(16) ha<u>l</u>ma kind of game wa<u>l</u>m 'smother'
he<u>l</u>ma surname we<u>r</u>m 'warm'

There is no voice specification in the coda sonorant, because it cannot be licensed by a following obstruent. Since the coda sonorant lacks Voice it cannot carry a low tone either. Therefore, only a high tone is possible. According to our analysis, then, there should be a dragging tone on the stressed syllable.

Compare this with an alternative analysis which holds that [−voice] is the active force, in the sense that it is [−voice] requiring insertion of a high tone in the sonorant on its left. Obviously, a sonorant is not specified as [−voice]. Since there is no [−voice], it is not required to insert a high tone in the coda sonorant. This analysis, then, predicts that a tonal contrast should be possible in a coda sonorant followed by another sonorant. The examples in (16) already suggest that, indeed, only a dragging tone is attested in the relevant environment. The fact that our prediction is borne out by the facts strongly suggests that the analysis we propose is on the right track.[4]

Let us now summarize our analysis. The gap illustrated in (2) is explained in the following way. A low tone in a sonorant before a voiceless obstruent is not possible, because a low tone requires Voice. Before a voiceless obstruent, a sonorant has no Voice, because in that position Voice cannot be licensed. Since there is no Voice, there cannot be a low tone either. We point out that this analysis solves both problems mentioned at the beginning. We do not refer to [−voice]. Neither do we refer to a constraint that mentions the left neighbor of the obstruent.

A few problems of varying importance still have to be made explicit. We will turn to them in the following section.

4. Problems and Solutions

The first problem concerns the relation between SonVoi and the linking constraints. We have seen in (10) that in Japanese this constraint is ranked in between No-LC-Link and No-NC-Link. The same cannot be true in Limburg. We know from (2) that *all* sonorant consonants, liquids and nasals alike, disallow a low tone before a voiceless obstruent. In terms of our analysis this means that in Limburg the following hierarchy obtains:

(17) No-VC-Link » SonVoi » No-LC-Link » No-NC-Link

This hierarchy allows Voice to spread from an (underlyingly voiced) obstruent to a preceding liquid. In its turn spreading allows the liquid to satisfy ToneVoi. Conversely, if there is no Voice to spread to the liquid, which happens before a voiceless obstruent, then an underlying low tone must be replaced by a high tone. This is why no low tone can occur in a liquid before a voiceless obstruent.

A much more important problem concerns the question why a long vowel allows a contrast between low and high tone, irrespective of the voice quality of the following consonant. We have shown this in (3b). So far our analysis cannot explain this fact. To see this, consider a form with a falling tone, like *paater* (cf. 3b). Since there is no Voice to spread to the left, ToneVoi cannot be satisfied. According to the analysis we have worked out so far the low tone on the second half of the long vowel would therefore be replaced by a high tone, wrongly yielding a dragging tone.

To solve this problem we have to invoke a particular member of the family of faithfulness constraints, Head-Ident(F), proposed in Alderete (1995). This constraint specifically protects segments located in head position. Its formulation is as follows:

(18) Head-Ident(F):
Given a segment S which is linked to a head position, if S is specified as [αF], then its correspondent is also specified as [αF].

Notice now that a moraic consonant does not have any feature which is linked to the head. Accordingly, it can never violate Head-Ident(F). The features of a vowel, however, be it long or short, crucially differ from a moraic consonant in that they are linked to the head mora. Hence they can violate Head-Ident(F). If we now rank Head-Ident(T) above ToneVoi, we can explain why an underlying low tone on a long vowel is maintained in the output, even before a voiceless obstruent. We illustrate with the following tableau.[5]

(19) HEAD-IDENT(T) » TONEVOI » IDENT(T)

H L pa: tər	HEAD-IDENT(T)	TONEVOI	IDENT(T)
H H pa: tər	*!		*
☞ H L pa: tər		*	

If the second mora contains a consonant, HEAD-IDENT(T) is vacuously satisfied, because the features of a consonant are not linked to the head mora. Since HEAD-IDENT(T) is not violated, the lower ranked constraints become decisive. Since TONEVOI dominates the general IDENT(T), an underlying low tone is replaced by a high tone if it is linked to a sonorant consonant preceding a voiceless obstruent. We have already shown this in (15).

A further important problem is posed by forms of the type *mi̠n* (cf. (1)). In these forms the second mora contains a consonant, hence HEAD-IDENT(T) is irrelevant. Notice now that the sonorant (consonant) is not followed by a voiced obstruent, for the simple reason that it occupies the final position in the word. Since there is no voiced obstruent, Voice cannot be licensed in this environment. The analysis we have proposed so far now predicts that an underlying low tone is replaced by a high tone. This is a wrong result, because in forms of this type the second mora allows a full contrast.

Van Oostendorp (2000) shows that in many Dutch dialects, including the standard language, word edges resist phonological changes. Consonant clusters, for instance, are avoided by insertion of a vowel *to the left* of a word edge. Van Oostendorp argues that the location of Dutch epenthetic vowels can only be understood in terms of a constraint which specifically protects word edges. In this article we refer to this constraint as IDENT(T)-*WORDEDGE*. It is this constraint that can explain why a sonorant consonant in final position maintains its (low) tone, even though no voiced obstruent follows it. We have to rank this constraint above TONEVOI. Our solution is illustrated in the following tableau.

(20) IDENT(T)-*WORDEDGE* » TONEVOI » IDENT(T)

H L m i n	IDENT(T)- *WORDEDGE*	TONEVOI	IDENT(T)
H H m i n	*!		*
☞ H L m i n		*	

One last problem now remains. We have seen in (4) that the voice–tone interaction we are discussing here does not apply if a morpheme boundary separates the voiceless obstruent from the preceding sonorant. Since in examples of this type the sonorant consonant is not final, Ident(T)-*Wordedge* is irrelevant. Our analysis, as we have worked it out so far, therefore predicts that an underlying low tone cannot be maintained in this environment. This result is wrong, as is shown by the examples in (4).

We can solve this problem if we adopt some mechanism to account for the faithfulness of derived (or inflected) forms to their bases. For instance, one could introduce a split between lexical and postlexical phonology into the model, or alternatively, one could adopt a family of Output-Output constraints. In the latter case we would have to rank Ident(T)-OO above ToneVoi. This solution is illustrated in the tableau in (21).

(21) Ident(T)-OO » ToneVoi » Ident(T)

H L *Output* k i n *Input* H L k i n tj	Ident(T)-OO	ToneVoi	Ident(T)
H H k i n tj	*!		*
H L ☞k i n tj		*	

Notes

* We would like to thank an anonymous reviewer for his/her careful reading of an earlier version of this article and for a few constructive and helpful comments.

1. According to our reviewer "… it seems a little premature to claim that phonological low tone licensing before a sonorant-voiced obstruent sequence is phonetically ungrounded". He/she suggests a possible solution along the following lines. Firstly, although it might be true that F_0-depression by voiced obstruents is stronger after oral closure, it nonetheless does occur to some extent on the preceding vowel (a fact that is not inconsistent with the proposals of Hombert, Ohala and Ewan 1979). Secondly, sonorants can act as F_0-depressors. Thirdly, these two tendencies could possibly amplify each other, which could perhaps explain the phenomenon occurring in Limburg. Although there do not seem to exist any systematic studies of the behavior of F_0 in sonorant-obstruent clusters we wish to point out the following obvious draw back of this approach: it leads us to expect that crosslinguistically a similar amplification could act as a significant factor in tonogenesis and intonation. As far as we know this prediction is incorrect.

2. For an alternative view cf. J. Mascaró and L. Wetzels (to appear).

3. In the tableau we neglect vowels. We will come back to the voice characteristics of vowels.

4. This does not mean that a falling tone never occurs in a sequence of sonorants. In fact there are many forms with a falling tone in this environment. However, these forms are almost always derived by conversion from a base with a dragging tone. For example, from the forms in the righthand column in (16) the verbs *walm*, *werm* and *vorm* can be derived by conversion. Obviously, the constraints regulating the tonal effects of conversion are ranked above ToneVoi. In a few rare cases, however, a falling tone appears in the relevant environment which cannot be attributed to conversion. Our reviewer points out to us three such forms: *urn* 'urn', *wulm* (name), *kalm* 'calm'. We admit that these forms are very problematic for us. We point out, however, that the great majority of forms does confirm our prediction. For this reason we maintain our claim that our analysis is on the right track.

5. In this article we do not want to get involved in the discussion about the exact representation of long vowels in Dutch dialects. For this reason we have chosen for a neutral notation of length in tableau (19). Here we only note that in the standard view long vowels are bimoraic. This view, however, has been challenged in Van Oostendorp (2000), who claims that 'long' vowels are not long at all, phonologically, but tense.

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