0. Introduction

Limburg dialects in Belgium and The Netherlands are generally assumed to have an intonational system which is characterized by a lexical tone distinction. This is to say that differences in lexical meaning are conveyed by tonal means. In accordance with other papers on the subject, these tonal accents will be referred to as accent I ("stoottoon") and accent II ("sleepootoon"). This tonal distinction is well-attested in the dialects of Maastricht (Gussenhoven and Aarts, 1999; Gooskens and Rietveld, 1995), Roermond (Gussenhoven, 2000), Venlo (Gussenhoven and Van der Vliet, 1999), and Baexem (Heijmans 1999, Heijmans 2002). Historically, it has been assumed that lexical tone is characteristic of all Limburg dialects, but recent research has indicated that this may not be true. Cajot (2001) describes a geographical area south of Maastricht, the dialects of which (no longer) have a tonal contrast:

De enquête bracht een op de taalgrens rustende boog van 270° ten (zuid)oosten van Tongeren/Bilzen resp. ten zuid(westen) van Maastricht/Valkenburg aan het licht die een gebiedje aan weerskanten van de Maas begrenst waarin geen oppositie (d.i. betekenisdragend klankverschil) tussen de tonen waar te nemen was. (Cajot, 2001: 74).

A similar report of a ‘toneless’ Limburg dialect is found in Heijmans (1999, 2000, 2002) and concerns the dialect of Weert. This town is situated in the Dutch province of Limburg on the northwestern periphery of the geographical area with lexical tone. It is very close to the provincial border with Noord-Brabant and about 10 km from the border with Belgium. This dialect is in fact a grouping of different rural varieties and an urban variety.

This report of a ‘toneless’ Weert dialect is not in agreement with observations in Verhoeven (1992) and Verhoeven and Connell (1992) who also investigated the lexical tone contrast in this dialect and the assumptions made there were that it did actually have a lexical tone distinction. The results of a production experiment revealed significant differences in the alignment of a rising-falling pitch configuration in syllables with an
assumed lexical tone distinction. It was also observed that these pitch differences were concomitant with a durational difference of the tone-bearing vowel. Both the durational difference and the pitch distinction were interpreted at the time as the phonetic correlates of the tonal distinction. This point of view has recently been questioned in Heijmans (1999), Heijmans (2000) and most explicitly in Heijmans (2002). She compared the tonal distinctions in the dialect of Baexem with the realisation of cognate words in Weert and reports a clear tonal difference in Baexem, but not in Weert: In Weert, minimal pairs that had been regarded to differ in lexical tone did not show any pitch differences: the pitch curves were identical. Moreover, the analysis of cognate words in the two dialects indicated that words with sleeptoon in Baexem have a long vowel duration in Weert, while those with stoottoon in Baexem have a short vowel in Weert. In combination, these observations seem to suggest that Weert is non-tonal: the only phonetic reflex of what has been assumed to be a tonal distinction in Weert is argued to be a vowel duration contrast. The data presented in Verhoeven (1992) and Verhoeven and Connell (1992) are clearly problematic for Heijmans interpretation: they do confirm vowel duration differences, but in addition there was also a significant pitch difference: in absolute terms the onsets of falling pitch movements associated with accent I are located significantly earlier with respect to the start of the tone-bearing vowel than those of pitch movements associated with accent II. These alignment differences are interpreted by Heijmans (2002) as the result of a tendency in languages for pitch movements to be located earlier on short vowels. She bases her interpretation on research by Rietveld and Gussenhoven (1995) who found that the alignment point of pitch targets moves towards the right when vowels are longer, i.e. in words with accent II. This explanation may indeed account for the pitch movement alignment differences there were reported in Verhoeven (1992) and Verhoeven and Connell (1992).

The only catch of this interpretation is that for it to be valid, similar alignment differences should also be reflected in Heijmans’ own Weert data. If the interaction between vowel duration and pitch movement alignment has caused the alignment differences in Verhoeven’s data, similar alignment differences should also be present in Heijmans’ data, especially since the experimental procedures for eliciting the target words was virtually identical in both studies. Heijmans’ data do not reveal any pitch differences of any kind: “none of the examined words in the corpus showed intrinsically different intonation contours than those illustrated here” (Heijmans, 2002: 13). The contours that are illustrated for Weert are all identical.
It is clear that Heijmans’ account of the phonetic differences observed by Verhoeven is not consistent with her own phonetic data on Weert, since she did not find any phonetic reflex of vowel duration in the pitch contours. This casts doubt on the findings of Verhoeven (1992) and Verhoeven and Connell (1992). In order to clear up this inconsistency, it was decided to collect new data from the Weert area, irrespective of the question of whether it actually has a tonal distinction or not.

1. Materials and methods
In this production experiment recordings were made of single words embedded in the Weert equivalent of the carrier sentence “I now say …”. This carrier phrase places the test words in focus position. This method was chosen in order to keep the data collection consistent with Verhoeven (1992) and Heijmans (1999). About half of the words were chosen in such a way that they can be assumed to carry an accent I (or a toneless short vowel in Heijmans’ perspective), while the other half was supposed to carry an accent II (or a toneless long vowel according to Heijmans). A subset of these words were minimal pairs differing in the tonal distinction. These stimuli were arranged in 6 lists with a different random order. Each sentence was typed on a different sheet of paper in so-called Veldeke spelling, a standardized spelling system for Limburg dialects. The informants were asked to read the sentences as naturally as possible. They were not told about the real objectives of the experiment. The informants who took part in the experiment were 2 male and 2 female native speakers of the urban variety of the dialect of Weert. They had lived in the town of Weert all their lives and used the dialect in most of their daily encounters. The average age of the informants was 68. Only one of these informants had previously taken part in the production experiment reported in Verhoeven (1992) and Verhoeven and Connell (1992). All informants participated on a voluntary basis.

2. Results
It was argued earlier that the carrier sentence places the lexical item in focus position in the intonation contour. All realisations were assessed perceptually since it turned out that some informants on certain occasions switched to list intonation, i.e. the intonation contours had a continuation rise to suggest that there are still other test items coming up in the list. Such realisations were excluded from the measurements since they had a clear effect on the realisation of the nuclear accent. Subsequently, the segment boundaries of the tone-bearing vowels were determined on the basis of visual information in a wide-band spectrogram and vowel durations were
measured. Subsequently, the pitch transition within the vowel nucleus was visualised and several characteristics of the transitions were measured with PRAAT (Boersma and Weenink). In the first instance, the location of the pitch peak in the vowel nucleus was determined. This measure was expressed in absolute terms with respect to vowel onset. Secondly, the height of the pitch peak as well as pitch height at the end of the vowel were measured. Both measurements were expressed in Hz. In total, 865 observations were collected.

The first observation is that there is a clear difference in vowel duration in the two sets of words. The average duration of the vowels with accent II is 195 msec; that of words with accent I is 113 msec. An analysis of variance confirms that this difference is statistically significant (F(1,855)=637.56, p < .0001).

As far a the characteristics of the pitch configurations are concerned, it is observed that all configurations are (rising)-falling. A typical pitch configuration is illustrated by the pair [k´ni˘n] (rabbit) and [k´nin] (rabbits) in figure 1:

*Figure 1: pitch configurations on the pair [k´ni˘n] (rabbit) and [k´nin] (rabbits)*

![Pitch configurations on the pair [k´ni˘n] (rabbit) and [k´nin] (rabbits)](image)

Additional to the rising-falling nature of the pitch configurations, it can be seen in figure 1 that the peaks are located at different points in the vowel nucleus. An analysis of variance of the peak locations of the movements associated with Accent I-words and Accent II-words reveals that the peaks are located differently and that this difference is statistically significant (F(1,853) = 17.400, p < .0001). The peak associated with accent I is located earlier with respect to vowel onset than the peaks associated with accent II. The
respective average peak locations are 52.99 msec and 61.32 msec, a difference of 8.33 msec.

In addition to peak location, the pitch movement falls to a significantly lower level at the end of the vowel nucleus in accent II: in accent II the pitch falls to 125 Hz, while it only falls to 154 Hz in accent I. This difference in pitch excursion amounts to 3.61 semi-tones.

Finally, it is noted that there is also a clear difference in the excursion size of the falling pitch movement within the vowel nucleus: in Accent II pitch falls by 4.86 semi-tones, while it only falls 1 semi-tone in Accent I: this difference is also significant (F(1,853)=362.133, p < .0001).

3. Discussion

The aim of this study was to investigate the alignment of pitch movements associated with assumed tonal accents in the dialect of Weert. The results of a production experiment where target words were inserted in a carrier phrase indicate that the vowels differed significantly in vowel duration: vowels in Accent II-words had an average duration of 113 msec, while those in Accent I-words had an average duration of 195 msec. Although the durational differences found here are somewhat smaller than those reported in Verhoeven (1992) and Verhoeven and Connell (1992), the findings are in good agreement.

As far as the pitch configurations are concerned with are associated with the assumed tonal accents, it is confirmed that their alignment is significantly different within the tone-bearing vowel: The (rise)-fall in accent II is typically located at 61.32 msec after vowel onset, while that of accent I is located at 52.99 msec: peaks in Accent II-words are thus located earlier in comparison to Accent I-words.

In addition it is found that the pitch level at the end of the vowel nucleus is also significantly different in the two sets of words: the pitch level is substantially lower in Accent I-words. This suggests that the falling pitch movements associated with accent I-words falls to the bottom of the speaker’s pitch range, whereas it remains significantly above this level in Accent II-words where the end of the falling pitch movement generally coincides with the end of the postvocalic consonant.

These results are consistent with the findings reported in Verhoeven (1992) and Verhoeven and Connell (1992) where virtually identical alignment differences were found. They do not support Heijmans’ claim that the pitch configurations associated with both accents are identical.
The alignment differences observed in this experimental study can be accounted for in different ways. On possible interpretation is one in which the alignment differences are regarded as a by-product of differences in vowel duration: the peak of the pitch configuration is located later in longer vowel durations (those of Accent I-words). This interpretation is consistent with findings for Standard Northern Dutch in Ladd, Mennen and Schepman (2000) who found that:

(…) the Dutch F0 rises under study are anchored to two places in the segmental string: The beginning of the rise is aligned with the beginning of the onset consonant of the accented syllable, and the end of the rise with the end of the syllable. In our materials, the “end of the syllable” is at the end of the vowel if the vowel is phonologically long, and in the following consonant if the vowel is short. (Ladd, Mennen, Schepman 2000: 2693)

This interpretation implies that pitch movement alignment is dependent on vowel duration: this would suggest that Weert does not have a lexical tone contrast, but that what has been traditionally assumed to be a tone contrast is in fact a phonological contrast in vowel duration.

Another interpretation is one in which the alignment differences are essential to the tonal difference between Accent I and Accent II. An argument in favour of this interpretation is the substantial perceptual difference between the two pitch configurations. The average pitch level at the end of the vowel nucleus is …. semitones in Accent II words and …. semitones in Accent I words. Psycho-acoustic research (‘t Hart, Collier and Cohen, 1992) has shown that differences of this size can be perceived by native speakers of Dutch and may thus well be perceptually relevant.

The data in this paper are not able to solve the controversy about the tonal status of the Weert dialect, but they highlight the importance of further perceptual research which is likely to shed more light on this issue.

5. Conclusion
This paper investigated the phonetic characteristics of pitch movements associated with what has traditionally been assumed to be a tonal contrast between Accent I and Accent II in the Limburg dialect of Weert. This study was inspired by the conflicting nature of the phonetic data regarding this distinction. The results confirm the earlier findings of Verhoeven (1992) and Verhoeven and Connell (1992) that besides substantial durational differences, the assumed tonal contrast also coincides with a difference in pitch.
movement alignment. Whether these pitch movement alignment differences are indicative of a lexical tone contrast is an issue which has to be further investigated by means of perceptual experiments.

References